CORP 2006
GEO MULTIMEDIA 06

SUSTAINABLE SOLUTIONS FOR THE INFORMATION SOCIETY
NACHHALTIGE LÖSUNGEN FÜR DIE INFORMATIONSGESELLSCHAFT

PROCEEDINGS
TAGUNGSBAND

11th International Conference
on
Urban Planning and Spatial Development
in the
Information Society

February 13-16, Congress Center Vienna, Austria

11. Internationale Konferenz
zu
Stadtplanung und Regionalentwicklung
in der
Informationsgesellschaft

13.-16. Februar 2006, Congress Center Wien

Manfred SCHRENK (Editor / *Herausgeber*)

www.corp.at

C O R P 2 0 6

GEO MULTIMEDIA 06

SUSTAINABLE SOLUTIONS FOR THE INFORMATION SOCIETY
Proceedings of 11th international conference on
Urban Planning and Spatial Development
in the
Information Society

NACHHALTIGE LÖSUNGEN FÜR DIE INFORMATIONSGESELLSCHAFT
Beiträge zur 11. Internationalen Konferenz zu
Stadtplanung und Regionalentwicklung
in der
Informationsgesellschaft

edited by / herausgegeben von

Manfred SCHRENK (Hg./Ed.)

WIEN, 2006

CD-Edition: ISBN: 3-9502139-0-2; ISBN13: 978-3-9502139-0-4 EAN: 9783950213904

Print-Edition: ISBN: 3-9502139-1-0; ISBN13: 978-3-9502139-1-1 EAN: 9783950213911

Im Selbstverlag des Vereines
CORP - Competence Center for Urban and Regional Development
Kompetenzzentrum für Stadtplanung und Regionalentwicklung

Baumgasse 28, A-1030 Wien
office@corp.at; www.corp.at

CORP2006: February 13 - February 16, 2006
Congress Center Vienna, Austria/ Congress Center Wien, Österreich

Editor /// Herausgeber:
Manfred Schrenk, Baumgasse 28, A-1030 Wien

Publisher /// Medieninhaber und Verleger:
CORP - Competence Center for Urban and Regional Development
Kompetenzzentrum für Stadtplanung und Regionalentwicklung
Baumgasse 28, A-1030 Wien
office@corp.at; www.corp.at

CD-Edition: ISBN: 3-9502139-0-2; ISBN13: 978-3-9502139-0-4 EAN: 9783950213904

Print-Edition: ISBN: 3-9502139-1-0; ISBN13: 978-3-9502139-1-1 EAN: 9783950213911

PREFACE: 10 years of CORP-conferences

Exactly 10 years ago, from February 14-16 1996, the first CORP-event took place at Vienna University of Technology.

Even then the major topics were

- tools for planners
- new possibilities of communication and public involvement in planning processes by new media
- impacts of ICT on physical space, on the perspectives for cities and regions.

Well, the 3rd point, the physical but also socio-economical and cultural impacts of "info-society" that has become the major topic over the last years, sounded somehow exotic for most of the conference-participants (and even more for the non-participants) – "coulourful maps" were much more in the focus ….

Even then, back in 1996, we published all infos on CORP, including the proceedings, free on the internet – a tradition that we still follow.

CORP quickly became the leading conference for the topic of urban development and information society, with more then 130 presentations and about 400 participants from all over the world, and by that also contributed to the image of Vienna and Austria as know-how-nodes in the info-society.

Still after 10 successful conferences there was the question on how to proceed:

- More of the same? Doing just the same as long as it works somehow?
- Evolutionary improving the concept, like it has been done over the last years, with going a little bit more international and interdisciplinary and finding interesting key topics every year?
- Becoming a strictly scientific conference or doing the opposite, developing towards a strictly buisness-oriented meeting?
- or "let it be", not doing an 11th event?

And there was another possibility:

- with all the positive experiences from the last years completely re-invent the event …

Together with the congress organizers of **i.con**vienna, especially with director Dr. Gerhard Hrebicek, a completely new concept was developed: there are 9 independent international conferences at the same time under one roof, tied together by the "umbrella" of i.con, and each participant has full access to each of the conferences – beside CORP these are Real Estate, Mobile World, Corporate Social Responsibility, Management Consulting, IT, Brand Management, Infrastructure and Environmental Technologies.

VORWORT: 10 Jahre CORP

Vor exakt 10 Jahren, vom 14.-16. Februar 1996 fand die erste CORP an der TU Wien statt.

Schon damals ging es um

- Werkzeuge für PlanerInnen
- neue Kommunikationsmöglichkeiten in Planungsprozessen durch neue Medien
- die Auswirkungen der Informations- und Kommunikationstechnologien auf die Stadt- und Regionalentwicklung,

wenngleich der dritte Punkt, der mittlerweile in den Mittelpunkt gerückt ist, nämlich die räumlichen Auswirkungen der Informationsgesellschaft und die Perspektiven, die sich für Städte bieten, damals für viele der TeilnehmerInnen noch sehr exotisch anmutete und man sich eher der Begeisterung für „bunte Karten“ hingab.

Bereits damals, 1996, wurde das CORP-Programm und der komplette Tagungsband frei im WWW verfügbar gemacht - eine Tradition, die wir bis heute aufrecht erhalten haben.

Mit mehr als 130 Vorträgen und etwa 400 Teilnehmer-Innen aus aller Welt hat sich die CORP rasch zur welt-weit größten regelmäßigen Veranstaltung zum Thema Stadtentwicklung und Informationsgesellschaft entwickelt und auch einen Beitrag zum Standortprofil Wiens und Österreichs in Sachen IKT geleistet.

Trotzdem stellte sich nach 10 erfolgreichen Ver-anstaltungen, also nach der CORP2005, die Frage, wie es weitergehen soll:

- Mehr vom Gleichen? Ein Erfolgsrezept so lange verfolgen, wie es irgendwie noch geht?
- Eine konsequente evolutionäre Weiterentwicklung wie in den vergangenen Jahren? Ein bißchen mehr international, ein bißchen mehr interdisziplinär, interessante Schwerpunkte ...
- Besinnung auf die „reine Wissenschaft“ und strengste Auswahlkriterien für die Vorträge oder „endlich abheben“ Richtung Wirtschaft?
- oder es ganz einfach „sein lassen“?

Und dann war da noch eine Möglichkeit:

- Die Veranstaltung unter Mitnahme der positiven Erfahrungen komplett neu erfinden ...

Gemeinsam mit dem Kongress **i.con**vienna und dessen Direktor Dr. Gerhard Hrebicek wurde ein völlig neues Veranstaltungskonzept entwickelt: 9 Fachkonferenzen, die jeweils auch allein stattfinden könnten, werden parallel unter einem Dach abgehalten, und alle TeilnehmerInnen haben vollen Zugang zu allen Veranstaltungen - neben CORP sind das Konferenzen zu Real Estate, Mobile World, Corporate Social Responsibility, Management Consulting, IT, Brand Management, Infrastructure und Environmental Technologies.

By actively interlinking the topic conferences and thereby supporting interdisciplinary exchange as well a contacts between research, buisnesses, administration and politics an added value for all participants shell be generated – a concept that planners should like and that is typical for Vienna: bringing together things that at the first glimpse do hardly have anything in common and “just look what happens …”

If this concept can work and will be successful?
Well, who knows … - at least I believe in it!

As the positive reactions show the approach seems to be an interesting one. A very positive result and a great honour is the improved co-operation with **ISOCARP** – International Society of City and Regional Planners (www.isocarp.org) as well as **PLANUM** (www.planum.net) - both international institutions will have their own workshops / seminars integrated into CORP-program.

Also the sponsors and exhibitions have reacted very positvely and I hereby thank them for their faith in the new developments.

It are primarily the speakers/authors and the participants who have to decide if “CORP new” is a worthwhile conference, if there are interesting topics and intensive interdisciplinary exchange and and if new buisness- and research opportunities arise – the amount and quality of submitted papers and the registration of participants show clearly that the planners community seems to trust in the quality of the new developments.

As I write these lines I am as exicted as I was back in January 1996 some days before the very first CORP – and I am convinced that in 2006 we will see the best CORP ever so far and in the upcoming 10 years we will have the opportunity to continuously improve it.

I wish you a very interesting and successful CORP2006, a lot of interesting contacts and new impressions and look forward to receive your comments and suggestions for upcoming activities.

Manfred Schrenk
Vienna, January 2006

Mit dem gezielten Herstellen von Querverbindungen soll sowohl der interdisziplinäre Austausch wie auch der Kontakt zwischen Wirtschaft, Wissenschaft, Politik und Verwaltung gefördert werden - ein Konzept, das gerade PlanerInnen mit ihrem meist ohnehin interdisziplinären Zugang liegen sollte und das hervorragend zum Standort Wien paßt: man bringe Menschen, Ideen, Projekte zusammen, die auf den ersten Blick kaum etwas miteinander zu tun haben und „schaue einmal, was passiert ...“.

Ob dieses Konzept aufgeht?
Nun, wer weiß ... – ich glaube jedenfalls fest daran!

Dass der Ansatz offenbar nicht ganz uninteressant ist zeigen die überaus positiven Reaktionen internationaler Planungs-Institutionen: es ist eine große Ehre, dass es bei der CORP2006 eigene Workshops der **ISOCARP** – International Society of City and Regional Planners (www.isocarp.org) wie auch von **PLANUM** (www.planum.net) geben wird.

Auch die Sponsoren und Aussteller der CORP, bei denen ich mich hiermit herzlich für das Vertrauen und die Unterstützung bedanken möchte, haben die neuen Entwicklungen äußerst positiv aufgenommen.

Darüber entscheiden, ob die „CORP neu“ eine gute Konferenz ist, wo es zu intensivem fachlichem und interdisziplinärem Austausch kommt und wo sich neue Geschäfts- und Forschungsoptionen eröffnen, müssen die Vortragenden und TeilnehmerInnen – Anzahl und Qualität der eingelangten Papers und der Verlauf der Teilnehmeranmeldungen sprechen klar dafür, daß auch hier das Vertrauen in eine positive Entwicklung groß ist.

Jetzt, wo ich diese Zeilen wenige Tage vor der Veranstaltung schreibe, bin ich genau so in banger Erwartung wie im Jänner 1996, wenige vor der ersten CORP – und ich bin überzeugt, daß es die beste bisherige CORP-Veranstaltung wird und dass uns in den nächsten 10 Jahren gemeinsam noch einiges einfällt, was zu verbessern ist.

Ich wünsche Ihnen eine interessante und erfolgreiche CORP2006, eine Vielzahl neuer Kontakte und Eindrücke und freue mich auf Ihre Kommentare und Anregungen für kommende Aktivitäten.

Manfred Schrenk
Wien, im Jänner 2006

INHALTSVERZEICHNIS / TABLE OF CONTENTS

LIST OF AUTHORS / AUTORENVERZEICHNIS

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

Urban planning in the global economy: what can be done?

Pierre LACONTE

(President, Foundation for the Urban Environment; Abdijdreef 19, 3070 Kortenberg, Belgium, +322 759 61 88, pierre.laconte@ffue.org; www.ffue.org)
President ISoCaRP – International Society of City and Regional Planners,
Honorary Secretary General of the International Association of Public Transport UITP

1 TRENDS IN MOBILITY AND URBANISATION

1.1 Society values, mobility and spatial development

In advanced industrial countries the societal values, in line with Locke's philosophy, tend to put the emphasis on individual achievements rather than on group solidarity, on the individual's rights, rather than on his duties. Gender complementarities give way to equal access. Producers of consumer goods or services and their marketing advisers have made good use of this trend through detailed customer socio-cultural typologies and refined market segmentation.

In particular the automobile industry has diversified its products to suit individual tastes and quest for individual recognition as well as convenience and comfort. The automobile, together with the individual detached home, reflects a change in social values sometimes referred to as "Me culture" or "mass individualism" (GAUCHET, 1985). This has been a major factor in urban change towards lower density forms of urbanisation because of the space consumption by the automobile and its parking (ILL. 1: Space consumption by mode)

The success story of the car remains in full bloom. According to the OCDE countries statistics during the last fifteen years (1980 to 1995) the vehicle-kilometres travelled increased by 65% while the car ownership increased by 50% and the population by 13%. There are four times more new cars than new babies. Vehicle-kilometres travelled have increased five times faster than the population. Mobility increases much faster than the economy.

1.2 Observation of Europe's urban and rural space: the polycentric paradigm

At European Level, ESPON (European Spatial Planning Observation Network), based in Luxemburg, is collecting available data about land use, urban and rural. Its maps indicate among others a ranking of locations according to the influence of functional urban areas (ILL. 2: Urban-rural Typology 1999) and a ranking of locations according to its accessibility or time to reach them (ILL.3: Potential accessibility multimodal 2001).

These observations open the way towards policy discussions about either accepting the spatial trends or trying to change them. Discussions around the European Spatial Development Perspective (ESDP) are illustrated by the debate around polycentric development. The three maps exemplify the views of the peripheral and maritime regions' lobby (ILL. 4: The "evil blue banana"; ILL. 5: The "evil black pentagon"; ILL. 6: The "good global economic integration zones").

Statistical ex-post observations are complemented by real time satellite observations of the land cover (CORINE LAND COVER: www.eea.eu.int). They irrefutably picture the dynamics of Europe's changing urban and rural landscape: nearly a million ha of Europe's land cover were converted to artificial/urban surfaces in the period 1990-2000.

They also give clues about the actual policies at work and their results.

An example of dynamic change revealed by the satellite observation is taken from Ireland. Over the last ten years the urbanisation, i.e. the transformation of agricultural land into urban features such as infrastructure, residence, shopping, etc, is now de facto covering the whole country. EU financed programmes aimed at revitalising agriculture by improving access to farms are shown to provide in fact a subsidy to second residences, as no signs of agricultural activity do appear in the plots benefiting from these subsidies and farm buildings appear to have been transformed into residential use (conservatories, swimming pools, etc.).

Another example of land use dynamics is taken from Spain. Large transfers of water from the Ebro Basin to the urbanising coastal areas of Murcia and Almeria are occurring. The implementation of the National hydro-graphic plan would encourage these transfers, at the expense of existing aquifers. A heated debate is taking place about this issue (ARROJO).

Future progress in observation could include a synergy between satellite imagery of expanding urban use and policy analysis based on common definitions. A forthcoming tool for full fledged land accounting is to start in 2006 and be fully operational in 2009: The Infrastructure for Spatial Information in Europe – www.ec-gis.org/inspire.

The overall finding is that dispersed urbanisation is gaining ground all over Europe, particularly in coastal areas and resort-type locations. The environmental effects are also evidenced, in terms of increased water consumption and pollution of ground water reserves. Policies both reflect and enhance this trend.

1.3 Observation of specific urban areas and policy findings

Comparable data about urban areas are difficult to collect.

The definition of urbanised areas does not correspond to the municipal boundaries. Therefore comparisons can only be made if available municipal statistics are reworked in accordance with a common definition

Employment basins are probably the best criteria for defining a functional urban region.

To be comparable, observations of employment basins also need to include the same indicators, measured in the same way.

This exercise has been done for 100 cities in the UITP "Millennium Data base" (UITP 2001).

The observations are for the year 1995 and the Data Base was published in 2001.

The observation of these 100 cities allows interesting comparisons, not only of urban development, but also of policies and their results in terms of land use dynamics.

The illustrations indicate the link between land use and energy consumption and overall cost of personal mobility within an urban area. See ILL.7-(Modal choice and energy consumption per inhabitant) and ILL.8 (Modal choice and transport cost in percentage of GDP).

The general findings of the UITP Data Base, analysed by J. Vivier, could be summarized as follows :

- Public transport consumes in average four times less energy per passenger kilometre than the automobile
- Dense cities of Asia or Europe, well served by public transport and soft transport modes, are spending much less resources for their mobility than the spread-out cities of America or Africa both in monetary terms and in terms of accident numbers :
- The % of GDP spent on transport, not including parking, ranges from 4 % (Copenhagen) to more than 20 % (Jakarta)
- There is a clear relation between public transport use and supply of parking
- Sustainable urban mobility requires an integrated supply of built space, public transport, parking and amenities. In cities where the population is less than 20 inhabitants per hectare public transport costs more to the community than motorised private transport. The higher the density, the higher the patronage
- Growth in income does not necessarily imply an urban development model based on the automobile and urban sprawl. Inversely growth in automobile traffic in developing countries may compromise economic development and worsen the living conditions of city dwellers
- Rail modes and public transport modes separated from general traffic are the most competitive in larger cities, as they escape congestion

To mention specific examples a comparison between Singapore and Houston, cities of comparable size and affluence, indicates that Singapore spends each year 10 billion $ less than Houston for the transport of its inhabitants, i.e. 3.000 $ less per inhabitant, while insuring a better accessibility to all its inhabitants, whether or not they use an automobile. Houston comes last in the accessibility ranking and one of the worst in terms of travel times, at a cost of 14 % of its GDP

The Singapore policy favouring the use of public transport rather than the use of the automobile is an example of decoupling between economic growth and motorization. This restrictive automobile policy has not hampered Singapore from becoming the premier Asian business hub, according to the Economist Intelligence Unit Asian survey of April 2002, and a healthy fiscal surplus allowing future tax cuts.

The case of Copenhagen is outstanding: only 4 % of its GDP is spent on transport, due to a combination of some individual automobile use restriction and strong use of bicycle, notwithstanding the Nordic climate. Munich, Frankfurt, Vienna, Milan, Paris and London all spend less than 7 % of their GDP for transport. By contrast, for the Chennai (Madras) or Jakarta metropolitan areas the figure is above 20%.

In a dynamic perspective the findings confirm the UK Standing Advisory Committee on Trunk Road Assessment (SACTRA 1995) about the Generation of traffic. It has shown that the additional traffic induced by new roads is producing in itself a congestion that tends to be higher than in the existing situation

To conclude this first part of the paper devoted to land use and mobility, let us quote Prof. Phil Goodwin's remarks at the 2004 EU Hitachi Science and technology Forum about the effects of urban sprawl: "Congestion will increase in intensity, duration and geographical spread. The supply of road space will not be matched by demand. So demand management will provide the key policy context. (…) Because of this new demand-led policy agenda the way technology is applied to transport will be changing fundamentally. The dream – technology for capacity and speed – is mistaken. It will be replaced by technology for demand management, environmental protection and quality of life" (GOODWIN).

This naturally brings us to the second part of this paper: urban planning.

2 URBAN PLANNING AND THE EUROPEAN UNION'S POLICIES

The EU has no direct competence on urban matters but many of its Directives and programmes have an impact on them. This is why many cities have a direct representation in Brussels, beside their national and regional representations. These Directives and programmes have become part of the background to be taken into account in urban planning.

- REGIONAL POLICY

The regional policy is mainly embodied in the structural funding programmes for areas with below average income (ILL. 9 Map of the priority areas for development help by the EU). It is clear from this map that the European help, namely through the Regional Development Fund help on infrastructure, has been favourable to the peripheral areas in the EU and the areas peripheral to cities, although some help has been provided to urban projects (ILL.11. Photo of Manchester's Metrolink. Metrolink is a pioneering tram-train network replacing since 1992 an old commuter rail line and using the streets as well as the rail tracks).

However the URBAN Community initiative, launched in 1994, has been an important EU programme exclusively in favour of cities themselves. It was part of the follow-up to the Green Paper on the Urban Environment (Com (1990) 218). This Green Paper analysed the complex relationships within the Urban System and recommended a policy combining economic, social and environmental help to cities. Specific actions recommended included improving water quality in Lisbon and Naples and improving air quality in Athens through the construction of a Metro. It recommended support for measures combining land use and transport, traffic management, congestion pricing, enhancement of the historic heritage and urban green spaces.

ILL. 10 shows the huge success of this initiative in number of participant cities.

The URBAN Community initiative allowed direct contacts between the Commission and individual cities, which did not necessarily please the central governments sitting at the Council of Ministers. URBAN II could go ahead as a result of a strong cities lobbying movement. But there will be no URBAN III. It has disappeared from the Regional Programme 2007-2013 (Com 2004/107). An urban dimension could however be introduced in the new Regional Policy Objective II (Enhancing regional competitiveness through the strengthening of cities) and the new Objective III (Territorial cooperation through city networks, programmes and projects).

- TRANSPORT POLICY

The transport policy is meant to help develop the European single market, and the economic and social cohesion, through major transport infrastructure projects such as the Trans European Networks (TEN), not specifically related to cities. According to most observers the transport policy has been mainly favourable to motorways and transport of goods by trucks, not to a balance between modes (BANISTER).

- ENVIRONMENT

A major European development in the urban planning field has been the Directive on Strategic Environment Assessment – SEA (Com (2001) 42) – that became compulsory since21 July 2004. It requires an environmental impact assessment not only of projects but also of urban programmes and plans. It requires an examination of alternatives, and the publication of the findings, before the adoption of the programmes and plans. It aims at integrating the requirements of the specific environmental Directives (air and water quality, soil contamination, noise levels, etc)

On the other hand the Commission has entrusted the European Environment Agency with the preparation of an Urban Environment Thematic Strategy Report (Com (2004) 60). Its preparation is going on and it should be presented around the end of 2005.

- OTHER

These three areas are of particular importance to cities because of the regulatory and incentive framework they have put in place. Other important areas include IT applications to cities and urban planning (for example intelligent transport systems), Research and Technology Development Programmes (the 7th Framework Programme is presently under discussion and includes themes of interest to cities) and the Cultura Programmes (funding of urban heritage projects).

Besides programmes linked to a specific area of competence within the Commission, cities can benefit from initiatives and programmes spanning over the entire Commission. A recent example of these is the European Governance White Paper (2001) and the Framework for trilateral agreements between the EU, the national governments and regional/local authorities (Com (2002)709). Some agreements have already been signed (Milan).

Last but not least the sheer dimension of the European Single Market has generated a global institutional economy at European level. Tenders tend to be Europe-wide. Planning practices tend to look at Europe-wide partnerships. Urban projects are looking for Europe-wide implementation funding.

3 URBAN PLANNING AND MANAGEMENT IN THE GLOBAL ECONOMY: REGULATORY FRAMEWORKS

Two broad schools of thought seem to emerge from the ongoing practice world-wide.

3.1 Laissez-faire and creative chaos

The first one could be summarised as planning along the Business-as-Usual scenario. Business-as-Usual means the pursuit of the world-wide sprawl of cities (the Ecumenopolis announced by Doxiadis in the 60's). It is also called "Edge City", i.e. a mix of urban development and open space, shaped according to public investments in motorways and urban infrastructures and evolving along the changing flow of private development initiatives. The Business-as-Usual scenario somehow goes hand in hand with the weakened position of the planning profession, as the huge build up of infrastructures was masterminded by engineers, not planners (LACONTE 1). This scenario accepts the growing dominance of individual transport for people and goods, as mobility by cars and trucks are what the trend indicates. Freedom of location, made possible by dispersion, can generate diversity and creativity, knowledge and employment.

To sum up, it sees planning as a consensus-building process (mediating between the main actors within a given space), rather than formulating a vision for a community of citizens living in a specific place.

It however ignores the high economic, social and environmental cost of dispersed human settlements:

- The economics of sprawl require a massive transfer of resources from the public purse into the infrastructures and services of privileged suburbs, eventually to become new brown fields. Moving out of the city to the suburbs or beyond is a preferred economic choice for citizens only if the cost of accessibility is a cost not borne by them (external cost). Urbanisation without neither borders nor economic constraints actually undermines the city and its historic accumulation of economic investments.

- The social cost of sprawl is the demise of solidarity between generations and classes, richer and poorer neighbourhoods. It limits democratic governance to fragments of the urban space ("urbanisation" vs. "urbanism").
- The environmental cost lies mainly in the over consumption of undervalued but nevertheless precious open land and in the increase in fossil fuel consumption resulting from the increase of vehicle miles travelled and the resulting pollution, ground ozone level and acceleration of climate change. Shopping centres are in fact a trade-off between cheaper shopping and costlier travel.

This urban philosophy and practice have been prevalent in the US (WEBBER), with the major exception of Portland, Oregon.

Portland's urban growth has to take place within the boundaries fixed by the 1976 State legislation, what has led to a higher urban density and a reported higher quality of life.

A countertrend seems to appear in the US planning practice, as a result of the successful "New Urbanism" movement, that advocates the development of higher density urban clusters and the revival of traditional urban settings (www.cnu.org).

3.2 URBAN PLACE BUILDING WITHIN THE GLOBAL ECONOMY

The second school of thought might be summarised as Urban Place Building. Challenging the urban sprawl, this second school of thought has a proactive vision of cities as specific human communities and as specific built places. It pays attention to urban form and welcomes emerging new dense urban clusters, "Cities on the Rebound" and "Liveable Communities".

It explores the potential of historic heritage and of cultures, both intellectual and popular, for shaping or reshaping urban identity and pride of belonging to a city and it praises the quality factor of personal relations. It takes its inspiration from Christopher Alexander's timeless ways of building rather than Le Corbusier's urban functionalism. It encourages mixed use developments that save energy spent on motorised transport and urban centres attractive to both commuters and residents ("back from the edge"). While the creative laissez-faire approach would rather be identified with the US the place building approach would rather be identified with Europe and its tradition of innovative cities and urban entrepreneurship.

3.3 EXAMPLES OF PLACE BUILDING

CURITIBA, Brazil: THE ECOLOGICAL PROJECT

The Ecological City (concept by Jaime Lerner and Cleon Ricardo dos Santos) of Curitiba remains more than ever, after 25 years of Jaime Lerner rule (as planner, Mayor and State Governor) a Mecca of sustainable development: booming industry and services, social cohesion, environmental management. The Curitiba master planning process aims at developing five high density corridors. Each of them is served by express buses running on reserved lanes. This idea of an express bus network has been taken over and expanded in Bogota.

Implementation has been made possible through a market-led transfer of development rights from designated low-density areas, landmarks and space reserved for public parks and water catchments.

Citizen Awareness is achieved through strong citizen participation in cleaning and greening, urban education in schools e.g. selective garbage collection) and green jobs for the street children. Social cohesion and abundant industrial techno parks have made it a booming employment place (see www.ippuc.pr.gov.br)

As president of the International Union of Architects, Jaime Lerner has further pursued the dissemination of urban practices favouring environmental quality and solidarity.

BERLIN, FRG: THE CRITICAL RECONSTRUCTION

Since the City regained its Capital status its planning has aimed at reconstructing the central parts along the lines taught by its rich history. Under the 12 year leadership of its "Baudirector" Hans Stimmann, it adopted a strong regulatory planning framework called "critical reconstruction".

The strict rules on bulk and building height and the fact that the planning regulations include the obligation to provide some 20% housing in all office buildings had striking effects. They generated the production of high density mixed office/shop/housing projects within the authorised bulk limits. These projects often integrated the remains of buildings that escaped the war and the urban massacre of the 50s and 60s. In turn they generated a mix of urban activities, day and night, and appear to be much more resistant to the current overproduction crisis than projects built in the periphery.

A typical mixed use project integrating the remains of a pre-war building is the "Tacheles" project (Oranienburgstrasse), aimed at filling a large site that has remained mostly vacant since the war. Its overall design (by Andres Duany) includes offices, shops and new housing. Individual buildings are to be built by different architects in a way that allows subsequent changes in use (ceiling height 3.20 m; building depth of 13.50 m, etc.). The project integrates existing listed buildings (not only their facades). But its completion will depend on the evolution of the property market.

By contrast to the general master plan, the reconstruction of the Potsdamer Platz, which was part of the Wall, became the responsibility of the Federal Government, owner of the land. The reconstruction was entrusted to the Treuhand (a public body in charge of the privatisation of Eastern German enterprises). The Treuhand in turn sold it, en bloc and with no planning strings attached, to Daimler Benz and Sony. The size of the project and the high density-high rise buildings had the effect of creaming off the demand for new offices in Central Berlin, while the sites between the Potsdamer Platz and the former City centre remained largely vacant.

The "critical reconstruction" process is still fully under way. In spite of the economic crisis Berlin is more than ever Europe's largest building site and hence a sparring ground for the property world: The advocates of laisser-faire try (without success) to circumvent the master plan, guardian of city planning order, of urban shape and of the existing parcelling out…

The constraints of the Berlin Master plan do in no way exclude international contemporary architecture, represented by, among others, Daniel Libeskind, I.M. Pei, Frank Gehry, Norman Foster, Jean Nouvel and Dominique Perrault (ILL. 12: Friedrichstrasse after its reconstruction and building by Jean Nouvel).

Berlin is the host of the Council for European Urbanism's 2005 Congress (www.ceunet.de).

BILBAO, Spain: BUILDING A CULTURAL IMAGE

The abrupt collapse of the iron and steel-based economy in the 80's generated an acute crisis of the City (350.000 inhabitants) and its Metropolitan area (880.000 inhabitants). It affected the Region's economy and society as a whole (loss of confidence and self-pride). It also brought the realisation that the city should shape a new economic, social and physical vision in accordance with the requirements of a modern service based society, rather than attempting to look at other industries to generate activity and jobs. Industrial activities and jobs had for many decades created prosperity but also a negative urban image. Hemingway remembered it as prosperous but ugly.

The new vision would concentrate on place making and public art, on quality of life and urban pride, on accessibility from the outside and mobility inside. This vision became embodied in a strong general master plan for the City adopted in 1989 (Ibon Areso Mendiguren, chief planner, presently political head of planning as Deputy Mayor).The master plan concentrated on the transformation of the industrial waterway that crosses the city and links it to the Nervion Estuary. The implementation of the master plan was only possible if the key areas along it, such as railway yards and old warehouses, were controlled by a single hand instead of a multitude of public fiefdoms pursuing their own agenda. These fiefdoms included State agencies, the Province and 30 municipal governments. The crucial step and key to the Bilbao renaissance was an agreement by all the political factions to delegate the development of their real estate to a public corporation collectively owned and controlled by them: Rià 2000 (Angel Nieva Garcia, General Manager). The Port Authority was persuaded that its historic know how in handling and storing goods should no longer be used in the urban part of the waterway. The Railways were persuaded there was more added value for them in joining the city-wide vision than sticking to their own investment plans.

The most improbable tract of waterfront industrial land (although located at five minutes walk from the central Place of the CBD) was cleared and partially used for the Bilbao Guggenheim Museum (ILL. 13) and the Congress Centre. The remainder of the tract became very valuable land, entirely controlled by Rià 2000, and is presently developed as offices, a five star hotel and luxury apartments. The equity is used to rehabilitate difficult areas such as the slums of the crime-ridden Old Bilbao. The waterfront of Old Bilbao has been made entirely pedestrian. A new tram line, with exclusive right of way, follows the waterfront (opened Dec. 2002). Old Bilbao now starts to attract new investors. The existing commuter rail line running south of the waterway has been modernised and a spectacular new Metro crosses the city and runs north of the waterway along urban marinas towards the new port.

To sum up, the Bilbao economic, social and environmental vision has been to switch from industry to services and culture and to consider its underused waterfront, tracks and wharves as an asset rather than as a liability. It was implemented through an effective "public-public" partnership aimed at co-ordinating the high quality public front investments needed to attract the private sector.

For an in-depth account and comments about Bilbao, in Spanish and French, see Masboungi, A. (Ed.), Bilbao: La culture comme projet de ville, La cultura como proyecto de ciudad; Paris: la Documentation française, 2001, Euro 20 – ISBN 2-11093151-5. A summary report is available in English (LACONTE). For a detailed report in English about the Basque Country as a City-Region, Bilbao and Vitoria, see: Fundacion Metropoli, Euskal Hiria, Vitoria: Central Publishing Services for the Basque Government, 2002, Euro 30– ISBN 84-457-1905-X.

Bilbao is hosting in October 2005 the Congress of the International Society of City and Regional Planners (www.isocarp.org)

SINGAPORE: ADVANCED TECHNOLOGY AT THE SERVICE OF SUSTAINABLE DEVELOPMENT

A remarkable feature of Singapore's transport policy is its continuity and its long term goal to balance investments in the public and in the individual modes, knowing that the space consumption of the automobile, including parking provision, is up to 100 times the space consumption of a public transport user. Ownership and use of the car are subject to marginal social cost pricing. This is achieved by setting quotas on car ownership: each month a fixed number of "Certificates of Entitlement", i.e. new license plates, are auctioned and the unsuccessful bidders have to try again later. The use of the car is subject to a congestion charge ("Electronic Road Pricing" – see ILL. 14), applicable in the Central part of the city and on the congested parts of the motorways network. The level of the charge effectively varies with the level of congestion.

In June 2003, about seven years after the initial decision, the Land Transport Authority (LTA) of Singapore, in charge of all surface transport infrastructures, opened its 20 km long driverless North East heavy rail line (NEL), with a capacity of 75.000 passengers per hour in each direction.

LTA justified its decision in favour of automatic operation by safety considerations, the human behaviour of drivers being considered as less reliable than automation (KNUTTON 2003). It was built by Alstom and is operated under a 30 year license by SBS, the island's largest private bus operator, at its own risk, without subsidies. Smaller automatic people-movers are connecting several of its stations to neighbourhoods and shopping centres.

Optimised staff efficiency is achieved by ensuring the same training to the stewards (Customer Service Assistants) and the station managing staff (Assistant Station Managers). The entire staff is thus deployed in the public eye instead of buried in a cabin.

The opening of the first automated heavy rail transit line, to be followed by two others, is the latest achievement of the Singapore transport policy, twenty years after the decision was made in favour of building a mass rail transit system, against the opinion of the World Bank, confirmed by a team of Harvard economists (PHANG 2003). By 2006 the underground rail network length will reach 145 km.

On the other hand the technical progress in deep tunnel boring techniques, including more efficient distance monitoring of shields, better adapting to terrain uncertainties and reduction of damage risks at the surface have lowered the cost of tunnelling.

Deep tunnelling also generally dispenses from expropriation if it does not affect the future use of the surface land. The alignments of deep tunnelled transit lines can therefore be fixed independently from

the street pattern, horizontally linking the points of maximum future demand along a string of underground stations.

These underground stations can be linked to the surface both vertically, through lifts, and diagonally, through escalators. The points of exit can be freely located by the owner of the system, within the circle of exit opportunities above each station. The size of this "circle of opportunities" is directly proportional to the depth of the tunnel.

The actual location of the exits can therefore be made according to an analysis of the negotiated costs and advantages of any number of potential places. They can be either on public land or, preferably, on private land ready to be redeveloped and whose owners could see the advantage of incorporating a direct access to the underground rail network.

As within the "circle of opportunity", there is obviously more than one location that presents a real estate interest, the respective owners can potentially be put in competition. This is where the principle of uncertainty comes in. In fact the "circle of opportunities" can be "elongated" thanks to the fact that the owner of the system has the possibility to locate the stations at any point within reasonable distance from the next one on the line.

In the case of automated transit the reduced costs of operation would therefore be combined with a reduced cost of expropriation and potentially the benefit of some value capture.

4 CONCLUSIONS AND ITEMS FOR DISCUSSION

1. Europe has been studied in the "European Spatial Development Perspective". They suggest the existence of a European "banana" or "pentagon". Peripheral and maritime regions are lobbying the EU to provide incentives aimed at changing this situation. Statistical observation of the European space is complemented by real time satellite observation ("Corine Land Cover"). Its accuracy and frequent updating helps to analyse the dynamics of Europe's changing urban and rural landscape towards ever more artificial surfaces.
2. URBAN SPACE. Observation of urban areas and their environment in a comparable way requires a uniform definition of urban employment basins and uniform observation tools. This was achieved by the Millennium Cities Data Base for Sustainable Mobility. Such comparisons allow an assessment of urban policies related to mobility, energy consumption and environmental quality. For example the % of GDP spent on transport, not including parking ranges from 4% (Copenhagen) to more than 20% (Jakarta). Accessibility ranking and travel times put Singapore on top and Houston at the end notwithstanding a cost of 14% of its GDP. Findings illustrate the possibility of an effective decoupling of economic growth and growth of energy consumption. The growing traffic congestion, as an inevitable result of the increase in automobile ownership, whatever the amount of road investments, suggests the need for travel demand management, and therefore the search for urban forms favouring sustainable mobility and energy savings, at all policy making levels, from the EU level down to the level of cities themselves.
3. EU. The quest for sustainable cities is not directly part of the EU competence. But the EU policies deeply affect land use in general and urban land use in particular, justifying an increased attention of cities for the EU. The regional policy of the EU and the use of the structural funds have acted in favour of reducing disparities between European regions and therefore favoured peripheral areas within the Union at the expense of the existing urbanised clusters. An awareness of the urban problems has led to the URBAN community initiative, which has allowed direct contacts between Europe and its cities. This initiative has now been thwarted and other tools are being considered to link urban planning and the EU structural funds. The transport policy has in a similar fashion favoured pan European motorway networks and high speed rail connections ("Trans European Networks"), while urban transport networks received less support (such as the funding of the Athens Metro). The environment policy is by contrast encouraging integrated urban panning by requiring, since July 2004, a Strategic Environmental Assessment of urban plans and programmes.
4. CITIES. Urban planning as a regulatory framework for urban development has lost part of its clout, because of the growing structural role of the transport infrastructures: airports, motorways, urban rail investments, etc. The planning of these infrastructures is subject to politics. Their implementation is dominated by specialised engineering disciplines, leaving little place to the urban planning professions. The Laissez Faire and creative chaos of spaces structured only by their infrastructures has become the underlying philosophy of many urban developments. It is often associated with the US urban planning practices. The challenge to cities is therefore to be able to conceive and implement an integrated urban project, achieving "Place building", within the constraints of a changing global context.

5. EXAMPLES. Four examples have been selected among many, to suggest that integrated planning remains possible as well as desirable, if a strong willed individual or group has developed a vision and the implementation tools. CURITIBA, Brazil, is a prime example of sustainable urban development, combining economic growth, social cohesion and environmental quality, through the vision of its Mayor-architect. BERLIN, FRG, is an example of a Capital's rebuilding; using the rich history of its Prussian urban past. Under the leadership of its planning director it has achieved the principles of mixed use development and recreated a vibrant central core on the very location of the infamous wall and its surrounding no man's land. BILBAO, Spain, is an example of a city that suddenly lost its entire coal and steel based industry as a result of global competition and developed a collective vision for an integrated alternative urban project. It succeeded in building a place of culture and services capable to thrive within that same globalisation that took away its industry. SINGAPORE combined the challenge of building a nation capable to discourage military invasion and a star of the global economy, while making optimal use of its scarce land resource. This has been achieved, under the leadership of its founder, by developing a state-of-the-art public infrastructure ranging from the airport, automated port services, high tech urban transportation and multiple IT applications. The Government has been encouraging a service and high tech based private sector, a high level of personal income and a low level of individual energy and resource consumption. It achieved this result through a strong planning and regulatory framework, an effective travel demand management and the stewardship of its scarce natural resources, so enhancing the quality of life of its citizens. The replicability of such examples in other contexts remains a point of contention.

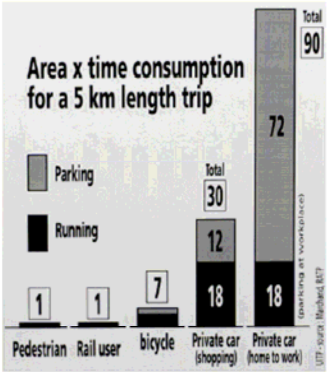
5 REFERENCES

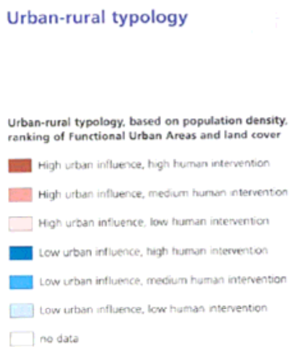
ARROJO, P. (ed.), "El Plan Hidrologico Nacional a debate", Zaragoza: Fundacion Nueva Cultura del Agua, 2001
BANISTER, D. et al. "European transport Policy and Sustainable Mobility", London: SPON Press, 2000
DUNPHY, R. et al., "Ten Principles for Successful Development Around Transit", Washington D.C.: Urban Land Institute, 2003
ECTP (European Council of Town Planners) "Try it this Way: Sustainable Development at the Local Level", The Hague: ECTP, 2002
FALUDI, A (Ed.), "European Spatial Planning", Cambridge, MA: Lincoln Institute of Land Policy 2002
GAUCHET, M., "Le désenchantement du monde", Paris : Gallimard, 1985
GOODWIN, P., "Can IT Solve The Transport Problems?" in: EU Hitachi Science and Technology Forum '04 "Transportation and IT, Impact on European Society", Stockholm, 14-16 May 2004
KNUTTON, M., "Rapid Transit: Singapore", International Railway Journal, May 2003
LACONTE, P (Ed.)., "Changing Cities, a Challenge to Planning", Philadelphia; The Annals, 1980
LACONTE, P., "Smart Growth: a Tale of Three Spanish Cities", Urban Land Europe, Washington D.C.: ULI, 2004
PHANG, S.-Y., "Strategic Development of Airport and Rail Infrastructure: the Case of Singapore", Transport Policy, 10/2003
SACTRA (Standing Advisory Committee on Trunk Road Assessment), "Trunk Roads and the generation of traffic", London: HMSO, 1995
UITP (International Association for Public Transport), "Millennium Cities Data Base for Sustainable Mobility" Brussels, 2001
WEBBER, M., "The urban Place and the Non-Place Urban Realm", in: GRAHAM, S. (Ed.), "The Cyber Cities Reader", London: Rutledge, 2003
WILLOUGHBY, C., "Singapore's Motorization Policies" 1960-2000", Transport Policy 2001

6 ILLUSTRATIONS

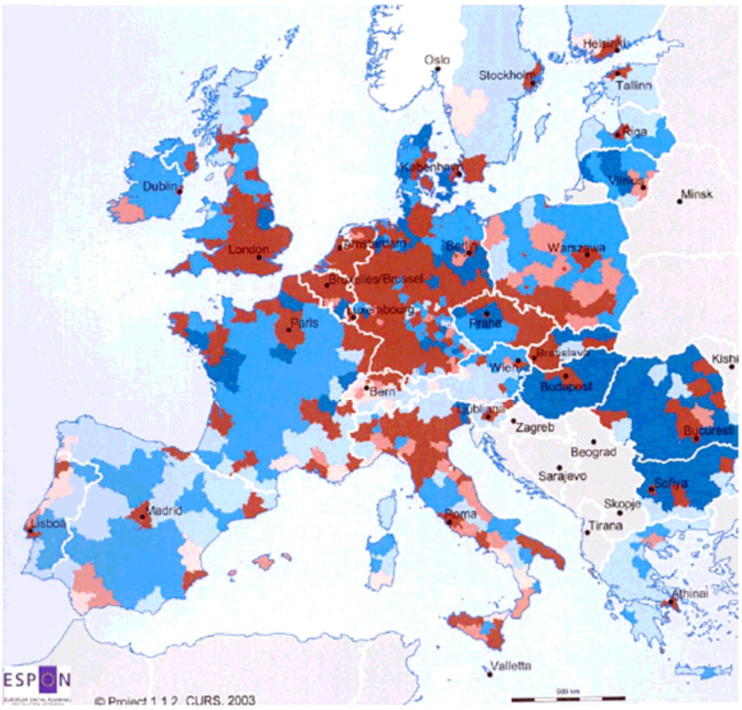
7 BIO.

Pierre Laconte, President of the Foundation for the Urban Environment, is Honorary Secretary General of the International Association of Public Transport UITP, which he has been leading during some 15 years, and President-elect of the International Society of City and Regional Planners. He was one of the three planners in charge of the masterplan and the architectural coordination of Louvain-la-Neuve, a new town developed by the Catholic University of Louvain around a new railway station, 25 km south of Brussels. Louvain-la-Neuve presently has a day population of 40.000. It has won the Abercrombie Award of the International Union of Architects in 1976.

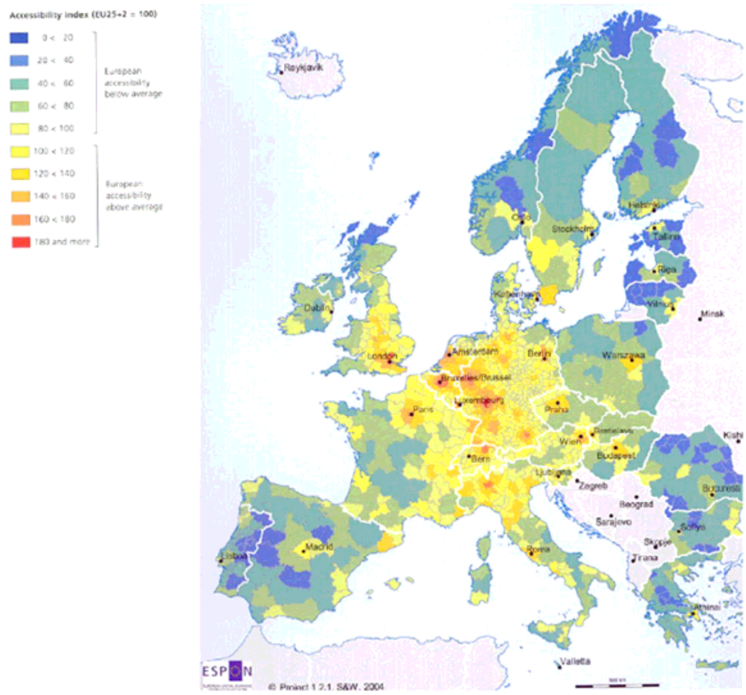




(1) Space Consumption by Mode (RATP)

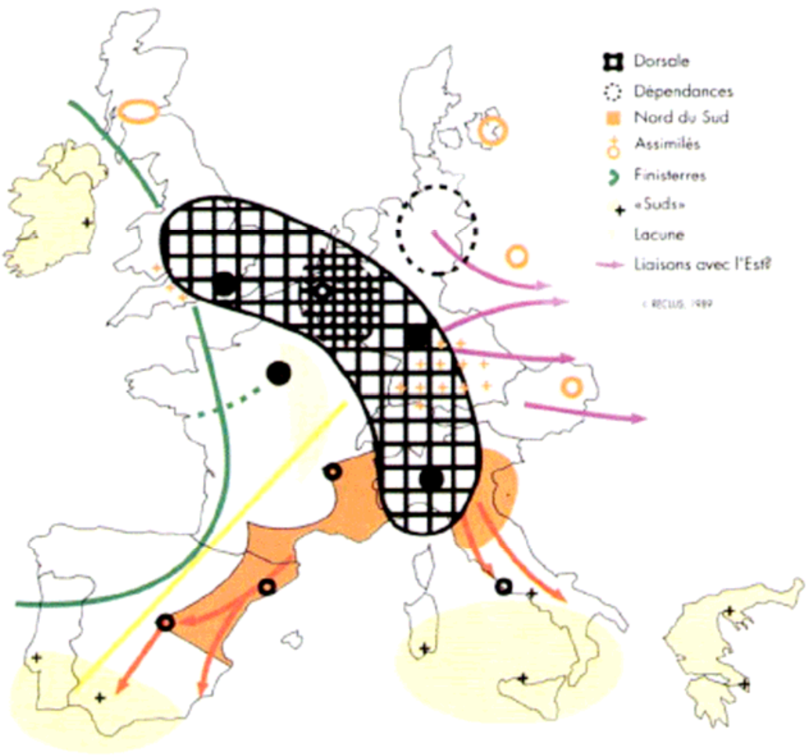


(2) Urban-rural Typology 1999 (ESPON)



(3) Potential accessibility multimodal 2001 (ESPON)

The Blue Banana Indicating the (Core) Area with Most Cities with More than 200.000 Inhabitants

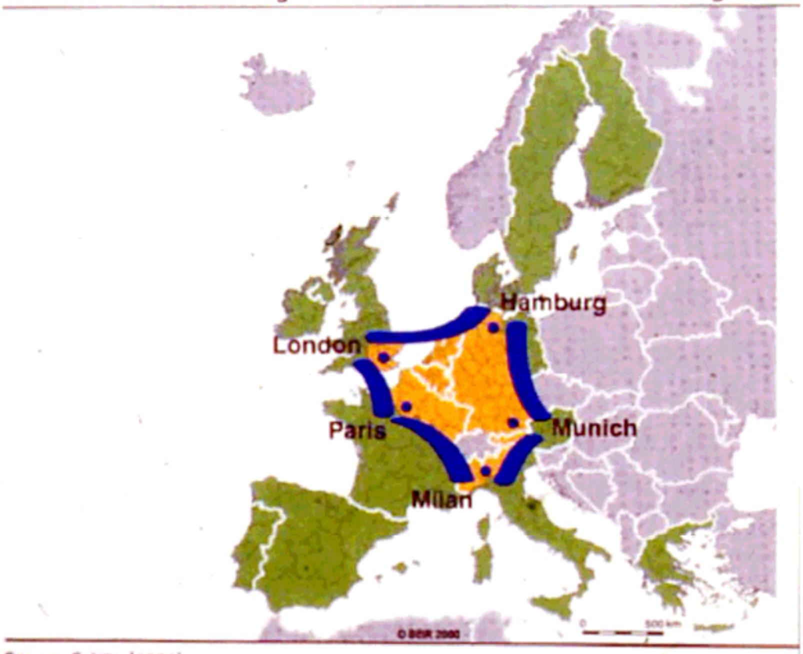


Source: Brunet (1989)

See Chapters 2 and 4

(4) The "Polycentricity" paradigm (I): the "evil Blue Banana" (FALUDI)

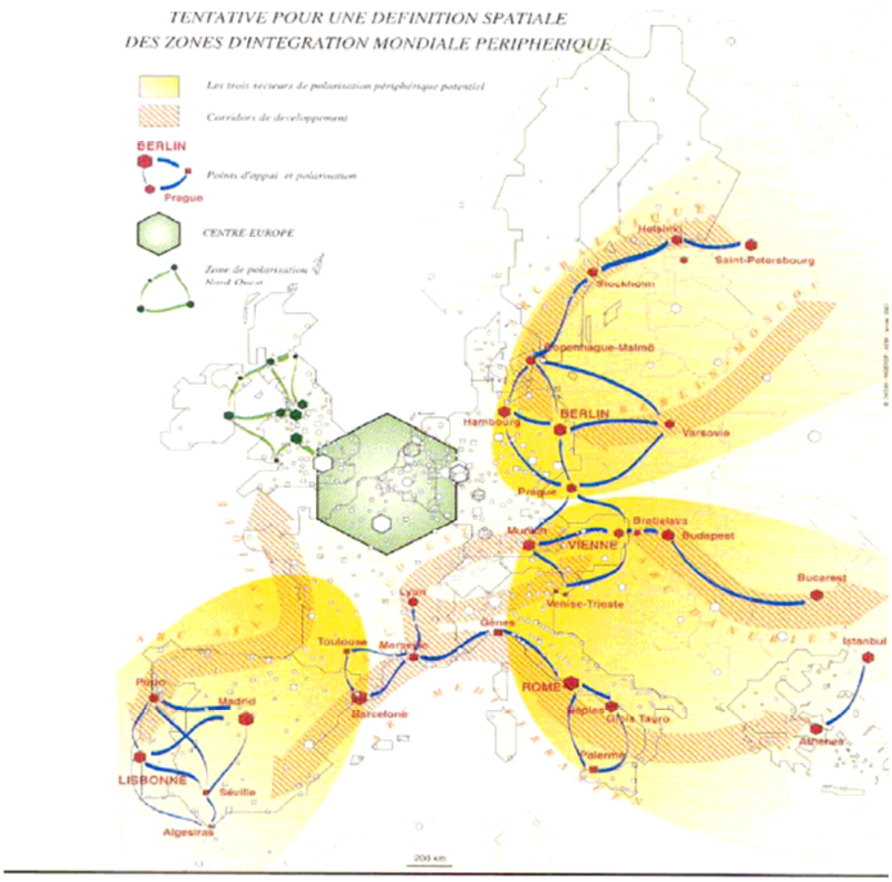
The "20-40-50 Pentagon," Just One Global Economic Integration



Source: Schön (2000)

(5) The "Polycentricity" paradigm (II): the "evil black pentagon" (FALUDI)

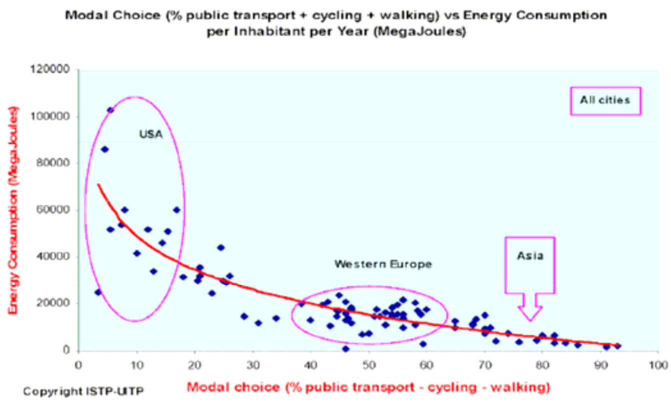
Possible Development of New Global Economic Integration Zones



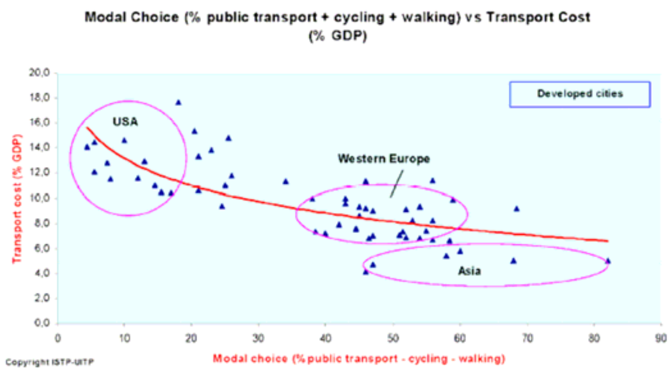
Source: French Presidency (2000b); Guigou (2002)

See Chapter 4

(6) The "Polycentricity" paradigm (III): the "good global economic integration zones" (FALUDI)



(7)



(8)

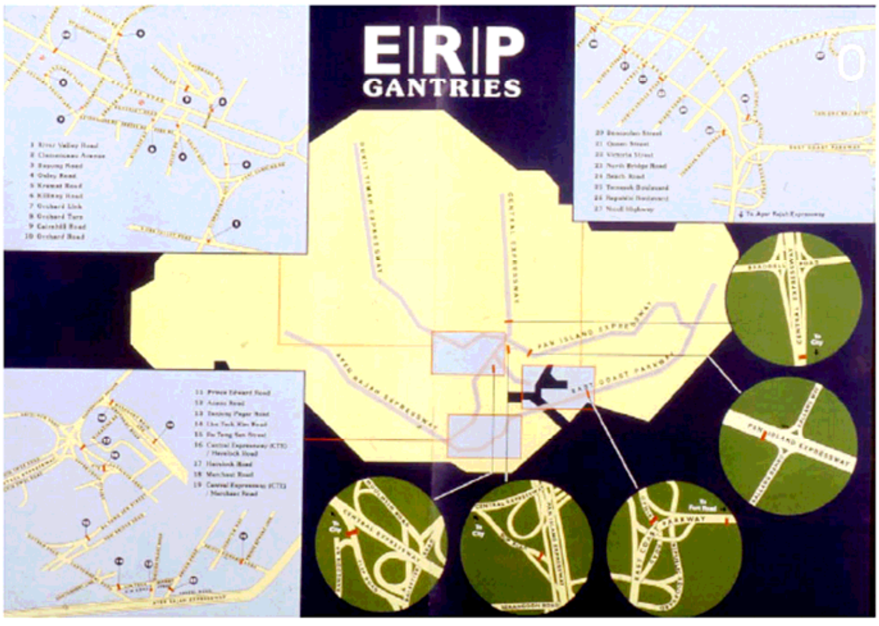

Villes participant à l'Initiative communautaire URBAN
Programmes URBAN I (1994-1999)
Programmes URBAN II (2000-2006)
Programmes URBAN I puis URBAN II
(1994-1999 et 2000-2006)
41 Badalona
42 Barakaldo
43 Cáceres
44 Cadiz
45 Cartagena
85 Le Havre
86 Le Mantois
87 Lyon
88 Mantes-la-Jolie
89 Marseille
126 Den Haag
127 Heerlen
128 Rotterdam
129 Utrecht
Autriche

(10)

(11)

(12)

(13)



(14)

🏆 **reviewed paper**

The Sustainable City Game: Systems Dynamics Modeling Toward a Democratic Urban Design Process

Richard S. LEVINE, Michael T. HUGHES, Ernest J. YANARELLA, Casey Ryan MATHER

Center for Sustainable Cities, University of Kentucky, Lexington, KY 40506-0041 USAEmail: rlevine@uky.edu

1 ABSTRACT

While it has become a buzzword at global conferences, within the scientific and design communities, and among policymakers at a variety of levels, sustainability has largely remained an abstract concept whose abstraction, on the one hand, has served to gather wide-ranging support, but on the other hand, has not been useful in achieving its implementation. The Center for Sustainable Cities in collaboration with Oikodrom, the Vienna Institute for Urban Sustainability, has developed an operational definition of sustainability at the scale of the city-region as a participatory, balance-seeking design process.

Our scenario-building design process of sustainable cities is informed by systemic feedback generated by the Sustainability Engine™, a software utility under development at the University of Kentucky that combines systems dynamics modeling software with the functionalities of intelligent CAD, GIS, and facility management programs. This design process, or what we call the Sustainable City Game, is a democratic method for the generation, governance, and management of sustainable cities in which stakeholders may place any desire on the table, but in order for a given proposal to move forward in the iterative process it must be embedded in a scenario that on a systemic level is approaching balance.

The Sustainable City Game will be explored in the context of two case studies. First will be an examination of a Sustainable Urban Implantation designed for the overbuilding of Vienna's Westbahnhof railroad yard wherein new urban models were developed that are particularly well suited to the flexible urban design process of the Sustainable City Game. Second, will be an investigation of the European Commission sponsored SUCCESS research project wherein seven proto-sustainable Chinese villages were studied and their metabolisms were projected forward as future sustainable cities through the utilization of an early form of the Sustainability Engine™.

2 DEFINING SUSTAINABILITY

Sustainability and sustainable development have been rallying cries for social movements and NGO's and buzzwords of global conferences, however, their true meanings have remained highly contested. The Brundtland Commission definition of sustainable development has been the most popular and has served as a minimalist definition around which most of the current discussion of sustainability has been framed. Its abstract nature, however, has served to conceal as much as it reveals, and thus it has only been helpful in forming a broadly based social consensus. Recently, Simon Guy and his associates, Simon Marvin and Graham Farmer, in light of the myriad interpretations and competing logics of sustainability, have deemed sustainable architecture, sustainable cities, and sustainable development "essentially contested concepts." Applying a social constructivist analysis to sustainability, Guy and his colleagues argue that the "separate but not autonomous" logical frameworks that create the discourse on sustainability effectively prohibit the search for a more encompassing framework of which these individual logics are a part. Lacking an objective datum to anchor the substance of sustainability, for Guy and his associates the sustainable city becomes merely "an open or empty concept which is filled by sets of competing claims about what the sustainable city might become" (Guy and Marvin, 1999: 273).

Without denying the essential contested character of sustainability, the work of the Center for Sustainable Cities at the University of Kentucky and Oikodrom, the Vienna Institute for Urban Sustainability suggests a way out of the conundrum in which social constructivism places sustainability. This avenue lies in working back into the linguistic thicket and eco-scientific renderings of sustainability in order to build the theoretical base of an operational process for actually achieving sustainability—a process that seeks to synthesize and transcend the various competing logics of sustainability expressed in the work of Guy, Marvin and Farmer through the establishment of an objective metric and working within a clear operational definition of sustainability.

First, it is necessary to examine a common misunderstanding within the sustainability movement: the difference between growth and development. While many, including the famous Brundtland Commission, use the terms "sustainable growth" and "sustainable development" interchangeably; Herman Daly and John Cobb have lucidly presented a sharp distinction between the two. Daly and Cobb define 'growth' as "quantitative expansion in the scale of the physical dimensions of [a] system," while defining 'development' as "qualitative change of a physically non-growing…system in dynamic equilibrium with the environment"(1989: 71). They establish the nature of the earth as non-growing and argue that "any system of a finite and non-growing earth must itself also eventually become non-growing"(1989: 71). The term "sustainable growth" then becomes self-contradictory. Similarly, Michael Redclift has shown that complex natural ecosystems initially pass through a phase where growth and production is favored, to a mature and sustainable developmental phase where diversity, regeneration and stability are fostered (1987). Therefore, as Daly and Cobb write, "growth will become unsustainable eventually…but sustainable development does not become self-contradictory"(1989: 71).

Daly and Cobb's rejection of the concept of sustainable growth runs parallel to their rejection of the promethean environmentalists' or "human exceptionalist" school's theoretical means of facilitating this growth: the idea that all natural resources can infinitely be replaced by humanly created substitutes. This theoretical economic tool of substitutability embedded in what has come to be called "weak sustainability," is dismissed by Daly and Cobb in favor of "strong sustainability" that requires "maintaining both humanly created and natural capital intact separately, on the assumption that they are complements rather than substitutes in most production functions"(1989: 72). In 1999, Eric Neumayer wrote in favor of the concept of strong sustainability but lamented that "so far there does not exist a comprehensive study measuring SS [Strong Sustainability]"(p.202) After exploring and rejecting various measures including sustainability indicators and the ecological footprint analysis, in 2000 the Center for Sustainable Cities with Oikodrom formulated the Sustainable Area Budget (SAB) to serve as a yardstick to measure and operationalize strong sustainability (Levine, Yanarella, Dumreicher, Broyles).

2.1 Sustainable Area Budget

The Sustainable Area Budget is an equitable land budget from which a city-region must satisfy its needs now and into the future. This metric of sustainability means that in principle, each individual is entitled to one six billionth of the earth's regenerative capacity interpreted as land area. A city's working budget is the aggregated Sustainable Area Budget of its citizens. Within this fixed land budget, the citizen-stakeholders of a city-region are free to negotiate a way of life according to their own locale, culture and creativity, as long as no harmful imbalances are exported beyond their SAB or into the future.

The Sustainability Indicator method, currently the most popular approach among policy-makers, creates checklists of indicators, intended to measure and incrementally reduce the levels of unsustainability. By disaggregating the problem of unsustainability into many sub-problems, it makes it easier to deal with them in isolation. However, at no point on any of the separate indicator scales or on the aggregated scale is there a place where sustainability can actually be said to exist.

The Ecological Footprint method is a highly quantitative approach that is effective as an analytical tool for assessing the environmental load of a city by calculating the territory appropriated by current human activities. While metaphorically and visually, the approach is a powerful and compelling educational tool, it is not useful in shaping a solution once the magnitude of the problem is recognized because it urges stakeholders to embark upon a succession of separate, incremental movements to reduce their town's Ecological Footprint, rather than dealing with the town as a whole system. Thus, it fails to understand and grapple with the synergistic consequences of the many causes of unsustainability.

By contrast, the Sustainable Area Budget approach begins from the premise that sustainability is an ongoing, balance-seeking process, not a collection of incremental steps. Through seeking a quantitative yardstick from which to launch a policymaking process of democratic deliberations, it produces a paradigm shift from trying to reduce environmental loads, to collectively restructuring a place's processes and lifestyle within an equitable budget of the earth's ecological resources. In doing so, the SAB allows the sustainability agenda to advance beyond the boundaries of weak sustainability into a warranted state of strong sustainability.

2.2 Operational Definition

The Center for Sustainable Cites with Oikodrom have developed an operational definition of sustainability that presents a comprehensive, scientific, democratic, design and governance method that integrates conflicting interests through a scenario-building process:

> Sustainability is a local, informed, participatory, balance-seeking process, operating within a
>
> Sustainable Area Budget, exporting no harmful imbalances beyond its territory or into the future,
>
> thus opening the spaces of opportunity and possibility.(Dumreicher, Levine, Yanarella, 1998-2001)

Sustainability is a local...: Sustainability needs a place to happen. Although problems aggregate and become manifest on a global scale (e.g., ozone depletion, global climate change), offenses to the environment are produced locally. When dealt with locally, where "local" means the city/region, the neutralization or reuse of all negative byproducts must be considered part of the price of doing business. The earlier history of our civilization is the history of city/regions--largely autonomous towns that gained virtually all of their material needs from their local countryside and had to maintain the quality of the countryside in order to sustain their way of life. From this perspective, sustainability can only happen at the scale of the city/region--the largest scale capable of addressing the many urban architectural, social, economic, political and other imbalances besetting the modem world and simultaneously the smallest scale at which such problems can be meaningfully resolved in an integrated and holistic fashion.

… informed...:In order to be able to maintain the quality and the productivity of the local region and its countryside one must understand the consequences of the metabolic activities occurring within the city/region. Earlier towns operating within a largely closed system received rather rapid feedback as to the consequences of their activities. Because almost all activities manifested locally, causes and effects related to those activities were quickly understood. When imbalances threatened the city/system, they were noted and adjusted locally. In the modem world there are effectively no local boundaries and positive activities at a small scale may well have negative consequences at larger scales. By using modern means, however, we gain powerful tools both to design and monitor major energy and material flows and to model the projected implications of different processes we might choose to include in our city/region.

…participatory...: Sustainability is a process by which a local community can decide how it will afford to live within its natural budget and the limits of its own creativity. Such a process starts with the principle that sustainability is nonnegotiable, where in principle everything else is negotiable. That means that all participants in the process must agree that the health, equity and viability of the city/system is the precondition for any other decision. Secondly, as the sustainability process proceeds, stakeholders increasingly realize that they share a common destiny and that significant synergies will result from their creative encounters and negotiations. Through many iterations, the city/region becomes understood more as an urban ecosystem and less as adversarial, zero-sum game. Eventually, the players become partners and more focused on building common wealth.

… balance-seeking process...: The problem with our existing economic system is that it has no built-in mechanism to insure its own long-term survival. It is not designed to pursue balance. As noted above, natural ecosystems in early stages of succession are also designed to maximize production at low levels of diversity, but as such systems mature, and organic material accumulates, the emphasis shifts away from production and toward maximizing diversity, resiliency and maintaining internal balances. This needs to be the model for human ecosystems.

… operating within a Sustainable Area Budget (SAB) ... : In the past, nature was assumed to be so vast as to be able to comfortably absorb any and all offenses that humankind's activities dumped onto it. It is now clear that we have long since exceeded many of nature's capacities. The Sustainable Area Budget is our concept for the natural budget in land area, available for each city/region to support its way of life. A simple determination of the SAB for a city/region goes something like this: simply divide a country's total land area by its population and multiply by the number of people in the city/region. In the longer term SAB's will need to be defined and applied globally, requiring political consensus in its determination and application.

… exporting no harmful imbalances beyond its territory or into the future: The key idea here is that when the prior part of this definition is realized such a city/region will effectively export no problems beyond its territory or into the future. On the other hand, even this circumstance is negotiable, given our Fifth Operating Principle for Sustainable Cities, which states that "imbalances are to be negotiated outward." This means that in some cases an imbalance may be exported from the city/region, but only if its rebalancing can be accounted for by an agency beyond the scale of the city/region.

… thus opening the spaces of opportunity and possibility: such a process is seen as an empowering and liberating activity that maximizes the principle of locally bounded informed choice within globally recognized limits.

This definition employs the Sustainable Area Budget to offer for the first time a metric of sustainability embedded in an operational process that can allow for the implementation of sustainability projects. The definition formulates the Sustainable Area Budget as a means of defining the sustainability datum of a city-region and describes a kind of balance-seeking game—what the Center has termed the Sustainable City Game—that can come into play. Unlike most current decision-making processes which, because of competing interests, become highly charged power struggles that focus on single issues without taking into account the sustainability of the whole system, the Sustainable City Game is a non-threatening concept through which a sustainable decision making process can be initiated. Engaged in the Game, the citizen-stakeholders of a given city-region negotiate amongst themselves how they can afford to live within the limits of their land budget limited only by their own culture and creativity.

3 THE SUSTAINABLE CITY GAME

The Sustainable City Game begins by encouraging players to place any legitimate needs and ideas on the table. Then, varied teams of stakeholders—together with designers, social scientists, natural scientists, and other professionals—attempt to assemble a number of different design scenarios that represent these competing interests. These design scenarios would all be negotiated within the Sustainable Area Budget of the city. Thus, the design and development of the city becomes an empowerment process, engaging citizen-stakeholders in the shaping of their common, sustainable future. These scenarios are then modeled as both physical designs and energy and material flow models using the Sustainability Engine™, a utility still under development that combines some of the attributes of intelligent CAD, facilities management and GIS software together with systems dynamics modeling software to become the principal feedback, design and management tool in the negotiation of sustainable city-regions (Levine, Yanarella, Radmard, Dumreicher, 2003).

The practice of architecture in recent years has increasingly gravitated toward the delivery of contract documents in intelligent CAD and/or facilities management formats. Through embedded databases these formats provide the capability of extracting many sorts of useful information about the virtual building. Material takeoffs of virtually every nut and bolt together with their locations and specifications are easily charted. Maintenance and replacement schedules can be developed and recorded. Changes made in material, size and energy performance are automatically projected through the building model and its database and the reverberations of those changes can be instantly displayed. It is a small conceptual step from the design and management of conventional buildings to the design and management of sustainable cities. One difference is that in the case of sustainable cities, much more information is attached to the components, systems and building blocks that make up the city model. Within the memory storage of the Sustainability Engine™ will be module libraries of components and building blocks containing myriad attributes—including such things as embodied energy, distance from source, cost, availability within the SAB, labor requirements, recyclability, land use implications, energy and material flow connections to other regenerative systems, and the various inputs and outputs involved in the functioning of the module within the city-system. These modules function as plug-in, "free body" objects that provide inputs and outputs when attached to a larger city-system scenario model.

In the playing of the Sustainable City Game, stakeholders together with architects and scientists attempt to assemble a sustainable city model, drawing on the existing building blocks from the Sustainability Engine™ that most closely meet their needs and desires. If no building blocks are suitable, existing blocks are modified or the architects develop completely new ones that respond to the local architectural vernacular, particular site conditions, material availability, the local technical know-how, and the desires of the stakeholders. Because any urban design that represents the needs or interests of only one stakeholder or group of stakeholders will not contain the diversity or complexity of a real town, such a limited model when run on the Sustainability Engine™ will appear in its first trial run as a city-system that is grossly out of balance. The feedback of this imbalance becomes an important moment for the stakeholder-players. It indicates to them that in spite of the fact that their immediate needs may have been well satisfied by their preferred urban proposal, because their interests represent only a portion of the city-system, many other needs must be met in order for the city-system to be approaching equilibrium. This feedback then supports a significant operational principal of the sustainability endeavor: any proposition may be put on the table, but in order to be carried forward in subsequent iterations of the Game, the overall city-system scenario in which the proposition is embedded must be approaching equilibrium. Very quickly it is seen that no matter how beneficial a given proposition may appear (or however politically powerful its proponent), it must still attach itself to a more extensive network of mutually supportive propositions to form a larger, well-balanced, synergistic scenario in order to remain viable as the Game progresses.

The Game is played through many iterations and at each successive step the scenarios become more sophisticated and more complex. In a similar fashion, the Game itself and its module libraries take the form of learning ecologies through repeated game-playing, becoming more elaborated and accumulating more options and being able to provide more sophisticated feedback. Because of its growing successes the Game and the city models its playing generates, become attractors of people and interests who are in a position to act upon what they have negotiated to be their preferred form and structure of a locally determined sustainable city. As the game becomes sufficiently serious that construction is planned and carried out and people come to live in the city, the same stakeholder process that generated the city form and structure using the Sustainability Engine™ continues to be employed as the process by which the city advances its development, modification, maintenance and governance (Levine, Yanarella, Radmard, Dumreicher, 2003).

4 WESTBAHNHOF SUSTAINABLE URBAN IMPLANTATION

Our operational definition of sustainability suggests a dense, compact city with a dynamic balance between community and privacy. It suggests a community rich in architectural form, public space, and individual and collective opportunities. It suggests a city with a strong sense of itself as a place, a clear and defined form, and a common destiny. It suggests a human-scaled environment, not one that is over-scaled and sized to primarily accomodate vehicles, industries, and faceless institutions. Yet, it also suggests a city able to find appropriate space for the metabolic and economic processes of a modern city (Dumreicher and Kolb, 2003). In order to proceed from theory to practice, the evolution of a coherent, consistent, and complete theory of the sustainable city-region has been paralleled by the co-evolution of a new urban form. The City-as-a-Hill is a concept first developed by the Center for Sustainable Cities and Oikodrom as an urban implantation to be built over the Westbahnhof railroad yard in Vienna. The City-as-a-Hill is a flexible urban construct that is able to fulfil many of the requirements of the sustainable city-region suggested by the operational definition, making it the sort of new urban model that is particularly well suited for use with the Sustainable City Game.

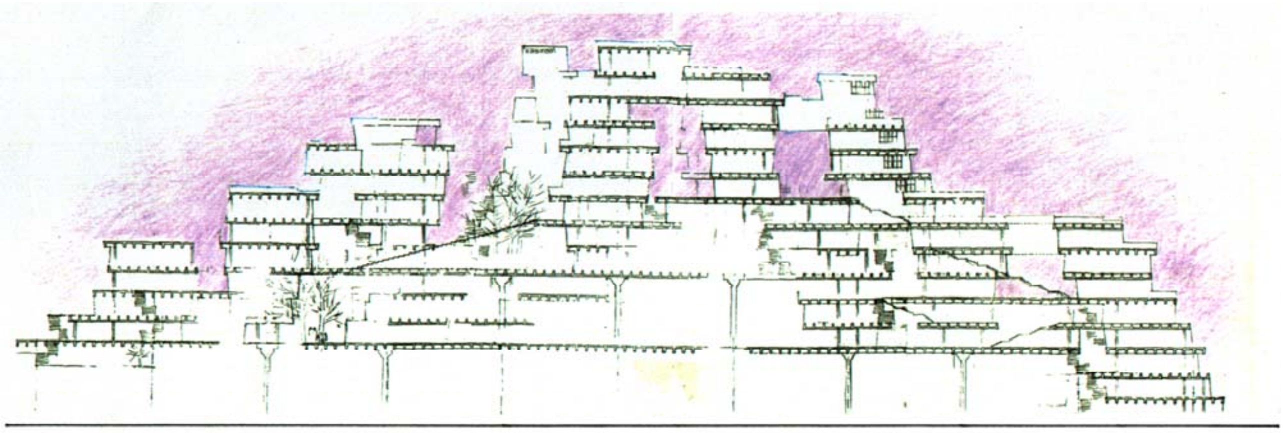


Figure 1: Sectional View of the Westbahnhof City-as-a-Hill Sustainable Urban Implantation

Originally inspired by the dense human-scaled urban fabric of medieval Italian hilltowns, the new model provides a walkable pedestrian scale, which requires few vehicles, and allows for public space such as markets and squares. However, whereas its medieval counterpart was a city built on a hill, the new urban model becomes a city built as a hill, with the inner “hill” being comprised of the many large-scale industrial buildings, mass transportation and other necessary infrastructure that is needed for the operation of a modern city. The sustainable City-as-a-Hill would be surrounded by a large agricultural hinterland corresponding to its population-based Sustainable Area Budget that would supply all of the land-based resources necessary to support its industry and way of life. The construction of the “hill” is made possible by a flexible structural system, the Coupled Pan Space Frame, a post-tensioned concrete structure developed by Richard S. Levine at the University of Kentucky. This space frame spans large distances and at the same time allows for systems infrastructure to be interwoven within the depth of the structure. The space frame system also easily accommodates future expansion and modification of the city, allowing the surface to evolve and increase in complexity over time (Dumreicher, Levine, Yanarella, Radmard, 2000).

5 PROJECTING SUSTAINABILITY FROM THE CHINESE VILLAGE

Recently our Center’s focus has shifted from the implementation of sustainability in existing unsustainable cities of the West, as demonstrated by the Westbahnhof Sustainable Urban Implantation, to the identification and projected expansion of proto-sustainable villages within the context of the rapidly developing Chinese urban landscape. Within the next five to ten years at least 400 million Chinese farmers are projected to migrate from their rural villages to hundreds of new or enlarged industrialized cities. There are strong indicators that these new Chinese cities will be massively unsustainable from economic, environmental, social, and cultural perspectives. China’s extensive industrialization and urbanization program will have dire consequences not only for China but the rest of the planet as well. It is therefore essential that sustainable alternatives to this detrimental development be created and implemented. The goal of the European Commission sponsored research program “SUCCESS” has been to forge a sustainable future for the Chinese village. Working with seven villages in six Chinese provinces, SUCCESS has initiated sustainable civil society processes which have the potential of increasing the life quality and economic potential of the villages through Sustainability Oriented Means.

The great majority of China’s developing cities will be extensions of existing villages which have historically maintained a balanced relationship with their landscapes and resources. Recently, this balance has been interrupted by China’s rapid and uncontrolled modernization. However, in spite of a few unsustainable practices that have crept their way into these village-systems, the villagers still produce their own food, provide most of their own labor and material resources, and balance the effects of their way of life on the natural environment. For this reason, the SUCCESS project has identified the traditional village as an appropriate place to begin to implement sustainability processes and to provide a starting point for the modeling of the future sustainable city. Because the villages are much smaller in scale than existing towns or cities, they are much easier to model and understand as a whole. The villages are the repository of generations of collective wisdom that reflect a culture and design that have never been far from a balance with local resources. They are thereby much easier to bring to sustainability through the playing of the Sustainable City Game.

The SUCCESS project team of 40 researchers worked collaboratively using our operational definition of sustainability. Through synthesizing scientific tools with design and participatory methods, our process seeks to avoid the narrow determinism of specialized scientific disciplines and, in so doing, demonstrate a rich and complex means of accommodating diverse and conflicting interests to create a Sustainable Civil Society (SCS) form of governance.

5.1 Initiating the Sustainable City Game in China

The SUCCESS project researchers worked with the villagers to determine which aspects of their lives were essential to be maintained and which were better to change (Dumreicher and Kolb, 2005). By placing the villagers concerns and suggestions on the table and augmenting them with the researchers' methods and skills, the SUCCESS project initiated the first step in the sustainable city gaming process.

A specific example of this gaming process is the participatory design and construction of a bathhouse in Xia Futou in Henan Province. Without a fully developed Sustainability Engine™, or even a computer, the design negotiation process was acted out in the streets and byways of the village. A number of site plan proposals were "drawn" at full scale with rocks placed in the shape of the proposed building on a site adjacent to the future bathhouse. Through this process, a conversation between the architects of the SUCCESS project and the villagers emerged and eventually led to an agreed upon plan.

5.2 Systems Dynamics Modeling of a Chinese Village

During the SUCCESS project a systems dynamics model was developed for a village named Dujia located in China's southwestern Yunnan province. The relationships among the different parts of the village system were constructed from systems diagrams comprised of "Intelligent" icons that linked together to form an interconnected web of cause and effect relationships. These mathematically-based systems icons represent the metabolism, that is, the energy, time and material flows of a village. It is possible to add or subtract functions from the village model or to change their relative quantities to enable "what if" questions to be asked by citizen stakeholders.

Dujia's main source of income is from the growing of commodity crops for export. Part of the agricultural economy of Dujia was modeled, along with other aspects of their day-to-day life, and modeling experiments were conducted by changing the agricultural allotment for different crops. In conducting this simple "what if" experiment, the model showed that sugar cane, considered to be one of the major cash crops of the village, was associated with a negative net cash-flow. With further analysis it was discovered that the villagers would actually be able to eliminate almost half of their annual labor yet still increase their net earnings if they simply stopped growing and tending to sugar cane. The large amount of income generated bi-annually from the sale of sugar cane had seemed to indicate it was a profitable venture, however the expenses associated with its production which gradually accumulated throughout the year caused a net loss it its procuction.

The causes and effects of this slow aggregation of expenses becomes evident through the systems dynamics modeling process, and from this point the villagers become aware of the kinds of "what if" questions it may be useful to ask and have entered into the systems dynamics modeling process. A positive feedback loop of information is constructed from this participatory process and eventually, more and more complex determinations are made through the numerous "what if" questions to permit villagers to synthesize new scenarios making possible a sustainability enhanced quality of life.

5.3 The Future Sustainable Chinese City-Region

While the SUCCESS project initiated, in seven villages, the empowerment process necessary for the playing of the Sustainable City Game, it will be necessary to look past the scope of SUCCESS in order to generate a sustainable future for China. During the SUCCESS project the current metabolism of Dujia was studied and modeled as an example of a typical traditional Chinese village. Unsustainable practices, such as the use of fossil fuels, agricultural chemicals, and other unsound agricultural techniques were replaced in the systems dynamics model with sustainability-oriented equivalents. This systems model can be used as a template for future models that could project traditional Chinese villages into modern sustainable cities.

If the future Chinese city is to evolve from the village with sustainability as its intention, then merely regurgitating western patterns of "green" projects will not be sufficient. A city that tries to achieve sustainability through a checklist of "best practices" or though accumulating incremental improvements in efficiency through bureaucratic regulations will continuously hit increasingly insurmountable barriers that could inadvertently hurl it further into the chasm of unsustainability. This is because, as previously stated, sustainability is an ongoing balance-seeking urban design process that can only function when developed as a whole system. As standards change, the "best environmental practices" of the present, that merely seek to create a less unsustainable city, will become the unacceptable practices of the future. On the other hand, any city-region that has negotiated its urban balances within its Sustainable Area Budget cannot become obsolete in the future.

For example, establishing criteria for maximum CO_2 emissions standards for a given industry is indicative of today's bureaucratically oriented approach, which is, in and of itself, too specific and narrowly focused to make any real steps toward sustainability. In contrast, following the principles outlined here, a sustainable city-region must balance out its total CO_2 emissions from all sources according to its Sustainable Area Budget at the scale of its region. If it chose to allocate a particular factory with a large part of that budget, due to its great importance in the town-system, this would be perfectly acceptable as long as the total budget of the city-region-system was not exceeded and CO_2 on a net basis was not exported beyond the city's territory. The specific path to balance that each city takes should not be governed by isolated decisions that do not consider the possibilities of seeking equilibrium at the scale of the whole city-region-system.

After the Chinese village is modeled and projected into the future on a sustainable basis, this "proto-sustainable" Chinese village is used as the starting point for the participatory evolution of larger towns and cities whose growth and development proceeds through this same sustainable scenario building, aimed at developing diverse, vibrant new towns for China's future. As the first sustainable city emerges, its success would provide the momentum and enthusiasm for the building of additional sustainable cities, each with different activities and industries and therefore, different urban and architectural design. Because of its architectural flexibility, the City-as-a-Hill urban model, as developed in the Westbahnhof Sustainable Urban Implantation, could be a framework within which the Chinese sustainable city-region could also be developed. The City-as-a-Hill is small enough to be affordable to build in a short period of time and would be much more amenable to mirroring traditional small-scaled Chinese urban and residential patterns than the many foreign-influenced unsustainable urban patterns that are now emerging all over China. A network of such cities could be linked together to form a regional network of synergistic sustainable settlements. In this way, sustainability could be exported from traditional villages to the hundreds of new cities forming across China.

6 CONCLUSION

The massive urban industrialization of China is an extraordinary experiment that will affect the entire world. The traditional Chinese village has operated for thousands of years according to balance seeking proto-sustainability processes. However, this way of life is largely dying because the recent "open door" governmental policies have promoted virtually unchecked industrial growth at a scale and speed never before seen in Earth's history. China is presently the most experimental society on the planet. While most of the experimentation has involved adopting a great variety of western unsustainable practices, the SUCCESS project represents an alternative course that can bring China toward future city models that are rooted in Chinese culture, but also function as modern industrial cities that operate on a sustainable basis. Building on the Westbahnhof Sustainable Urban Implantation and our definition of sustainability, the research initiated in China through the SUCCESS project demonstrates the resources, technology, and, more importantly, the operational process necessary for generating the first modern sustainable city.

7 REFERENCES

Daly, Herman E. and John B. Cobb Jr. 1989. *For the Common Good: Redirecting the Economy toward Community, Environment, and a Sustainable Future*. Boston: Beacon Press, p. 71-72.

Dumreicher, Heidi and Bettina Kolb. 2003. "Seven Theses on Town and City Quality," in Exploitation and Overexploitation in Societies Past and Present, ed. Brigitta Benzing, Lit verlag, Munster, p. 241-261.

Dumreicher, Heidi and Bettina Kolb, "The Definition of Sustainability in the View of the Social Sciences: Seven Chinese Villages and their Potential for a Sustainable Future", PLEA 2005 (Passive and Low Energy Architecture) Beirut, Lebanon.

Dumreicher, Heidi, Richard S. Levine, and Ernest J. Yanarella. (© Oikodrom The Institute for Urban Sustainability, Vienna, Austria and Center for Sustainable Cities, Lexington, KY), 1998-2001

Dumreicher, Heidi, Richard S. Levine, Ernest J. Yanarella and Taghi Radmard. 2000. "Generating Models of Urban Sustainability: Vienna's Westbahnhof Sustainable Hill Town" in Williams, Katie, Elizabeth Burton and Mike Jenks. *Achieving Sustainable Urban Form*. New York: E & FN Spon (Routledge).

Guy, Simon, and Simon Marvin. 1999. "Understanding Sustainable Cities: Competing Urban Futures." *European Urban and Regional Studies* 6 (3): 273.

Levine, Richard S., Ernest J. Yanarella, Heidi Dumreicher, and Tiffany Broyles. 2000. "Beyond Sustainability Indicators: The Sustainable Area Budget." Making Sustainable Development Visible: Indicators for Regional Development, Gratz, Austria.

Levine, Richard S., Ernest J. Yanarella , Taghi Radmard, and Heidi Dumreicher. 2003. "Sustainable Cities: A Strategy for a Post-terrorized World. http://www.terrain.org/articles/13/strategy.htm, (13).

Neumayer, Eric. 1999. *Weak versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms*. London: Edward Elgar Publishing, p. 202.

Redclift, Michael. 1987. *Sustainable Development: Exploring the Contradictions*. London: Routledge, Kegan & Paul.

eSchwechat.at –
Schwechat's Information Society Programme for Building the Future

Helmut PAUGGER

Innovation Consultancy GmbH, Schwechat, Austria; h.paugger@innocon.at

GENERAL

eSchwechat.at is a five years Information Society programme for the Municipality of Schwechat, Austria (2005 – 2009).

Within eSchwechat.at an ICT location Schwechat with an internationally known Center of Excellence in eHealthcare/eHomecare shall be established and a Schwechat Information Society created.

1 WHY eSchwechat.AT?

The Municipality of Schwechat lying directly on the outskirts of Vienna is an old industry and modern services town (OMV, Borealis, Brau Union, HTM, Vienna International Airport, Austrian Airlines etc.) with 16.000 inhabitants. About 20.000 jobs within the city borders make Schwechat to one of Austria's top 3 richest municipalities.

Concerning these figures Schwechat just could go on with business as usual. But – next to industry and (airport) services – Schwechat has decided to become a future oriented HighTech location within Information and Communication Technology (ICT).

2 HOW DID IT START?

In 2002 the Municipality of Schwechat planned to establish a Fachhochschule (FH, University of Applied Sciences) for technology. Parallel Innovation Consultancy GmbH (with its brands "innocon" for regional development within HighTech and "danubetec.net" for technology center systems) and STRABAG Project Development were looking for a well fitting site to establish a technology center for ICT in or around Vienna. Due to the planned Fachhochschule the Municipality of Schwechat, Innovation Consultancy and STRABAG Project Development decided to combine both projects and locate them in Schwechat.

After the Council of University of Applied Sciences' decision against a new Fachhochschule in Schwechat Innovation Consultancy proposed to locate an ICT institute of Vienna University of Technology instead of FH. And the Municipality of Schwechat agreed.

Further the decision was made to establish the technology center in an existing but very new and still empty building within Schwechat's Concorde Business Park and to run it within a cooperation between the Municipality of Schwechat, Innovation Consultancy and the landlord Raiffeisen Evolution.

After the R&D group RISE (Research Industrial Software Engineering) of Vienna University of Technology moved in, "concorde technology center schwechat – concorde.tcs" was opened at 12 November 2003. Within the opening party Innovation Consultancy presented Schwechat's new mayor the idea of a Schwechat Information Society programme to create an outer system around the inner one of concorde.tcs.

In 2004 and the first half of 2005 a lot of different preparation tasks were performed to run a future Schwechat Information Society programme: A new municipal business promotion system focussing on ICT firms was developed – the heart of them: eSchwechat.at. Further location marketing activities were started by the event series "match.IT!" (IT matchmaking events on international level) and "talk.IT!" (information events for IT topics) to position Schwechat as an ICT meeting point in Central and Eastern Europe (CEE). And last but not least planning tasks to establish a municipal Early Stage investment company to finance ICT start ups were begun.

3 AIMS OF eSchwechat.AT

The following items are the main aims of eSchwechat.at:

- Establishment of an ICT location Schwechat with an internationally known Center of Excellence in eHealthcare/eHomecare
- Establishment of a Schwechat Information Society (integration of ICT where ever useful): citizens, economy, administration etc.
- Moving in of ICT firms, founding new companies, growth of existing enterprises
- Creation of new and well-paid jobs
- Influx of new citizens
- Improved education of Schwechat's citizens: vocational training, schools, academic: under-graduate, post-graduate
- Integration of disadvantaged people (seniors, handicapped etc.)
- Democratisation of ICT

4 METHOD AND BEST PRACTISES

Concerning well-working best practise projects, e.g. "Ronneby 2003", Sweden (1993-2003), "TelecomCity Karlskrona", Sweden (90s), "eTampere", Finland (2003-2007) and "Vantaa HiTech Programmes", Finland (since 2004), the following win-win-strategy was chosen to implement eSchwechat.at: First municipal investments will lead to first ICT projects, one project will stimulate the next one by creating new interest (mass media, companies, citizens). Companies will move in, will be founded, will grow, all leading to additional municipal taxes enabling further municipal investments. This will result in an "upswing coil"...

5 MEASURES (STARTING 2006)

5.1 schwechatNET

The project's goal is to establish a broadband WLAN cover over the whole municipality of Schwechat using 2,4 and 5GHz WiFi technology. Next to the offer of cheap Internet and voIP telephony the project generates need for applications and thus enables new projects within the fields of eHealthcare/eHomecare, eGovernment/eVoting/eAdministration, eTraffic, eLearning etc.

5.2 Early Stage investment company

Idea of the project is to support Schwechat based ICT start ups, mainly within eHomecare/eHealthcare by investing into the companies' Early Stage phase. With a starting fund volume of EUR 2,000.000.- average investments of EUR 100.000.- per start up shall be placed for a time span of about four years. The Early Stage investment firm will be organised as a private company with guarantees of the Municipality of Schwechat and will be combined with an incubator for the start ups offering housing, coaching, networking, first clients etc.

5.3 Central European Institute of Technology

A high level R&D organisation, starting with three R&D institutes for ICT will be established. Around the existing RISE institute (nowadays mainly dealing with eHealthcare) an institute for eHomecare as well as one for urban, spatial planning and environmental Information Technologies shall be located in Schwechat. Next to R&D high-level education (under-graduate and post-graduate) will be offered. The Central European Institute of Technology will be CEE-oriented and create spin-off companies.

Within the project also a technical high school with eHealthcare/eHomecare focus operated in evening classes and – after graduation – offering a Fachhochschul education by distance learning will be established.

5.4 International projects of Schwechat's schools

To increase internationalisation as well as the use of ICT international projects are performed by Schwechat's secondary schools. Recently a cooperation between Europahauptschule Schwechat and Martinlaakso secondary school of Vantaa, Finland was started.

5.5 Vocational training

eSchwechat.at focuses on R&D and education within all levels. Also for adults tailor-made training content will be offered, mainly for ICT, management & entrepreneurship and Eastern European languages.

5.6 LivingLab / First Client – Function

The whole town of Schwechat, mainly the facilities of the municipality act as a LivingLab (testbed) for new ICT developments of Schwechat based companies. First projects were already started between the RISE institute and the city administration within the field of eAdministration. A new project now was created between the municipal senior's residence and a consortia of the future eHomecare institute and some ICT companies including the operator of schwechatNET.

The Municipality of Schwechat also acts as a first client for new ICT companies to make things starting. Interesting projects and products pushing eSchwechat.at's goals are supported.

5.7 Twin City Partnerships

To increase the internationalisation of Schwechat as well as to run interesting ICT developments the city administration has started a cooperation with the Finnish Municipality of Vantaa which shall also lead into a twin city partnership. Further cooperation with other cities are planned.

5.8 Programme Management, Steering Group and Location Marketing

The programme management of eSchwechat.at is done by the initiator Innovation Consultancy. Important part within this task is the internal (for Schwechat's citizens) and external location and programme marketing. The programme management is supported by a steering group representing the important players for municipal development in Schwechat.

Next to the "match.IT!" and "talk.IT!" event series for location marketing the "IT Forum Schwechat", a think tank for the future ICT development and branch marketing in Austria will start in February 2006.

5.9 Budget

There is an annually municipal budget of about EUR 1,000.000.- for the diverse measures. Next to this sponsor money and private investment will increase the budget of eSchwechat.at for the programme time till 2009.

6 SUMMARY AND VISION

eSchwechat.at already nowadays has created a lot of interest in Austria's and CEE's ICT branch. Until 2009 the programme will make Schwechat to Austria's leading ICT location – embedded into leading international ICT communities.

reviewed paper

The role of abstract (immaterial) values in projects of urban area regeneration: a case for literature

Joseph STEFANOU, Athanassios BALERMPAS

(Professor Joseph Stefanou & Mr Athanassios Balermpas,
National Technical University of Athens, Department of Architecture and Civil Engineering, Athens, Greece, Email: athbal@panafonet.gr)

1 INTRODUCTION

During the last decades there have been significant and prolonged attempts to regenerate urban areas, aiming in reducing degradation and economic decline, revamping their natural environment, improving quality of life for its residents and generating sources of financial rebirth, either by providing activities traditionally associated with this area, or by capitalizing on its potential as a tourist destination.

Regeneration projects are currently observed mainly in Europe[1] around cities with significant cultural history. They can be separated into two types: those projects that involve regeneration of the historical city centers and those that involve regeneration of former industrial areas outside the main residential clusters[2].

Projects aiming in the regeneration of specific urban areas, irrespective of their socio-economic targets, should always take into consideration the preservation - if not the reinforcement – of the physiognomy of these particular areas. Sometimes this could even involve the restoration of functions and activities that in past times contributed in creating a special characteristic ‘vibe’ for these areas.

2 DEFINING THE PHYSIOGNOMY OF AN URBAN BUILT SPACE

Research in defining the content of a concept such as physiognomy has led to the conclusion that it is very much linked with the human experience. Physiognomy, when used in relation to environment, is a term that describes the identity of a certain space, in other words the sum of those characteristics that register this space unique in the way that it is inhabited, recognized or understood by people. However, urban space is primarily created by people and it is also registered as a characteristic part of its culture. Human activity is the measure for the development and appearance of the urban built space, whereas in the countryside, the natural element is the primary one. Therefore, the urban built space is being transformed through human intervention into the concept of ‘topos’ (the place)[3] as expressed by Socrates in Plato’s Dialogue of ‘Timaios’. Since the beginning of historical times, human activity identified in the development of cities a natural improvement in their quality of life and the perfect environment to create their culture. From antiquity to contemporary times the city has been the main point of reference for defining human progression and cultural growth.

Due its significance in defining human progression, the city has been naturally the subject of many research projects and studies; amongst those, key are the studies regarding the image of the city and the ways that this image is being projected. In every circumstance, city space or the city itself projects a mixture of its eternal and temporary elements, as they are defined by the behavior of its inhabitants collectively as well as individually. The orientation of those characteristic elements is a constant quest, since life in the city is ever changing, unstoppable, progressing in fast pace. On the other hand, we cannot ignore the facts that the very elements of the physiognomy of a city are established and documented as necessary knowledge for the smooth running of one’s life. Simultaneously, the physiognomy of an urban built space produces certain impressions that lead to the formation of opinions regarding the space that determine the attitudes or actions that people will take towards this particular environment. Finally, the elements of the physiognomy of the city will also create to the individual a set of concepts, which in return manifest the different ways they experience the city through all their senses. [4]

As ‘topos’ the city always had the ability to evoke images and stimulate people’s intellect and emotion. Through processing that stimulation and those images, each person determines their position towards their urban environment, either as an individual or through collective conscience, as a group of citizens. On both occasions the human position, either as an individual or a collective response, can create actions that will impact the physiognomy of this particular city. Therefore, researching and studying these human positions and actions towards a city is of double importance for examining the physiognomy of a city: on the one hand they can research which characteristics of the city are the ones that have greater influence in the individual or the group of citizens in forming an opinion towards the city; on the other hand, they can also observe the consequences and impact of the human actions which were developed through certain images and other stimulation from the city.

The ‘**logos’** (the written artifacts) and the ‘**myth’** have been recognized[5] by the those involved in the physiognomy of the urban landscape as those factors primarily connected with the human intellect. The city is also the place where people from different classes and backgrounds congregate with the expectation that they will benefit from urban life; so the city becomes a ‘social space’ where relationships, laws and obligations are developed, wealth is created and certain historical events take place. All these are connected with the urban landscape in different levels and measures.

---

[1] MITOULA, R., Urban Regeneration as Tool of Conservation of the Physiognomy of the City in EU Countries, 10th Pan-Hellenic Architectural Congress, Athens 2002.

[2] STEFANOU, J., CHATZOPOULOU, A. & NIKOLAIDOU, S., Urban Regeneration, TEE Publications, Athens 1989

[3] URBAN DESIGN AND DEVELOPMENT LABORATORY, National Technical University of Athens, The Physiognomy of the Hellenic City, National Technical University of Athens Publications, Athens 2000.

[4] BASSILARA, A. & STEFANOU, J., The Non-visual Dimensions of the Landscape, International Conference on Landscape, Aristotle University of Thessalonica, Thessalonica, 2005

[5] URBAN DESIGN AND DEVELOPMENT LABORATORY, National Technical University of Athens, The Physiognomy of Landscape – The Physiognomy of the Hellenic City in the 21st Century, National Technical University of Athens Publications, Athens 2001.

Similarly, the intellectual and social activities that develop are an extension of the same **social space**. A structure of values, habits, customs, communication methods, ideologies, religions and cultural creations is devised in order to support the co-existence of all these people in the urban environment. All these manifest the importance of the city as a centre of **culture.**

The social and cultural reality that is formed in the urban built space produces a series of stories that are delivered through different mediums, either in the form of written manifestations or as part of the oral tradition. The stories do not usually follow the linear development of historical facts, but, while in general terms they are unique in the way that they develop their plots and themes, they are similar on the importance of the role played by the city in their development. The stories with the above characteristics form what we will call the '**myth'** of the city. The myth could create a positive or negative influence in the general atmosphere of a city and 'put a good or bad spell' on it. In the majority of cases it either becomes **'logos'** (written artifacts) – the sum of many narratives connected with the city – or contributes to other forms of written speech, whose focus may be different, but they will use the myth of the city in order to promote other elements of their narrative.

At this point we should not overlook the points made in the theories of Rossi[6] as well as Hiller and Hanson[7] who advocate that the architectural space is a primary element in the social environment. They view the city as the theatre stage; they urge us to examine it from the point of view of the actors and the stage set, instead of the performance that the audience witness. It is the former that produces elemental living statements and experiences that can influence the image of the city. Those living testimonies and their subsequent experiences create meanings and feelings that haunt the space and create the first material for the myth and the narrative of the city to take place.

In particular, we should also examine the function of 'logos' (the written narrative) of the city in the process of its mapping and memory. Through the narrative new elements and forms are developed in the city that go beyond the common understanding and they map the space by giving it a certain characteristic. Through the narratives of the Italian immigrants in the USA at the beginning of the last century the Statue of Liberty was 'mapped' – it was the first image they could see in the entrance of the harbor and it was a sign of hope and a new life; a similar case is Ellis Island, the place where they were obliged to go through for the Immigration Authorities and the necessary quarantine. The 'mapping' of those two spaces in people's conscience happened through different types of narratives: those of the older to the younger generation, written documents, films, etc. At the same time, those two characteristic spaces of New York were kept alive in the memories of the Italian community in the USA, through – but not just – the narratives. In particular, the memory of the use of Ellis Island remained even after 1974, when it ceased. However, this memory and the fact that it was now a characteristic symbol not only of the physiognomy of the city of New York but of the whole country contributed to the decision of the civic authorities for its future use – as museum and touristic landmark/attraction.

The power that both the myth and the narrative of a city hold is very important because both elements target the human intellect and emotion. The performances that they produce are carried through the collective and individual conscience for a long time and there is always the possibility of rekindling the interest for them. There are many examples where the myth and narrative of the city prove stronger than the hard reality. An urban residential area in Athens, Kallithea, had been in the past a place preferred for residence by wealthy, upper middle class citizens and, as a result, there was an air of contentment and quality of life associated with that place. Nowadays this reputation of Kallithea remains, even though the circumstances and the facts have changed. Though the area has lost most of its characteristics, due to the myth and the narrative of the area, it has maintained its 'good name'. In addition, a city like Venice, which nowadays is faced with many and serious problems regarding its physical environment – the pollution of the water in the canals, for example - still remains in the imagination of those planning to visit the city as an idealistic place projecting positive messages.

3 ELEMENTS THAT DEFINE THE PHYSIOGNOMY OF THE CITY AND THEY CAN BE TRACED IN ITS LITERARY TRADITION

M. Tafuri, as well as Joseph and Julia Stefanou[8] pointed out that a very important element in the physiognomy of a city is its socio-economic and political system; that system influences the city's image, its size and development. Following this point we seek in the human actions and ideologies the foundations and causes for the physiognomy of a city.

A. Rossi[9] proposes two main parameters to help us understand the development of the city: the city's planning blueprint and its monuments; he promotes as the most important elements in a city its historical continuum and the memories that it creates in its citizens. Rob Krier[10] emphasizes the functionality and importance of the city's periphery.

G Cullen believes that the city is like a theatre stage where different scenarios are enacted between the two main protagonists, the people and the environment. He explains that the environment provokes human response in three levels:

- The visual, that experiences the city as something to look at
- The one referring to the space, and
- The one referring to the context

For K. Lynch[11], most important is the collective image of the city and he concludes in the following quality measurements regarding its appearance:

6 URBAN DESIGN AND DEVELOPMENT LABORATORY, NTUA, The Physiognomy of the Hellenic City, National Technical University of Athens Publications, Athens 2000.
7 ibid
8 STEFANOU, J., & STEFANOU, J., Description of the Image of the City, University Publications, National Technical University of Athens, 1999
9 ibid
10 ibid

Its uniqueness or its transparent form; the simplicity of its form; its continuity; the dominance of its characteristics; the clarity of its links; the way you find its orientation; its visual observation point; how conscience one is of its movements; the chronology, the names and their meanings. He puts all these measurements together and explains that the collective image of the city is built on these 5 elements:

1. Points of references
2. The Routes and Landmarks
3. The Nodes and Junctions
4. The Boundaries
5. The Districts

A series of studies published by the National Technical University of Athens, also examines the development of the physiognomy of a city. They all conclude that in order to define the physiognomy of a city one has to go through a process of 3 stages. In the first stage the natural characteristic elements of the city are the main objects of its study. We look at the physical space, its climate and the fauna that one encounters around and within its urban spaces. Next, we study the elements that have been created by the human intervention, like cultural and intellectual achievements, activities and proposals; architecture and city planning; social activities and manifestations. In the third stage all the facts gathered in the previous stages are put together to record the organization of the city and the city is mapped horizontally and vertically in order to research the framework (civil and aesthetic) that will promote and guard its special physiognomy[12].

4 THE RELATIONSHIP BETWEEN LITERATURE AND THE URBAN ENVIRONMENT

Literature is probably a rather more powerful influence than history in the development of the myth of a city. According to Wilhelm Dilthey[13] a socially structured meaningful reality, what he calls 'Lebenswelt' – the world of the intellect – is comprised by laws and obligations invented by humans, objects and consciousness that come from a variety of sources, from architecture to moral systems and the arts, including literature. Based on the above theory we could validate the participation of literature in the social reality.

In particular we can point out that according to this conclusion, works of literature are arranging life in a orderly and meaningful way; Dickens, for example, gave hope and meaning in the abominable living conditions of the 19th century metropolis. In that respect, individual works of literature, like Dickens' novels, are parts of the greater framework of literature, in which we can include the actual novels and the lives of their creators, the study of literature and in general all the elements that are part of the literary reality. The world of literature represents a great part of human activity, that of the written artifacts, and it directs us towards a wider social activity – the creation of an acceptable society of knowledge.

Literature gains social visibility and presence in the world through its interrelation with politics, law, technology, language, education, property, individual creativity and many other cultural elements and thoughts around important human issues. In this way, literature is accepted in those mechanisms and codes that transform simple acts in socially meaningful facts.

Literature is also very flexible in retaining those elements that establish the memory and conscience of a place, because it can transgress boundaries of the past and present. The myth of a work of literature demands the existence - each time – of a special scenography, or series of different sets (landscapes, districts, neighborhoods, houses, shops, interior spaces) that will serve its purpose. In particular, the writers of the realism and naturalism literary movements are trying to capture the myth with clarity and detail regarding the novel's environment and then try to portrait it as realistically as possible. The naturalists, in particular, emphasize the environment because according to their school of aesthetics, the environment together with heredity determines the human fate.

In the novel, the writer is obliged to build the environment in order to create the foundation of his or her narrative. He or she, then, will choose either a large picture composition, like a big city which its squares, buildings, markets and traffic, or a relatively smaller picture composition. In both cases, when we talk about a realistic novel, the writer has to build a believable set for the environment. For this task, he or she does not rely solely in imagination but they will do some research and check the details in order to achieve an accurate description. The Greek writer Alexandros Kotzias describes the process:

"the writer knows well even the neighborhoods that his characters live or frequently visit – the writer has grown up, played or worked in those places, or else he or she has walked through them, he or she has somehow experienced them. Every novel is set on a specific district, a specific street. The writer, before writing begins, has clearly mapped everything in his or her imagination helped by eye witnessing the actual spaces." [14]

However, the urban environment within a novel can play multiple parts, beyond the one of the detailed stage setting; it can also be, for example, allegorical or symbolic for the narration of the myth. Different theories on narration can decode the relationship of the writer and the novel's environment. We can refer to the narration theory of the 'three', where we identify three possible narrative situations:

- The 'authorial' narrative, when the point of view is usually external
- The 'first-person' narrative, when the author and the character merge, and

11 ibid
12 CHATZOPOULOU A., The Framework for the Promotion and Protection of the Physiognomy of the Hellenic City, The Physiognomy of the Hellenic City, National Technical University of Athens, 2000
13 KERNAN, A., The Death of Literature, Princeton University, 1999
14 KOTZIAS, A. 'Alithomanes Chalkeion' – the Poetics of a Novelist, Magazine Grammata and Technes, issues 64 – 65, Athens, January-March 1989

- The personal narrative, when the point of view is that of the reader, the recipient of the story.

The novelist receives stimulation that creates the need to express themselves through the composition of the 'myth', a story. In the first instance we have the ability to estimate the impact of the image of the urban environment during the initial stimulation that in literature terms it has the romanticized name of 'inspiration'; we can then observe the development of the story that will become the 'vehicle' the writer will use in order to communicate. Especially during the formation of the story, the writer is interested in setting the space and time for it; as a result he or she will present elements of the urban space that could reveal characteristics of its physiognomy. In the novels of Charles Dickens, for example, the alternative movement of the story between the city and the countryside is part of the myth. The countryside represents tranquility, innocence, happiness and humanity. The city represents misery, violence, criminality and the struggle for life.

Following the composition of the myth, the writer then will need to progress with the narrative action and gather all the methods that they will use in order to communicate their messages to their target audience. The narrative action in turn, is also based on the author's experiences, memories, thoughts in the same level perhaps with that of the author's life determining the composition of the city's 'myth'. A characteristic example is the choice of appropriate places to set romantic love scenes. This happens based on the personal experiences of the author as well as the fashions of the time in which the writer is setting the novel. In the novel 'Yugerman' of the Greek author Karagatsi, whenever the hero wants to offer himself some moments of calmness or uninterrupted communication with his girlfriend, with whom he is really in love, he chooses the hill of Kastella in Pereas. Even in the 1980s, at a time that the neighborhoods on the hill were in decline, the area was still considered a suitable place for isolation and the meeting of lovestruck couples. Today, the area maintains the image of a place to meet and enjoy a romantic view of the coastline of Saronic bay. A series of small scale regeneration programmes carried out by the municipality of Pereas in the last decade of the 20th century have reinforced this aspect of the area's character.

To conclude, even during the narrative action we can identify the relationship of the writer with the space that he or she lives or chooses to inhabit as part of their world of the novel. In all the narrative actions the writer is being driven by their concepts, ideas and impressions which are directly or indirectly linked with their social and cultural background and position, and influence their choices – even when those choices are made unconsciously. As a result, in the novel we encounter the reflection of the social group that the writer belongs to and the social circumstances that they face while creating the novel. These elements can present us with some vivid images of the urban environment, seen through a series of prisms that add more interest, because they echo the ideologies and social situations that develop the appeal and physiognomy of a space.

On the other hand the readers of the novel have in their disposal a series of options to choose from in order to 'communicate' with the work: they can choose the indifferent – also known as the unresponsive one – reading. The interpretive reading aims to decipher the writer's intentions. The critical reading aims to classify the novel in a certain hierarchy, which sometimes is very special to each reader. Lastly, in the 'biased' reading, when the reader starts with some preconceptions towards the text that he or she then imposes during the reading of the novel. This situation kick-starts a dialectic relationship with the novel where the reader compares the novelist's words with his or her own interpretation and their experience can be significantly different from that of the writer or any other reader.

Therefore, it is quite clear that the special characteristics of a space are increased by the fact that they will create in their turn emotional and aesthetic impressions. It is also evident that the physiognomy of a city will never cease to create aesthetic and emotional stimuli, which could lead to some form of artistic manifestation. This manifestation, since it also carries the very personal element of its creator, it has a great influence on the written artifacts and the myth of the city. This influence is great not only because this manifestation impacts on the formation of the city's special elements, but because it contributes in building continuation and sustainability for its space.

Based on the above approach, the relationship between literature and the combination of the factors that form the physiognomy of a city becomes now clearly significant. Therefore, every regeneration project that wants to maintain the physiognomy of the urban space that it attempts to reinstate, when considering the abstract (immaterial) values, one should also consider the presentation of this particular space in the works of literature.

This could be achieved following two directions simultaneously:

- By searching the elements of the physiognomy of the urban environment that have influenced the novelists in building and narrating its myth.
- By exploring the ways to influence the perception or the knowledge of the reader (audience) towards the characteristic images of a city while her or she is reading a work of literature which features the city.

So, during the planning stages of a regeneration or renovation of an urban space, one will have to develop a model that will include:

a) the stimuli that the particular urban space creates to the novelists
b) the way that those stimuli are developed into the myth and its narration
c) the influence that reading a certain work of literature has on defining the physiognomy of the city

The team that will undertake to design the regeneration and redevelopment of an urban landscape should first research the image in the city's myth and written artifacts that have been created for this particular area. The elder residents as well as the 'informed' visitors have certain expectations regarding this area. They will be prepared to see how the regeneration activity will enhance or otherwise contribute in reclaiming those certain characteristics that created the physiognomy of that space. This could be achieved in different ways:

- By promoting the monuments or characteristic architecture and city planning elements

- By supporting employment activity that is connected with the regenerated area
- By organizing events that support the above actions

5 CONCLUSION AND RECOMMENDATIONS

A series of abstract (immaterial) values comprises the myth and the written artifacts of the urban landscape, two important factors for defining its physiognomy. Such factors are the history evidenced in the written and monumental, physical form (it includes also politics, economic and cultural history), folk tradition, social anthropology and literature. The latter in particular is a very strong factor in mapping the city's image, since it involves rational and emotional elements. In addition, literature is essential in promoting to the reading audience this particular image that will create expectations, emotional involvement and sightseeing interests. Especially regarding sightseeing, a recent example demonstrating the power of literature in generating interest in specific urban areas is Dan Brown's popular novel The Da Vinci Code; since the novel was published and featured some of Paris landmarks, the number of visitors in these landmarks has increased significantly.

Considering all the above, it is clear that every design of an urban regeneration or renovation project should include as study of the image of the urban space in literature.

There is the opportunity to conduct a research on the stimuli that novelists have received from a specific space as well as the ways that they developed these stimuli in their novels. In the next stage it would be interesting to measure how much impact these novels had in the reading audience and record the emotional and mental expectations they generated to real and virtual visitors. The conclusions from this type of study and research would assist the architects and city planners in making decision towards their redevelopment and regeneration plans as they will understand not only the space's functionality and physical formations but also the social and psychological impact it has in the human collective conscience.

6 BIBLIOGRAPHY

VASSILARA, A. & STEFANOU, J., The Non-visual Dimensions of the Landscape, International Conference on Landscape, Aristotle University of Thessaloniki, Thessaloniki, 2005

CHATZOPOULOU A., The Framework for the Promotion and Protection of the Physiognomy of the Hellenic City, The Physiognomy of the Hellenic City, National Technical University of Athens, 2000

DICKENS, C., Oliver Twist, Penguin Popular Classics, London 1994 (reprint)

KARAGATSI, M. Yugerman, Estia publications, Athens 1991 (reprint)

KERNAN, A., The Death of Literature, Princeton University, 1999

KOTZIAS, A. 'Alithomanes Chalkeion' – the Poetics of a Novelist, Magazine Grammata and Technes, issues 64 – 65, Athens, January-March 1989

MITOULA, R., Urban Regeneration as Tool of Conservation of the Physiognomy of the City in EU Countries, 10th Pan-Hellenic Architectural Congress, Athens 2002.

STEFANOU, J., CHATZOPOULOU, A. & NIKOLAIDOU, S., Urban Regeneration, TEE Publications, Athens 1989

STEFANOU, J., & STEFANOU, J., Description of the Image of the City, University Publications, National Technical University, Athens 1999

URBAN DESIGN AND DEVELOPMENT LABORATORY, NTUA, The Physiognomy of the Hellenic City, National Technical University of Athens Publications, Athens 2000.

URBAN DESIGN AND DEVELOPMENT LABORATORY, NTUA, The Physiognomy of Landscape – The Physiognomy of the Hellenic City in the 21st Centrury, National Technical University of Athens Publications, Athens 2001.

URBAN DESIGN AND DEVELOPMENT LABORATORY, NTUA, The Physiognomy of Landscape – Archimides Programme, National Technical University of Athens, 2001.

URBAN DESIGN AND DEVELOPMENT LABORATORY, NTUA, Models of Planning in Historical Cities – The Planning Development of Ermoupolis, Syros,

National Technical University of Athens, 2003

reviewed paper

The contribution of Community Support Framework (CSF) in the development of coastal area in Greece.

Minas ANGELIDIS, Agisilaos ECONOMOU

(Professor, National Technical University of Athens (N.T.U.A.), Patision 42,10682, Athens, Greece Email: angelidi@central.ntua.gr; Cand. PhD National, Technical University of Athens (N.T.U.A), Nikaias 18,17122, Athens, Greece, Email: aghs@mail.ntua.gr)

1 INTRODUCTION

Greece has an extensive coastline, which means that it also has an extensive coastal area. Simultaneously, the bigger percentage of the population lives in the coastal regions, as a result of which the coastal area presents important problems because of the intensity of human activities. The lack of infrastructures and the insufficient legislation have led to the deterioration of the situation in this area, naturally at the expense of the natural resources.

In the efforts made both for the resolution of the problems in the coastal area, and for its growth, an important role has been played by the economic aid from the European Union via the Community Support Framework (CSF).

As is analyzed below, the support of the sectors of production by the CSF have an important effect in the coastal regions, since big rural extents, manufacturing enterprises and tourist activity, take place in the coastal area.

In the present paper an effort is made to determine the degree up to which the Community frames of support have helped the development of the coastal area and the factors that led to the present situation are investigated. Initially, there is a reference in the three CSF and then their effect in the development of coastal area is analyzed. The sectors which were supported and the results in the regions where the aids were applied are recorded.

As it is realised by the research, the CSF improved up to a degree the existing situation in the area that they were applied, even if a great number of problems continue to remain without solution.

2 THE COMMUNITY SUPPORT FRAMEWORK

The objective of the policy of the Union for the economic and social cohesion was the restriction of regional inequalities aiming at the convergence of economies of Member states. Generally, this policy encouraged the development of the regions of Greece and consequently the coastal area as well.

The regions of Greece received important surges of resources from the Community from her first time integration (1981).

The actions of the Structural Funds (European Fund of Regional Development (ETPA), European Social Fund (ESF), European Agricultural Fund Department of Orientation (EGTP), Financial Instrument of Orientation of Fishery (FIFG)), in the regions of Greece are:

The Mediterranean Integrated Programmes (IMP)

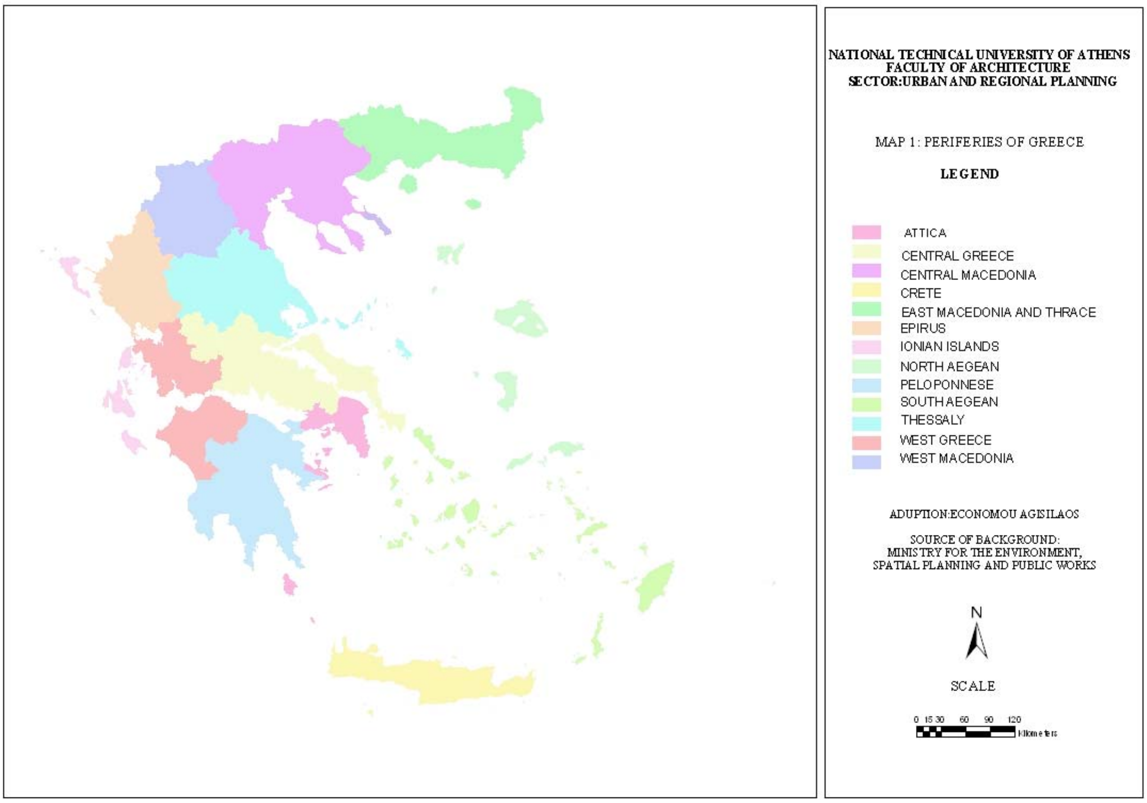
The Community Support Framework 1989 - 1993 (First CSF)

The Community Support Framework 1994 - 1999 (Second CSF)

The Community Support Framework 2000 - 2006 (Third CSF)

The Integrated Mediterranean Programme (1986 - 1992) aimed to materialize an effort for the development of the regions via the multiannual operational programs. In Greece 7 IMP's were worked out (Macedonia, Thrace, Western Greece, Peloponnesus, Islands Aegean, Eastern Central Greece, Attica and one of thematic Information technology [1].

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)



Graph 1: Periferies of Greece

The actions for the development of Regions began with the first Community Support Framework 1989 - 1993 and continued with the Second Community Support Framework Support 1994 - 1999. The third Community Support Framework 2000 – 2006 is in development today.

The actions of reduction of regional inequalities for the period up to 1999 were focused in the development of regions, in the reformation of regions that presented problems of industrial decline, and in the protection of sensitive or with declining population of rural regions [2].

2.1 1st Community Support Framework (CSF) 1989 – 1993.

The Community Frame of Support 1989 - 1993 included big and small works of infrastructure, in all Regions of Greece. In the big works are included the Underground of Athens, the roads axis Athens - Thessalonica, Athens - Corinthus, the works of modernisation of railway axis Athens - Thessalonica, the purchase of new “Intercity" trains, etc. In the small works are included the streets, the networks of water supplies and sewerages, the harbours, the airports, the units of biological cleaning, the schools, the hospitals etc.[3]

At the same time with the works of infrastructure, the CSF included actions for the development of the primary sector and rural regions, the improvement of competitiveness of enterprises, the development of human resources and the development of tourism through the framework of Common Rural Policy (CAP) and various programs as the program LEADER

2.2 2nd Community Support Framework (CSF) 1994 - 1999

The development of Greece and its regions s continued with the exploitation of resources from the 2nd Frame of Support and the Fund of Cohesion.

The 2nd CSF was used mainly for the constructions of big works of infrastructure, and the interconnection of country with its neighbours. At the same tine it supported the productive sector, the improvement of competitiveness, the upgrade of environment and the creation of better conditions of living in the urban centres [4]. In addition to this, investments in infrastructures of transport, telecommunication, energy and development of human potential via the improvement of system of education of professional situation were financed .

The materialisation of the 2nd CFS in Greece took place by means of 13 regional programs (PEP), one program for each region and via another 17 sectoral programs. Consequently other Community Programs that are reported in various sectors such as in the research, the technology, the environment, the education etc were materialised. In these programs Universities, enterprises, various institutions and privates individuals participated resulting in the better comprehension of the European Union and in the exchange of knowledge and know-how. The objective was the development of the country in relation to it's infrastructures, conditions of life, competitiveness and human potential [5,6,7,8,9].

2.3 3rd Community Support Framework 2000-2006

The third Community Frame of Support 2000- 2006 was determined in an economic and social environment, where the bases from the previous CSF for the constructions and modernisation of infrastructures, sectors of production, the competitiveness and improvement of human potential had been set The financing of the third CSF was significantly larger than the two preceding CSFs giving the possibility to construct more and bigger works.

At the same time the improvement of the economic situation of Greece, allowed the country to enter the Euro zone on January 1st 2001.

	MIP	1st CSF	2nd CSF	3rd CSF
	(1986-1993)	(!989-1993)	(1994-1999)	(2000-2006)
Total Budget	3.212.391 thou. ECU	12.956.054 thou. ECU	29.721.300 thou. ECU	44.751.168 thou. EURO
National public participation	33.1%	42.0%	23.8%	25.8%
Community participation	56.9%	50.3%	47%	50.7%
Private participation	10.0%	7.7%	29.2%	23.4%
Cohesion Fund				
Community participation			3.061.200 thou. ECU	3.320.000 thou. EURO

Table 1: Financing Table of Co – funded development programmes in Greece 1986-2006 [10]

The aim of the third CSF was to contribute in the further convergence of Greece with the European Union. The objectives of the third CSF are related[11]:

to the human potential (Education and initial professional training, Employment and professional training).

to transports (Road axis, Ports, Urban development, Railways, Airports, Urban Transport)

to competitiveness

to rural development- Fishery (Rural development - Reconstruction of countryside, Fishery).

to the improvement of quality of Life of (Environment, Culture, Health and Welfare)

to the Society of Information

to Regional Development (Regional Operational Programs (PEP), Eastern Macedonia and Thrace, Central Macedonia, Western Macedonia, Epirus, Thessaly, Ionian of Islands, Western Greece, Sterea Hellas, Attica, Peloponnese, Northern Aegean, Southern Aegean, and Crete).

2.3.1 <u>The effects of the 3rd CSF in the various sectors of production are:</u>

<u>Primary Sector (Agriculture, livestock, forestry, fishing mining, quarrying and slatterns)</u>

The aid of Community Funds for the agriculture development has a direct relation to the development of the coastal area, because a great number of rural extents are found in the coastal area. While, the sector of fishery is very closely connected to the coastal area.

From the Operational Program of Rural Development and reconstruction of Countryside, programs of development of rural area in unfavourable island regions were undertaken . At the same time, the rural exploitations and the veterinary surgeon units of coastal area of Epirus, Peloponnese, and Islands of Aegean. Also were supported, the irrigation networks in the Sterea Hellas, the Epirus and the Thessaly were modernised.

In the sector of Fishery, the coastal space had more benefits. The Operational Program "fishery" contributed to the reformation of the Greek piscatorial fleet, and to the manufacture and improvement of piscatorial harbours and shelters. At the same time, the units of aquaculture were supported and the sectors of transformation and the marketing of piscatorial products were supported. Finally, also professional fishermen were aided by the socio-economic metres that were financed by the program.

With regard to forestry, the exploitation of private forests was supported.

<u>Secondary Sector (Manufacturing, electricity, gas, steam, water supply, construction and public works)</u>

The secondary sector plays an important role in the economic development of the regions. The aid of this sector has apparently an effect in the coastal area as well because a number of manufacturing enterprises find themselves in this area.

In the secondary sector, investment plans of manufacturing SME in the entire the Greek coastal area were financed and the manufacturing enterprises in the frames of Developmental Law in the northern Aegean were supported . Also, the infrastructures in Industrial Park (BIOPA)(Western Greece) were improved and research was supported

Tertiary Sector (Trade, restaurants, hotels, Transport, storage, communications, banking, insurance, personal affairs, other services)

The tertiary sector constitutes the most important activity of the coastal area because of the intense tourist activity that appeared in Greece over the last 20 years. Consequently, the development of the tertiary sector is also accompanied by the development of the coastal area.

From the Operational Program "Competitiveness", the coastal area benefited via the subsidy for qualitative modernisation of hotel units, rented rooms, apartments and camping facilities. (Thessaly, Peloponnese, Ionian, Epirus, Northern and Southern Aegean.)

Transports

With the 3rd CSF the big works that began with the 2nd CSF are completed . Thus, the parts of PATHE (Patra - Athens - Thessaloniki Evzoni highway), the Egnadia of Road, the interconnections with the central airports and ports, and the Junction Rio – Antirio are all completed. All these contribute in the connection of the coastal area of the regions, with the mainland, the countries Central and Eastern Europe, the Balkan countries. Apart from the hyper-national works of transport, road departments, national road construction, urban roads, rural and provincial road construction are manufactured and upgraded. At the same time, the railway network, connecting the coastal area with the mainland and the transeuropean figurative network is upgraded Also, six harbours of country are upgraded and developed, while the airports of Thessalonica "Macedonia and Heraklion in Crete are modernized and developed as well.

Telecommunications

Telecommunications of SME in the Sterea Hellas, the Southern Aegean and in Ionian are supported.

Remaining Services

An important role in the development of a country is played by the the existing infrastructures of Health, Social Care and Education. Thus, the development of this infrastructures via the Community Frames of Support is also examined.

Health – Social Care

In the sector of Health and Social Care from the Operational Program interventions take place for the upgrade of infrastructures in health, Social Care and social concern. In the coastal area urban Health Centers, new Hospitals are built and programs of supply and upgrade of equipment of existing units are realized.

Education

In the sector of Education by the 3rd CSF new schools were constructed and training programs for the upgrade of professional qualifications and dexterities were realized.

Protection of environment

The coastal space includes appreciable ecosystems, which need protection. On the other hand, the maintenance of natural resources constitutes an essential condition for the development of the region. To this direction, from the Regional Operational Programmes (EPPEP) works for the protection of environment concerning the management the humid and solid waste with installations of treatment of sewages, the improvement of system of water supply, the re-establishments of the polluted spaces from dangerous outcast and the tips have been financed [12].

Land-planning and urban studies in organisms of local self-government and reformations aiming at the sustainable development were realized. Also, institutions of management for the protected regions were created, some of which are also found in the coastal space.

Particular importance was given in facing marine pollution with the purchase of 4 anti-pollution boats and in the creation of quality of marine environment follow-up networks .

Culture

The coastal space allocates appreciable monuments of the Classic and Byzantine season and appreciable archaeological sites. Thus, the support of the sector of culture has an indirect positive effect in the development of coastal space. The aid of the 3rd CSF via the operational program "Culture" concerns the upgrade, the exposure and the protection of Museums and archaeological sites.

Improvement of quality of life

As was reported above the aid of urban infrastructures of the coastal space, and the increase of employment had as a result the specialisation of human potential and the improvement of the quality of life. The various meters aim at as the inversion of both the demographic shrinkage and the marginalisation of islands.

In the 3rd CSF the growth and the protection of small islands, the upgrade and the protection of semi-urban environment, the creation of dynamic islander centers, the aid of their role and the cover the social and economic needs of their individual settlements are promoted.

Repercussions

The application of the CSFs had undeniably positive repercussions in Greece and in its regions and therefore in the coastal space, since 12 out of 13 regions present an extensive coastal area. The first CSF supported the coastal area to a small degree since its main contribution was in the development of country via the manufacture of big works. Also, the support of the secondary sector did not have the expected repercussions in the competitiveness and did not decrease bureaucracy for the candidates investors. But, the first CSF contributed to the acquisition of experience in the sectors of administration, management and evaluation of work, so that it influences considerably the configuration of the organizational framework for administration of the work s of the 2nd CSF [12].

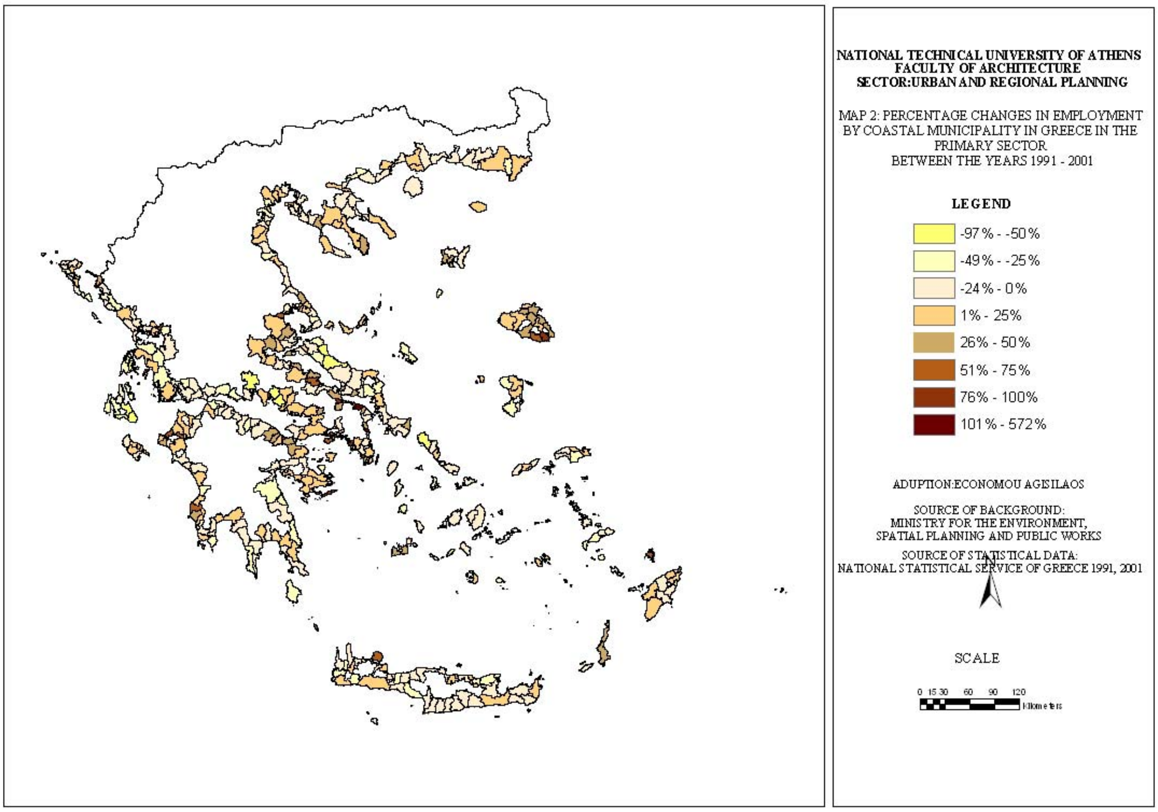
The coastal space was supported more with the 2nd and 3rd CSF mainly in the sector of infrastructures, a thing that constitutes an important factor for the economic growth of the region. In the 2nd CSF were presented problems of absorption of available credits with result the deferral of credits in the works with increased rates of absorbency contrary to the 1st CSF that was followed with an absorption rate of 93% with the application of regional programs [13].

As it was reported above, the Community Frames of Support had an important effect in the sectors of production, as it was made clear by research on the employment in the coastal Municipalities of Greece. During the period of time between 1991 - 2001 a small reduction in the employment in the primary, contrary to tertiary, which presented an increase of 37.68 % in unemployment. We can conclude that the coastal space benefited more in its tertiary sector of production because it presents an intense tourist growth during of last decades.

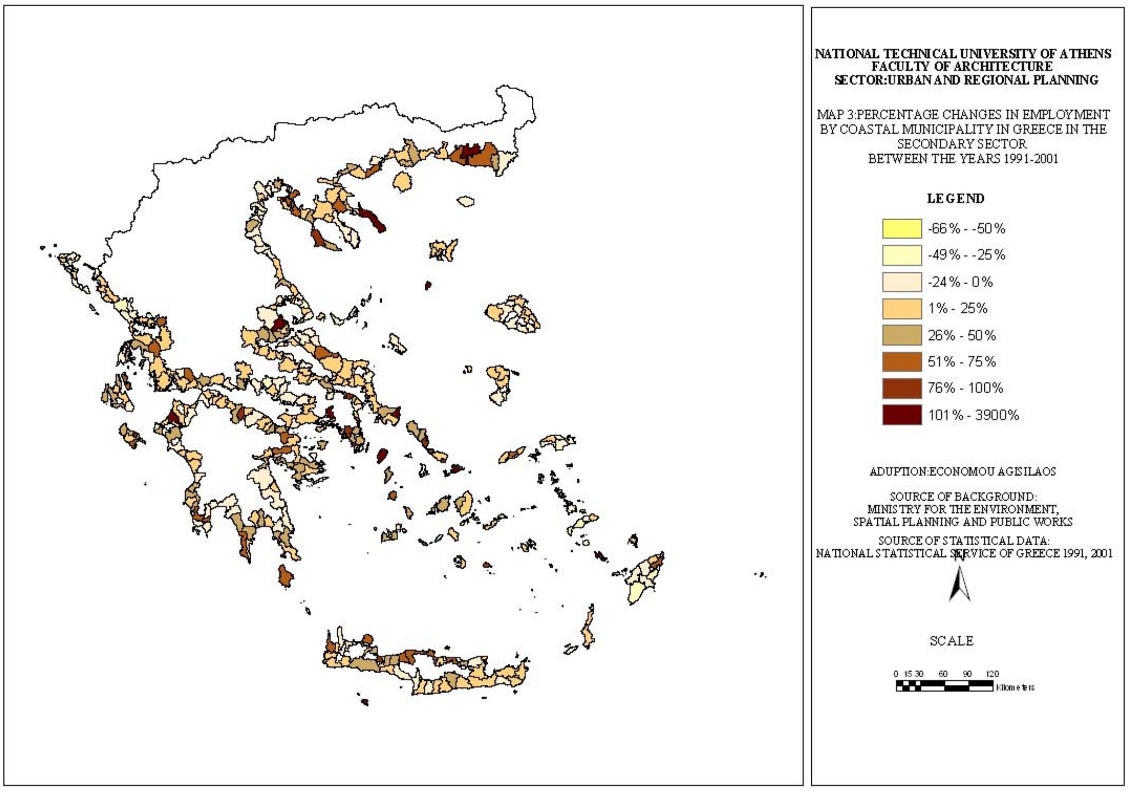
Sector of production	Employment by sector	Employment by sector	Ghange in employment in the coastal area of Greece, by sector (%)
Year	1991	2001	1991-2001
Primary Sector	298385	289721	-2,90
Secondary sector	347926	388693	11.72
Tertiary Sector	798501	1099357	37.68
New	193467	214009	10,62
Total	1638279	1991780	121.58

Table 2: Changes in the employment rates in each sector individually in the coastal area of Greece between 1991- 2001.

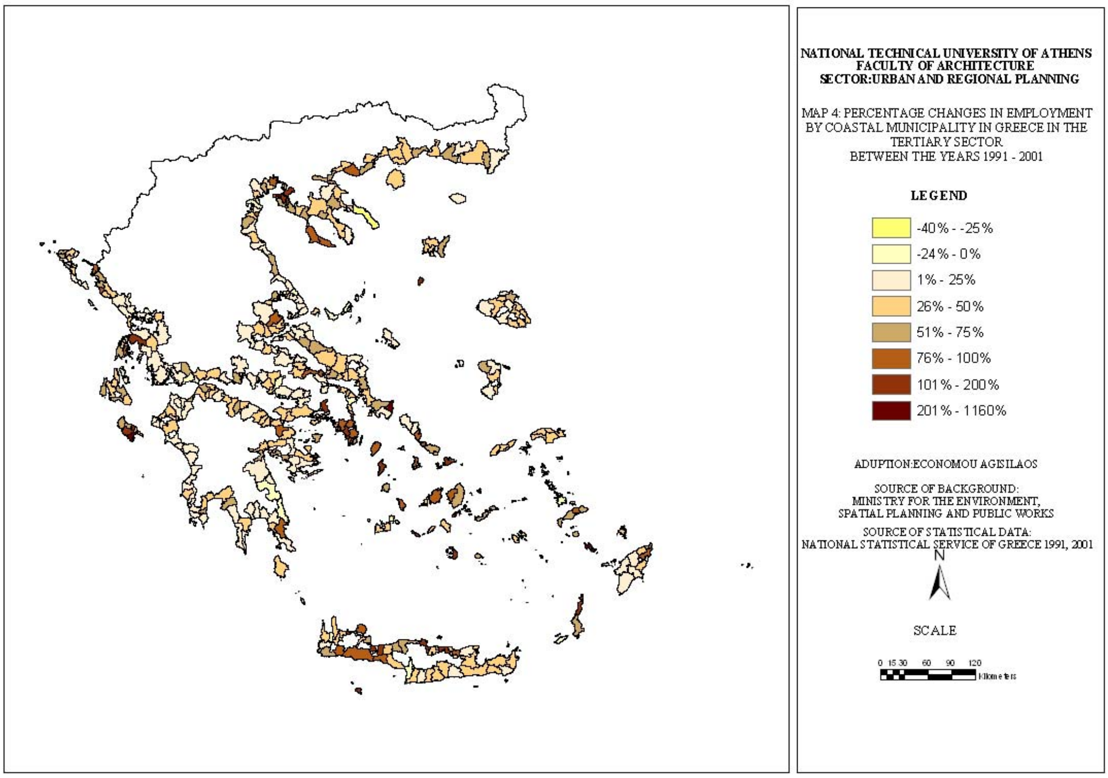
From the above table we realize that in the coastal space prevails the tertiary sector. The coastal regions that show this changes are presented into following maps 2,3 and 4.



Graph 2:Percentage changes in employment by coastal municipality in Greece, in the primary sector between the years 1991-2001.



Graph 3: Percentage changes in employment by coastal municipality in Greece, in the secondary sector between the years 1991-2001



Graph 4: Percentage changes in employment by coastal municipality in Greece, in the tertiary sector between the years 1991-2001.

According to the report of the Greek Ministry of Economics in the beginning of the Third CSF the Greek economy in spite of the macroeconomic stability, the privatisations and the decline of regional inequalities, demonstrates important lacks in infrastructures (in the sectors of transports, urban regions and environment), high rate of unemployment, low rate of employment of women, low productivity, high percentage of people occupied in the agricultural sector and a delayed in its development telecommunications sector .

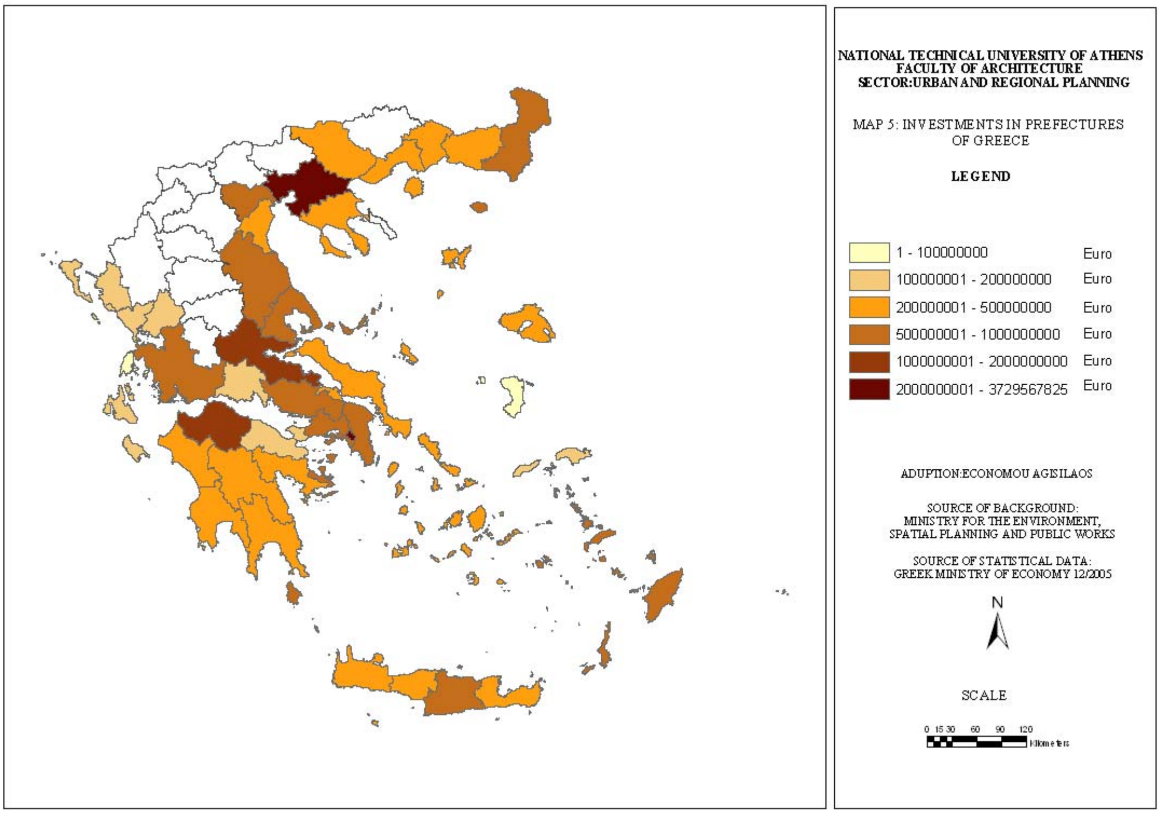
For the measurement of economic prosperity the indicator of Crude Domestic Product (GNP) that constitutes and one from the meters for the determination of aims of developmental policy is used [14].

According to the elements of economic service an increase of GNP was observed at the duration of the applications of the Community Frames of Support, a thing that means that the economic prosperity of coastal regions of country increased, since it constitutes integral piece of remainder Greece.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Real GDP growth (Annual % change)	2.1	2.4	3.6	3.4	3.4	4.5	4.6	3.8	4.6	4.7
GDP per capita PPS (EU25=100)	71.7	71.1	71.7	71.4	71.4	71.9	73	77.5	80.8	81.7
Employment Growth Annual % change	0.9	-0.5	-2.2	7.5	0.1	0.3	-0.3	0.1	1.4	3.1
Unemployment % of labour force	9.2	9.6	9.8	10.9	12	11.3	10.8	10.3	9.7	10.5

Table 3: Macroeconomic indicators of Greece (1995-2003) [15].

From the research it was was clarified that the investments in the coastal municipalities are parts of the total investments provided for the corresponding municipalities. The investments in the prefectures that include coastal regions are presented in map 5 The prefectures that accumulated the largest portions of the economic aid, are Thessaloniki, Attica, Achea and Fthiotida, contrary to the islands, Lefkada and Chios that were less generously funded.



Graph 5: Investments in prefectures of Greece that includes coastal areas.

3 CONCLUSIONS

The surge of Community structural resources in Greece up until now helped in the development of Greece via the various works, actions and subsidies in all the sectors and had as a result in some degree the development of regions. The Community incomes were distributed in all the regions and the coastal area as integral part of these, profited from the various works that have taken place.

The coastal area benefited by the creation of small works via the first CSF and the IMP. Moreover, it benefited by the second CSF, provided that the productive sectors were supported more. However, the greatest benefits came from the third CSF since the works that began in the second CSF were completed.

The actions of the CSFs, as we analyzed, was sectoral and fragmentary, and contributed to the improvement of the existing situation in the areas where they were applied. Nevertheless, the works are inadequate to resolve the problems of the coastal area, because these are big in extent and are caused by the intensity of human activities. For example, the protection of water resources of the coastal area requires the connection of all coastal settlements with units of biological cleaning, and their service from areas of Sanitary Burial of Litter. The cost to achieve this is very big and was impossible to be covered from the three CSF.

Nevertheless, important results had the improvement of transports, and the connection of the coastal area with the big works (PATHE, Egnatia, Ionian road), and the urban centres, contributing in the tourism development and at the same time in lifting its isolation. While, the works for the protection of the cultural heritage have contributed in the support of tourist development and the protection of environment.

As it was underlined above, the CSF they can cover all the sectors. The coastal area was helped mainly by the sectors which have a direct relation as the tourism, the Fishery, the sea transports. However their action, as it appeared in the Island area, was limited. Emphasis was given mainly in the second and third CSF, in the big works of National importance and not in the small works. Also, because of the particularity of coastal area, in the islands, the development of big works is not encouraged. An important number of islands present problems in their development, in the improvement of quality of life of their residents. This happens in many cases because of the degradation of natural resources due to the overexploitation by tourism, the decline of the agricultural sector and the lack of infrastructures and services.

After research of statistical data, it is observed that the employment in the hotels and the restaurants increased in the coastal area during the last 20 years

Generally, the CSFs showed the lack of infrastructures in the Greek area and the need for application of suitable policy. Even though these CSF motives for development in the most Kapodistrial Municipalities were given suitable investments that would constitute a source of income for the future did not take place, resulting in most Municipalities to present economical problems, a factor that affects negatively their further development.

The particularity of the coastal area of Greece, the big length of its coasts, the sensitive natural environment, the intense conflicts of land uses (tourism, agriculture, and arbitrary layout) require more money and more actions in order to achieve better coastal zone management.

The Community incomes by themselves cannot resolve the problems.Good management of economic resources is required. Depending on the policy that will be applied and the priorities that will be set, the corresponding results are expected.

4 REFERENCES:

[1] www.env.gr

[2] Stefanou J., Mitoula R.,"The contribution of the Community Support Frameworks and the ESDP to the conservation and improvement of the Greek cities' physiognomy", Proceedings of the Conference:Policy of Sustainable Urban Development in Greece, Faculty of Architecture of the N.T.U.A., Athens 2005.

[3] Greek Ministry of Economy, "European Co-Financed Developmental Programs in Greece. Policies - Results - Perspectives" An Information Booklet Prepared by the Greek Ministry of Economy and Finance General Secretarial for Investments and Development Managing Authority of the CSF, pp.1-72,2005.

[4] See [2].

[5] European Committee, "The regions of Greece in the European Union", Official Publications of EU, Brussels pp. 2-36.1999.

[6] European Committee, "The regions of Greece in the European Union, Northern Aegean, Southern Aegean, Crete", Official Publications of EU, Brussels, 1999

[7] European Committee, "The regions of Greece in the European Union, Eastern Macedonia - Thrace, Central Macedonia, Western Macedonia", Official Publications of EU, Brussels,1999

[8] European Committee, "The regions of Greece in the European Union, Thessaly, Sterea Hellas, Attica", Official Publications of EU, Brussels, 1999

[9] European Committee, "The regions of Greece in the European Union, Continent, Ionian Islands, Western Greece, Peloponnesus", Official Publications of EU, Brussels, 1999

[10] see [2].

[11] European Commission "The structural Funde and the coordination there of with the Cohesion Fund – Plan of Directives for the programmes 2000 – 2006, Brussels 3.2.1999.

[12] Mitoula R., "Regional Development in Greece – 3rd CSF and Environment, Proceedings of International Conference HELECO 2005, 3-6 February, Athens 2005

[13] Consolas N., "Modern Regional Economic Policy", Publications Papazesi, Athens, 1997

[14] see [13]

[15] Eurostat, 2005

Geographic Information System and Genetic Algorithm Application for Multicriterial Land Valorization in Spatial Planning

Mirza PONJAVIC & Zikrija AVDAGIC & Almir KARABEGOVIC

(MSc EE Mirza Ponjavic, Gauss, Geoinformation Systems, Stupine B9/6, Tuzla, mirza@gauss.ba
PhD Zikrija Avdagic, Sarajevo University, Faculty of Electrical Engineering, Zmaja od Bosne b.b., Sarajevo, zikrija.avdagic@etf.unsa.ba
MSc EE Almir Karabegovic, Gauss, Geoinformation Systems, Stupine B9/6, Tuzla, almir@gauss.ba)

ABSTRACT

This paper is focused on the development of methodology for multicriterial land valorization in land use planning by application of genetic algorithm. One of the key tools for design of the decision support system based on this methodology is geographic information system which serve to quantify multicriterial data and represent resulting spatial data. The methodology and the algorithm are applied to a specific problem of spatial planning in Tuzla Canton, Bosnia and Herzegovina.

The crucial points of the research are the following: possibility of multicriterial valorization of the land from the GA use perspective, how to utilize the capacity of the GA optimization techniques in the frame of decision support system and with usage of the GIS tools and how to apply the GA in the field of genotype presentation in spatial modeling.

1 INTRODUCTION

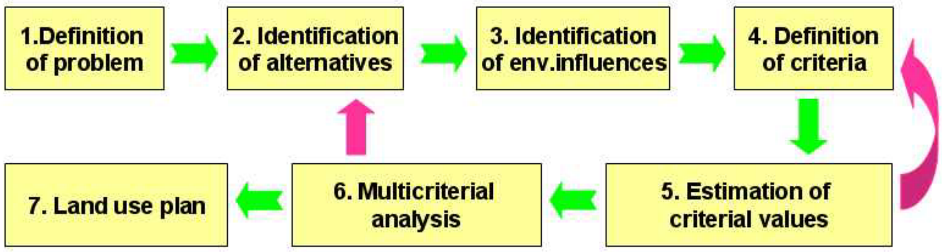
One of the key products in urban spatial planning is digital land use map, that with a system of settlements and traffic infrastructure plan, describes spatial organization [4]. Using the optimal model of multicriterial land use valorization with geographic information system (GIS), this map could be generated automatically [1]. The model requests a methodology built on existing principals of spatial planning and based on both GIS and multicriterial spatial analysis applications[10]. The methodology could be used for development of decision support system in spatial planning.

In this work it has being developed a methodology for finding the optimal model of multicriterial land valorization in land use planning by application of genetic algorithm (GA). One of the key tools for design of the decision support system based on this methodology is geographic information system which serve to quantify multicriterial data and represent resulting spatial data. The methodology and the algorithm are applied to a specific problem of spatial planning in Tuzla Canton, Bosnia and Herzegovina.

2 MULTICRITERIAL OPTIMIZATION PROBLEM IN SPATIAL PLANNING

The optimization problem always exists when there are more alternatives in space, among which the most acceptable should be selected. So, problem is related to multicriterial optimization [8].

Spatial planning methodology contents three phases: analysis, synthesis and planning. Graph 1 shows procedures during the multicriterial analysis in spatial planning.



Graph 1: Multicriterial Analysis Process

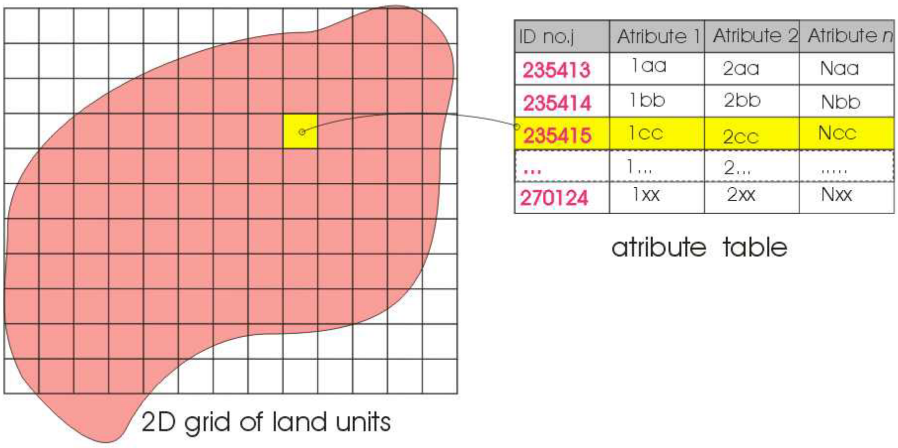
In synthesis phase of planning, typically, opposed alternatives for spatial organization are presented by synthesis models. Due to environmental trend in urban spatial planning it is defined a, so called, environmental model based on protection of environment, and as such favors criteria which guarantee an environmental values continuity. Another one is functional, based on aspect of as more as possible land exploitation for settling, not seeing the environmental consequences.

Simulating these variants by adjusting the criterial weights it is possible to search for optimal model of spatial organization. This fact designates to possibility of genetic algorithm application in multicritrial optimization process.

3 SPATIAL REPRESENTATION

For an example is used region of Tuzla Canton enclosing 13 municipalities with total area of 2700 km2. For spatial representation of the region of interest is used 2-dimensional grid of cells (land units), arranged in rows and columns, and with resolution of 100mx100m (Graph 2). To each of land units, it is added a database record, i.e. a set of attributes related to the unit properties in sense of its accessibility. By these attributes, during the multicriterial analysis it is performed scoring and classification of the units. Optimal model of land valorization is result of processing of data related to specific criteria [12].

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)



Graph 2: 2-dimensional Grid of Cells

For realization of 2-dimensional grid, its integration with criterial database and geographic thematic representation of results is used GIS [7].

Additionaly, this GIS approach makes planners enable to use various spatial information formats such as vector or raster data and convert it in spatial multicriterial data.

4 CRITERIAL FACTORS AND CATEGORIES USED FOR LAND USE VALORIZATION

For land use valorization, the following criterial factors are used:

land accessibility (related to the center of settlement),

slope of terrain,

relative height (above lowest point) of terrain,

aspect of terrain,

value of land usable for agriculture and forestry (according to adopted soil classification) and

environmental value of vegetation coverage (estimated according to basic topographic classification and CORINE methodology).

For synthesis models (functional and environmental) are introduced the following four categories of land use:

extraordinary suitable,

very suitable,

suitable and

unsuitable.

Extraordinary suitable category is related to area for reconstruction, and basic use is mixed: collective and individual dwellings with central functions (e.g. services, administration etc.).

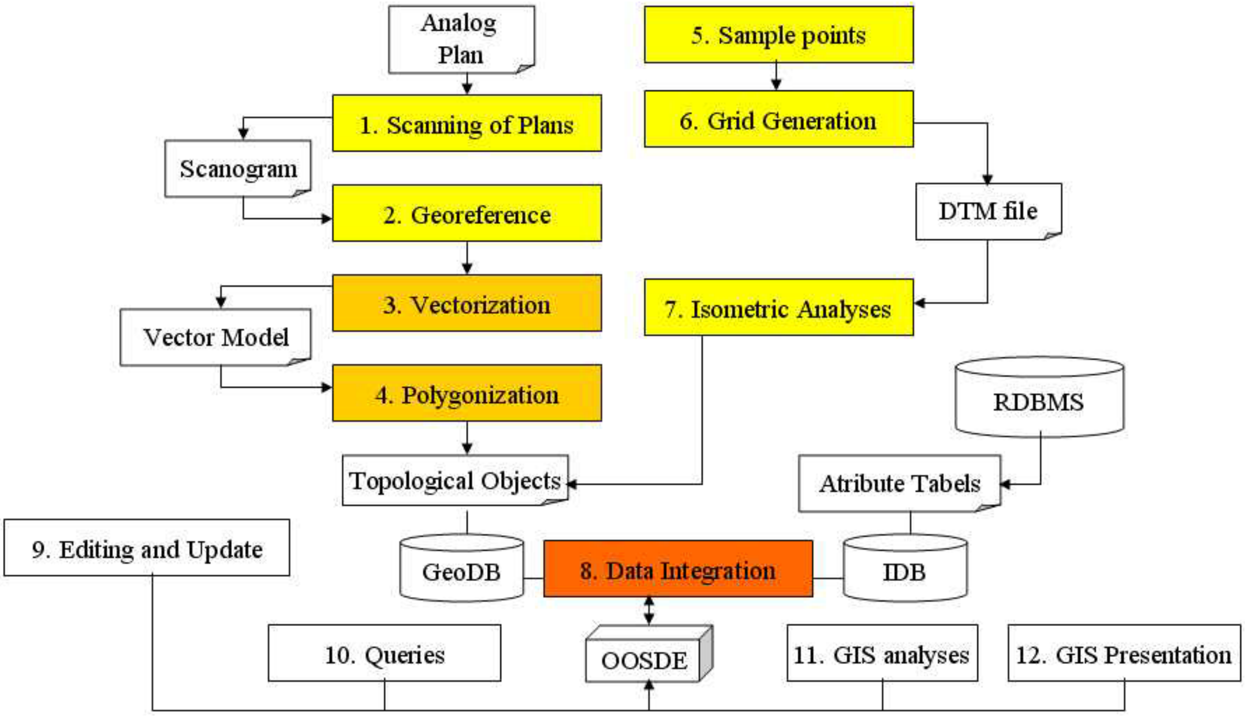
Very suitable category is related to area of intensive urbanization with collective and individual dwelling units, industrial and recreation zones.

Suitable one is related to area of extensive urbanization with mostly individual dwelling units, rural agricultural production and small business.

Unsuitable category includes two sub-categories. One is related to area mostly intended for agricultural production, and only exceptional for other uses. Another, which is related to area reserved only for forestry and agriculture, is not considered here.

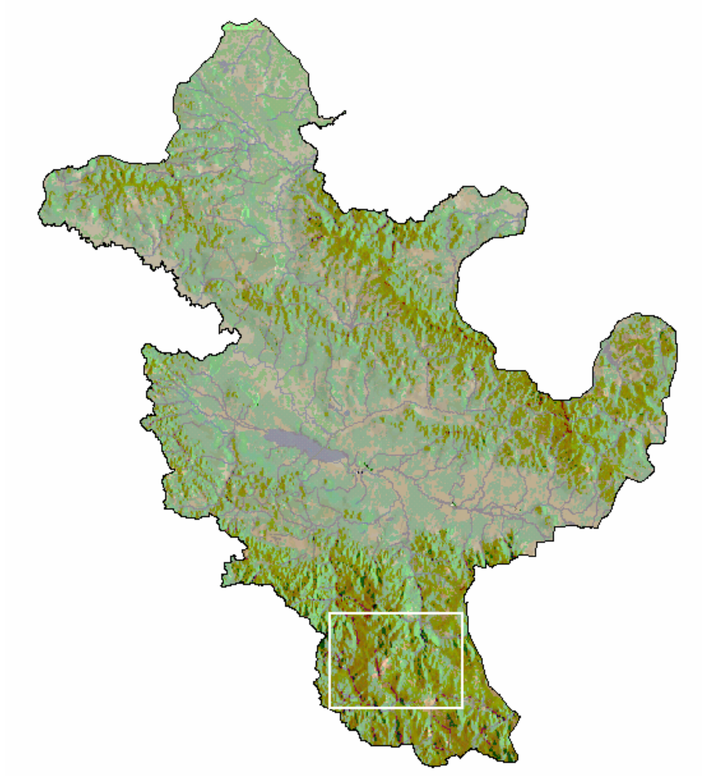
5 APPLICATION OF GIS IN DATA PREPARING FOR MULTICRITERIAL ANALYSIS

Study of multicriterial land valorization of Tuzla Canton starts with application of geographic information system. Graph 3 shows procedures (analytical process model) of data production for multicriterial analysis e.g. scanning plans, georeference, vectorization, polygonization, data integration etc.



Graph 3: Analytical Process Model of Data Production in GIS

Graph 4 shows 3D model of Tuzla Canton that enables classification of heights, aspects and slopes of terrain. By defined parameters for every class of aspect and slope it is possible to create thematic map in GIS.



Graph 4: 3D Model of Tuzla Canton

Assignment of criterial values to classes is realized by selection of objects belonging to specific class and by attachment of common attribute values in database.

Five classes are defined for aspects: east, west, north, south and horizontal. Slopes are divided into five classes: flat, small inclination, inclined, steep and very steep. During the classification of relative heights, three zones are used for scoring: plain, hill and mountain land. To classify usability, here are used three categories of land bonity, and classification of land accessibility is based on chronometric analysis realized in GIS. By CORINE methodology is provided classification of environmental value of land [6]. All classes are scored in scope from 1 to 5 points (Table 1).

Slope of Terrain Classes	Slope of Terrain Description	Aspects of Terrain Classes	Aspects of Terrain Description	Relative Hights Classes	Relative Hights Description	Land Usable Value Classes	Land Usable Value Description	Environmental Land Value Classes	Environmental Land Value Description	Land Accessibility Classes	Land Accessibility Description	SCORES (1-5)
flat	0-2%	horiz.	0-360°	plain land	0-300m	1st agrozone	I-IVa category	very low value	2.3.1, 3.2.1	very near	0-5min	5
small inclinat.	2-4%	South	135-225°	-	-	-	-	low value	2.2.1	near	5-10min	4
inclined	4-10%	East/ West	45-135°/ 225-315°	hill land	300-700m	2nd agrozone	IVb-VI category	middle value	2.2.2, 2.4.3, 3.2.2	accesible far	10-15min	3
steep	10-20%	-	-	-	-	-	-	high value	2.4.1, 2.4.4, 3.2.3,	far	15-20min	2
very steep	20-30%	North	0-360°	mountain land	above 700m	3rd agrozone	VII-VIII category	very high value	3.1.1, 3.1.2, 3.1.3	very far	20-30min	1

Table 1: Scoring of Land Units

Land for reconstruction is determined by analysis of existing construction areas, as it is shown in Table 2.

Order Number (k)	Municipality	Area Used for Reconstruction (P_{ok}) in hectars
1	Banovici	165
2	Celic	341
3	Doboj Istok	383
4	Kalesija	124
5	Gracanica	422
6	Gradacac	770
7	Kladanj	578
8	Lukavac	1485
9	Srebrenik	155
10	Sapna	280
11	Teocak	402
12	Tuzla	508
13	Zivinice	127

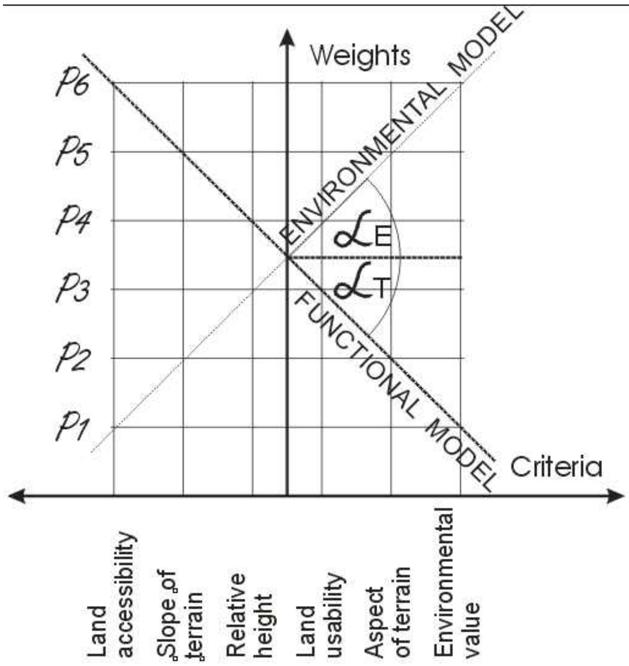
Table 2: Balance of Areas Used for Reconstruction

6 REPRESENTATION OF ALTERNATIVES BY SYNTHESIS MODELS

Weights of criteria are defined according to differences in their importance which are adopted as linear dependent values in a model. Table 3 shows normalized weights for two syntesis models according to their importance related to the specific model.

Normalized Weights for	Land Accessibility	Slope of Terrain	Relative Height	Environmental Value	Aspect of Terrain	Land Usable Value
Environmental Model	0.28	0.24	0.19	0.14	0.10	0.05
Functional Model	0.05	0.10	0.14	0.19	0.24	0.28

Table 3: Weights of Criterial Factors for Environmental and Functional Model



Graph 5: Synthesis Models and Values of Criterial Weights

According to Graph 5, behavior of the model, in functional and environmental sense, is possible to describe by the following set of linear equations:

p_1= -2,5 tg α + 3,5
p_2= -1,5 tg α + 3,5
p_3= -0,5 tg α + 3,5
p_4= 0,5 tg α + 3,5
p_5= 1,5 tg α + 3,5
p_6= 2,5 tg α + 3,5 (1)

where p_1 , p_2 ... p_6 denote weights of specific criteria, and α is angle of model gravitation that represents how much the model gravitates to some of the alternatives (synthesis models).

7 OPTIMIZATION OF MODEL

If coefficient of direction, tang α i, vary from -1 to 1, then angle of gravitation, α i , takes values from $-\pi/4$ to $\pi/4$. Optimum model is characterized by total suitable area P depending on the angle α .

If existing land for construction is adopted as extraordinary suitable category, then the condition for model optimization can be described by expression:

$F = (P_r - P_O)^2 = \min .$ (2)

where P_r is extraordinary suitable area for optimum model, and P_O is existing land for construction.
In order to make description of the problem easier, function $P_r(\alpha)$ is presented by appropriate polynomial ψ_r , and expression (2) can be transformed into:

$\Phi = [\psi_r(\alpha) - P_O]^2 = \min .$ (3)

which represents objective function for model optimization.
As a method for solving optimization problem it is used the genethic algorithm that is based on natural selection, the process that drives biological evolution. It can be applied to solve various optimization problems in which the objective function is discontinuous (or with discrete values), nondifferentible, stochastic or nonlinear.

The building blocks of the genetic algorithm are evaluation of fitness, selection, recombination and population of chromosomes.

The genetic algorithm repeatedly modifies a population of individual solutions (chromosomes). At each step, the genetic algorithm selects individuals at random from the current population to be parents and uses them produce the children for the next generation. Over successive generations, the population evolves toward an optimal solution [5].

8 FITNESS FUNCTION

According to expression (3) fitness function F_f can be described as:

$$F_f = \sum_{k=1}^{n} \Phi_k = \sum_{k=1}^{n} \left[\psi_{rk}(\alpha) - P_{Ok}\right]^2 \qquad (4)$$

where n is total number of enclosed municipalities.

The expression (4) is used for evaluation of fitness values needful for creation of each next generation of potential solutions (chromosomes).

Fitness function is defined in M-file (Matlab) by calculated polynomial coefficients and balance of areas from Table 2.

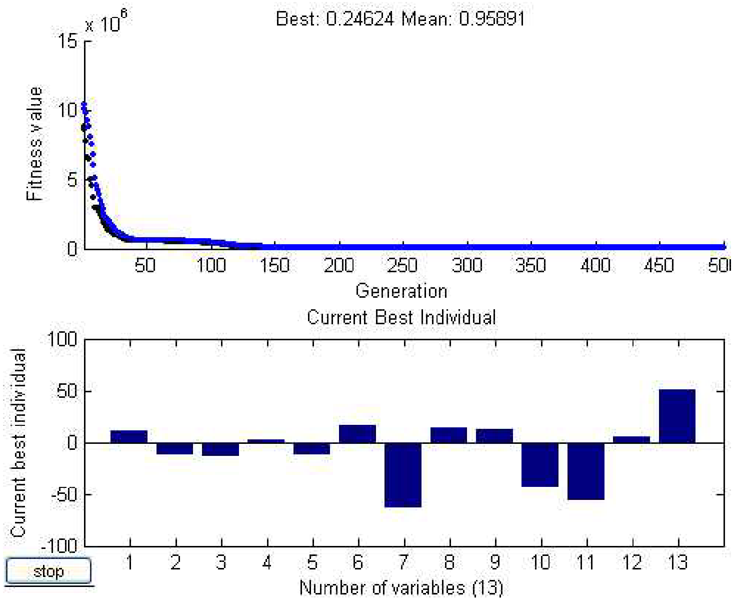
9 REPRESENTATION OF CHROMOSOME

For representation of chromosome it is used binary string λ [2]. Variable is encoded so that it presents real values of the angle of gravitation in radians. Domain of searching is defined with adopted precision of 0.01 radian. By this way, the solutions are presented by chromosomes (104 bits strings) consisting of 13 genes.

Each of the gene (8 bits string) represents model (by angle of gravitation) of specific municipality.

10 PARAMETERIZATION OF GA AND RESULTS

After the testing, the parameters which gave acceptable results of optimization are determined as: roulette wheel selection, 100 chromosomes in population, elite count 2, crossover fraction 0.25, mutation with gaussian distribution, single point crossover and stopping after 500 generation.



Graph 6: Current Best Individual and Fitness Value

Final value of fitness obtained in the last generation is 0,24 ha, while predefined value of tolerance is 2 ha (Graph 6).

Angles of model gravitation (MGA) obtained by GA optimization are given in Table 4.

Order Number (k)	Municipality	MGA (α_k) in *rad*
1	Banovici	0,103
2	Celic	-0,118
3	Doboj Istok	-0,131
4	Kalesija	0,026
5	Gracanica	-0,127
6	Gradacac	0,162

7	Kladanj	-0,639
8	Lukavac	0,133
9	Srebrenik	0,118
10	Sapna	-0,437
11	Teocak	-0,571
12	Tuzla	0,049
13	Zivinice	0,507

Table 4: Angles of Model Gravitation

11 LAND USE CLASSIFICATION AND THEMATIC PRESENTATION IN GIS

Applying the genetic algorithm for searching the optimum model for land use classification are determined values of the angles of gravitation enough close to optimum. In order to achieve final objective of multicriterial analysis, it is necessary to perform aggregation, i.e. summing the factorized criterial values and classifying the areas according to the land use (already described).

Total value of a land unit is calculated as:

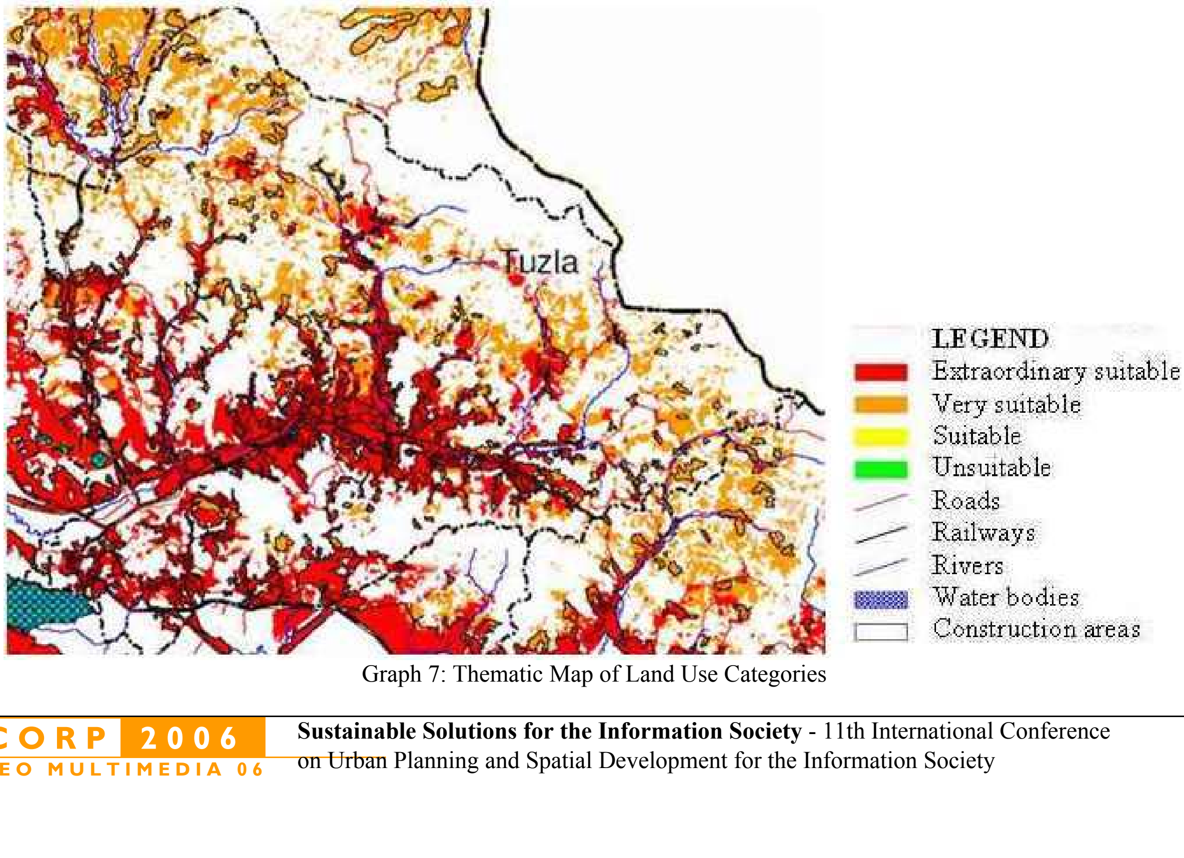
$$\upsilon_{zk} = (w_{1k}f_1 + w_{2k}f_2 + w_{3k}f_3 - w_{4k}f_4 - w_{5k}f_5 - w_{6k}f_6 + \upsilon_{\max})/(\upsilon_{\max} - \upsilon_{\min}) \qquad (5)$$

where:
w_{ik} are normalized weights from equations (1), for criteria $i=1...6$ and municipalities $k=1...13$,
f_i is assigned scores for specific criteria, and
$\upsilon_{\max}$ i $\upsilon_{\min}$ are maximal and minimal value of land unit ($\upsilon_{\max}$ =3.276, $\upsilon_{\min}$ =-3.276).
Table 5 shows ranked values used for classification of land use.

Category of Area	Ranked Values (normalized)
extraordinary suitable	0.75 - 1.00
very suitable	0.50 - 0.75
suitable	0.25 - 0.50
unsuitable	0.00 - 0.25

Table 5: Ranked Values for Land Use Classification

Based on the ranked values, total land units values are presented by thematic visualization in GIS. To each of the ranks (classes) is assigned a corresponding color (Graph 7).



Graph 7: Thematic Map of Land Use Categories

12 CONCLUSION

This paper shown how to apply genetic algorithm (GA) in optimization of spatial valorization multicriterial model during the regional urban planning process.

The matter exposured in the work, described both the problem of multicriterial spatial valorization from land use aspect and finding the optimal model methodology and it was illustrated by actual examples taken from the spatial planning area and available existing studies in this field.

The crucial points of the research were the following:

possibility of multicriterial valorization of the land from the GA use perspective,

how to utilize the capacity of the GA optimization techniques in the frame of decision support system and with usage of the GIS tools and

how to apply the GA in the field of genotype presentation in spatial modeling.

As one of the approaches for finding a methodology for multicriterial land use valorization, application of genetic algorithm gave acceptable results. Weights used in initial equations of mathematical presentation, are indirectly optimized by modified objective function applied in GA during fitness values evaluation. Populations of binary vector strings which indirectly represent solutions for criterial weights, are maintained by unique mechanism of GA [3]. By the applied methodology is enabled searching the alternatives of spatial organization for given land use categories and finding the optimum alternative.

The optimum can be searched for various given parameters influencing the objective function.

Due to its general application, genetic algorithm could have key role for development of a decision support system for spatial multicriterial analysis.

13 REFERENCES

[1] ALERT S.: Information Systems; The Foundation of E-Business, Prentice Hall, New Jersey, USA, 2002
[2] AVDAGIC, Z.: Vjestacka inteligencija & fuzzy-neuro-genetika; Elektrotehnicki fakultet u Sarajevu, GrafoArt, 2003
[3] AVDAGIC, Z.: Metode i primjena vjestacke inteligencije; Elektrotehnicki fakultet u Sarajevu, GrafoArt,2004
[4] BUBLIN M., Prostorno planiranje; Univerzitetska knjiga, Sarajevo, Studentska stamparija, 2000
[5] GOLDBERG D.E.: Genetic Algorithms; Addison Wesley, 1989
[6] LONGLEY P., GOODCHILD M., MAGUIRE D., RHIND D.: Geographic Information Systems and Science; John Wiley&Sons, England, 2002
[7] PONJAVIC M., LOJO A.: GIS u gazdovanju prirodnim resursima; Gauss d.o.o. Tuzla, 2004
[8] BIGGERO L., LAISE D., “Organizational Behavior and Multicriterial Decision Aid”; 2nd Annual Conference of Innovative Research in Management, Stockholm, 2002
[9] MATTHEWS K.B., CRAW S., MACKENZIE I., ELDER S., SIBBALD A.R.: “Applying Genetic Algorithms to Land Use Planning”; Proceedings of 18th Annual Conference of the BCS Planning and Scheduling SIG, ISSN 1368-5708, 1999
[10] PONJAVIC M., “GIS Application in Implementation of Spatial Plan”; IV Conference of Urbanism in Bosnia and Herzegovina, Tuzla, 2002
[11] PONJAVIC M., KARABEGOVIC A., “Land Inventory System and Valorization of Agricultural Areas”; Progis International Conference "IT in Rural Areas", 2004
[12] STEWART T.J., JANSSEN R., VAN HERWIJNEN M.: “A genetic algorithm approach to multiobjective land use planning”; University of Cape Town, University for Environmental Studies, Vrije Universiteit Amsterdam, 2004
[13] PONJAVIC M., AVDAGIC Z., KARABEGOVIC A.: "Applying Genetic Algorithm to Land Use Planning Problem of Multicriterial Optimization", ICAT 2005 - XX International Symposium on Information Communication and Automation Technologies, Sarajevo, 2005

Geographic Information Systems on the Internet: Sustainable Solution for the Information Society

Darinka GOLUBOVIC- MATIC

(MSc Darinka Golubovic Matic, Köln, dgolubovicmatic@hotmail.com)

1 INTRODUCTION

The world is changing rapidly under the growing influence of information and communication technologies (ICT) and globalization, which are reciprocally strengthening factors. This process of transforming our industrial society into an informational society has the potential of dematerialization – substitute information and knowledge for material products to some extent, as well as progressive globalization of the economy that has thus far boosted goods production, freight volume and passenger transport. The information society also means the acceleration of innovational processes, and thus an ever faster devaluation of those already existing by new, whether hardware or software, technical products or human skills and knowledge (Hilty, Ruddy 2005). The relationship between the information society and sustainable development are of great concern when we consider the future of our planet (Välimäki, 2002).

The last decade has seen exponential growth, in the use of the Internet for the delivery of a whole new set of services across the globe, coupled with a growing reliance on new ICT to support the functions and delivery of municipal services for urban planning and management. Geographic Information Systems (GIS) have advanced into an increasingly important information tool, especially on-line Public Participatory Geographic Information Systems (PPGIS), with the aim to enlarge the level of citizen's involvement and participation in decision-making processes. This paper will investigate the potential of GIS on the Internet to support public participation in sustainable management of the urban regions in Germany, with the crucial question: Is GIS, on the Internet, a sustainable solution for the information society?

2 GIS ON THE INTERNET

A Geographic Information System (GIS) is an organized collection of computer hardware, software, geographical data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information (ESRI, 1995). The GIS has been used for solving a wide range of planning problems. The GIS, on the Internet, can allow many more people to have access to GIS functionality and to enhance community participation in planning. The GIS used to support public participation is often referred to as Public Participation GIS (PPGIS) (Steinmann, Blaschke, Krek, 2004). "Public Participation GIS" (PPGIS) is a closed set of methods and technologies intended for public participation, presentation of various forms, and combinations of spatial information depending on aspects selected for problem perception (Krygier, 1997). Thanks to the GIS on the Internet, which is becoming a powerful communicational tool between different interest groups, it is possible to involve the public in the planning process from its very beginning. So-called on-line PPGIS are being used to facilitate the delivery of spatial information to participants and allow them to return their information for inclusion in the database (Craig et al, 2002).

The use of GIS on the Internet (PPGIS on the WEB) should be to:

- enhance the participation of the public and their presence. Kingston (2001) presents that the use of PPGIS on the WEB enhances the public opinion and helps to reflect their real agenda.
- enhance the public reliability, objectivity and confidence on the data in the planning process. Also, PPGIS on the WEB, should enable on-line relative data, quick up-dating, and easy accessibility from everywhere.
- empower the public participation process, by incresing the number of participants, and by deepening the involment of the public in the planning process.

Keyem (2000) summarizes the topology of differences between GIS applications and PPGIS applications:

- Focus – in GIS it is technology; in PPGIS it is the people and technology
- Goal – in GIS it is to facilitate official policy-making; in PPGIS it is to empower communities
- Organizational structure – in GIS it is rigid, hierarchical and bureaucratic; in PPGIS it is flexible and open
- Details – in GIS they are specified by technologists and GIS experts; in PPGIS they are specified by users, focus groups
- Applications – in GIS they are led by independent specialists; in PPGIS they are specific, project-level activities
- Approach – in GIS it is top-down; in PPGIS it is bottom up

a. Interactivity of PPGIS applications

By definition, interactivity is an overused term that basically means that the client or user is engaged to interact with the content or information. In the framework of a PPGIS application, interactivity refers to the user's interaction with the application using computer. Steinmann, Blaschke, Krek (2004) distinguish four stages of interactivity PPGIS applications:

- Information delivery – the stage where participation exists in an entirely passive mode and can be described as "the public right-to-know". On this stage, the delivery of on-line services to the user is in a one-way direction and has some sort of informative status for the users. The users can extract geographic information by using the PPGIS application and the data stored in the database.
- On-line discussion – the stage where the participation has a higher degree of interactivity which is achieved through the two-way exchange of information and participant's suggestions and comments. This stage includes the on-line discussion among participants, planning offices and planning authorities. The possibilities of drawing changes on the map are not included in this stage.

- Map-based discussion – the stage with PPGIS applications which provide the user with possibility of communication on the basis of an on-line map. The participants can (geo)graphically express suggestions for changes or can make comments on specific objects in the selected map. A PPGIS application and its specific tools enable the participants to send their personal map version together with annotations or additional material to the planning authorities. Participants send their suggestions to the people responsible for collecting this material, but they are not actively involved in the decision/making process through iterative processes or feedback-loops.
- Involvement in decision-making – during this stage, participants can actively contribute to the decision–making process and participate in the final planning processes and consequently in the decision making. The main difference to the previous stage, is the binding character of the citizen's decision.

b. GIS functionalities included in PPGIS applications

There are different GIS functionalities included in PPGIS applications which range from basic operations to more complex operations, such as 3D visualization or statistic calculation. Some GIS operations also allow for "personalized views" of data sets and enable the user to access information on specific topics. The standard GIS functionalities are usually needed for PPGIS applications:

- Topological overlay – GIS is traditionally organized in different layers and then they can be combined in a customized map. Topological overlay is an analysis for determining the spatial coincidence of geographic features presented in layers, which are integrated in a GIS.
- Informational retrieval – In a GIS, graphical data is related to the attribute data describing their characteristics. Attribute data can be a number describing the features of the object or a qualitative description of the object. The user can, with the simple mouse, click on a spatial element and retrieve attribute data about the selected object.
- Query – When performing a query, it implies that the user can retrieve the data according to the related terms, phrases or features chosen.
- Data selection tools – These functions enable the user to select spatial objects on the specified thematic data layer. They are usually used if the participant submits a comment related to the object or a question about the characteristics of the selected object.
- Zoom and Pan – GIS zooming bottoms usually show zoom in with an (a+) or zoom out (a-) symbol. The usage of these tools enables the users to change their view and the level of detail by clicking on a location or by dragging a box to define a particular extend. The pan functionality enables the user to move the map on the screen into the position they like, focusing on the part of the map that is of interest to them.
- Distance measure – This function enables the user, for e.g., to measure the distance between two locations or the total distance of the route, with multiple stops. The calculation is performed in the background and the result of the measurement is displayed on the map or underneath.

3 THE INFORMATION SOCIETY

The Internet knows no national borders. German cooperation with partners in Europe and the rest of the world is an essential part of the Federal Government's Internet strategy. Germany supports the implementation of the EU's eEuropa 2005 Action Plan for the creation of a European Information Society, as well as i2010, known as "European Information Society 2010".

c. Improving Public Participation

E-government and the provision of better services for public participation in Europe was one of the responses to the Lisbon Strategy. The eEurope 2005 Action Plan was launched at the Sevilla European Council in June 2002 and signed by the Council of Ministers in the eEuropa Resolution of January 2003. The aim of the eEurope iniative was to use the power of ICT in order that it may provide a favourable environment for private investment, job creation, productivity and growth, while modernizing public services and giving all citizens the opportunity to participate in the Global Information Society. On June 1, 2005, the European Commission announced, i2010 – also known as "European Information Society 2010"- with the aim to promote growth and jobs in the European Information Society and media industries. The new five-year strategy, which is meant to succeed the previous eEurope 2005 initiative, provides a comprehensive framework for the development of the digital economy. In this respect, EU policy instruments such as regulatory initiatives, research, and partnerships will play a key role in the implementation of the new strategy. Among other things, the Commission will, in particular, promote high-speed, secure, broadband networks to support the delivery of rich and diverse digital content in Europe.

According to the European Commission, the i2010 initiative will contribute to the implementation of three policy priorities:

- **Create an open and competitive single market for the information society and media services within the EU**. To this end, the Commission will propose the following initiatives: an efficient spectrum management policy in Europe (2005); a modernization of the rules on audiovisual media services (end 2005); an updating of the regulatory framework for electronic communications (2006); a strategy for a secure information society (2006); and a comprehensive approach for effective and interoperable digital rights management (2006/2007).
- **Increase EU investment in research on information and communication technologies (ICT) by 80%**. Europe currently lags behind in ICT research, investing only EUR 80 per head as compared to EUR 350 in Japan and EUR 400 in the US. Among other initiatives, i2010 will promote trans-European demonstrator projects to test out promising research results, and take measures to better integrate small and medium-sized enterprises in EU research projects.

- **Promote an inclusive European information society**. The Commission will propose an **Action Plan on e-Government for citizen-centered services (2006)**; three “quality of life” ICT flagship initiatives in the areas of aging, intelligent vehicles, and multilingual digital libraries (2007); and a number of actions to overcome the geographic and social digital divide, culminating in a European Initiative on e-Inclusion (2008).

Concerning e-government, the European Commission’s i2010 Communication notes that making public services “better, more accessible and more cost-effective” is a “key challenge”. In spite of considerable advances achieved in the roll-out of electronic public services, the Communication stresses that "much remains to be done to demonstrate economic impact and social acceptance” of e-government. In addition, there is still a need to develop “common interfaces, portability of identity from one system to another and authentication systems”, the Communication says, as well as for “new practices, new skills and different rules” (European Commission, 2005).

4 THE CASE STUDY: THE PROJECT OF THE CITY OF BERLIN

Senate Department of Urban Development in Berlin developed online PPGIS applications for urban management. Public participation on all levels on the planning process is possible and available on the Internet, not only on the information level, but also on the active concrete participation level. The preparatory use plan (Flächennutzungsplan) and the legally binding land use plan (Bebauungsplan) are present on the Internet with the help of GIS and giving an opportunity for active public participation. The objective of the project is to promote the sustainable urban management.

d. PPGIS on the Internet (Bebauungsplan I-216 Postblock)

The system of the project Bebauungsplan I-216 Postblock was built on a website with spatial data (digital map data) and the GIS web system on the Internet. The site enables the public to participate in the process, anywhere and anytime. It enables viewing extensive amounts of GIS-based data from surveys, as well as, statistical analysis on the internet. The site contains presentation of various subjects related to the legally binding land use plan, and the public is able to respond and comment to the planning team. The site is http://www.stadtentwicklung.berlin.de/planen/b-planverfahren/de/oeffauslegung/i-216/index.shtml , Figure 1 presents the print screen of the PPGIS on the Internet.

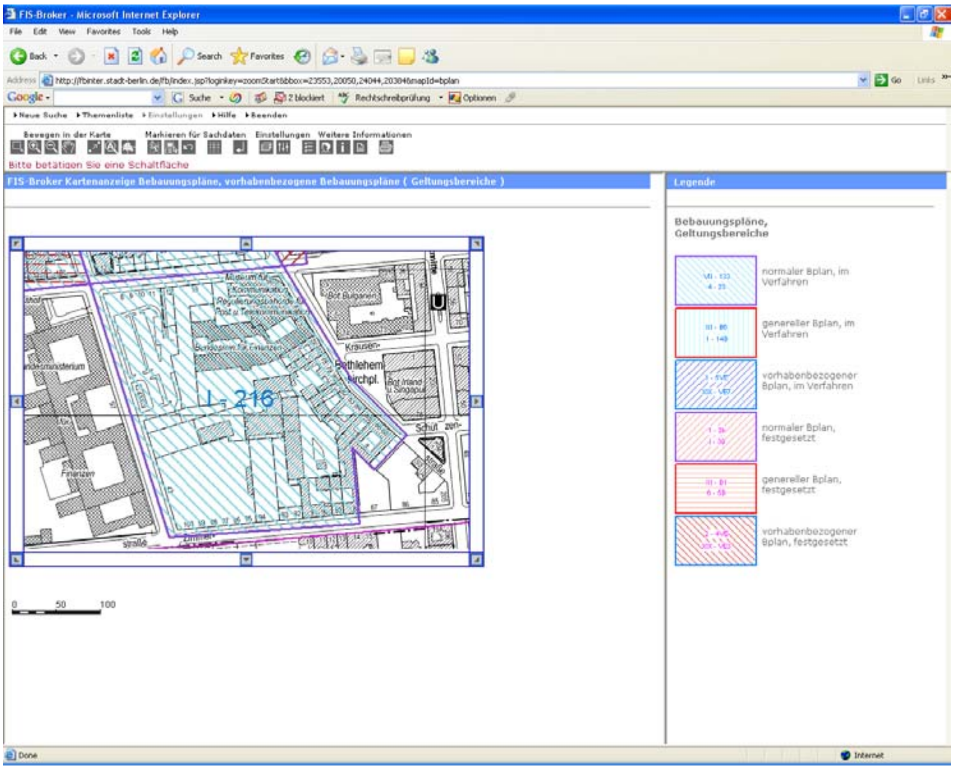


Figure1: PPGIS on tne Internet „Bebauungsplan I-216 Postblock“

The PPGIS application for the project “Bebauungsplan I-216 Postblock” in respect to different forms of on-line participation and on the degree of interactivity, can be defined as ‘on-line discussion.’ The participant has a high degree of interactivity which is achieved through the two-way exchange of information and participant’s suggestions and comments. The on-line discussion among participants, planning offices, and planning authorities is included. Besides the standard GIS functionalities like- topological overlay, informational retrieval, query, data selection, zoom and pan- PPGIS’s project “Bebauungsplan I-216 Postblock” gives an opportunity to have direct contact with the planning office via e-mail or phone.

5 CONCLUSION

The GIS on the Internet in Germany is technically mature and widely used at all levels of administration and planning for urban management. The German Information Society has developed impressively in the last few years. The project of the Senate Department of Urban Development in Berlin is one example of how the GIS on the Internet is a sustainable solution for the information society with the characteristics of on-line discussion to improve government decision-making and to increase efficiency, and also the role of citizens in decision-making.

6 REFERENCES

BANGER, Samir: Integrating GIS with web for public participation , on line available at: http://www.gisdevelopment.net/technology/gis/techgi0058pf.htm

CRAIG,William; HARRIS,Trevor; WEINER Daniel (2002): **Community Participation and Geographic Information Systems,** Taylor & Francis Group

European Commission unveils new Information Society strategy, on line available at: http://europa.eu.int/idabc/en/document/4340/330

GUDES, Ori; STERN, Eliahu; SVORAY, Tal: Geographical Information Systems on the Web for Public Participation in Planning, on line available at: www.hig.se/geoinformatics/proceedings/files/p459.pdf

HILTY Lorenz; RUDDY Thomas: Towards a Sustainable Information Society, on line available at: http://www.empa.ch/plugin/template/empa/*/32695/---/l=2

Information Society Germany 2006 (pdf), on line available at: http://www.kompetenznetze.de/Redaktion/Zentralredaktion/Literatur/medien/en/info__information__society-2006,property=pdf.pdf

KINGSTON, Richard (2005): Urban Regeneration in the Intelligent City, on line available at: www.ppgis.man.ac.uk/papers/ kingston_paper_CUPUM_2005.pdf

Senatsverwaltung für Stadtentwicklung, on line available at: http://www.stadtentwicklung.berlin.de/

STEINMANN, Renate; BLASCHKE, Thomas; KREK, Alenka (2004): Can Online Map-Based Applications Improve Citizen Participation?, on line available at: www.iapad.org/publications/ppgis/092804_bozen_last.pdf

STEINMANN, Renate; KREK, Alenka: Stärken und Schwächen von Public Participatory GIS (2005), on line available at: http://mmp-tk1.kosnet.com/corp/archiv/papers/2005/CORP2005_KREK_STEINMANN.pdf

VÄLIMÄKI, Jari (2002): The Information Society and the Use of Sustainable Development Indicators, on line available at: www.internetix.fi/futuralehti/2002_2/02_2_kansi.pdf

GIS As A Tool For Sustainable Development Of Model Green City In India

Piyali BANDYOPADHYAY, Sanhita BANDYOPADHYAY

(Piyali Bandyopadhyay, Central Pollution Control Board, Savannah Garden Road, D3 Vasant Kunj'New Delhi –110070, India, Bandyo_piyali@yahoo.co.in)

(Sanhita Bandyopadhyay, ENVIS Cell, Ministry of Environment & Forest, CGO Complex New Delhi , India 110070, bsanhita2@yahoo.co.in)

1 INTRODUCTION:

A sustainable development of a city is one which is self relient and healthy which is not overcrowded to jeoparadise living space. The broad regulatory and incentive structure needed to support the achievement of development goal, within a framework which promotes local and global sustainability, is relatively easy to conceive under two broad heading:

I. Ecological sustanability

II. Economic viability

The poverty suffered by the minority of urban dwellers in rich nation and the majority of the poorer nation can be drastically reduced without a large expansion in resource use the social and ecological cost of providing safe and sufficient water supplies, provision for sanitation, garbage removal, energy use and health care and ensuring safe, secure shelter are stated the quality of life of wealthy and unusual healthy environment. At the same time there is need to minimise the call on local and global environment capital demand a competence and capacity to act by city itself. Out of the most important policy issues in implementing sustainable developent is building the institutional framework within each city, district and region at local level. The capacity of local govt to plan and manage the area under their jurisdiction, to promote more sustainable pattern of resource use and urban forms to invest is needed infrastructure and service to enhance the locality attraction for more productive investment which guided by the needs and priority of the citizen for both development and sustainabality. And, overall, local govt cannot take on the role without a strong financial base, the support of national govt and an apprpriate legislation, regulatory and incentive structure. But to make effective policies, plans and implementation procedures must be designed and implemented. This in turn requires accurate spatial information. Remote Sensing and Land Information System (LIS) Geographical Iinformation Systems (GIS) are effective instruments for data capture, processing and communication within urban planning and management processes.

2 NEED OF STUDY:

Cities in all parts of the world face mounting challenges such as population shifts, inadequate or aging infrastructure, sprawl, the spread of informal settlements, traffic congestion, water shortages and air pollution,. Metropolitan cities grow beyond imaginable proportions, particularly in the developing world. Urban issues therefore warrant – and receive – increasing attention. Thus, the ever increasing, urbanization process accelerates as a name of Primate City escalating the socio-economic demands, which altering the biophysical environment of the city.

According to the 1995 UN Census these are six largest cities on the planet are Tokyo, Mexico, Sao Paulo, New York, Bombay & Delhi. The National Capital of India, Delhi, is a city where indisputable economic progress related to urbanisation is accompanied by tremendous environmental concerns, congestion, poverty, and housing shortages. Delhi's population increases and reach to 13.5 million. To make city viable to future growth it was suggested for a planned decentralization to outer areas named as National Capital Region. Gurgaon is one of 22 "satellite" town in this region, today turned over a new leaf, joining important position on the industrialmap of India and now Gurgaon is challenged by a very fast growth rate and it is one of the most prestigious industrial townships in India and is home to major icons in information technology. Its close proximity 25 km to Delhi will make it an ideal showcase for the whole of India.

Agenda 21, adopted by the United Nations Conference on Environment and Development on 14 June 1992 in Rio de Janeiro, is the international community's response to the United Nations General Assembly's call for halting and reversing the effects of environmental degradation. It is a comprehensive programme of action to be implemented by Governments, development agencies, organizations of the United Nations System, and independent groups in every area where human activity affects the environment.As one of the signatories of the resolutions regarding Agenda 21, India is committed to the implementation of Agenda 21.

Accordingly, India is considering applying the Green City concept to Gurgaon City as "Model for Sustainable Urban Management" by incorporating environmentally sustainable solutions with respect to:

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

I. Water Supply And Waste Water Treatment;
II. Energy Supply, Energy Savings And Renewable Energy Development;
III. Waste Management, Soil Pollution And Air Pollution;
IV. Cleaner Industrial Technologies And Environmental Management;
V. Agriculture And Food Industries;
VI. Building Construction And Urban Ecology Management;
VII. Urban Traffic And Transportation.

Main objective is to achieve lasting harmony between man and nature and to protect the interests of future generations. An integrated medium to long-term planning and implementation strategy, close public-private participation, public awareness and responsibility constitute. A basic approach is to a holistic solution to urban environmental concerns.

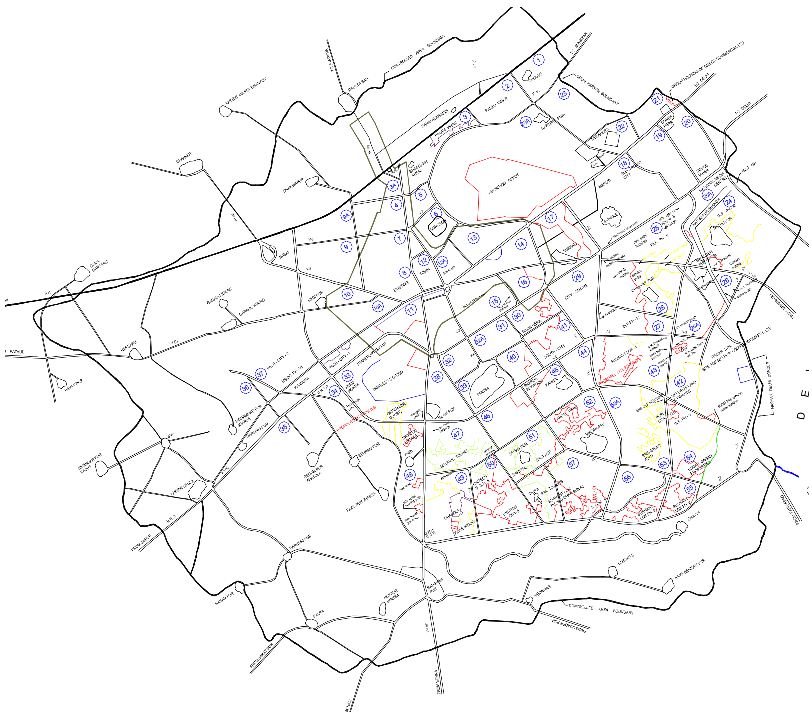
3 AIM OF STUDY:

This paper aims to integrate above aspects of Model Green City by using GIS. The essential links are coordinate data of buildings and personal identification codes. A geographic information system (GIS) is allowing resource agencies, scientists, and watershed groups to compile and analyze information at multiple temporal and spatial scales. It helps to make identification and description the limiting factors, synthesize data for use in developing and implementing plan, identify data needs, analyze and prioritize data to support plan, for inventory, update and evaluate programs and activities related to **SMART Cities**

4 EVOLUTION:

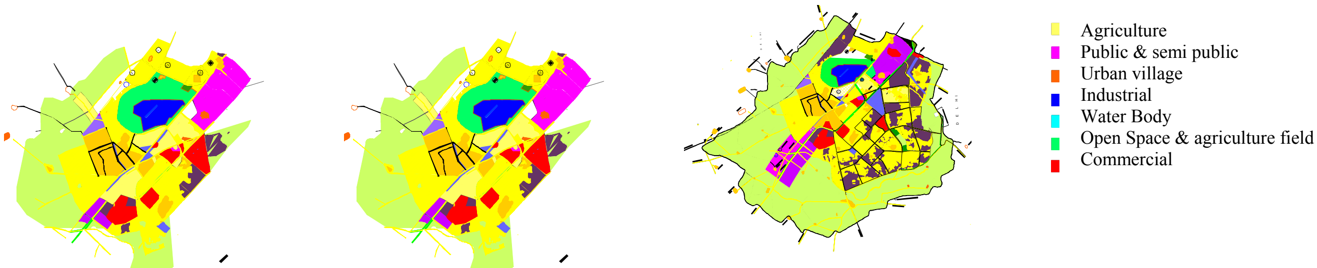
Gurgaon, with a standard urban area at about 50 square km. and a resident population of about 230,000 (1997 figures), the floating population is 10,000 per day. Average annual population growth is 18-20%. The district headquarter is situated in Gurgaon city. Now Gurgaon has become one of the most important corporate and industrial hubs of state Haryana in India. Gurgaon also known as 'Guru Gram' or 'Guru Gaon' (village of the spiritual teacher) was named after Dronacharya, a character in the Epic Mahabharata. It is said that Guru Dronacharya of the Pandavas and the Kauravas gave spiritual instructions to them at this place. The office and manufacturing plant of India's largest car maker Maruti Udyog Limited is situated here as are a large number other industries. Another area in which Gurgaon is excelling is the IT industry and software development. Real estate is booming here with new buildings coming up at an astronomical pace. Now this city is chosen for a showcase for sustainable urban development as a model for other Indian.

Gurgaon city is located at 28°53' N latitude and 75° 35' E longitude and is situated at a distance of 25 kms south-west of Delhi, the national Capital and 285 km from state headquarters of Chandigarh. It lies at 229 meters above mean sea level and forms a part of the National Capital Region. Gurgaon district is an area of confluence of aravalli huills, Indo-Gangetic plains and Indian desert, Gurgaon urban area can be broadly classified under two district sections namly the HUDA(Haryana Urban development Authority) area and the old town (municipal area limit). The area under HUDAcan be further subdivided into (i) private coloniser area, (ii) Huda sector (iii)Institutional area and (iv)the urban villages. The current estimated population of Gurgaon including the urban area, the existing town, and the 17 village surrounded by urban development is 400,000 (HUDA 2001). The projected total population of the urban area for the year 2011 is around 1.6 million.



The Gurgaon city has been the head quarters of Gurgaon district, the southern most district of Haryana since 1816, and has exhibited steady growth after the partition. Spread over an area of 15.33 sq km the Gurgaon town had a population of 1,73,542 and the Gurgaon urban area had a population of 2, 29,243 spreading over an area of 30.2 sq km according to 2001 census. The population density shows that Gurgaon city and urban area are densely populated as compared to the Gurgaon ditrict. The most important factor for this is its close proximity to Delhi.Rewari railway line on the south-western outskirts of Delhi. National Highway No. 8 passes throgh its main core of city. This Gurgaon originated as a village called Guru gram. Since that time it has been undercontrol of various rukes who come to rule from Delhi like Maurya, Tomar, Chauhan and Mughals. The Gurgaon district passed into British hands in 1803 and revealed in 1851. In 1966 Haryana took birth and it was designated as district and has been Tehsil and district headquater. The first development pro was in 1971, 77 and further 82 and NCR in 1989 asigned as important hub for development. In 1981 haryana model has been eveolved as Public-private partnership and it was boost up as Electronic City. But it was boost up where Maruti udyog has been set up in 1984 and in 1997 been develop Corporate park.It becomes recognise as class I town in 1991.The city has developed into 4 phases:

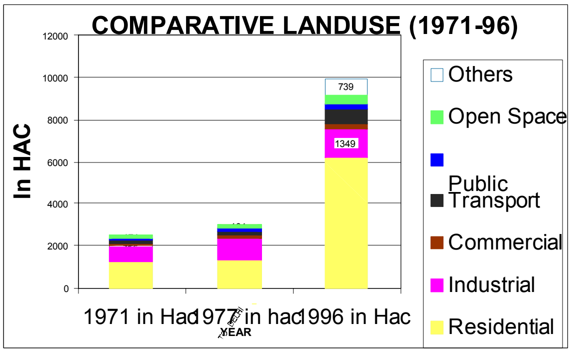
I. 1968-71:
II. 1975-78:
III. 1985-95
IV. 1995-present



1971 1986 2001

5 EXISTING ENVIRONMENTAL STATUS:

The urbanisable area is divided into 57 sectors under various land uses. The extent of land use is given below:Haryana urban development Authority has so far acquired and developed most modern lines with a network of wide sector roads. In residentioal sector minimum 45% of area under a particular sector is kept for parks, open spaces, roads and community building including community centres, dispansaries, schools, creshes, police post, post office, electric sub station, etc. As per the norms adopted by HUDA. Even higher order facilities provided for every estimated population of one lac persons include provision of colleges, hospitals, police stations, telephone exchange, fire stations. To meet the Commercial needs of the town, a City-Centre in Sector No.



29 covering 480 acres of land has been acquired and planned to provide for facilities like World trade Centre, Finannce District, Commercial Office towers, departmental stores, Cimnma house, hotels, fire station, leissure valley, amusement park, etc. Three other District Centres in sector 23A, 56 and 47, to serve a clusters of adjoining sector have also been planned besides the local convenient shopping centres in each residential sector.Three sectors viz. Sector 18(part), Sector 32 and 44 have exclusively been planned for institutional land use which include Corporate Offices, Training, research and development Institutions like Pepsi , Coca Cola British Telecom, Flour Daniel, GE Capital, CI Dunpont , Global business park etc.It has excellent location for future growth, too.

More than 80 % population are literate . The economic charecteristics of an area play a determining role in the overall development of the region. In Gurgaon, the maximum share of population is in tertiary sector (72.6%) followed by secondary (25.7%) and primary sector (1.7%). The functional classification of Gurgaon can be designed as service town.

The urban services provided under the master infrastructural plan by HUDA encompasses the urbanizable area of Gurgaon(covering a part of the town area also). These include the following services:

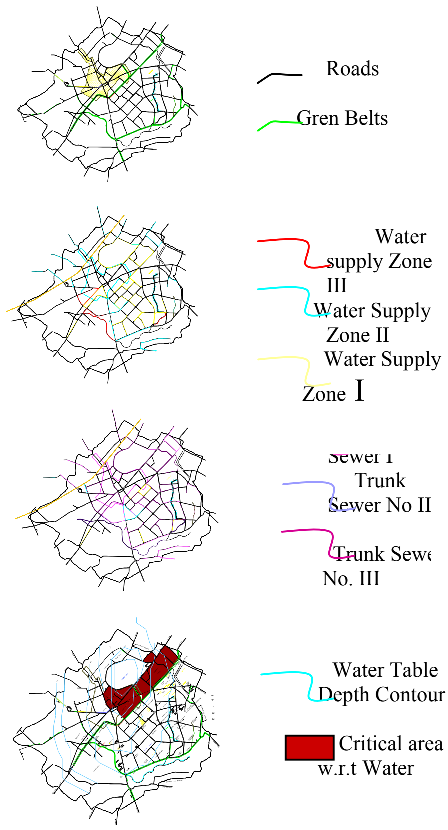
I. Drinking water Supply: total capacity is 12.5 lacs gallons which have been installed to serve across national Highway include sectors of 29, 30, 41, 27, 28, 25 18, 19, 20 24, 26, 26a, 42, 43, 53, 54 & 55, 56.(fig 3)
II. Sewerage System: As per topography of Gurgaon, the sewerage systemhas been divide into four zones. The slope of the urban area is toward the western side and the Najafgarh drain is vailble at a distance of 6 Kms from Gurgaon.the sewerage of the entire area will be collected near sector 4, near Delhi-Rewari railway Lione and be treated by the Sewerage Treatment Plant.Total capacity is 68 MLD , constructed under the Yamuna Action plan is functional .(Fig 3)
III. Storm water Drainage: It is situated at the tail of the Aravalli hiils has a natural gradient from the northeast direction to southwest direction.previously the storm water from the Aravalli hills and from the catchment area of Gurgaon flowed through the natural creeks and surface drains existing in the area with ultimate disposal to the Najafgarh drain. Due to urbanisation, the storm drains foe drainage has been channelised into seven zones.
IV. Street Lighting: gurgaon has total network of master roads i.e. V2 roads (60 meter R.O.W) and V3 roads (30 meter R.O.W) of 151.05 kms, of which the existing PWD (B&R) roads is 41.80 kms. The street lighting network is about 151.05 kms i.e. V2 roads is 40.48 Kms and V3 roads is 110.57 Kms of which the existing PWD, B&R roads forms part of master roads is 41.80 Kms.

V. Horticulture and Arbosiculture:Master Horticulture provides planting of trees along the roadsides, gree belt and in open space bersides development of green belt along National highway-8 and along roads 60 meter and 30 meter wide. Development of liesure valley on 29 sector is also used for this plan.Under this head road side plantation,provision of M.S. tree guars, plantation of shrubs, development of green Belts and thick plantation in green belts are also proposed.

VI. Community Building- External & internal: gurgaon town has 35583 residential building and 8127 shops/ institutional building as per the Municipal survey of 1999.There are 341 industries, 42 big marketts, 11 small markets 10 hotels & 134 big and small restaurant in Gurgaon Town and 42 hospital including nursing homes/dispensries and 71 schools/ colleges in UA. Total status of infrastructure of this are are as folows

6 CRITICAL ISSUES:

The urban- environmental issues in Gurgaon if not addressed and managed today, the stress on infrastructural provision will be reflected by the year 2010 AD when the construction of houses and colonies will be at their completion stage. The plethora of plans and policies, for sustainable urban development process in Gurgaon has assumed prime importance. Though, the few issues that still require urgent attention includes:



I. Solid waste disposal sites and cremation grounds

II. Need to shift from the traditional approach of planning to to more participatory and realistic planning. For that there is need full information to people.

III. Villages within the Urban Area tend to become repository of the poor and also acquire slum like character . The growth of informal sectors, unathorised colonies and urban villages along with the high rise private developers building have given rise to peculiar situation in Gurgaon.Hence all the areas need to be carefully planned and integrated within gambit of planning.

IV. A large proportion of the Gurgaon's population is still using water and as a result the ground water is becoming brackish due to over exploitation. The dramatic ground water lowering in Gurgaon poses a serious threat in future, with the depth of water lowering upto 40 meters in the central area and 30 meters in the adjoing areas.

V. Gurgaon poses an attractive land market for the investors/developers wherein a large proportion of the flats which are being built by the developers are kept vacant and speculation on the land considered.

VI. Having one main single connectivity from south Delhi to Gurgaon (Mehrauli-Gurgaon) the 21- Km Delhi Gurgaon stretch handles over 1.9 lakh passenger car units daily against its capacity of 40 PCUs. There is need to introduce intra city transportation system and strengthen inter city transport system is of critical importance in Gurgaon.

VII. The inclusion of low energy building and newer techniques to conserve energy must be incorporated in the plan from initial stage itself.

The resource potentials and carrying capacity of the region to be assesed and incorporated in the plan, whereby giving the details of the existing situation and future projections. To carry out carrying capacity in order to assess the extent to which development activity could proceed without endengering the environment. Basically carrying capacity refers how much land can carry in tern of human and animal population by supplying the basic needs like water, land, food and fodder. The carrying capacity has two aspects:

- Supply side of environment; life supporting system
- Demand site.

To carry out this analysis here to work out throgh use of GIS tool to assess the gap betwwn demand and supply as sector wise. Each parametersof Green city concept are taken for assesing the carying capacity of area in terms of:

I. **water supply and waste water treatment** can be done by using recycle of water use and water harvesting method:

A Recycling of Waste Water:

Total sewage generation:10.2 Mld

50% can be recycle= 5.2 Mld

out of that it would waste water i.e 80% 1 mld

if again it will recycle 2.5 mld.

Total Fresh water demand 5.19mld

From recycle of water 2.15

Remainn gap= 3.14 Mld

B Rain water Harvesting:

a) Total run off Residential Housing=0.2 mld
b) Total run off Public & semi public area=0.01 mld
c) Total run off paved area 0.0035 mld
d) Total run off grenn are 0.5 mld
e) Total run off =0.7135mld
f) Remaining gap=3.14 - 0.7135=2.416 mld

So, there is need for reduce of use by using ultra modern toilet facility and new plumbing design .

II. energy supply, energy savings and renewable energy development:

III. **waste management, soil pollution and air pollution**;

a) Total population:5000000
b) 1% floating population: 50000
c) For floating population solid waste generation:250gm /day=12500kg/day or1.25 tonnes
d) For residential 0.3 to 0.6kg=250 tonnes
e) For commercial =100 tonnes
f) For street sweeping=50 tonnes
g) For institutional =50 tonnes
h) For industrial=50 tonnes total solid waste=450 tonnes
i) Existing area for land fill site 4.2 hac
j) So, need for segration of biodegradable waste and collect from door to door.

IV. **cleaner industrial technologies and environmental management**: The most important objective of the waste management policy is to reduce waste amounts, and prevention has top priority by recognized waste hierarchy system:

- Cleaner technology - initiatives to prevent waste generation and maximum recycling and reuse.
- Incineration – waste is incinerated when it cannot be recycled and when residues from incineration do not cause environmental problems. Energy is recovered for generation of electricity and heat.
- Landfill disposal.

For these three hierarchcal set up these following issues are taken into consideration

- Waste management system – optimal operation of collection, transportation, treatment, and final disposal.
- Waste administration, organization, and economic instruments.
- Reuse – recycling, energy recovery, etc.
- Environmental communication.
- Sustainable landfills.
- Capacity building – legislative and administrative capacity as to planning, monitoring, and control.
- Training and education.

IV. agriculture and food industries:Food industry and beverages help to susstain villages and regional area to self sustain

V. building construction and urban ecology management: Energy efficient buildings are inograted over this are to take way of sustainble developmennt:

Basic energy sources in an eco-friendly building complex

Sky	Sun	Air	Water	Earth
-day lighting - heat sink	-heating - electricity generation - day lighting - greenhouse effect - solar chimneys	-ventilation - heat sink	-roof gardens - earth berms for insulation	-roof ponds - fountains for humidification - rainwater harvesting

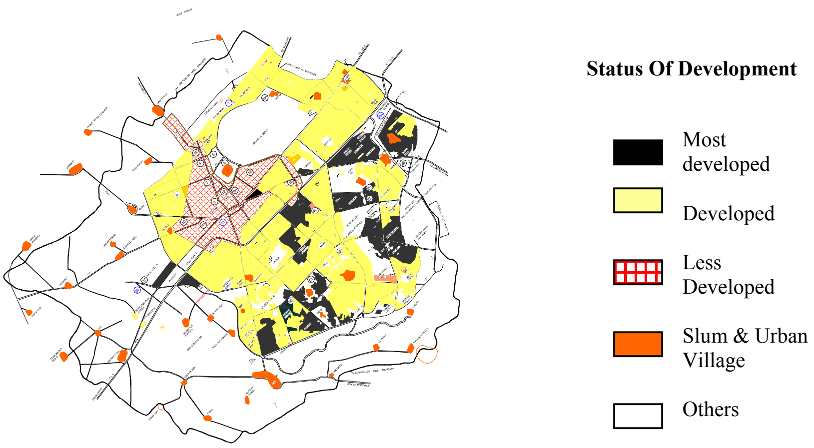
The first stage of green building design is to incorporate solar passive design interventions and try toreduce the loads on conventional systems. Energy conservation is possible by judicious design of lighting and HVAC (heating, ventilation and air conditioning) systems, controls and operation strategies.

VI. urban traffic and transportation.Intra sector transportation is needed and as well as restriction of car movement of internal road and padestrianisation can be done and cycle path is beneficiaries.

Hence the comprehensive profile of this area by identifying the major issues provides imperatives for devising planning inputs in formulation of concrete plan for this region. The accessibily of physical and social infrastructure of this area is mismatch in developmental process. Some area is having more and some are having less. As well as total quantum of fcility are also inadequate .

FACILITY	SECTOR							SUPER SECTOR					DISTRICT MODEL				CITY	AREA PER UNIT
	STANDARD 8	31 Existing Situation	Proposed	32 Existing Situation	Proposed	40 Existing Situation	Proposed	STANDARD Existing Situation	Proposed	32 Existing Situation	Proposed	40 Existing Situation	Proposed	Existing Situation	Proposed			
EDUCATION FACILITY																		
Pre primary school	4	1	7		8	6	2											0.08 HAC
Primary School	3	3	2			3	1											0.20 HAC
Senior Secondary School		1		3		1	2											1.60 HAC
Integrated School								1		1		1						3.50 HAC
College								1		1		1						4HAC
University																	1	10 HAC
Technical Education Centre																		4HAC
HEALTH CARE FACILITY																		
Intermidiate Hospital								1										2.70HAC
General Hospital								1				1						4HAC
Poly Clinic								1	1									0.30 HAC
Nursery Home	2	1				1			1									0.30 HAC
Dispensary		1				1												0.20 HAC
SOCIO CULTURAL FACILITY																		
Community Park	4																	0.06 HAC
Library	1																	0.2 HAC
Recreational Club								1										1.0 HAC
Music, Dance, Drama																	1	.1 HAC
Socio Cultural Centre												1						0.15 HAC
Distribution services																		
Petrol Pump																		
Milk Booth	4																	
LPG Godown		1						1										
Police Station		1						1										1.5 HAC
Police Post	31	1																0.16 HAC
Jail																	1	1 HAC
Fire Station												1						
COMMERCIAL CENTRE																		
Formal Shop	55							365										0.03HAC
General retail	35							295										0.05 HAC
Fruits & Vegetable	6							40										0.08 HAC
Service & Repair	13							30										
RECREATIONAL FACILITY																		
Local Park & Play Ground	4																	
Community Park								3										
District Level Park																		

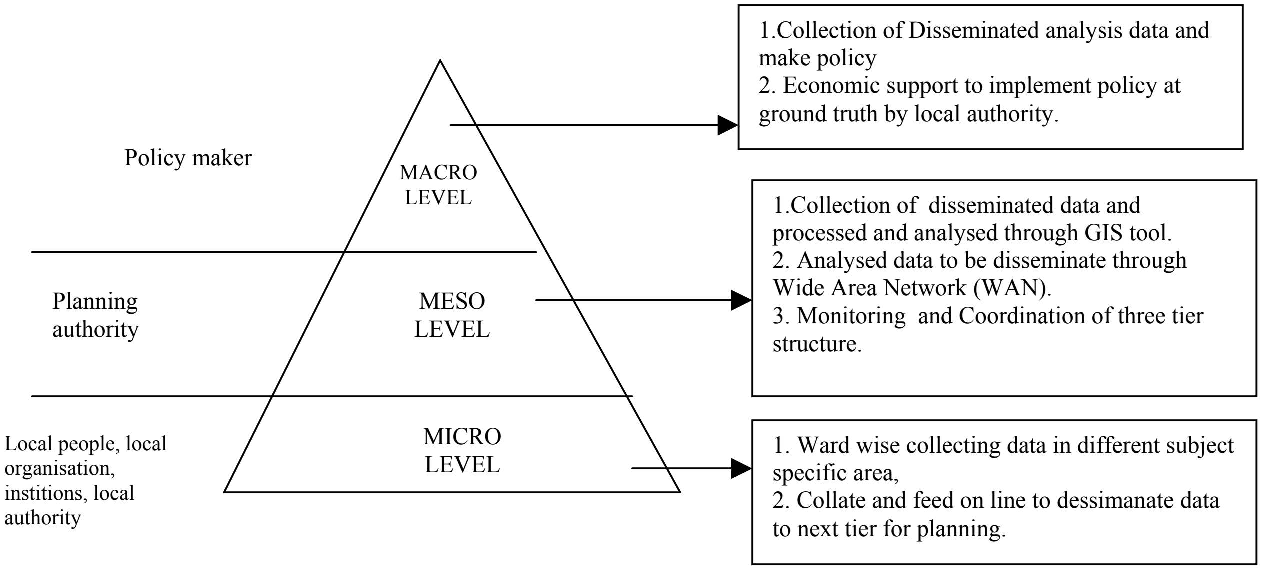
Due to unavailability of infrastructure some of sectors are lacking to pace of development . Some are developed i.e. which are under private coloniser and as well as land value is also high, some are lacking behind to grab the opportunity due to several constraints. To



overcome the situation there is need Participatory technique to maintan the information by local people and plan accordingly.Because Environmental Information is a source, which together with Physical, economical, technical and human resource is essential for national development. Sustainable development, which has evoved as the goal for human welfare in recent times, is rooted in the availability of right information to the right person at the right place and at th right time. The need for information arises at all levels, neghbourhood/ community level to Local ward office level or municipal authority level to higher policy makrer. This dessimaniation information is uploaded on-line in particular programme and after collecting this information policy has to be prepared and implementation can be drwan for future Ecological Sustainable and Economic Viable city.

7 SUGESSION:

In order to make Gurgaon into a green city, the action plans have been formulated database development through collecting data by local people, local organisation, institions, local authority (government and non government) can feed data according to suject head of Green City (Parameter) on internet line. After collecting data, data can be processed second level planning authority and can be analysed throgh GIS tool and has been provided with internet facility.At Focal point policy has been made and disseminate again in



internet and plan has to work out at local level planning.This process is basically to collect, collate processed, analysed dissemination of information by electronic mediaby using GIS Tool in planning measures.To work out the programme every sector can be used as area for implentation.This

reviewed paper

Land Uses in Greek Cities

Joseph STEFANOU, Roido MITOULA

(Joseph STEFANOU, Professor, National Technical University of Athens (N.T.U.A), Patision 42¸ 10682, Athens, Greece, joseph@central.ntua.gr
Roido MITOULA, Lecturer, Harokopio University of Athens (H.U.A.), El.Venizelou 70, 176 71, Athens, Greece, mitoula@hua.gr)

1 INTRODUCTION

The city has a history of existence of thousands of years. Its initial form was simple and constituted mainly of the palaces of the local ruler and the public buildings. Its size was small, since the capability of transportation was limited. The citizens moved in best cases with the help of animals. During the last centuries the city changes its form and grows in size. Poverty and unemployment in the countryside aided by the simultaneous appearance of industry, which is mainly located within or in the boundaries of cities, pushed the rural population to come to the cities, where existed promise of work and better survival possibilities. This phenomenon, combined with the development of transportation technology lead to an increase in the city's size and population.

The phenomenon of mass inflow was not handled properly in the Greek cities. The increase of population led at the same time to the increase of need for housing, in a short time and in a lower cost. The result of this was anarchic and cheap building out of the limits of cities under the tolerance of the state. As years passed by the without terms and out of limits building of cities, created serious problems in a lot of Greek cities and mainly in the big urban centres. [1]

In our days, the continuing accumulation of population leads to still bigger enlargement of cities. This is not followed by the simultaneous creation of infrastructures and urban services, so in a lot of cases, the quality of life of citizens is degraded. Therefore, the subject of sustainable urban planning and the right uses of land in the city is very important.

In the present paper the current prevailing situation of uses of land in the Greek city is investigated. Concretely, the categories of uses of land are analysed concisely, the relation of uses of land with Central Road Network (CRN) is illustrated. The causes that are related with the land uses and led the city to its current problems are investigated. In relation to the development of Greek space, some criteria placed by the European Union for the development of cities are presented. A thesis that is elevated in the paper and that concerns the exploitation of land, is the important role of the mechanisms of free market. Finally, the exported conclusions are recorded, with emphasis on the main points and proposals and thesis for the more effective organisation of land uses in the modern Greek city.

The final objective of the paper is firstly to provide information on the uses of land and the functionality of their applications in the Greek cities and secondly to investigate the methods which will improve and upgrade of quality of life for the citizens.

2 LAND USES

By the term "Uses of Land" is described the way with which the human activities are related with each other and are located territorial in the cities so as to serve the needs of functionality, aesthetics and protection of the environment. Generally, the current segregation of uses of land includes the following categories: [2]

- Regions of Residence: It includes unmixed and general residences with characteristics that differ depending on the density, the legality, the use, the quality, the income and profession of persons who live there
- Regions and places of central Operations: It contains Public Administrative Services, offices, retail trade, cultural, tourist and recreational activities
- Mixed regions: It is constituted of residences, manufactures, wholesale trade social activities
- Regions or places of educational installations: They involve pre-school, primary, secondary, higher, technical, public and private education as well as in tuition centres of foreigner languages
- Regions or places for installations of Medical Care: They include hospitals, clinics, doctor's offices, Organisations of Social Security, Medical laboratories, pharmacies
- Regions or places for installations of Providence: In this category exist babyhomes, day nurseries, asylum, homes for the elderly
- Religious installations: There are churches, monasteries, cemeteries
- Industrial and craft-based areas - technological parks and cities: The industrial and craft-based installations divided in noisy or not, unhealthy or not, as while in the cities exist also technological parks
- Installations of wholesale trade deposits, slaughterhouses: There are further subdivisions depending on the types of products (eg. meats, fruits).
- Places of green, free spaces and water places: They include forests, areas of green, lakes, rivers
- Athletic regions: Swimming pools, gyms, children's charms, football courts are included
- Areas of tourist installations: It is constituted of hotels, camps, camping areas
- Archaeological areas, traditional, protected areas. There are archaeological parks, museums, architectural monuments.
- Agricultural uses and installations of the primary sector: There are floriculture and cattle installation, breeding installation of pray
- Places of deposition of earth and excavation: Quarries of marbles, mines, tips, filled with rubble regions are included

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

- Military areas: Military camps, airforce bases and military education centres
- Special and limited use functions: In this category are contained distinguished institutes or research centres, spaces of international or other commercial exhibitions and remaining use of land
- Places of traffic: It is constituted of pavements, parking stations, railways, land, air and marine road networks
- Networks and installations of infrastructure: They are the networks of water supply, sewerage, telecommunications networks
- Not used spaces: They are surfaces that remain unused or their use has been interrupted.

In a lot of cases, there are combination of categories of uses of land in the urban environment. Thus, there are residences in the centre of the city, industries in and out of urban centres, houses with green spaces etc. Already, the above uses demonstrate their anarchic existence. During the ancient times in Greece, Ippodamos divided the space of the city in three categories. The “holy”, the “public” and the “private”. That means that the city had a "hierarchy" led by the “holy spaces”. Secondary were “public” and the last ones were the “private”. [3] In our days, the holy space has been downgraded so much, that entire buildings such the Ministry of National Education and Religions or the long distance station of buses are built over ancient Holy Temples. Similarly, downgrading is characteristic of the public spaces. In those spaces the sovereignty of "private” spaces increases. [4]

In the final configuration of uses of land in the city a very important role is played by the mechanisms of market and mainly by the secondary and tertiary sector of production, provided that these are primarily developed in the urban environment. Relative to the industry which usually occupies part of the residents in the city, the decision on whether it will be founded in the centre of city or in regions of low density depends on the size of the corporations (sector heavy or light industry), the market at which it aims (local, regional, national, international), the type and the size of the workforce, the requirements in infrastructures and the degree of harmful effects that it will cause. [5]

Of course, there also exist the techno-cities (group of industrial activities of high technology and research), that are usually found in the central area of a city. These can be centres of innovation or scientific parks and include offices, laboratories, units of production of new products. This departments usually collaborate with University laboratories. They can also be parks of transactions and trade, industrial areas of superior category. The services, are activities that belong to the tertiary sector of production and are developed in the city at high rates. They are public or private and their location depends on the director – directed relation and the centre point relation. The public services are usually located in the centres of cities and their arrangement does not depend on whether a region is rich or poor. On the contrary, the private services relate with the customers at which they are aimed. Finally, the location of tourist units in the cities depends highly on the control of uses of land and the limitation of building.

3 LAND USES IN GREECE - EXISTING SITUATION

In the beginning of the 20th century, with the appearance of Modern transportation, the urban planners who came from the architectural branch as Le Corbusier and later K. Doxiadis, glorified the linear development and Zoning. That means, the strict segregation of uses in zones. The eminent Chart of Athens, as a result of the famous Congress at CIAM is characteristic for its concentration in the Zoning.

The social revisions of many views on Modern intellect and the criticism about inhuman new cities and groups of residence during the decades of '60-'70 [7] led to the idea of mixture of uses and to the more flexible urban planning in the city. Today, in the spirit of sustainable development of cities, particular importance is given to the environmental dimensions of the problem concerning the combinations of special physiognomy of each city. [8]

The building and generally the current form of cities is a result of development that took place via the various historical situations and their social, demographic and financial effects. The form of urban tissues of Greek cities and the final configuration of land uses, are mainly a product of spontaneous urban development and non-existent of planning.

The post-war period in Greece was a turning point in the development of urban centres. The financial development and the industrial revolution that followed led a big part of the rural population to the big cities. Thus, a big part of the population moved to the urban centres and mainly to Athens. Thessalonica was the second in importance urban centre of the country. [9]

In addition, the refugee wave of 1922 from the Asia Minor contributed to the urbanisation phenomenon. This, combined with the continuous waves of internal immigration, led to the enlargement of Greek urban centres during the last decades. The urbanisation in the Greek cities was characterised by self-housing and arbitrary building. The increase in the use of private car, contributed also to the extension of cities out of their limits and the system of trading an old condemned house in exchange for a new apartment in a new building that was in effect mainly in decades the '60 and the '70 intensified the rapid construction and the increase of cities not only in both dimensions. All these, in combination with the progressive transformation of regions of holiday to regions of permanent residence, which were mainly built without planning, led to the current situation of Greek cities. [10]

In our days, regardless of the differences that exist between the various cities, the Greek cities do not always have distinquished land uses in their environment. Some common characteristics that we often meet are:

- The anarchic, without urban planning extensions of cities in the suburban and regional space, the big linear and along the street or even coastal increases, and the continuous incorporation of smaller settlements in wider urban or metropolitan units.
- The development of secondary residences that progressively led to the transformation of their character to urban.
- The improvement of accessibility of many regions, via the wide spreading and modernisation of the transportation and communication systems.

- The progressive reduction of rural land as a result of extension of uses of land against cultivated or other rural regions because of their low productive faculty or because of the decreased value in relation to the new uses.
- The permanent creation of infrastructures of the state sector (eg hospitals, universities, institutions, infrastructure of cultural work etc.) or of the private sector (eg groups of retail trade, big productive units etc.) in the urban environment. [11]

The lack of evident policy in Greece for the control of land uses, determined greatly the configuration of urban space, suburban areas and countryside. Thus, today one can observe very little enacted drawings of uses of ground, lack of functional control mechanisms of arrangement of activities and operations and sovereignty - in most cases of the mechanisms of the free market.

The result of all of the above was that regions with multiple uses of land were created. This has of course negative, but also in some cases positive effects. Examples of positive effects are the liveliness of the urban environment that elevates from the mixture of different uses, contrary to the unilateral development to which a lot of regions - in Europe mostly - were led, because of the strict zones that were applied.

The negative effects are more. The mixture of incompatible uses of land in the same region, such as industry and residence, bothersome recreation and residence etc. resulted in many problems. Another negative effect is the inability of organised decentralisation of central businesses and offices. In addition, the phenomenon of development along main road axes led to pollution, splitting up built-up structures, traffic congestion and also the hindrance of the comfortable services.

The road axes that connect the cities with other regions, the recreation areas, the agricultural areas, the industrial areas, present also problems. Because of the particular importance of these roads for the financial development of these regions and the lack of strict control by the Greek state, in a lot of cases intense construction along these arteries with anarchy and no control way appeared. [12] For example, the construction of buildings without planning along the CRN has resulted in frequent circulatory chaos and environmental problems. Intense construction is also observed at both sides of the central roads in the entrances of cities and concretely in the streets that connect the city with recreation are on summer resorts and, in the streets that connect the city with agricultural, industrial and other areas.

The result of the above is that the buildings prevent anyone going through the CRN to distinguish the limits on the urban areas. The intense construction, in combination with the advertising signs and the lack of undeveloped landscape and green, create an aesthetically ugly image. On the contrary, the social installations do not overload the Road Network.

Another phenomenon that we often meet in the Greek city is that of regions of general residence being crossed by streets of the CRN, resulting in circulatory and environmental problems.

Also, in many cases the linear development of centres of Greek cities along a road axis, or even linear growth of manufactures and industrial regions is observed. The life of the city residents can be facilitated to a large extent with the equitable urban planning of zones of Urban Use, relative to the CRN.

In this point, we must discuss the subject of "form of use", which has a particular importance, especially in the protection and elevation of the physiognomy of a city. [13] Thus, while a use is maintained, its form can change radically, with result the alteration or the downgrading of its physiognomy. A characteristic example is the old market of Karditsa. After its restoration, the historical building continues accommodating the uses of the local market, however the form of these uses has changed completely. The old traditional cafe, which accommodated all the meetings and transactions of farmers from one of the most productive regions of the country, changed to a modern cafeteria which changed finally its clientele, smell, acoustic, etc. landscape. Therefore, its role in the configuration of the physiognomy of Karditsa, a city which was a known Rural Centre has changed. [14]

The same problem confronted the researchers during the Research of Urban Planning of Hermoupolis of Siros. [15] Thus, in the old traditional market on Chios Street, phenomena of alteration of physiognomy because of the changed of the form of use have begun to present themselves. The shops of tourist attraction, feminine underwear's, jewelleries, have begun to replace and apply pressure on the fish-shops, groceries, butcher's-shops etc., which characterised the place of the historical market. The proposal of research team Decree of Urban Planning of city, taking into consideration these problems, suggests the protection of traditional forms of use of this market.

The lack of communal spaces and green areas which will insulated bothersome activities, is an additional disadvantage. Also, the extension of urban activities in the areas outside the cities has as a result the alteration and destruction of many natural spaces, rural and ecologically sensitive areas perametrically to the cities.

Phenomena like the above, which are obvious in the Greek space and especially in the city of Athens, are the productive activities in Western Athens and Piraeus, the circulatory saturation of the centre of Athens, the distribution of central functions along of Sigrou, Kifisias and Vouliagmenis avenues, the dissemination of functions in unserved district centres and the intervention of bothersome commercial activities. At the same time, in the suburban space there are dissemination of house uses, which contributed in the expansion of the limits of city of Athens.

At the same time, the demographic pressure that led to urban extensions without control and planning had as consequence the lack of technical and social infrastructure and environmental protection. These conditions are recycled and the problems are perpetuated.

It would be an omission if we did not refer to the relation of uses of land with the environment. The right urban planning of a city ought to include the concern for environmental policy. The various human activities and the high and dense building in the Greek urban centres, caused in a lot of cases downgrading of the natural environment. The urbanisation changes the local and sometimes even the regional climate. The temperature goes up, the rainfalls, the fog and the clouds are increased and cars, factories, light, residents create enormous amounts of heat.

In addition, high buildings and the streets are not always constructed so as to allow the airing of urban environment. Thus are presented the so called "urban thermic islands" that influence the climate and retain pollutant air. Today, the efforts are intensified for the confrontation of this phenomenon by planting trees, with use of light colour dyes for the reflection of solar energy and structural materials that contribute to the increase of reflection. At the same time, strict specifications for vehicles, buildings and the output of domestic appliances are established.

However, except for the environmental problems, the unconditional urban planning creates also a lot of problems of functionality and accessibility. The anarchic extensions of cities create many problems even for the near provincial regions. The narrow provincial streets, that often serve urban needs and the small streets of cities become unusable because of the traffic problem. The social services are impeded, while an increase of the pollution of air, water and the noise and the traffic congestion are inevitable.

The problems that elevated from the lack of organisation of uses of land in the Greek city are many and in a lot of cases it is difficult to confront and solve them. They led the city’s disfunction, downgrading and in a lot of cases to the disappearance of natural environment and the daily discomfort of the residents.

4 THE EFFORTS FOR IMPROVEMENT - INSTITUTIONAL FRAME AND EUROPEAN UNION

The legislative regulations that concern the uses of land in Greece began with the legislative regulation of 1923 where the urban legislation is reported in the organisation of space based on the refugee and urban co-operatives of that time. As years passed, the problems appeared and in the last years it became comprehensible that it would be suggested for measures to be taken for their confrontation. The initial reflection and irritation stimulus which caused the activation, were the environmental and functional consequences that elevated.

Already, since 1972 [16], the differentiation between uses of base and uses of covering was proposed. Basic uses are those that occupy concrete space permanently in the land eg. industry, trade, wholesale or commercial shops of retail trade, athletic installations, school installations, tourist installations, forests, cultivation etc. The uses of covering that refer to occasional operations which do not require permanent installations, for example wandering trade, public markets, etc that are occasional in some street of neighbourhood, tourism in historical centres of city, in forests, in coasts, sports of countryside etc.

However, up to 1974, essential changes at a legislative level were not observed. With the revision of the Constitution in 1974, the quality of building environment became a priority and since then a first effort of implementing environmental policy begins more dynamically. Thus, laws that aim in the functional urban planning and uses of land are established, while at the same time programs that aim in the environmental upgrade of cities are applied.

After the Greek and European collaboration is established Presidential Decree 1180/81 is established and the Studies on Environmental Effects are legislated and include:

- the description of work and its space of installation, the planning and its size,
- the determination and the evaluation of the effects of activities in the environment,
- the description of measures for the prevention, reduction or restoration of the negative effects in the environment,
- the study of alternative solutions and argued support of proposed solution, and
- simple summary of total study.

With law 1337/83 an effort to control land uses is made. Some of the programs that were developed and that aim at the wider and Pan-Hellenic management of this subject are the Areas of Built-up Control, General Urban Planning and the Areas of Social Factor.

Law 1650/86 places environmental terms for the planning of cities with its environmental effects. Mutual Ministerial Decision is created 69269/5387/90 and the works that requires Study of Environmental Effects are determined.

After the Summit Meeting of the United Nations in Rio D’ Janeiro in 1992 for the statement of need of protection of the environment and control of Development, Greece complied and applies a complete policy for the protection of the environment. Regulation 1973/92 (LIFE), the Community Frames of Support (CFS) and the Operational Program of Environment, which is included in them are applied. In a lot of cases, the European Programs, include forecasts on the improvement of uses of land in the cities in which they are applied.

In our days, Greece has complied with the European policies of development and has accepted significant aid from the EU via the financing programs. The aim of sustainable development as is promoted by the Union, in a lot of cases includes the right and harmonious regulation of uses of land in the city. Because, in no case can we speak at sustainability in one place, functional development of one place and protection of natural resources does not exist.

Some of the criteria that are placed by the European Committee for the sustainable development of cities are:

- the control of natural extension of cities
- the mixture of operations and social teams
- the careful management and regulation of the ecosystem of the city aiming mainly at saving resources
- the right organisation of urban transport for the improvement of communications of transports and for the protection of environment
- the protection and development of natural and cultural heritage

For the control of the extension of cities in the suburbs and the coastal areas, is proposed the idea of a "compact city" (city of short corridors) with the installation of corporations and other functions which will be motivations of withholding populations. Moreover, the effort of reconstruction of abandoned and industrial areas and the balanced offer of cheap shelter and high quality in the neighbourhoods is promoted. The mixture of uses and functions is necessary for the better access of all residents to basic services and installations of education, spaces of sanitary care and free spaces of recreation. These applications should be combined with the protection and development of urban green that plays as much an ecological as a social role. All the above, in combination with the right planning of transport and the organisation of means of mass transport, aim to release the citizen from his dependence on the car and to reduce the environmental aggravate. [17] Of course, presupposition for all these, is the right urban planning of functions of the city. With the right use of these policies of the Union, which are transformed into actions, in our days, Greece attempts to improve the planning of uses of land in the cities.

Already, by the law 2508/97 for the "Sustainable Development of Cities and Settlements of Country", Greece is aligned with the aim of the EU for the sustainable development of cities and important restrictions in the subjects of uses of land are set. At the same time, the "Complete Urban Intervention Plans aim in the best possible planning of the city and the functional rearrangement of uses of land, in relation always to its environment.

It is realised that these efforts are being intensified in the last years are necessary in order to face the problems that were created by the accumulation of population in the cities, the anarchic building, the building along the main road network, the lack of urban planning and generally the erroneous exploitation of urban land in the Greek space. The modern Greek urban legislative framework in combination with the European policy supports this effort. Of course, the laws and the actions are so many that it is difficult to include them all in the extent of this paper. However, the last regulations on the "Land Planning and the Sustainable Development" are very promising in the subjects of planning of Greek cities and uses of land in terms of an environmental, functional and aesthetic upgrade.

5 CONCLUSIONS

The Greek cities and mainly the big urban centres were led to a lot of problems that resulted from the ineffective planning and the lack of control of uses of land. The problems are related with the functionality of the city (for example the traffic problems), aesthetics (lack of tastefulness and harmony), but also with the environmental downgrading, which is a danger for the public health, from an organic and psychological view related to stress, etc.).

The enactment of uses of land via corresponding planing in both the Urban Planning and in the Urban Study of Extension of Revision was applied late in Greece (1989) despite the continuous incentives of urban planners. [18] Nevertheless and despite their enactment, their strict application has not been ensured until now. The effort that is being made over the last years in all sectors aiming at the upgrade of environment, the improvement of quality of life and the creation of "human" conditions of existence, is obvious. In spite of the efforts, problems such as the following continue to exist:

- the continuing arbitrary building
- continuing pressures for extensions of urban planning
- scattered out of urban planning building, etc.

Relative to the restoring - upgrading of urban space problems are determined in the following areas:

- improvement of social equipment
- maintenance at the communal and beneficial to the public green areas
- Quality of building environment
- Confrontation of traffic problem, parking station areas etc.

Apart from the European and other solutions that are given for the smooth internal operation and development of a city, it is also important to examine the application of a modern model of functions in the city. This will finally be necessary, because Greek cities were not built based on a specific urban planning.

The acidity of environmental problems in the current urban way of life, in a lot of cases flows from the wrong uses of land. The unfavourable effects impose a right urban planning for the improvement of the current situation. An ecological urban planning can resolve a lot of problems. It can lead to the efficient use of natural resources, to a healthy economy and the upgrading of the quality of life to the Greek cities.

6 BIBLIOGRAPHY

1. HATZOPOULOU – TZIKA AL.: Urban Planning Legislative Frame, ed. N.T.U.A., Athens 1997
2. ARAVANTINOS ATH.: Urban Planning for a Sustainable Development of urban space, ed. SIMMETRIA, Athens 1997
3. LAVEDAN P.: Histoire d'Urbanisme, Paris 1956
4. STEFANOU JOUL., STEFANOU JOS.: Description of the image of the city, University editions of N.T.U.A., Athens 1999
5. LABRIANIDIS L.: Elements of Financial Geography, ed. PAPATIRITIS, Thessaloniki 1992
6. CIAM: The Chart of Athens, ed. Technical Chamber, Athens 1981
7. MICHELIH A.: The unforeign of the citizen, ed. KASTANIOTI, Athens 1970
8. STEFANOU JOS. and Collaborators: The Physiognomy of Greek city, ed. MEDEON and Laboratory of Urban Design of N.T.U.A., Athens 2000
9. MITOULA R.: The Historical-Social-Financial and Legislative Frame as a factor of shaping of Physiognomy of Athens, mag. REVIEW OF DECENTRALIZATION LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT, issues 20, 22, Athens 2000
10. See 8, chapter of Hatzopoulou Al. and Mitoula R., "The Legislative Frame"
11. AGELIDIS M. :Spatial Planning and Sustainable Development, ed. SIMMETRIA, Athens 2000
12. MARATOU TH, "Uses of Land on the length of Road Axons", Doctorat Thesis of N.T.U.A., Athens 1999
13. Laboratory of Urban Design of N.T.U.A., "The physiognomy of Greek places", Athens 2001
14. VOUZA K.: The form of use, After Doctorat Research of Architectural School of N.T.U.A., Athens 2001
15. Laboratory of Urban Design, "The Urban Planning of Hermoupolis", ed. N.T.U.A., Athens 2003
16. KEPE, Prospective Planning of Country Development. Chapt of Nationals Space Planning, Athens 1973
17. European Commission, "Development Planning of Community Space, Official Editions of European Union, Brucells 2001
18. See 2
19. Lows: L. of 1923 Government's Newspaper 228A/16.8.1923, P.D.1180/81, L.1650/86, Regulation 1973/92, L.2508/97

Spatial Data Infrastructure in Germany – Principles and Initiatives

Hartmut MÜLLER

(Prof. Dr.-Ing. Hartmut Müller. Mainz, University of Applied Sciences, i3mainz – Institute for Spatial Information and Surveying Technology, Holzstr. 36, D-55116 Mainz, mueller@geoinform.fh-mainz.de)

1 SUMMARY

Since several decades many efforts have been made to establish a powerful spatial data infrastructure all over Germany to support as many users as possible. One important subset of SDI is provided by the German surveying authorities. This subset can be looked as the backbone of a comprehensive SDI which covers all segments of spatial data. On the other hand, local authorities usually start from a different status of their IT development. Some of them already use geoprocessing software tools, others don't do. The requirements concerning spatial data contents, spatial data formats, etc. often looks different. Sometimes this is due to organisational reasons, sometimes due to other reasons. All these circumstances have to be kept in mind when developing a strategy to improve SDI at all levels.

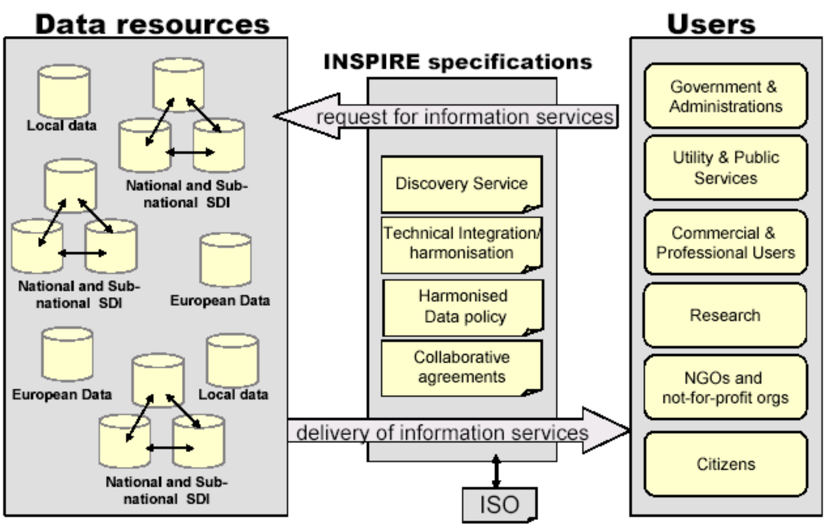
The current situation concerning SDI, mainly at the local and regional levels, suffers from its heterogeneity and, partly, its non-availability. Further efforts have to be made to bring together those elements of an SDI which are already available with all other SDI components provided by a broad community of current and potential users. Improvements are necessary at both, technical and organisational, levels. Integration of SDIs from different levels is a core part of functionality. Guidelines on how to achieve this integration can help to promote the integration work in practice.

A broad survey took place to explore the current situation in regional administration bodies in the south-western part of Germany. The result of this survey was a documentation concerning the current status of the use of geoprocessing software tools and the users needs with regard to spatial data structures and spatial data processing routines. Implementation of a spatial data infrastructure including all needed data, IT functionality, personnel skills, etc. is an ample task, sometimes long lasting and costly. That is why, usually, a step by step approach has to be used. Cost benefit considerations were made to identify the potential benefits obtainable through an SDI. From the concrete benefit numbers a priority list was generated, which can be used as a guide for the subsequent implementation steps which will take place in the near future. The users needs were collected in a comprehensive document which consists of a detailed description of all requirements and which is intended to be used as a technical base for future IT acquisition procedures.

2 SDI LEVELS

The term Spatial Data Infrastructure (SDI) encompasses the policies, standards and institutional arrangements involved in delivering spatially related information from all available sources to all potential users. A spatial data infrastructure provides for a basis for spatial data discovery, evaluation, download and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and the general public.

Currently, many regional and national Spatial Data Infrastructure initiatives are taking place. According to Smits et al. (2002), most of those initiatives are very much in line with the ISO/TC211 and the OpenGIS Consortium developments. In order to get regional and national SDIs interoperable, the INSPIRE - Infrastructure for Spatial Information in Europe initiative was founded (INSPIRE, 2006). One of its outcomes is an architecture reference model and foundation standards (see Graph 1) proposed in a Position Paper of the AST - Architecture And Standards Working Group (Smits et al, 2002).



Graph 1 INSPIRE Information Flow (Source: Smits et al. 2002)

ISO as the "International Organisation for Standardisation" is a network of national standards institutes from 147 countries working in partnership with international organisations, governments, industry, business and consumer representatives. The Open GIS

Consortium, Inc. (OGC) is a member-driven, non-profit international trade association fostering the development of geoprocessing interoperability computing standards (Open Geospatial Consortium, 2005).

INSPIRE is the large current initiative of the European Commission to promote the multipurpose availability of feasible geographic information. The purpose of this initiative is to support European Community policies with a territorial dimension or impact. INSPIRE is supposed to address technical standards and protocols, organisational and co-ordination issues, data policy issues including data access and the creation and maintenance of spatial information in the context of a European Spatial Data Infrastructure ESDI. The INSPIRE vision outlines a Spatial Data Infrastructure which addresses data resources at the European level, at the national and sub-national level and at the local level, as well. The INSPIRE initiative even links with relevant initiatives at the global level such as the work concerned with a Global Spatial Data Infrastructure (GSDI). Therefore, the INSPIRE principles should be considered at all levels of an SDI implementation.

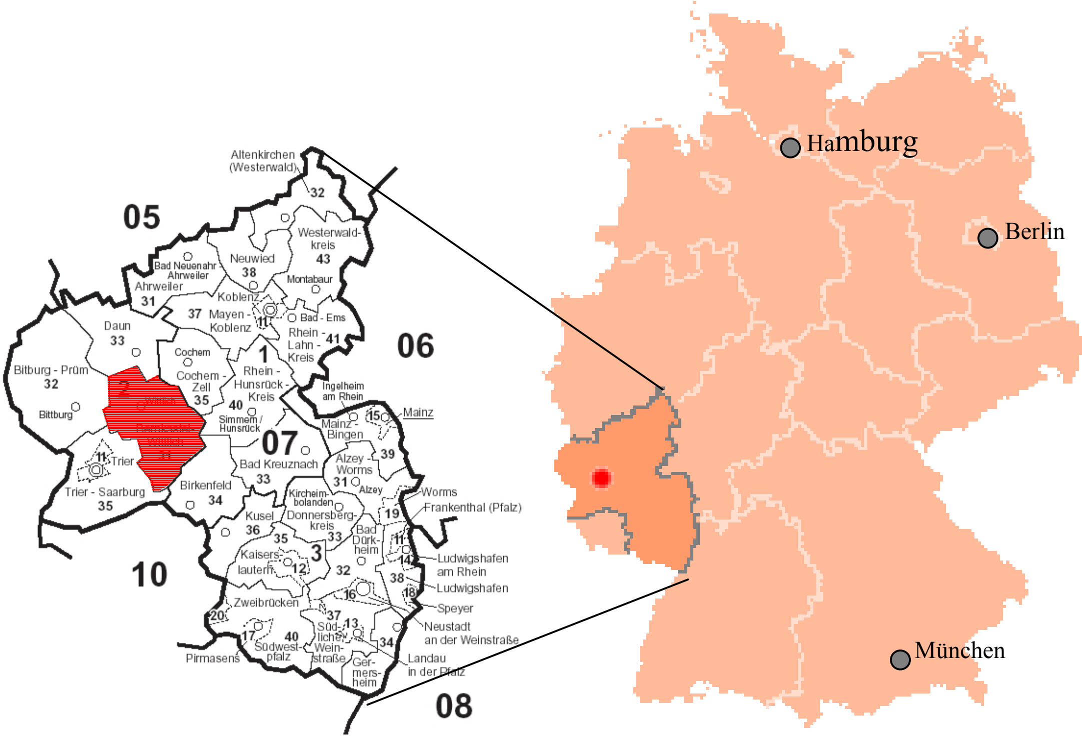
At the sub-national or regional level, one of the main goals is to process all relevant geographic information by jointly linking it to the information available at the two adjacent administrative levels, namely to the national level at the one hand and to the local level at the other hand, respectively. The needs of potential users have to be elaborated in detail with regard to access to transformed data, pictures, maps, reports, multi-media content, to metadata search and retrieval for data and services, to data access at distributed content repositories located at different geo-spatial data servers and so forth.

The following sections describe a project initiative which supports the implementation of a regional level SDI starting from the given administration structures. Special credit is given to the situation in one of the German Laender, Rheinland-Pfalz.

3 GERMAN ADMINISTRATION STRUCTURES AT THE REGIONAL LEVEL

3.1 Given Situation

Germany is a federal republic consisting of 16 states (so called "Laender"). One of these federal states is Rheinland-Pfalz with 4 million inhabitants. Rheinland-Pfalz itself consists of 24 rural district areas (see Graph 2).



Graph 2 Administration Levels of Federal Republic of Germany

The Nomenclature of Territorial Units for Statistics (NUTS) was established by Eurostat in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the whole European Union (Eurostat, 2005). Every NUTS territory has an individual alphanumeric code attached. The German Laender form the German part of the European NUTS 1 level territories, the same holds for the German rural district areas forming the NUTS 3 level territories. For all 24 rural district areas (NUTS 3) forming the Land Rheinland-Pfalz (NUTS 1) a Geo Information System (GIS) implementation is planned. Geo Information Systems provide for one important, may be the most important, part needed to realise the operability of an SDI.

The tasks of a local authority, one for each rural district area, are complex. Several hundred employees care about the needs of the citizens in many fields of life: education, sports, civil protection, nature conservation, preservation of ancient monuments, building inspection, motorcar permit, social welfare, youth matters, decrees, to name a few of them.

The federal state of Rheinland-Pfalz, like entire Germany, faces two big challenges. It has to work with less financial resources and, at the same time, it should change the service for the citizens and for the economy for the better. The intention is to achieve a modern public administration which is efficient and transparent, which accomplishes more and costs less. The implementation of a GIS

System which a spatial data infrastructure demands for can help to reach these goals. The government of the federal state Rheinland-Pfalz intends to promote the GIS-implementation in context of an overall e-government solution.

In the past, the local authorities had invested – if they had done so – into systems which are able to work with structured data only inside a closed local authority unit. Important information, which is of prime importance for these organisations, is available in a wide range of different formats and is maintained either on incompatible systems like special data-servers, general purpose web-servers, data bases or is still available only in an analogue form like on paper sheets and on paper maps. As a result, co-workers of public administration units spend 30 % of their time to search for information, according to a study of the DELPHI-group (DELPHI Group, 2005).

3.2 Usability of geo-spatial basic data

In Rheinland-Pfalz there is one regional authority, called LVermGeo, which provides for the geo-spatial basic data of the whole state,. In 2002 the LVermGeo contracted with the Landkreistag Rheinland-Pfalz, the umbrella organisation of all 24 local authorities.

According to this contract the local authorities are licensed to use all geo-spatial public administration basic data available in

- the Automated Real Estate Register – ALB, which includes information about land parcels (e.g. key numbers, location, ...), type of property, ownership, etc.,
- the Automated Real Estate Map – ALK, which comprises cadastral boundaries, landscape parcels, type of landuse, buildings, special topographic features, house numbers, etc.,
- Digital Landscape Models – DLM,
- Digital Topographic Maps – DTK,
- Digital Terrain Models – DGM,
- Digital Orthophotos – DOP.

In the past every local authority had to accept the payment of specific licence fees to the LVermGeo for every data set they needed. As a result of the new contract all local authorities get the right to use all the data they need for a lump sum which is to be transferred once a year from the authorities responsible for them at the state level to the authorities providing for the geo-spatial data.

4 A PROJECT INITIATIVE AT THE REGIONAL LEVEL

The umbrella organisation of the local authorities, Landkreistag Rheinland-Pfalz, started a broad state-wide project initiative. The main goal of the project initiative is to develop a conceptual model, where the business processes of a local authority are mapped as far as they are directly linked to GIS items. The benefit and the application potential of a GIS will be clarified by documentation and analysis of these business processes. The conceptual model has to be compatible with the ISO-standards and the recommendations of the OpenGIS-Consortium.

It was assumed that in all the 24 local authorities the same business processes (combined intersection) are running – which in the meantime could be proved to be close to reality.

Moreover, the project develops a GIS implementation strategy for one exemplary local authority. The strategy has to support the modular build-up of a GIS. The requirements for the GIS solution are described in detail in a set of specifications. This set becomes the basis for the subsequent tendering procedure.

By reason of its modular build-up the study supports all local authorities at the same time:

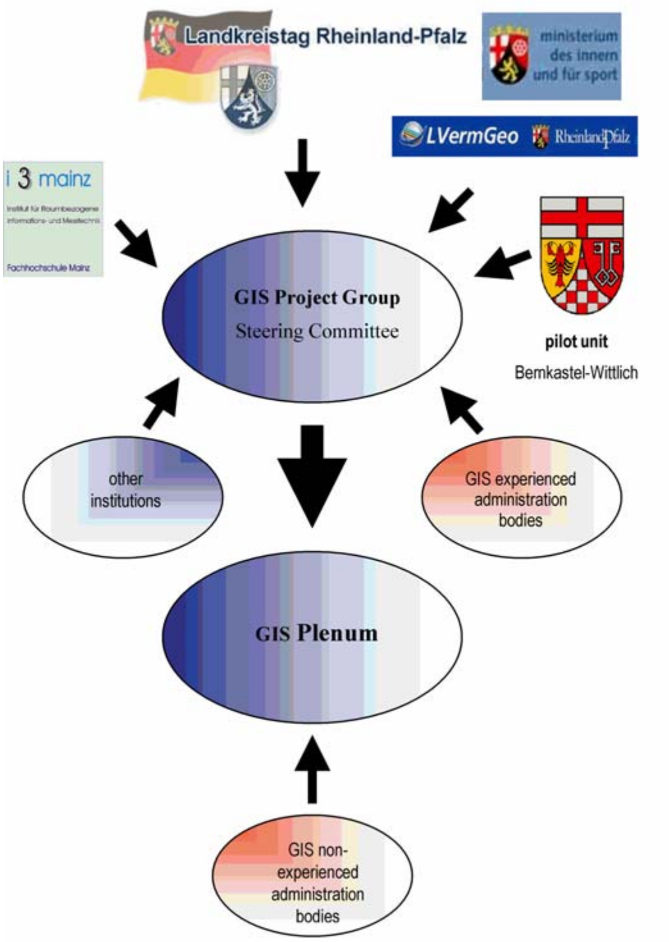
- Authorities which have still no GIS in use,
- Authorities which already use a GIS, and want to optimise it,
- Authorities which use a GIS and want to adapt it to additional requirements.

This set-up ensures that all local authorities addressed by the study can take their benefits from the project no matter in which stage of the GIS implementation they are. Another goal of the study is to prepare a strategy how to build up a spatial data infrastructure for the co-operation and the data exchange within the local authorities themselves on the one side, and in between the local authorities and other public administration bodies on the other side. All existing spatial data which are generated in the different administration bodies have to be integrated in future (see INSPIRE, for instance).

5 PROJECT ORGANISATION

The following section outlines the principles of project organisation as agreed upon all participants (see Graph 3).

- The **project group** consists of approximately 20 experts. The group members are co-workers of those local authorities which already got experience in the implementation and maintenance of a Spatial Data Infrastructure. This group is responsible for the continuos audit of the attained results, with the purpose to achieve transferable results from the pilot unit to the other 23 local authorities.
- One of the 24 local authorities, Bernkastel-Wittlich (for the location see Graph 2), acts as a **pilot authority**.



Graph 3 Project organisation chart

- **i3mainz** completes the work for every item of the principal workplan (see next section), mainly for the pilot authority unit.
- All work results are audited by the project group (project steering committee, see Graph 3) on a regular 2 months time basis.

After passing the project group audit, the results are presented to all authorities and to the GIS plenum which meets twice a year.

The **GIS plenum** consists of more than 50 members, mainly of 2 responsible from each of all affected 24 local authorities. The members of this group transfer the project results to their own local authority.

6 PRINCIPAL WORKPLAN

According to Behr (1998) the principal project workplan was set up as follows (see Table 1)

System analysis	System selection	System implementation
Strategic planning Field research and analysis Conceptional modelling Professional concept IT-concept Cost benefit analysis	Public tender Offer rating Functional tests System rating, system recommendation	System installation, system acceptance Data acquisition, data migration System use

Table 1 Principal work plan

7 ACTUALLY COMPLETED TASKS

At the moment of writing this paper, all activities linked to the tasks which are listed under ‘System analysis’ and ‘System selection’ (see Table 1) had been completed for the pilot authority.

7.1 System analysis - strategic planning

The complete project runs in joint co-operation with the project group. All elaborated documents are collected and archived to generate medium-term and long-term valid guidelines for the GIS implementation in Rheinland-Pfalz, Germany.

7.2 System analysis - field research and analysis

The practical field work was done at the local authority of Bernkastel-Wittlich acting as the pilot authority.

The whole administration unit consists of 20 departments. Like in a production environment, the work results of administration offices can be labelled with the term 'products'. Every department is responsible for a specific list of such 'products'.

The field research bases upon the 'products' as its principal unit. The reasons for that decision are:

- The meaning of the term 'product' is well established and well understood by the potential users in all offices.
- Project results obtained for 'products' can be easily transferred to the other 23 local authorities.
- 'Products' are well suited to prove the GIS application potential to the political decision level (e.g., district administrators).

Altogether about 170 different 'products' were identified. 'Products' for example are:

- Tourism support of tourism in the region
- Building administration management of the buildings owned by the authority
- Finances bank credits, safeguard credits, financial statistics
- Roadwork to ensure save roads
- Traffics organisation of school buses, public traffic
- Heavy loads control of heavy loads crossing the region
- Infection prevention avoidance of infectious illnesses
- Land use regulation control of land use in the region
- Landscape architecture to guarantee for a feasible development of cities and villages
- Protection of species protection of wildlife habitats
- Drinking water control to guarantee for the quality of drinking water
- Agrarian subsidy to distribute special subsidies for farmers

To analyse the user requirements for all 'products' a two-step questionnaire was developed.

Questionnaire A was developed to generate a general overview about all 'products' by collecting answers to a list of questions (see Table 2).

• What is the purpose of the product?	• Is it possible to support this product by a GIS application?
• Which data are in use ?	• Is it possible to use the geo-spatial basic data provided by LVermGeo ?
• How is the spatial data reference defined?	• Which other authorities profit from the results?
• Which software will be established ?	• How many people access the data ?
• Which formats will be used ?	• Are there any special problems to be observed?
• Is a GIS / Online-GIS already in use?	

Table 2 Questionnaire A, overview of contents

After survey completion all products were classified to identify their overall GIS potential (see Table 2).

Evaluation category	Number of products	Percentage
1	**8**	**5 %**
2	**8**	**5 %**
3	**134**	**77 %**
4	**3**	**2 %**
5	**19**	**11 %**
Sum of 'products':	**172**	**100 %**

Evaluation category 1	own spatial data processing – GIS applications already in use
Evaluation category 2	own spatial data processing – user-potential clearly identified – highest priority for GIS implementation
Evaluation category 3	own spatial data processing – GIS implementation priority to be defined after the cost-benefit-analysis
Evaluation category 4	no own spatial data processing – only results from other GIS users to be used
Evaluation category 5	no own spatial data processing – only administration procedures, no GIS benefit

Table 3 Results of general product evaluation

As a result of this survey, most of the 'products' ended up in category 3. That means that the application of GIS theoretically would be possible in most cases. However, before investing financial and personal resources the feasibility of such a GIS application has to be checked for those products to guarantee a reasonable cost/benefit ratio (see next section).

The next step was to develop the more detailed Questionnaire B for all products in the evaluation categories 1 till 3. The Questionnaire B was only applied to the products in categories 1 to 3, because only these 'products' have their own GIS potential, thus reducing the amount of exploration work for many project participants.

Questionnaire B is dedicated to gather more in-depth information concerning data structures (Table 4).

• Notation of the data	• Have the data for the same subject to be maintained with different time validity (historical data)?
• How many analogue, how many digital data are available?	• Which metadata are involved ?
• Is it graphic or alphanumeric data ?	• How good is the data availability ?
• Where does the data come from, who is the producer ?	• Are there any synergy effects with other products?
• How accurate are the spatial data ?	• Which is the data protection / privacy policy?
• Are there any regular data updates ?	

Table 4 Questionnaire B, overview of contents

The questionnaire was filled by a GIS expert performing personal interviews with the professionals who produce the products. Thanks to the fact that the interviewed persons had joined a presentation about GIS at the beginning of the project, they knew what a geo information system (GIS) could do for them, which helped to speed up the interview process. General information concerning the IT infrastructure was gathered directly from the IT department. Some interesting information which is still missing like currently available skills of the potential users, for instance, will be collected in a later project phase.

Following the principal work plan the results were presented to the project steering committee (see Graph 3), passed the audit and, after that, was presented to the GIS plenum to disseminate the information among all potential users all over the Land Rheinland-Pfalz.

7.3 System analysis - conceptional modelling, professional concept, IT-concept

Commercial systems are available to meet the needs of a public administration institution, in general. That is why the aim of the project was to develop a specification rather than a software package. The work concentrated strictly to the definition of the specific needs of the organisation under consideration. The final software solution should be defined in close co-operation with an experienced software system provider. The work specifically done for the pilot authority mainly focuses on the conceptional modelling step resulting in a detailed requirements specification. Actually, the professional concept mainly follows the current workflow. Its further development will be left to future project stages. The main decision concerning the overall IT strategy was to hold all data owned by the district administration office itself in house rather than to rely on an external service provider.

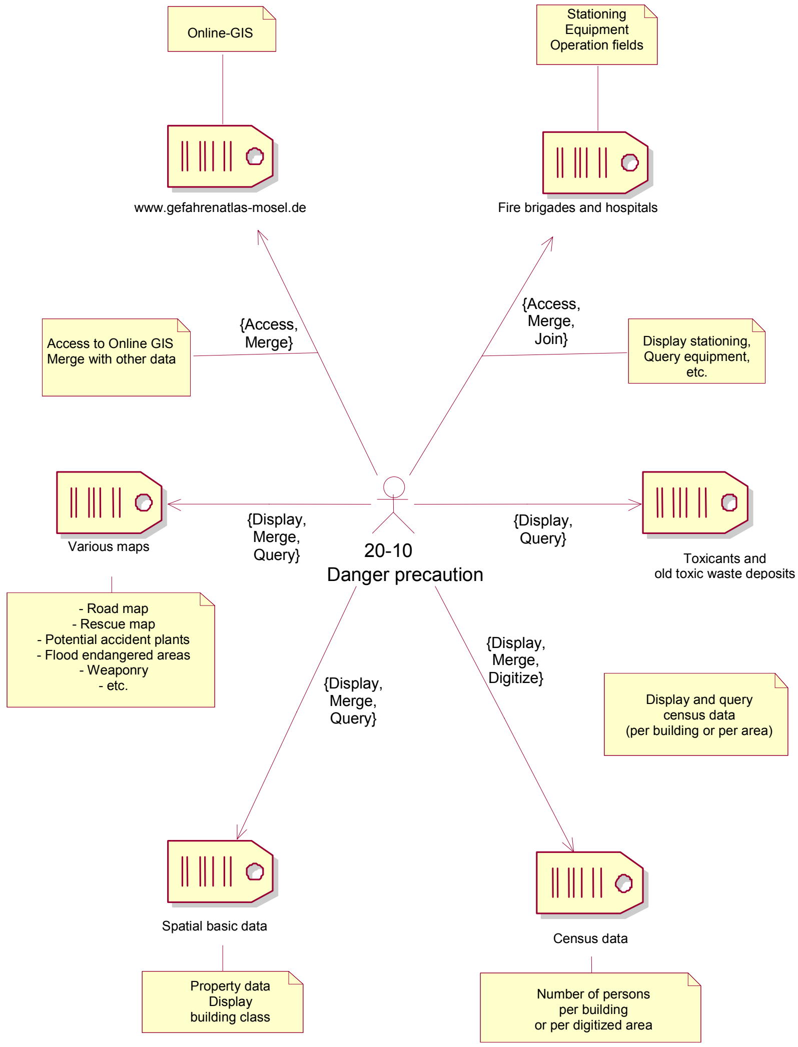
The user requirements for all products for which a high or medium benefit potential of spatial data processing capabilities was identified (see next section) were collected in a comprehensive document consisting of the complete set of specifications. A formalised presentation method was used, namely the graphical needs presentation in the form of use case diagrams, one for each product (see Graph 4). The formal description language UML provides for the tools to generate such diagrams.

The Object Management Group (OMG), a not-for-profit computer industry specifications consortium, provides for free download of many modeling specifications, the most-used of which is the Unified Modeling Language™ - UML (UML, 2006). The OMG members define and maintain the UML specification which is published in the form of documents available for free download. The UML has become an industry standard to specify, to visualise, to construct, and to document the artefacts of models for software-systems, business-models and other non-software-systems.

The following reasons why to use UML in this project were identified.

- Relations between actors and use cases can be shown.
- Relations between different use cases can be shown.
- When modelling the system one can follow an object-oriented approach.
- UML is in use in a new conceptual model for the German geospatial basic-data.
- UML helps to structure the problem.
- UML helps to generate the documentation.
- UML helps to prepare for the functional specifications.

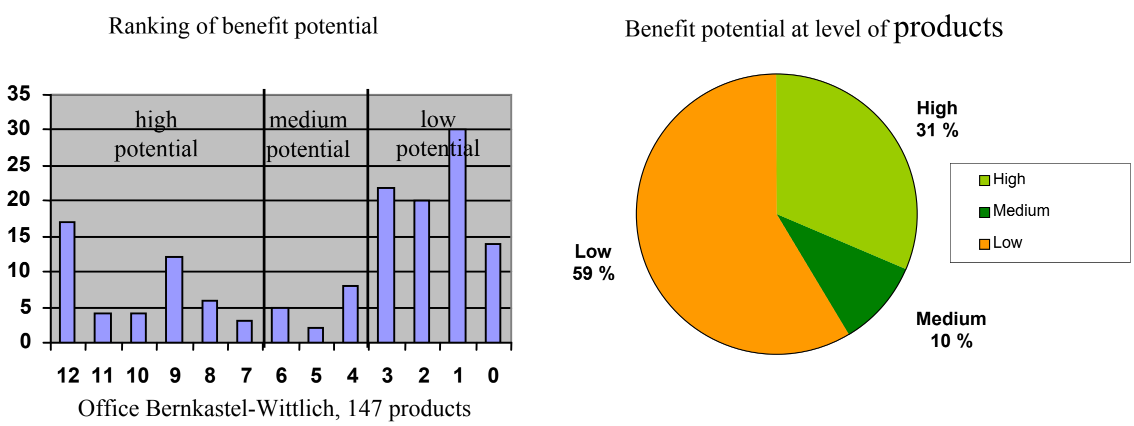
As the main diagram class, we used the use case diagram class, which shows the relations in an easily understandable way. Use case diagrams, therefore, are very well suited to link the users point of view on the one hand to the needs of the precise IT specification on the other hand. Graph 4 shows the requirement specification for the product 'Danger precaution' which is one of the services delivered by the administration office under consideration. The graph makes clear which data sets have to be accessed in which way to produce the desired results.



Graph 4 Use-case diagram for the public service product 'Danger precaution'

7.4 System analysis – cost benefit analysis

To keep the efforts for cost benefit investigation at a reasonable level no detailed analysis was performed. Instead of that the benefit potential of the identified subset of service products was ranked (see Graph 5). The purpose of this ranking is to provide for a list of priorities for the GIS implementation: highly ranked products should be supported by GIS capabilities first. Even if the chosen simple ranking method does not consider any possible synergies between different products leading to a potentially changed ranking list, it helps to support management decisions concerning the stepwise introduction of GIS technology in the whole administration unit. Graph 5 shows the results for a subset of 147 products, which means for 85% of all 170 products. As can be seen for about 30% of the investigated products the use of GIS promises a high profit in terms of the ranking of the benefit potential.



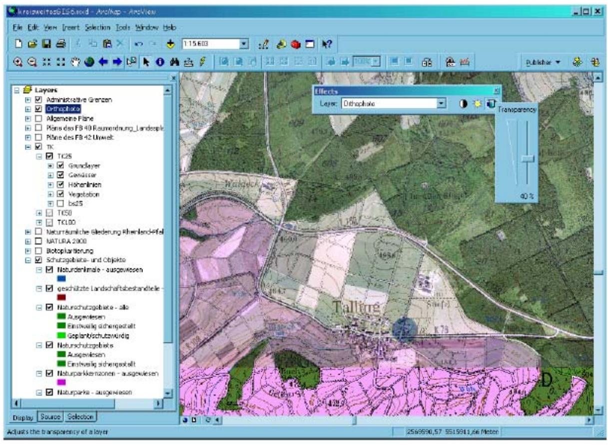
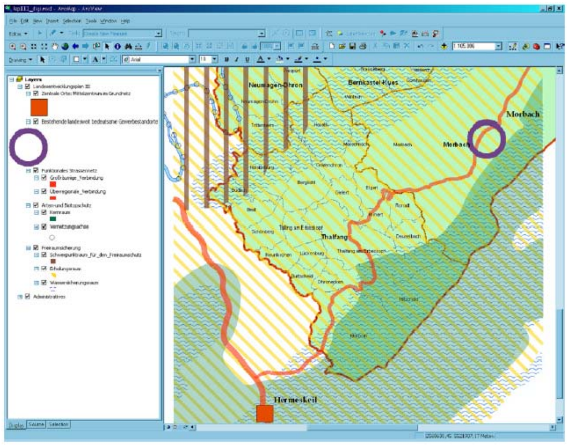
Graph 5 GIS benefit potential, district administration office

7.5 System selection – public tender, offer rating, functional tests, system rating and recommendation

The tender procedure was performed according to the provided German regulations. To guarantee for a correct result of the rating procedure a catalogue comprising a large set of decision criteria was developed. Based on the content of this catalogue all offers of system vendors were ranked. The ranking list served as input for the final resolution of the political committee deciding on which software system seller to award the contract. The resolution passed in November 2005.

8 PILOT APPLICATIONS

To prove the feasibility of the concept, in their diploma work two students developed a GIS supported workflow for several selected products. This work took place before the overall system was implemented. The produced digital data and workflow results were used in the system selection process as input data for the tests to be passed by potential software providers. In that way it was possible to define the test procedures in an early stage by using real data and realistic workflow. This procedure was of great help to get a safe base for the decision which of the offered systems to select. Graph 6 shows two graphs supporting the planning process for a wind power plant. The left-hand image shows the formally protected areas to be considered in the planning process. Visualised digital orthophotos in the background help to get the orientation in space. The right-hand image shows the surrounding area taken from the development plan of the Land Rheinland-Pfalz which has to be considered in the planning process, as well.

Graph 6 GIS pilot applications, district administration office (Source: Brück, C., Orth, A., diploma thesis, Mainz, 2005, unpublished)

9 UPCOMING ACTIVITIES

The next stage in the project will comprise the implementation of the selected software system which provides for the needed functionality to manage the available spatial data. A 5 month test phase is planned to be passed by the selected system before the formal system acceptance tests will be performed. In that way for both parties, for system users as well as for the system provider a reasonable time span is available to ensure for the proper system functionality which will be adapted best to the users needs.

At the same time a large number of paper maps will have to be transferred into a digital form in order to be processed by the GIS. This task is crucial as well because the large majority of employees use computers only in order to support and to facilitate their daily work rather than being interested in introducing new technologies. That is why such users will only accept a system filled with complete and up to date data sets from the very beginning. Contracts between partners at he regional and the local administration levels are under preparation to perform this work in close co-operation in order to share the costs among several partners involved in the project.

10 CONCLUSIONS

All over the world the construction of powerful SDIs is an item under discussion. When coming to the details, the implementation of a feasible SDI often turns out to be a complex task. Therefore, only a step by step approach following a clearly defined strategy will lead to success. Special credit has to be given to the fact, that all modules created by local implementation processes should fit into the overall concepts of SDI.

11 REFERENCES

Behr F.-J., 1998, Strategisches GIS-Management. Wichmann Verlag, Heidelberg.
DELPHI-Group, 2005, www.delphigroup.com
Eurostat, 2005, http://europa.eu.int/comm/eurostat/ramon/nuts/splash_regions.html
INSPIRE, 2006, http://www.ec-gis.org/inspire
Masser, Ian, 1998, Governments and geographic information, London, Taylor and Francis
Möllering H., 1995, The German Cadastral and Land Registration System. In: Int. Symposium of the FIG. DVW., Wittwer Verlag: 45-52, 1995
Open Geospatial Consortium, 2005, www.opengis.org
Sandmann H.-J., 1995, Land Use Planning and Land Readjustment. . In: Int. Symposium of the FIG. DVW., Wittwer Verlag: 100-126, 1995
Smits, P.C. et al., 2002, INSPIRE Architecture and Standards Position Paper, JRC-Institute for Environment and Sustainability, Ispra, INSPIRE AST PP v4-3 en.doc, European Commission, Joint Research Centre, 2002, EUR 20518 EN
UML, 2006, http://www.uml.org/

Spatial data infrastructure of Navarre (Idena)

S. FONTANO, M. A. JIMÉNEZ, M CABELLO

(S. FONTANO, M. CABELLO: Trabajos Catastrales, S.A. Ctra. del Sadar s/n –Edif. El Sario. 31006 Pamplona (Spain)
sfontano@tracasa.es/mcabello@tracasa.es
M.A. JIMENEZ: Government of Navarra. Public Works Department, Avda. San Ignacio 3. 31002 Pamplona (Spain)
ma.jimenezdecisneros.fonfria@navarra.es)

Key words: Metadata, Corporate information systems Spatial Data Infrastructure, Navarre,
SITNA (Territorial Information System of Navarre), IDENA (Spatial Data Infrastructure of Navarre).

SUMMARY

Navarre has made a great effort in the last several years to have a real Territorial Information System, (better known by the acronym SITNA) and it has configured itself as the component within the Corporate information system of Navarre that places within reach of all citizens, data of a very diverse kind which refers spatially to the territory of the community.

Despite the undoubted success of the implementation of this initiative, the passing of time made it clear that there was an important gap in the loading of data, because it was carried out without taking into account the question of metadata.

At that time, there was a lack of standards, experiences and coordination among institutions, in short, an unclear horizon concerning this matter that advised against the design of a metadata system with an uncertain future.

The evolution of this matter in the last two years in Europe has seen a radical change after the publication of the proposal of European Directive INSPIRE[1] (Infrastructure for Spatial InfoRmation in Europe) that established an infrastructure for spatial information for the area of the European Union, the election of the ISO-19115 standard and the following multiplication of SDI initiatives in all fields.

This context frames the IDENA initiative (Infrastructure for Spatial Data of Navarre) that tries to give SITNA those characteristics that it lacked: Catalogue of Meta information, Interoperability with other SDIs and Distribution.

The present article describes the general approach of the IDENA project, focused on IDENA architecture and ist components as well as the resolution of the metadata work flow within the IDENA project and the interoperability with other Spatial Data Infrastructures

1 INTRODUCTION

As it is well known, INSPIRE is an initiative of the European Commission whose goal is to promote the creation of an Infrastructure for European Spatial Information, establishing what geographic information is pertinent, with conditions of harmonization and quality to the service of the training, application, follow-up and evaluation of the community policies with a territorial dimension or impact.

The general situation of the Spatial Information in Europe is that of great fragmentation of dataset and sources, vacuums in the availability, lack of harmonization among datasets of different geographic scales and duplication of information collections. These problems make identification, access and use of the available data difficult. To solve these problems and fulfill the principles of INSPIRE, the documentation of all existing spatial data in an SDI becomes essential with the goal of making its characteristics known. This way, the principal objective of an SDI: DISCOVER, ACCESS, USE the geographic information, is achieved. The key to all this is the metadata.

The SITNA model is a Corporate Information System that tries to offer concrete and advanced consultancy services, analysis and management of the different backgrounds of identified users by designing appropriate tools for each of them.

Besides this, Navarre did not have a Spatial Data Infrastructure recognized within the INSPIRE framework, which lead to a readjustment of the System that would allow, maintaining the current operation and tools, the collection of the concepts contemplated by INSPIRE for the development of the SDI, as well as the initiatives that were already in progress, establishing the objectives and the steps to follow for the IDENA implementation (Spatial Data Infrastructure of Navarre)[2].

2 IDENA: SDI FOR NAVARRE

2.1 What we understand as SDI

An Infrastructure for Spatial Data tries to identify and place within reach of the whole world, the geographic information that it has, properly documented through standardized metadata. From this point of view, it is therefore understood, that SDIs constitute real catalogues of cartographic products available through the Internet, that allow the user to access and obtain geographic information and that look for the interoperability with other SDIs on all levels (local, regional, national, international...). Basically, one can say that an SDI is made up of a base of metadata, with a catalogue whose consultation interface is the same as other SDIs as well as consultation tools. All this allows the localization of what data and services are available with similar characteristics, on a specific subject, in a specific spatial location. In short, consult the metadata that interests us offering, at the same time, the possibility of visualizing it. All this greatly facilitates the correct use of the information.

[1] Commission of the European Communities, 2004. “Proposal for a Directive of the European parliament and of the council establishing an infrastructure for spatial information in the Community (INSPIRE)”, Brussels. http://www.ec-gis.org/inspire/.

[2] The prototype of IDENA was presented in the JIDEE’04 conferences in Saragossa, the official presentation was held on March 9, 2005.

The IDENA initiative (Infrastructure for Spatial Data of Navarre) began during 2004, to complement and give the Territorial Information System of Navarre (SITNA) those characteristics that it lacked: Catalogue of Meta information, Interoperability with other SDIs and Distribution.

IDENA will be the Infrastructure for Spatial Data of Navarre, that will fulfill the objectives outlined by INSPIRE for the elaboration of regional SDIs and will be interoperational with other SDIs, like the Spanish or European. Therefore, it should also have the necessary technological elements and provide the geographic data contemplated by INSPIRE.

2.2 IDENA Objectives

The main objective of IDENA, consequently, is to provide access through Internet to the geographic information of the Corporate Information System of Navarre in an integrated and open way. Initially, we formulate a serie of generic goals.

For data:

1. Documentation of all system information according to the background metadata defined from standards.
2. Make the search for information possible based on specific search criteria (this criteria is based on the INSPIRE directive) through a metadata catalogue (Localization service).
3. Allow the free viewing of the results of our searches, for metadata as well as data (Viewing service).
4. Offer the free download of basic data (Download service).
5. Facilitate the acquisition of paid data through electronic commerce (Paid service).

For components:

1. Development of a map viewer.
2. Implement services for access to spatial data services.
3. Development of a feature server (WFS), a coverage server (WCS) and a map server (WMS).

All this, respecting the standards and protocols recommended by INSPIRE (ISO 19100 and Open Geospatial Consortium) for interoperation with other SDIs on different levels (national, international, etc.).

3 IDENA ARCHITECTURE

As mentioned earlier, a SDI has to be accessible for any user through the Internet. The architecture designed by IDENA is shown in the following figure:

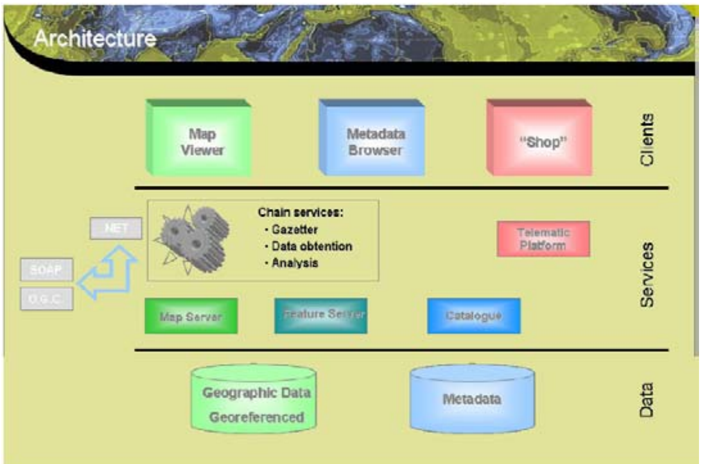


Figure 1. IDENA Architecture

The IDENA portal is made up of three main elements: a Map Viewer, a Metadata Search Engine and the Shop.

- Map viewer. This tool will allow viewing, consulting, identifying, etc. the spatial information of Navarre. At the same time, it will also allow the connection with other information servers (geographic data of other SDIs that follow the same standards and protocols), to view spatial data on other scales (other Spanish communities, European...).
It offers standard navigation tools, and also has others such as transparency, legend view, access to thematic information for a specific point on the map, save maps, etc.

In the final product, the Map Viewer will work with geographic data and georeferenced data, and will have a map server and a feature server. It also will offer other complementary services like the Gazetteer, data extraction and analysis.

- Metadata Search Engine. This tool allows metadata searches based on different criteria established by INSPIRE.
The result of this search presents a list of all the data including these criterias. Each result will mention 5 principal characteristics (title, summary, editor, format and additions).

Once the data of interest is found and selected by the user, it could access the following options:

- Visualization of the Map Viewer: “See map”.
- Consultation of the metadata (the main metadata will be seen and complete metadata can also be accessed): “See details”.
- Downloads, shop (for free data, with registered users or the sale through Internet): “Products”.
- Link to SITNA: “Go to SITNA” .
- Link to Website: “Go to website” .

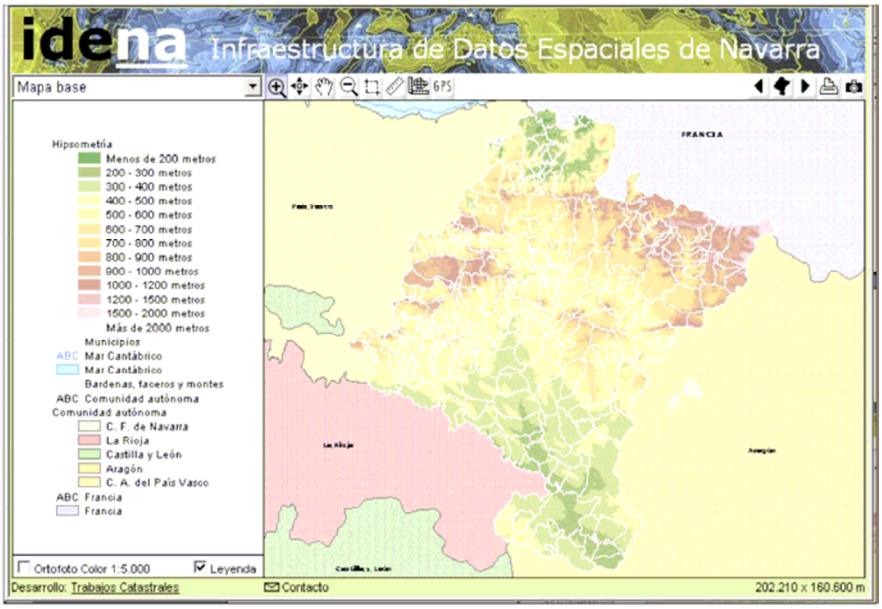


Figure 2. Map Viewer IDENA

Figure 3. List of search results

- **Shop**: It will include the following tasks or elements: shopping cart, on-line downloads, physical product orders, payment, tracking of orders and authentication.

Through the telematic platform of the Government of Navarre, it will be possible to buy geographic information (with electronic signature, a payment method and Safe Electronic Communication). This utility is not operative in the IDENA portal jet.

4 METADATA IN IDENA

4.1 Definitions of Metadata

The most common definition of metadata is " data about data" . It describes the content, quality, condition and other characteristics on itself. It helps to locate and understand the spatial data available.

INSPIRE mentions that metadata must be maintained up-to-date by a person responsible for the data and must present a background compatible with the metadata standard ISO19115 (obligatory within INSPIRE). We will return to this question.

The main functions of metadata are the following:

- Organize the data to allow users to know it better and, as a consequence, use it, avoiding duplications and detecting errors. All this helps maintain the investment in the data.
- Facilitate the transfer of data by offering information on file formats, volume, localization, etc.
- Allow the on-line distribution of the data incorporating addresses to download files, either free or pre-paid, through descriptions on how to carry out these processes.

- Facilitate the search of data in a complex corporate database. Metadata standards allow a user to make a consultation, which is redirected to the different metadata catalogues registered in the main server. The result is a list of metadata from different servers.
- Avoid the erroneous use of data by including descriptions of how there were created, what goal and how they should be used.
- Insure the integrity of the data as well as its safety.

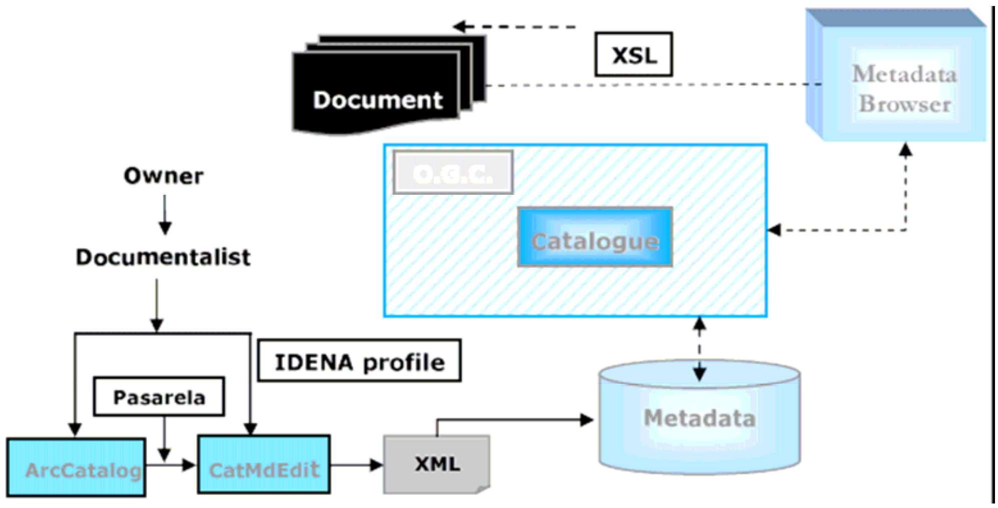
4.2 Standard of metadata used

The metadata can be shared among the different producers and users, so, it should be understandable for everyone. For this, metadata standards have been designed trying to create common points of view for the different actors involved in the spatial information making this documentation comprehensible for all those that " speak the same language" .

The International Organization for Standardization is a federation of national standardization organisms. They also receive the collaboration of international organizations, governmental or not. This organization is divided, internally, into technical committees in charge of elaborating standards for different themes. The committee that has elaborated this standard is the ISO/TC 211, designated to geographic information. Besides the metadata standard, there is an extensive list of other standards related to geographic information.

4.3 General Approach

Among the short-term objectives, we have already mentioned that offering the user the possibility of searching and identifying existing data, with precision, and reaching a basic level of interoperability that opens the IDENA data to any other SDI.



This figure shows the flow that the approach unites from the previous sections, and that we will now describe:

- In first place, is the metadata creation function for all existing data. This task has been carried out by the metadata administrator, according to the IDENA background (this will be commented, in detail, in later sections), combining the use of two tools: ArcCatalog and CatMDEdit (the first allows the extraction of some spatial attributes from the data such as format, number of objects, etc.; with the second, we can complete the metadata with more detail).
- Once the metadata registers has been created, we export from CatMDEdit to XML format (metadata exchange format), been stored and sent to become part of a metadata catalogue.
- The IDENA user can search according to defined criteria (Metadata Search Engine). These searches are done on the metadata catalogue, and the results are shown with a view, following the specific style of IDENA through the use of style formats (XSL). These style formats will be of two types: general and specific (first it shows the more important or highlighted metadata, and next all those established by the IDENA background).

4.4 Structure and exploitation model

The IDENA information warehousing has a layer-item structure. The layers (dataset) are groups of items fundamentally according to thematic criteria and information headlining (example: land registry will be the layer and the plots of land, buildings, etc. its items). From this point of view, the items are constituted as the essential element of the territorial information. However, when we talk about document cartographic series or metadata this division is not very clear as well as it is not when depth level to use is different according to layers.

The layers of available information are very wide types, from cartography in different scales, spatial planning, environmental resources, land registry, postal addresses, administrative divisions, agriculture, etc. and, of course, the raster images. There are some layers much well known than others, that means that we have to structure layers in different levels. Also it is necessary to structure the meta information in layers (or " parent" levels) and items (or " child" levels) with different levels of integration. The following figure shows some examples of existing dataset and the structure they have adopted. The metadata creation tool indicates the higher hierarchical level each data belongs to and what are those that hang from each level. The general idea is offer through the catalogue client application all the integrated metadata (basic and detailed) for the data in any level of disintegration.

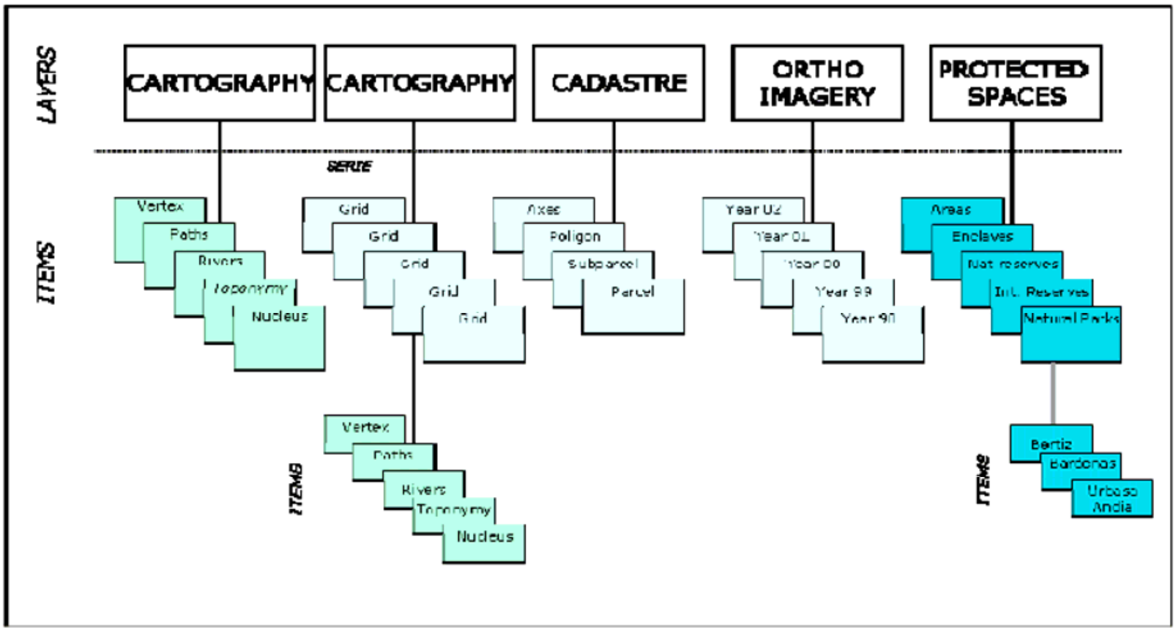


Figure 5: Structure of the warehousing of IDENA metadata (example for some data).

The search engine, according to the search criteria established by the user, offers the “ layers” as results (see structure of the previous figure) that meet the criteria. Each layer offers information and access to all the included items.

4.5 Background description

The metadata described in the ISO19115 standard are very numerous and propose a very extensive documentation of the data that could lead to dejection and the risk of limiting creation advancement. The problem is, on one hand that it deals with a very general standard that should be useful in any discipline related to territory and in any country; on the other hand, that many of these elements will never be used.

For this reason, a more limited nucleus is proposed, in such a way that, although serving to collect basic information for more habitual searches, it avoids the need for excessive effort in the creation of metadata.

The SG NEM (Work Subgroup of the Spanish Metadata Nucleus) of the Superior Geographic Council, for the Infrastructure for Spatial Data of Spain (IDEE), has been intensively working on the definition of the NEM background.

NEM is the acronym for the Spanish Metadata Nucleus, a minimum group of metadata items, recommended for use in Spain when creating metadata for geographic data. That NEM is based on the nucleus of the ISO19115 metadata standard, in the Dublin Core Metadata, in the description elements of Quality and in other additional elements considered of interest in cataloguing.

The same way that a nucleus for the IDEE has been established, IDENA has established its own background adapted to its needs and based on the NEM.

IDENA Metadata Nucleus = Spanish Metadata Nucleus (ISO Core 19115 + Dublin Core + Quality + Additional NEM Elements) + Additional IDENA Elements

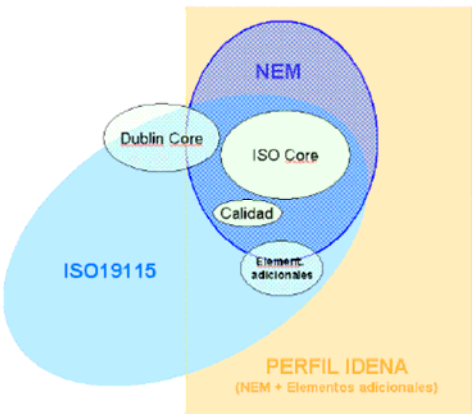


Figure 6: The background of IDENA metadata

The background of IDENA Metadata is:

- 22 elements of the ISO Core:
- 7 are obligatory, in other words, the metadata can not be considered valid if at least it does not collect information from these fields (marked as M in the table on the following page).
- 15 are optional (marked as O and C in the table on the following page).
- 4 additional elements from the Dublin Core without correspondence with any ISO Core element.
- 6 Quality elements. These elements are included to complete the element '/LQHDJH' of the ISO Core in order to determine the data quality.
- 4 Additional elements of the NEM background.
- 6 Additional and specifically elements answering the needs from IDENA .

Finally, we have 36 elements from the NEM plus 6 elements specifically for IDENA.

Next, there is a more detailed revision of all the elements that configure the IDENA background.

4.6 Metadata Background

4.6.1 The ISO 19115[3] Core Elements

The international standard defines a group of very extensive metadata elements, but in the truth time, the group of elements used is quite small. However, it is essential to use a basic number of elements for the metadata. The next table shows the principal nucleus of the standard (the &RUH), the minimum necessary to document the data.

(M) are obligatory; (O) optional and (C) conditional.

Dataset title (M) (MD_Metadata > MD_DataIdentification.citation > CI_Citation.title)	**Spatial representation type** (OR) (MD_Metadata > MD_DataIdentification.spatia lRepresentationType)
Dataset reference date(M) (MD_Metadata > MD_DataIdentification.citation > CI_Citation.date)	**Reference system**(OR) (MD_Metadata > MD_ReferenceSystem)
Dataset responsible party(OR) (MD_Metadata > MD_DataIdentification.pointOfContact > CI_ResponsibleParty)	**Lineage**(OR) (MD_Metadata > DQ_DataQuality.lineage > LI_Lineage)
Geographic location of the dataset (by four coordinates or by geographic identifier) (C) (MD_Metadata > MD_DataIdentification.extent > EX_Extent > EX_GeographicExtent > EX_GeographicBoundingBox or EX_GeographicDescription)	**On-line resource** (OR) (MD_Metadata > MD_Distribution > MD_DigitalTransferOption.onLine > CI_OnlineResource)
Dataset language (M) (MD_Metadata > MD_DataIdentification.language)	**Metadata file identifier** (OR) (MD_Metadata.fileIdentifier)
Dataset character set(C) (MD_Metadata > MD_DataIdentification.characterSet)	**Metadata standard name** (OR) (MD_Metadata.metadataStandardName)
Dataset topic category (M) (MD_Metadata > MD_DataIdentification.topicCategory)	**Metadata standard version**(OR) (MD_Metadata.metadataStandardVersion)
Spatial resolution of the dataset (OR) (MD_Metadata > MD_DataIdentification.spatialResolution > MD_Resolution.equivalentScale or MD_Resolution.distance)	**Metadata language** (C) (MD_Metadata.language)
Abstract describing the dataset (M) (MD_Metadata > MD_DataIdentification.abstract)	**Metadata character set** (C) (MD_Metadata.characterSet)
Distribution format (O) (MD_Metadata > MD_Distribution > MD_Format.name and MD_Format.version)	**Metadata point of contact** (M) (MD_Metadata.contact > CI_ResponsibleParty)
Additional extent information for the dataset (vertical and temporal) (OR) (MD_Metadata > MD_DataIdentification.extent > EX_Extent > EX_TemporalExtent or EX_VerticalExtent)	**Metadata date stamp** (M) (MD_Metadata.dateStamp)

Table 1: ISO Core[4]

4.6.2 Dublin Core[5] Elements

There are 4 elements included in the Dublin Core standard that do not have correspondence with the elements collected in the ISO Core (although they could find correspondence with elements of the ISO19115).

The Dublin Core is a standard for the creation of metadata for general resources, not only for geographic information.

3 International Organization for Standardization, 2003. " International Standard ISO19115. Geographic information – Metadata" . www.iso.org

4 Source: The OpenGISTM Abstract Specification. Topic 11: OpenGISTM Metadata (ISO/TC 211 DIS 19115). Version 5.

5 Dublin Core Metadata Initiative, 2003. "Using Dublin Core – The Elements" . http://dublincore.org/documents/usageguide/elements.shtml

This standard contains 15 elements, 11 of which have correspondence with the elements of the ISO Core, but not with the other 4. These 4 elements are:

- Contributor: Contributor (would correspond with the element Credits of the ISO 19115): Recognition of those people that have contributed, one way or another, in the creation or modification of the data (through economic means, work, support, etc.).
- Relation: Relation (would correspond with the element ‚Integration information of the ISO 19115): Relationship to related resource.
- Rights Management (would correspond with the element ‚Information on legal Constrictions / Restrictions): Information to offer: restrictions on access, use, others restrictions and legal restrictions.
- Type: (would correspond with the element Hierarchy Level): Nature or type of content of the resource. The type includes terms that describe general categories, functions, types or integrated levels for the content.[6]

4.7 Quality elements

The ISO19115 standard collects information on the quality reports carried out on the data (determines what quality controls have been performed on the data).

A dataset can have passed one or various quality reports, which can be of the following types:

- Commission: Excess of data in the file.
- Omission: Lack of data in the file.
- Logical consistency: Degree of adherence to the logical rules of data structure, attributes and relationships.
- Position accuracy: Accuracy of the position of the objects.
- Thematic accuracy: Accuracy of attributes and relationships. Determines the fidelity of the values of the attributes, such as name, length, class code, population, etc., assigned to the objects with respect to the true value of the characteristic that they present.
- Temporary accuracy: Accuracy of temporary attributes and relationships.

Each one of these types of determined reports should specify: the name of the measurement, the description of said measurement and the result (value obtained).

Besides the quality reports, there are other metadata that also complement the quality information:

- Level: Hierarchy level of the data for the quality control.
- Declaration (state): General explanation of the knowledge of the data producer of the data group lineage.

4.8 Additional NEM elements

Besides the earlier mentioned elements, the NEM includes 3 others, considered important for the information provided with the data:

- Key words of subject and place. Word/s used to describe the subject or place corresponding to the dataset. Name of the formally registered thesaurus or a similar authority key words source.
- Form of presentation: Way that the resource is presented.
- Intention: Summary of the intentions that resource has been created.
- Specific use: Ways the resource is being used.

4.9 Additional IDENA elements

The previously commented elements correspond with the Spanish Metadata Nucleus (NEM); however, in the case of Navarre, they have established, for the moment, 6 additional elements, because they have been considered essential (distribution of information) or in some cases, interesting to complete the previously known information. These elements are:

- Alternative title: Short name, name in another language or acronym for which the cataloged information is known.
- Parent Identifier: identification number of the metadata file from which this metadata is a part (child).
- Frequency of maintenance and update.
- State: State of the resource, if it is completed, in progress, obsolete, etc.
- Supplementary information: Any other descriptive information on the dataset.
- Distribution. This section includes all the information that the standard has referring to the distribution of metadata, except for that already contained in the Core (On-line Resource and Distribution Format).

[6] This element is useful to determine if a resource is an integrated data or not, and if it is, what level of integration it presents (if it is a series or a page, a dataset or an item, an attribute...).

5 INTEROPERABILITY WITH OTHER IDES

Another of the INSPIRE requirements deals with the interoperability between different SDI. At this moment IDENA may interoperate with any SDI that use the OGC (Open Geospatial Consortium) standard, such as IDEE (SDI of Spain), INSPIRE (European SDI), GEODATA.GOV (North American SDI)...

The system has been designed to compare data across different regions, and visualize the datasets of Navarra close to any other region. Moreover, the advanced user could combine Navarra datasets with their own datasets by downloading those spatial data they need and work with all of them in more detailed analysis

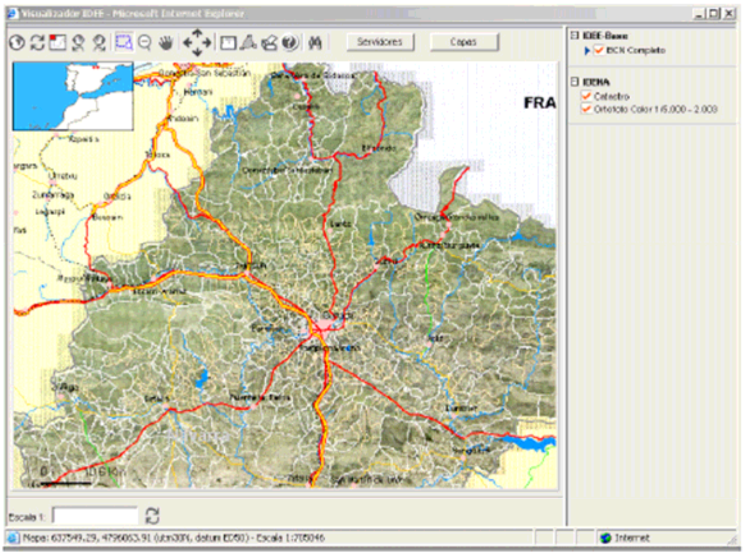


Figure 7. Visualization of IDENA information layers in the Spanish SDI Viewer

6 CONCLUSIONS

This article has focused, fundamentally, on the following aspects:

- IDENA architecture and its components (see figure 1).
- Resolution of the metadata work flow within the IDENA project, as well as on its different components (see figure 4).
- Establishment of the information structure (see figure 5) to create a better comprehension for users (simplify and structure search results).
- Definition of the IDENA metadata background.
    - Interoperability (see figure 7).
    -

Finally we could conclude:

Navarre and its Territorial Information System (SITNA) determinedly believe in the SDI world and, for this reason, have started a plan for the documentation of their entire information warehouse, which is currently in a fairly advanced phase.

IDENA is the answer Navarra need to comply with requirements from INSPIRE and Spanish SDI. It provides consistence to Territorial Information System of Navarra (SITNA), completing services profiles offered. It has been developed in a very short time: just six month from order to official presentation. That shows the great versatility of SITNA and the great technological answer capability from our company TRACASA.

Data for GIS

Vasily POPOVICH, Andrei PANKIN, Yan IVAKIN

(Prof. Dr. Vasily POPOVICH, Andrei PANKIN, Yan IVAKIN
SPIIRAS, OOGIS Laboratory, 14 Liniya VO, 39, St. Petersburg, Russia, Email: Popovich@mail.iias.spb.su; http://www.oogis.ru)

Abstract – Various purpose and scale geoinformation systems (GIS) are first and foremost interfaces to arrange for data access and user-friendly control of their transformation. As a rule GIS data specifics consists in their geographic reference (bind) i.e. reference to geographic coordinates.

The fact that GIS have quite a heterogeneous nature makes their use somewhat complex. At that various applications require an access to different data groups; many GIS applications are expected to work in real time or close to real time modes, thus, causing complications while arranging for data access and way of data representation.

Conventionally GIS data problems were solved through development of various data formats or specialized data bases; however, since recently the number of applied tasks requiring GIS capabilities keeps rapidly growing, the use of currently existing standards or development of new ones cannot contribute to the above problem solving.

The here presented research proposes to consider the complete GIS data transformation cycle to further implement these GIS as interfaces supporting decision making systems. Judging from the so far accumulated experience of GIS implementation and based on the available literature study it could be said that the class of these systems is extremely large. However, a special interest is now drawn to the GIS based decision making systems for managing the municipal aggregations, transportations (maritime, ground); controlling various purposes and scales monitoring systems.

In general case the process of data access and transformation is assumed to be considered in the light of three abstracting levels: harmonized, integrated and fused data. The above mentioned levels possess a physical basis and really reflect the information flows propagating from measuring devices up the hierarchy. The paper is only focused on main statements and does not go into details specifying each level.

1 INTRODUCTION

First of all let us cite a well known definition for data notion: Data - distinct pieces of information usually formatted in a special way. Data can exist in a variety of forms -- as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind [6]. Metadata describes how and when and by whom a particular set of data was collected, and how the data is formatted. Metadata is essential for understanding information stored in data warehouses and has become increasingly important in XML-based Web applications [6].

This paper is not aimed at identifying the difference between data and information notions, though by many studies as well as in common practice the above notions are perceived as identical; our research will mainly discuss data.

Significant interest was drawn to information and data notions upon Internet emergence and before that upon GIS emergence. Perhaps, the GIS developers were the first ones who faced the problems of using versatile and bulky information in real-time or close to real-time scales.

The given problem becomes even more acute when GIS are used as interfaces in decision support and decision making systems for subject domains of municipal aggregations management, maritime navigation and ground transportation control, ecological monitoring and other; actually, today, it easier to list the areas where GIS are not used than to mention all of those where GIS are intensively used or are under way.

GIS diversity stipulated an emergence of great number of information resources aimed at providing GIS for necessary data. Each of above resources, as a rule, is based on a definite data model, or on a so called data representation format. However, the major problem here is that the currently existing data formats and, consequently, based on them resources, with the exception of special cases, do not cover the information needs of advanced decision support and decision making systems (DSMS). Thus, a problem of various data sources grouping at a concept level arises.

This paper proposes to segregate three data groups or three data types: harmonized, integrated and fused data. The above grouping is important to better understand the following issues in data use and transformation processes:

- data type definition (measured data, preprocessed data, extrapolated and/or interpolated data and other);
- data source definition along with data quality and their credible degree.
- a possibility to use data in certain problems' solving;
- a possibility to perform further data transformations (as a rule, isomorphic transforms of integrated data are impossible).

The above given list does not claim to be exhaustive though allows explaining an idea or objective of data conceptual decomposition.

2 INFORMATION HARMONIZATION

The given process assumes a definition of main notions and their interrelations (ontologies) based on matching subject domains and/or responsibility areas. For instance, certain division into existing knowledge domains can be made: hydro acoustic, hydro meteorology, radiolocation,, theory of search, etc. Information harmonization can solve the following main problems:

- arranging for an access to possibly great number of information primary sources;
- allowing an information transformation into user-friendly representation (decoding, recognition, translation, …);

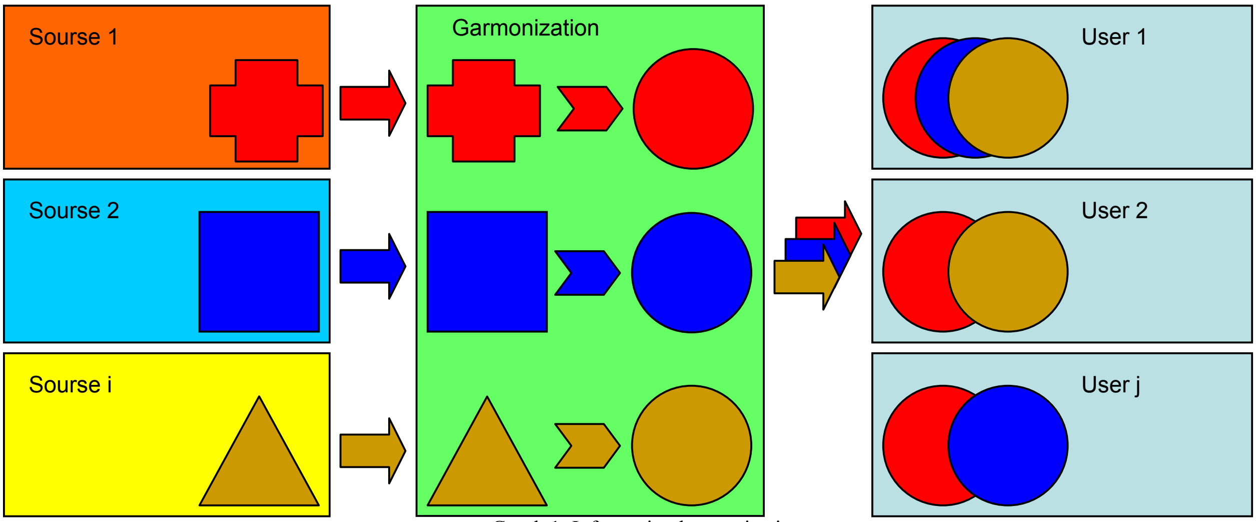
- arranging for an access to existing information resources.

Harmonization in a broad sense can be interpreted as data standardization.

Arranging for an access to primary information sources can be done on two levels: hardware and software. Generally, for GIS three following information sources' types can be proposed:

- not formalized information (regular text, raster graphics, photos, etc);
- formalized information (e.g., in XML format);
- formalized measurements' results (in textual and digital form);
- various formats of data bases;
- cartographic information in specialized formats;
- medium information in various specialized formats.

Graph.1 illustrates the graphic harmonization.



Graph 1: Information harmonization

As seen in Graph. 1 an access to every information source, as a rule, is arranged through different protocols, methods and/or mechanisms. As an example an access to Internet resources, data bases, GPS, GSM data, books, papers, etc can be considered. The harmonization idea consists in realization of clear principles and mechanisms of an access to information, their unification and types number contraction. Codes of the World Meteorological Organization (WMO) can serve as a good example. Currently the data main flow is being propagated though cables, transmitted as facsimile telegrams, and that significantly hampers their processing and further using, and this why WMO works on data reducing to uniform XML format to simplify operations with data of the kind.

Information harmonization process distinguishing feature is that harmonization result is oriented to a great number of users (customers).

As mentioned in [1], environmental information harmonization is more than essential in regional, national, European and global contexts.

First and foremost the above is stipulated by:

- global monitoring of the Earth surface, natural resources, and other data to be processed and realized in accordance with the Kyoto Protocol;
- European environmental policy including environment protection, cities development, protection against natural cataclysms;
- danger of adverse emissions, geophysical hazards, and technological risks;
- international cooperation, security policy pursued through development of appropriate maps and decision support and decision making systems.

Development of regional, national, European or global infrastructure of spatial data puts forward a requirement of information availability and mutual exchange. The above generates a requirement to introduce standardization and matching technologies. Status quo raises a question about information availability and exchange between different communities, thus, stimulating the efforts being put in data harmonization through a development of a common data geo model.

Development of the common data geo model will allow users to have an access to various data sources and software as the users need.

European Geoinformation Community stated a task to develop an open organization coordinating efforts in information harmonization.

By the initiative of British Geological Survey (BGS) and the Geological Survey of Canada (GSC) special meeting was arranged for in Edinburgh in November of 2003. Representatives of fifteen geological agencies from different countries and continents (Europe, America, Asia, Australia) attended this meeting. A work group for a development of data models was organized then to work under the auspices of the Commission for the Management and Application of Geoscience Information (CGI), that is a new commission of the International Union of Geological Sciences (IUGS). The work group establishe three subgroups: "Conceptual Model/Interchange", "Testbed" and "Classification Requirements".

In 1998 in Germany was established a governmental commission IMAGI (Interministerial Committee for Geo Information) aimed at developing and implementing the German National Spatial Data Base (Geodateninfrastruktur Deuschland: GDI-DE) having its major objective to introduce the harmonization and availability of needed geodata data in response to the query put through Internet.

Information harmonization assumes solving of certain tasks, whose totality can be divided into the following groups:

Organizational tasks, supposing definition of data sources and users, data acquisition system and users' informational level;

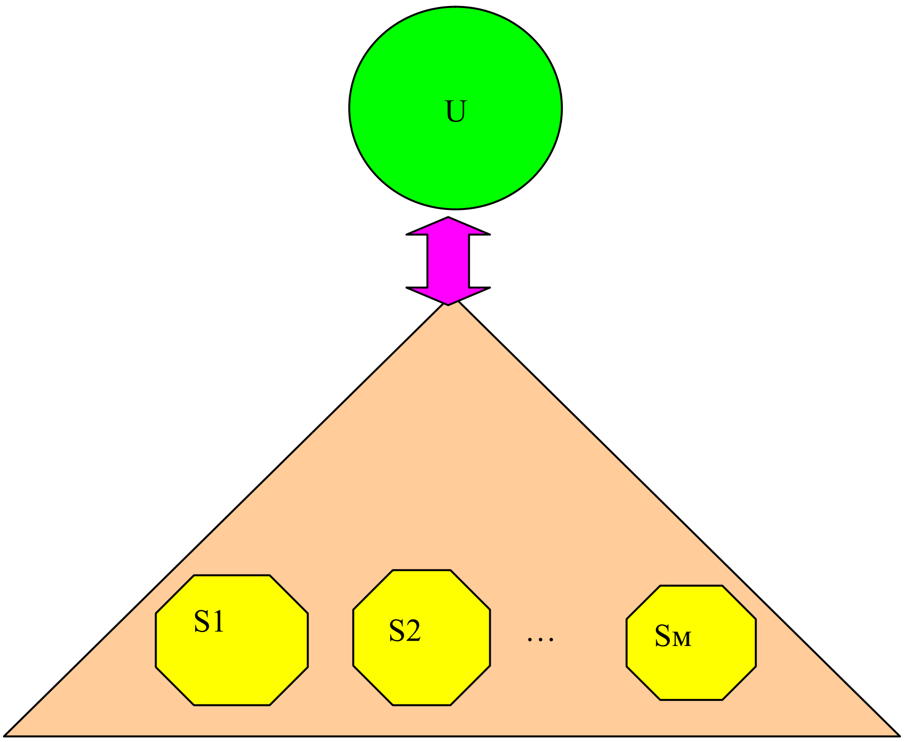
Technical tasks include protocols and standards realization by software and technical means as well as data access realization.

Legal issues. Development of license agreements, data copy rights and statuses, splitting of general information, arranging for security, copying, along with copy rights assurance.

Economic and social issues. Arranging for funding to maintain various works as well as estimating costs of information and services provided. Specifying the information market and costs, as well as expected profit and its distribution.

3 INFORMATION INTEGRATION

Information integration (access to information resources) for current tasks solving (modeling), see Graph. 1 Integration inevitably leads to data volumes enhancement, and, as a rule, is stipulated by a necessity to operate with huge data arrays in real-time or close to real-time mode. Integration is carried out to arrange for solving quite a narrow tasks' scope. Information integration for GIS can be illustrated by certain data formats like S 57, VPF and other specialized ones. Via these formats information is represented in a definite way, say, as structured data arrays. The purpose of such data arrays is solving of a certain tasks' set, e.g., data in S 57 format are aimed at arranging for navigation security within a given sea area; data in SXF format provide for topographic tasks solving on the Russian Federation territory. Currently a tendency of developing XML technologies based complex distributed data arrays can be observed. The above technology uses as a core the OWL language (Web Ontology Language). Specialized extension set GML (Geographic Markup Language) aimed at GIS data description is developed.



Graph 2: Information Integration

Data access is realized through different mechanisms, and it depends on the following factors:

- required speed of data processing (real-time or with an allowable delay);
- need of parallel processing and/or visualization of great data's number.

Depending on the above factors a direct access is provided for in the same format as the data storing format. Pretty often an intermediate data transformation is needed, as a rule, in the systems of GIS data visualization. This is stipulated by technical constraints of graphical stations and network performance and/or processors. For instance, data in VPF format can comprise information exceeding hundreds of GB depending on the scale. None of intelligent navigations can arrange for a real-time operation with such a data array. Nevertheless, given format integrated data are much more applicable to be further processed than just harmonized ones, located in different sources with different speed and access discipline.

Information integration distinguishing feature is that its result is aimed at solving tasks of a definite class.

Information integration assumes a definition of a certain data model. An example of information integration is a theoretic model of data in S 57 format. This model would be rather complicated if the further details of data vector representation were accounted for. The complexity is caused by the factor that navigation purposes require interrelated data of different kind, like isobaths, navigation signs, navigation channels, etc. At that certain data changing or updating may affect other interrelated data.

Along with the theoretic model a format that assumes an incorporation of one or several interrelated files was developed for data storing at computer medium.

It should be noted that data integration does not mean just a physical information amalgamation in one place, say, at a local user. The approach depends on the stated tasks and on the existing conditions. For instance, with regard to any format, providing for navigation security, a definite water-craft should have complete information about its current and planned navigation areas. Thus, the arranging for a timely correction of already available information is an absolutely different task. While, for example, solving the research tasks the information can be physically distributed within a certain network either local or global.

Information integration assumes number of tasks solving:

Organizational tasks. Definition of data sources and users, data acquisition system, their interrelation and updating system.

Technical tasks. Data formats realization and extension at transportation level as well as at interface level. Development and implementation of a system for data, in a given format, production, distribution, protection, and correction.

Legal issues. Development of license agreements, data copy rights and statuses, splitting of general information, arranging for security, copying, along with copy rights assurance.

Economic and social issues. Arranging for funding to maintain various works as well as estimating costs of information and services provided. Specifying the information market and costs, as well as expected profit and its distribution.

4 INFORMATION FUSION

Receiving a new information quality (reducing information volume) is the most complicated stage in data transformations. The given notion is associated with a known research area, whose history numbers several dozens of years. The development of data fusion model (DF) made a qualitative leap in this area. The above model is known as Joint Directors of Laboratories (JDL) Data Fusion Model [3]. It is noted in [4] that "fusion" can be considered in different contexts:

- software (Cold Fusion, e Business);
- physics (medicine, nuclear fusion);
- combining (integration-combination of various elements into a certain formation, integration-composition of components into a certain whole;
- knowledge (data fusion, susceptors' data fusion and information fusion).

"Data" and "information" notations are separated in [4]. Data fusion is an organized combining in the interests of analysis and decision-making, while information fusion is data combining aimed at receiving knowledge. DF is defined in [2] as a process of data from different sources composition. DF objective is specified as receiving information of higher quality. At that high quality notion depend on the application area. It might be noted, that majority of DF research perceives the information (data) quality improvement as DF main objective.

In most of advanced GIS applications the data high quality problem turned into a sequence of correctly formulated and stated tasks, having various solution versions and providing data high quality for definitely stated tasks.

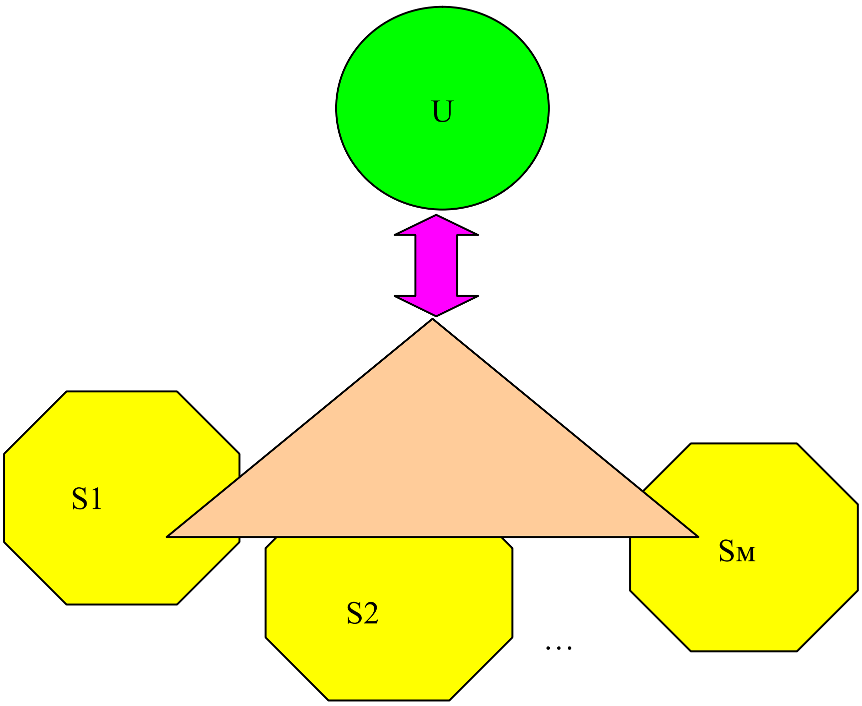
Currently the problem as a rule consists rather in data quality change than in data high quality.

The data quality change requires deep analytic study of the subject areas, so in a given context data (information) fusion will assume GIS technologies. Fusion (synthesis) main point is depicted in Graph.3. A diagram of information fusion for various purposes monitoring systems is given in Graph.4 as an example. The above diagram shows the information quality change upward the hierarchy. The idea of data fusion becomes obvious if to account for monitoring systems' complexity and their spatial distribution. The systems of the kind will hardly operate without the given mechanism.

Information fusion process distinguishing feature is a receiving of new information quality along with information volute reducing.

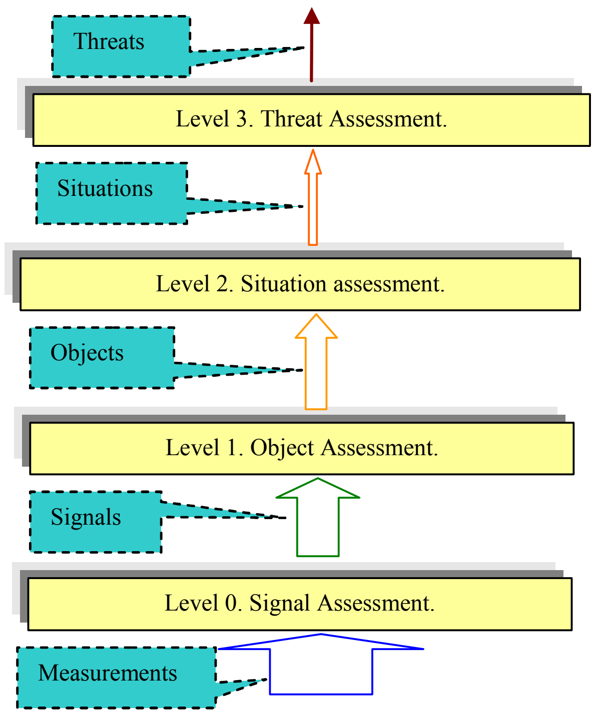
The levels given in Graph.3 demonstrate quality leaps in information representation. The mentioned diagram can be practically applicable to any monitoring system, and possibly not only to this class of systems. The considered case illustrates the Hegel's principle of quantity into quality transformation. However, there exists a nuance that is an absence of universal mechanisms able to perform such qualitative transformations. This rather is a system of special research incorporating a whole series of scientific leads.

Let us make further comments to Graph.3. At the zero level a signal is enhanced by a system or a physical fields measuring device against a background noises and interferences.



Graph 3: Information Fusion

At the first level a decision is made about definite class signal detection. The given levels differ in primary information as well as in mathematic methods. At the zero level a classic theory of signal detection is dealt with, and at the first level methods of classification and recognition are engaged. In some cases one more subdivision is added to the first level that is a track analysis having sufficient independence both in research methods and in application areas.

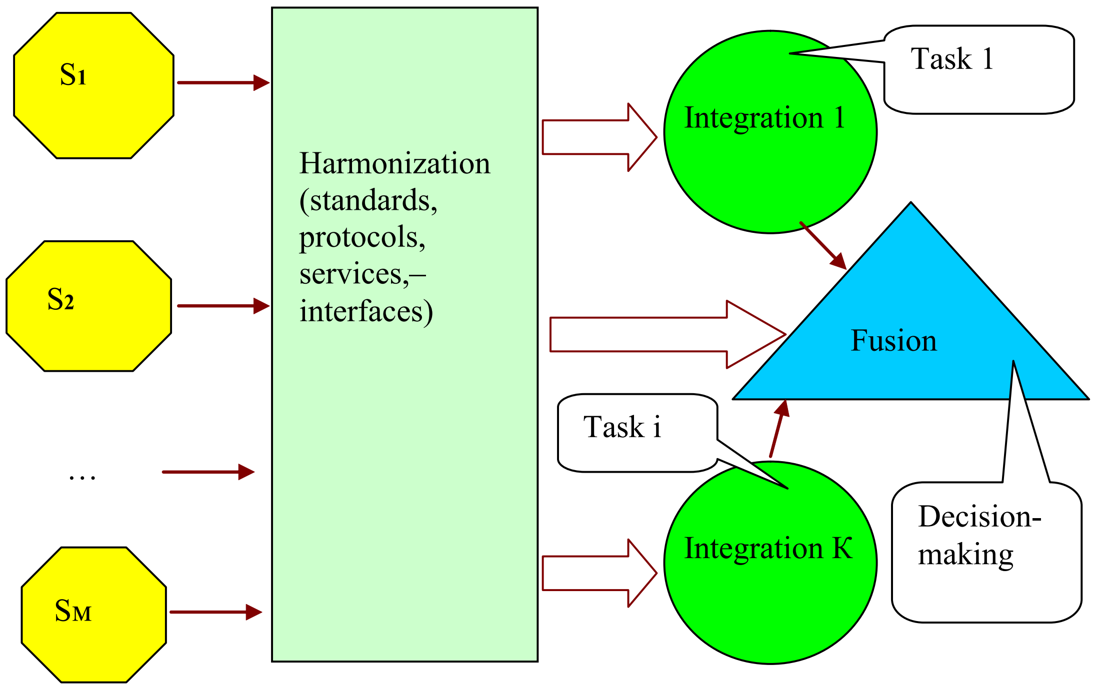


Graph 4: Information Fusion in Monitoring Systems

At the second level the possible situations generated by definite objects actions or inactions. This is one more qualitative leap in a sense of a subject being studied and in a sense of research methods being implemented.

As a rule, analysis of possible situations is not end in itself, and the following stage is a evaluation of potential threats, that might be derived by the current situation.

The above specified information processing levels are interrelated and interdependent as shown in Graph.5



Graph 5: Interrelation between information processing levels

Information fusion supposes some sequence of actions:

Organizational tasks: specifying data sources and users, data acquisition systems, their interrelation and updating system.

Technical tasks. Data formats realization and extension at transportation level as well as at interface level. Development and implementation of a system for data, in a given format, production, distribution, protection, and correction.

Legal issues. Development of license agreements, data copy rights and statuses, splitting of general information, arranging for security, copying, along with copy rights assurance.

Economic and social issues. Arranging for funding to maintain various works as well as estimating costs of information and services provided. Specifying the information market and costs, as well as expected profit and its distribution.

5 CONCLUSIONS

The information processing issues in GIS and GIS applications considered by this paper reflect that currently the problem goes far beyond conventional GIS research as well as their practical applications. Any endeavor of GIS introduction into real systems gives a rise to the above considered tasks of data harmonization, integration and fusion.

Here emerges a urgency of theoretical and practical investigations of different information processing levels for GIS and GIS applications. Some problems of the kind are being now solved directly or indirectly; technologies like web-services and service-oriented architectures concept are directly applicable to realization of information harmonization. Various extensions of laying-out languages, like GML, can and have to be used to solve data integration and harmonization tasks.

Historically data integration problem used to be solved through development of specialized data formats or data sets; the best known ones are S57, VPF, SXF, and various Shape formats. However, GIS implementation experience shows that there always arises a need to use data in at least two or more formats (i.e. global sources).

Data fusion in GIS is a field requiring the most complicated research and technological solutions. The peculiarity of this level is the orientation much more focused to a definite user than in case of integration; it is also complicated by a need of using rather sophisticated mathematical approaches and models.

6 REFERENCES

1. Kristine Asch, Boyan Brodaric, and etc. An International Initiative for Data Harmonization in Geology. //10th EC-GI&GIS Workshop, Abstracts,
2. Warsaw, 23-25 June,2004, p.9.
3. L. Valet, G. Mauris, and Ph Bolon, “A statistical overview of Recent Literature in Information Fusion,” Fusion 2000. IEEE AES March 2001.
4. White, F.E., “A Model for Data Fusion”, Proc. 1st National Symposium on Sensor Fusion, 1988
5. E., Blasch, “Fundamentals of Information Fusion and Applications”, Tutorial, TD2, Fusion 2002.
6. James Llinas, et al. “Revising the GDL Data Fusion Model II” 2005.
7. www.webopedia.com

🏆 **reviewed paper**

From fun to insight – virtual earth tools of tomorrow

Lukas MADL

(ARC Seibersdorf research Ges.m.b.H., Intelligent Infrastructures and Space Applications Department, Seibersdorf, Austria)

ABSTRACT

Earth – the blue planet floating in space. This image has had a major impact on collective perception since a photo has been taken for the first time from a rocket overcoming gravity. It envisions how beautiful, fragile and limited our planet is.Nowadays more and more satellites circle around the earth. Equipped with diverse sensors they are recording Terabytes of data from the geo-sphere per day. Until recently only the science and research community had privileged access to remote sensing data from sky. However cutting edge web-services such as "google earth" are now disseminating satellite images to the broad public. Hybridised with street vector maps and a huge amount of PoIs valuable applications have been implemented. You can plan your next holiday trip in 3D, teachers use the tool for training kids in geography. Al Goore's vision of a "digital earth" initiative seems to be nearly accomplished. But, how will those services develop further? What may be the next functionalities and possible impact on society on the long run? Today it makes fun to fly from cosmos view down to your own pool or to calculate the shortest route to the next pizza hut. Is that all? Consider the potential to "geo-enable" society. Not just to visualize the topography of the earth but to analyse and understand the ecological and economic impact of our modern life stile patterns on the geo-sphere. E.g. how much earth does an inhabitant of the "1st world" need of the "3rd world"? The average European consumes 24m2 just for his orange juice. Or could we monitor the progressive sealing of soil in real time? In Germany 15m2 per second are paved for settlement and traffic areas. What could an integrated "virtual earth" tool provide in the future?

🏆 reviewed paper

Data Quality for Spatial Planning – An Ontological View

Gerhard NAVRATIL

(Gerhard Navratil, Vienna University of Technology, Institute for Geoinformation and Cartography, Gusshausstr. 27-29, Vienna, navratil@geoinfo.tuwien.ac.at)

1 INTRODUCTION

Space is not an arbitrarily reproducible good. Although we can intensify the use of land by adding different levels like tunnels, our capabilities to use space are limited. Therefore planning the use of space is an important task. Planning in the small scale can be done by try-and-error. I can, for example, change the arrangement of the furniture in my living room to see if the new arrangement suits me better. This is not possible for planning in public space for two major reasons:

- Financial considerations: Moving furniture is much cheaper than providing necessary infrastructure to use space in a specific way.
- Temporal considerations: Try-and-error is time consuming. Since the arrangement of using land takes time, a frequent change would disrupt the use of land. Therefore the land will not be used efficiently. Too frequently changes may even lead to unused land or to ignorance towards spatial planning results.

The outcome of spatial planning should support the intended use. On the other hand, spatial planning should also guarantee that the solution is accepted by population since they have to use the space.

Recently data of the world became more detailed and has been used to create virtual worlds (recent results have been shown by Altmaier 2004; Ferko, Martinka et al. 2004; Ftáčnik, Borowský et al. 2004; Poesch, Schildwächter et al. 2004; Dorffner and Zöchling 2004; Hagen, Steinebach et al. 2005; Zeile, Schildwächter et al. 2005). This development required sophisticated methods (see for example Busch and Lüthy 2004; Holzer and Forkert 2004; Forkert, Haring et al. 2005; Kranz, Siegert et al. 2005) and programs (see for example Hesina, Maierhofer et al. 2004; Steidler and Beck 2004; Borovsky, Hesina et al. 2005; Mantler, Hesina et al. 2005; Steidler and Beck 2005) for the creation of such models. The models can be used for planning urban development as shown in the city of Baltimore (Cavicchia 2004), for comparing the impression of alternative solutions on the spectator (see for example Mambretti, Lange et al. 2004), or visibility analysis (Kerschner 2005). In addition new tools were necessary to manage the models and allow public participation (Arleth 2005; Warren-Kretzschmar, Neumann et al. 2005) and cross-border planning (Tchistiakov, Jellema et al. 2005; Von Wirth and Schrenk 2005).

The drawback of this development is the dramatic increase in data volume. Paar, Schoth et al. showed the contradiction between the quality of map documents as the legal basis for spatial development and the quality of 3D-visualizations (Paar, Schroth et al. 2004). The problem becomes even more serious if we do not only consider spatial aspects but also include the time as demanded by Drewe (2005) because changes over time must be reflected in the data thus again increasing the volume. This is why methods have been investigated to remove unnecessary data from existing data sets (Cromley 1988; Erickson 1996; Weiss and Dorffner 2005). In contrast to the development in public participation processes Dapp showed that political decisions are done without being able to present spatial (Dapp 2005). This observations lead to the following question: What are the quality requirements for spatial planning?

Assessing quality of data is difficult because it involves many different aspects. Frank proposed a tiered ontology to differentiate these aspects (Frank 2001). His ontology separates physical reality, observations of the physical reality, objects formed from the observations, socially constructed objects, and the subjective view of cognitive agents. The tiers have different methodologies for quality treatment and the structure thus provides a connection between the process of spatial planning and data quality.

The process of spatial planning varies depending on the problem to be solved. This also influences the data used the and the data quality needed. Planning the general course of a new highway, for example, needs data on physical obstacles like mountains, rivers, or built areas. Detailed information like a precise terrain model will not be necessary at this stage. The requirements for the quality of the obstacle's positions are also low. It does not matter where exactly the highway meets a river, it is only necessary to know that there is a river and a bridge will be needed. The highest quality is necessary when simulating observations. Thus the quality demand increases during the planning process.

The goal of this paper is to show the connection between the problem specification and the requirements for data quality. Thus after an introduction to the 5-tier ontology and data quality, section 4 establishes a rough separation of problem specifications. This separation does not claim to be complete and shall only serve as a reference frame. The next section then discusses the types of spatial planning in the context of the 5-tier ontology. Then quality requirements are discussed based on the quality descriptions shown in section 3. Some conclusions complete the paper.

2 5-TIER ONTOLOGY

Frank proposes a tiered ontology to describe phenomena in the real world (Frank 2001). The ontology consists of 5 tiers:

- Tier 0: Physical environment
- Tier 1: Observations of the environment
- Tier 2: The world of objects
- Tier 3: Socially constructed reality
- Tier 4: Subjective reality of cognitive agents

Tier 0 describes the physical environment we live in. The underlying assumption is that there is only one single physical environment. The problem is that we do not know much about tier 0. Tier 1 contains the results of observing tier 0. The separation of these two levels dates back to the Greek philosopher Plato. Plato already pointed out the necessity to separate reality from our knowledge about it. Frank assumes that each point in tier 0 has determined properties in space and time. Observations of these properties will be incomplete since it is impossible to observe all properties for all points in space and time. Tier 1 therefore contains our limited knowledge about tier 0.

A simplification process is necessary due to the enormous amount of data in tier 1. Tier 2 contains objects formed from the observations in tier 1. This is, for example, done in the human brain for visual observation. We do not see points reflecting light of specific wavelength. Tracking each point of some phenomenon would require enormous brain capacity. Therefore we simplify our observations by forming objects and tracking these only. Objects are defined by uniform properties for regions. Since the properties are observed in tier 1 the formation of objects is based on that tier. One of the definition criteria for objects is that they continue in time. Temporal constructs for objects have been defined by Al-Taha and Barrera (1994), extended by Hornsby and Egenhofer (1997), and formalized by Medak (2001).

Figure 1: Aerial image of the city of Nicosia

An example shall clarify the difference between tiers 1 and 2. Figure 1 shows an aerial image of the southern part of the city of Nicosia. The image is the result of an observation process and thus belongs to tier 1. What can be seen theoretically is a rectangular raster of points in different shades of grey. However, we do not identify these points. We automatically form objects and recognize houses, streets, and vegetation. All these elements belong to tier 2.

Tier 3 describes the socially constructed reality. Society is based on social processes. These processes may require external names like ‘Gerhard Navratil’ as the name for the author. Within tier 2 the author belongs to the classes mammal, human being, man, etc. This is not enough for social processes like spatial planning because it does not allow to distinguish between the same person in different roles (e.g. as a planner and a land owner).

Social rules may create institutions and relationships between them. The institutions are only valid within the context of social reality. An example for an institution is money (Searle 1995). A piece of paper with specific properties counts as ‘money’ in the social context of specified countries. Outside the corresponding social context this piece of paper cannot be used as money. This context may change over time. An example in the planning realm is the building regulations. Restricting the height of buildings is possible in several ways (e.g. by restricting the number of levels or by specifying the maximum height). Different countries use different methods and thus provide a different social context. In addition these methods are changed if necessary.

Finally tier 4 is the subjective reality of agents. Agents have to make decisions. They use their knowledge of the world to derive other facts and make decisions. Agents acquire their knowledge gradually by observations. They directly observe reality or obtain observations indirectly from other agents by observation, e.g., by using maps as shown by Frank (2000). A planning process relates to several types of agents. Planners propose solutions, politicians put the solutions into action, and citizens adopt their plans to the situation created by planners and politicians. Each of these agents has a different perspective depending on the acquired knowledge and the agent's goal.

3 QUALITY OF SPATIAL DATA

As shown in the last section we investigate properties of the physical environment by observation. The properties in the physical environment have a defined value and are thus called "real" values. Values gained by observations are called data. Unfortunately data deviate from the "real" values. Morgan and Henrion (1990) give the following reasons for these deviations:

- **Incomplete data**: What will be the U.S. defence budget in 2050? There is no observation describing this property.
- **Disagreement between different data sets**: What was the Soviet Union defence budget in 1987? There are different observations and the values are different.
- **Linguistic imprecision**: What is meant by "The river is wide"? The classification scheme used to classify the result of the observations may be unknown.
- **Variability**: What is the flow rate of the Ohio river? The property of the phenomenon varies according to which specific value has been observed.
- **Quantity**: What is the focal length of an optical lens? How precise do we determine the value?

The description of deviations in data must consider the data capture process. Two steps can be separated: Data is observed (or measured if quantifiable). Objects are classified and their boundaries generalized. Discussion of observation processes (Helmert 1872) and their accuracy leads to statistical methods and data quality (Guptill and Morrison 1995; Wang and Strong 1996; Veregin 1999). We separated the following aspects of data quality

- **Lineage**: What were the methods used to obtain the data and which processes were used to create the data set at hand?
- **Accuracy**: Variations in the observation process are inevitable. Accuracy is a description of the variation of position and attribute values based on a statistical approach.
- **Completeness**: Completeness describes the relationship between the occurrences of the phenomenon represented in a data set and the abstract universe of all occurrences of the phenomenon. Data completeness describes the omission observed between database and specification. It is the number of missing elements that should be in the data set. Model completeness refers to the agreement between the database specification and the abstract universe (Brassel, Bucher et al. 1995). Completeness also describes errors of commission. Commission is the fact that elements are in the database although they do not match the specification (wrong classifications).
- **Logical** Consistency: Data sets can be checked if there are logical contradictions. Parcels of cadastral data sets, for example, should not overlap.
- **Semantic Accuracy**: Semantic accuracy deals with cases where the phenomenon represented by a specific class in the data set does not fulfil all requirements for this class (Salgé 1995). Woodlands, for example, that are stored as oak woodlands in a database may not match the definition of oak woodland on which the database is based.
- **Currency**: Temporal accuracy or currency is an indication how up-to-date the data set is.

Classification of objects is based on the concept used to think about space. Discussion of these concepts leads to uncertainty measures because many concepts used in everyday life do not have crisp boundaries. We cannot specify, for example, how high a protuberance must be to be called a mountain. It is also difficult to specify the number of trees necessary to form a forest. Fisher separates four main aspects of uncertainty (Fisher 1999; Fisher 2003):

- **Error**: The idea of errors is that data emerges from measurements and these measurements may be wrong. In contrast to accuracy in data quality here we do not assume normal distribution for the measurements. We include systematic deviations and gross errors as well. The different aspects of error include accuracy, reliability, bias, precision etc.
- **Vagueness**: Lotfi Zadeh introduced the concept of fuzzy set theory (Zadeh 1965). A classification may result in an ambiguous situation if based on vague concepts. Classification of spatial objects may not be possible unambiguously. A protuberance, for example, may be both, a mountain and a hill.
- **Ambiguity**: Ambiguity arises if a classification produces different results if using the same classification but different procedures. The boundaries between the classes may be vague but the difference emerges from the classification process and not from the vague boundary itself.
- **Discord**: As shown with the concepts of vagueness and ambiguity classification schemes are used to form sets. It may happen that different classification schemes are used when creating different data sets. Contradictions between data sets emerging from differences in classification schemes are called discord.

The deviations influence decisions based on the data. Let us assume the following example: We navigate in an unknown city by walking through the streets. While walking we observe the layout of the streets and memorize these data. We can use that data to navigate between points in the network. However, we may face problems while driving a car in the same network since we usually do not observe driving restrictions while walking. Similar situations may occur with spatial planning if the data used was acquired for a different purpose. Data on the soil, for example, may be gathered for agricultural purposes and may ignore facts restricting the load capacity of the soil. This may lead to situations where buildings or parts of buildings start to sink.

A question to be answered when using data is the following: Does the data contain all information necessary to solve the problem? The answer to this question is called fitness for use as introduced by Chrisman (1984). A data set is fit for use if the amount of deviations is small enough to produce a useful output. In above example of a street network the data was useful for a pedestrian but not for a car driver.

4 TYPES OF SPATIAL PLANNING

Planning Portal, the internet portal of the UK Government for planning information, gives the following explanation for spatial planning: Spatial planning goes beyond traditional land use planning to bring together and integrate policies for the development and use of land with other policies and programmes which influence the nature of places and how they function (UK Government 2005). Spatial planning thus deals with development and use of land. Spatial planning shall also guarantee that the necessary processes can take place. The processes vary with the planning area. Spatial planning for small areas like the central place in village deals with local processes and may serve as a place for shopping, meeting other people, or celebrations. Planning for large areas must consider processes within a larger framework like nature preservation or transit. Spatial planning must include a verification to guarantee that the processes can be performed in the intended way.

Two approaches can be separated for the verification. The traditional approach produces models of the planned situations and presents them to the public for discussion. The models can be 2D or 3D, static (pictures) or dynamic (animations), analogue or digital. Geertman and Stillwell show the changes induced by the introduction of GIS in the 1990s (Geertman and Stillwell 2000). The basic idea of this type of planning is to represents reality with a model and to plan within the model. Rottenbacher proposes a different approach (Rottenbacher 2003). She suggests planning in the field. The focus is on the processes as understood by the citizens and grounds these processes in common experience of the reality.

We can separate two different cases of spatial planning. In the first case the planner faces a specific situation, that does not work properly. Examples for such situations are traffic situations where the increase in traffic density leads to breakdowns of traffic flow or destroyed infrastructure after a natural disaster like flooding or hill slide. The second case shall provide guidelines for future development. The planner provides a framework that must be filled successively by others whereas in the first situation the planner directly creates a new situation.

When dealing with a specific situation the planner must look closely at the situation at hand and must compare the existing objects with the objects necessary to fulfil the functions needed by the society. The objects in this case will usually be different areas of land. The areas must be bounded by visual obstacles like height differences, fences, rows of poles, or vegetation. Additional separation may come from the material covering the area. Meadows provide a different kind of use than areas covered with concrete or stone floor. The planning thus must be very specific and the definition of the objects is important. Depending on the situation it may be more convenient to

- create a solution as a common decision of the group affected or
- prepare a number of solutions and select one (e.g. in a public participation process).

The first case presents a communication problem. A group of persons must communicate and together develop a solution that meets their common demands. The method proposed by Rottenbacher works that way. The group commonly experiences the area by walking through it and discussing historic events, present structure and future development. The drawback of this method is the limitation to a small group of persons and a small area. It is possible to discuss if the group consists of a few dozen individuals and walking is possible if the area can be explored within a couple of hours. If the area or the group of persons is too large, other methods of communication must be found. This leads to the second case where an expert prepares a number of scenarios and only these scenarios are discussed in a larger group. The presentation of these scenarios usually include the virtual models mentioned in section 1. A solution between those extremes could utilize the Internet as a medium for discussion and creation of a solution (Navratil and Harnoncourt 2004).

It is impossible to experience the current situation directly if spatial planning shall provide a guideline for future development of a large area. This type of planning must rely on data describing the existing situation. Since the planning shall guide future development, the objects in the result can only be classes of objects and not physically existing instances. A development plan, for example may contain areas for housing and may even specify the density and height of the buildings or give some guidelines on the placement of the buildings. However, he development plan does not specify the buildings itself. The classes used in development plans are defined in laws.

We have seen three different types of spatial planning:

- Type A: Planning for future development
- Type B: Planning for dealing with a specific situation where planners propose solutions and a discussion leads to a decision
- Type C: Planning for dealing with a specific situation where the affected agents develop a solution

5 SPATIAL PLANNING IN THE CONTEXT OF THE 5-TIER ONTOLOGY

Planning is done by cognitive agents. The agent may plan according to his personal interests or as a representative of the society. An example for the first case is planning a vacation. The agent defines the goal and plans the vacation accordingly. After performing the vacation he checks if the goal was reached. Missed goals will typically lead to a change in the planning process. In the second case the agent acts on behalf of the society. The result of the planning process must fit the goals of the part of society affected by the planning.

The agents deal with socially constructed objects or physical objects while planning. A typical example for planning of type A is development plans for a region. The development plan separates the land into different classes, which are socially constructed. The definitions of these classes are written down in laws and can be formalized (Navratil 2002). The result of such a planning process is a subdivision into socially constructed objects like an area for housing. At the time of creation it may not be different from areas intended for other purposes like recreation, production, or transportation. The membership of that area to the class area for housing provides functions, which may result in legally created houses. These houses then are physical objects whereas the originally described area is only socially constructed.

Planning of types B and C includes dealing with real world objects. The goal of the planning process must support the functions needed by society. This requires socially constructed objects like lanes, sidewalks, pedestrian crossings, traffic lights, or parking lots. Although there may be no difference between the surface and shape of lanes and sidewalks they support different functions. These functions separate them from each other and thus they are socially constructed. Some of the functions required by society may include real world objects like vegetation or benches. The collection of objects depends on the functions that must be provided. The result of the planning shall be a working environment. The planner must arrange real world objects, where some of them must have special properties to serve a specific social purpose. Bands of asphalt, for example, must have a minimum width to serve as lanes.

The depiction of a possible solution as in planning type B is done for cognitive agents. The goal is to simulate an observation of the changed situation. The planner creates a model of the solution and shows it to the group of persons deciding about the solution. Contrary to the method where the involved persons experience the reality and use their imagination to discuss about the arrangement, the persons now has a clear understanding. The model thus must contain representations of all relevant real world objects to give the correct impression. This method has the advantage that each agent has the same observations and differences in the imagination cannot lead to misunderstandings. The disadvantage is that in general the reality will differ from the model. Especially wear can change the impression of constructions dramatically and buildings, that look nice when they are new may look deterring after a few years.

6 QUALITY REQUIREMENTS

Planning of type A starts from an existing situation and uses defined classes to streamline future developments. The description of the existing situation should include existing use of the land and parameters that conflict with specific types of use. It may not be a clever idea to dedicate swamps to industrial use, for example. It is therefore important to know about the properties of the land and changes should be documented in the data. Thus the data set must completely describe all influential parameters and contain all occurrences. Commission may create a problem if the correct situation conflicts the intended use. This fact becomes more important if the planner is far from the area he is working on. The larger the area of planning the higher is the probability that an error of omission or commission will go undetected and may create problems when trying to implement the plan.

The requirements for positional accuracy are rather low for planning of type A for large areas. This type of planning must be complemented by local planning and finally leads to planning of types B and C. During this process the requirements for positional accuracy increase and end in checking the legal compliance of determined buildings, where deviations of observations are ignored by judges (Twaroch 2005). Especially when creating virtual worlds of planned situations positional accuracy is important because gaps may result in image errors and may cause the spectator to reject the solution.

Semantic accuracy is an important aspect for defining the current situation in the planning type A. Differences between the semantics used to create the data set and the semantics used to read it will lead to misinterpretation. This may cause planning results that cannot be implemented or create high costs when implemented. Planning of type B is less critical on semantic accuracy. The reason is that the planner can visually check the reality and compare it to the data he works with. Differences in the semantics will be detected by the planner and can be eliminated before the planning process starts. This becomes even more evident in the planning type C, where the involved persons do not use data to create a solution but use direct observation of the reality.

Requirements for concurrency are similar to those on semantic accuracy. Since planning of type A requires complete sets of data the demands for up-to-data data sets are high. If it is possible to compare the data to reality, concurrency becomes less important.

Vagueness occurs with real world objects only. Socially constructed objects cannot be vague since the concepts separating the objects are clearly defined in the laws. Therefore the results of spatial planning of type A does not contains vagueness. The basic data, however, may be vague and thus clear definitions are important to deal with this problem. An example for such a situation is the definition of forest. The Austrian law links the class ‘forest’ to the economy of forestry. Areas are part of the class ‘forest’ if they are used for forestry. This eliminates problems like:

- How many trees are required to form a forest?
- How dense must the trees be to be called a forest?
- Is a street crossing a forest part of the forest or does it split the forest in two parts?
- Etc.

Problems of ambiguity and discord are avoided by using a single data set and a single classification scheme. This leads to higher quality demands concerning completeness and semantic accuracy since automatic checks of correctness are impossible if there are no independently created data sets.

7 CONCLUSIONS

We have separated three types of planning. Each of these types has specific quality requirements. Demands on semantic accuracy and completeness increase with the distance between planner and reality or with the size of the area. The demand for spatial accuracy, however, increases with the planning detail.

We have also seen that the problems of uncertainty are changed into problems of data quality. The use of adequate definition methods for the classes creates unique data sets. Problems of fuzzy boundaries are solved by unambiguous legal rules. As a result of this procedure the requirements for completeness and semantic accuracy become more important. Since the problem of currency also leads to an increase in the demands for completeness and semantic accuracy, these two are the most important quality parameters for planning situations where the planner cannot verify the data used for planning.

Planning of specific situations has lower requirements on completeness and semantic accuracy but has an increased need for positional accuracy. This fact is also reflected by the selection of scales in analogue approaches. Planning of large areas used scales of 1:20.000 and smaller whereas local planning was usually done using 1:10.000 and planning of concrete situations like single houses used 1:500. Since the pens used to draw these maps where the same in all cases the positional accuracy changed dramatically. Unfortunately with the use of computer systems and their unlimited zooming capacity this close connection between planning and positional accuracy was lost.

8 REFERENCES

Al-Taha, K. and R. Barrera (1994). Identities through Time. International Workshop on Requirements for Integrated Geographic Information Systems, New Orleans, Louisiana.

Altmaier, A. (2004). Virtuelle 3D-Regionen - GDI in der Praxis. AGIT, Salzburg, Austria, Wichmann.

Arleth, M. (2005). Future Tools for Area Administration and Public Participation. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Borovsky, P., G. Hesina, et al. (2005). MetropoVis: Time-Dependent Real-Time Rendering of Large and Photorealistic Virtual Cities. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Brassel, K., F. Bucher, et al. (1995). Completeness. Elements of Spatial Data Quality. S. C. Guptill and J. L. Morrison, Elsevier Science**:** 81-108.

Busch, H. and J. Lüthy (2004). Laserscanning in der Raumplanung. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Cavicchia, G. (2004). The Use of Information Technologies in the Urban Redevelopment Process in the City of Baltimore, USA. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Chrisman, N. R. (1984). "The Role of Quality Information in the Long-Term Functioning of a Geographical Information System." Cartographica **21**: 79-87.

Cromley, R. G. (1988). A Vertex Substitution Approach to Numerical Line Simplification. Third International Symposium on Spatial Data Handling, Sydney, Australia, IGU.

Dapp, K. (2005). Der Umgang mit räumlichen Informationen in der politischen Diskussion - Erfahrungen aus dem Hessischen Landtag. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Dorffner, L. and A. Zöchling (2004). Das 3D-Stadtmodell von Wien - Grundlage für Planungsaufgaben und Visualisierungen. AGIT, Salzburg, Austria, Wichmann.

Drewe, P. (2005). What about time in urban planning & design in the ICT age? CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Erickson, C. (1996). Polygonal Simplification: An Overview. Chapel Hill, Department of Computer Science, UNC Chapel Hill.

Ferko, A., J. Martinka, et al. (2004). Virtual Heart of Central Europe. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Fisher, P. F. (1999). Models of Uncertainty in Spatial Data. Geographical Information Systems - Principles and technical Issues. P. A. Longley, M. F. Goodchild, D. J. Maguire and D. W. Rhind. New York, Wiley & Sons, Inc. **1:** 191-205.

Fisher, P. F. (2003). Data Quality and Uncertainty: Ships Passing in the Night! International Symposium on Spatial Data Quality, Hong Kong, Hong Kong University Press.

Forkert, G., A. Haring, et al. (2005). Der Einsatz von Fahrzeug-gestütztem 3D-Laserscanning für kommunale Anwendungen. AGIT, Salzburg, Austria, Wichmann.

Frank, A. U. (2000). Communication with maps: A formalized model. Spatial Cognition II (Int. Workshop on Maps and Diagrammatical Representations of the Environment, Hamburg, August 1999). C. Freksa, W. Brauer, C. Habel and K. F. Wender. Berlin Heidelberg, Springer-Verlag. **1849:** 80-99.

Frank, A. U. (2001). "Tiers of ontology and consistency constraints in geographic information systems." International Journal of Geographical Information Science **75**(5 (Special Issue on Ontology of Geographic Information)): 667-678.

Ftáčnik, M., P. Borowský, et al. (2004). Low Cost High Quality 3D Virtual City Models. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Geertman, S. and J. Stillwell (2000). "Geoinformation, Geotechnology and Geoplanning in the 1990s." Working Paper - School of Geography University of Leeds **2000**(1): 29.

Guptill, S. C. and J. L. Morrison, Eds. (1995). Elements of Spatial Data Quality, Elsevier Science.

Hagen, H., G. Steinebach, et al. (2005). Datenmanagementsystem für die Stadtplanung. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Helmert, F. R. (1872). Die Ausgleichungsrechnung nach der Methode der kleinsten Quadrate. Leipzig, Germany, B. G. Teubner-Verlag.

Hesina, G., S. Maierhofer, et al. (2004). Texture Management for High-Quality City Walk-Throughs. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Holzer, J. and G. Forkert (2004). Effiziente Erzeugung von 3D Stadtmodellen aus vorhandenen Vermessungsdaten. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Hornsby, K. and M. J. Egenhofer (1997). Qualitative Representation of Change. Spatial Information Theory - A Theoretical Basis for GIS (International Conference COSIT'97). S. C. Hirtle and A. U. Frank. Berlin-Heidelberg, Springer-Verlag. **1329:** 15-33.

Kerschner, M. (2005). Die Nutzung von 3D-Stadtmodellen auf GIS-Arbeitsplätzen. AGIT, Salzburg, Austria, Wichmann.

Kranz, O., F. Siegert, et al. (2005). Generierung interaktiver 3D-Stadtinfoirmationssysteme aus Daten der High REesolution Stereo Camera (HRSC) am Beispiel des 3D-Stadtplans München. AGIT, Salzburg, Austria, Wichmann.

Mambretti, I., E. Lange, et al. (2004). Evaluation of Visual Attributes in Urban Parks Using Conjoint Analysis. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Mantler, S., G. Hesina, et al. (2005). Real-Time Rendering of Vegetation and Trees in Urban Environments. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

Medak, D. (2001). Lifestyles. Life and Motion of Socio-Economic Units. A. U. Frank, J. Raper and J.-P. Cheylan. London, Taylor & Francis. **8:** 139-153.
Morgan, M. G. and M. Henrion (1990). Uncertainty. Cambridge, UK, Cambridge University Press.
Navratil, G. (2002). Formalisierung von Gesetzen - Am Beispiel des Österreichischen Allgemeinen Grundbuchsgesetzes. Vienna, Institute for Geoinformation.
Navratil, G. and M. Harnoncourt (2004). geoTalk: eine Raum-Zeit-Kommunikationsplattform. CORP, Vienna, Austria.
Paar, P., O. Schroth, et al. (2004). Steckt der Teufel im Detail? Eignung unterschiedlicher Detailgrade von 3D-Landschaftsvisualisierung für Bürgerbeteiligung und Entscheidungsunterstützung. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Poesch, T., R. Schildwächter, et al. (2004). Eine Stadt wird dreidimensional: 3D Stadtmodell Bamberg. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Rottenbacher, C. (2003). "Das Gehen im bewegten Planungsprozess." Zoll+ Schriftreihe österreichischer Landschaftsplanung und Landschaftsökologie(3): 4-7.
Salgé, F. (1995). Semantic Accuracy. Elements of Spatial Data Quality. S. C. Guptill and J. L. Morrison, Elsevier, Oxford**:** 139-151.
Searle, J. R. (1995). The Construction of Social Reality. New York, The Free Press.
Steidler, F. and M. Beck (2004). CyberCity Modeler, Generation, Updating and Continuation of 3D-City ModelsWith On-Line-Editing - Visualization With TerraView 2.0. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Steidler, F. and M. Beck (2005). CyberCity Modeler: Automatic Texturing of 3D City Models; TerrainView-Web: 3D Web-VRGIS. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Tchistiakov, A., J. Jellema, et al. (2005). eEarth: Bridging the Divided National Geo-Databasesvia Multilingual Web Application. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Twaroch, C. (2005). Richter kennen keine Toleranz. Intern. Geodätische Woche, Obergurgl, Wichmann.
UK Government. (2005). "Planning Portal Glossary." www.planningportal.gov.uk.
Veregin, H. (1999). Data Quality Parameters. Geographical Information Systems. P. A. Longley, M. F. Goodchild, D. J. Maguire and D. W. Rhind, John Wiley \& Sons, Inc. **1:** 177-189.
Von Wirth, T. and M. Schrenk (2005). CENTROPE_MAP: Building a Cross-Border Geo-Data-Infrastructure. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Wang, R. Y. and D. M. Strong (1996). "Beyond Accuracy: What Data Quality means to Data Consumer." Journal of Management Information Systems **12**: 5-34.
Warren-Kretzschmar, B., A. Neumann, et al. (2005). Interactive Landscape Planning - Results of a Pilot Study in Koenigslutter am Elm, Germany. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Weiss, P. and L. Dorffner (2005). Generalisierung von Mehrzweckkarte und 3D Modell der Stadt Wien. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.
Zadeh, L. A. (1965). "Fuzzy Sets." Information and Control **8**: 338-353.
Zeile, P., R. Schildwächter, et al. (2005). 3D-Stadtmodell-Generierung aus kommunalen Geodaten und benutzerspezifische Echtzeitgenerierung mithilfe von Game-Engine-Techniken. CORP & GeoMultimedia, Vienna, Austria, Selbstverlag des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien.

🏆 **reviewed paper**

Virtual 3D City Models as Foundation of Complex Urban Information Spaces

Jürgen DÖLLNER, Konstantin BAUMANN, Henrik BUCHHOLZ

University of Potsdam, Hasso-Plattner-Institut

{juergen.doellner, konstantin.baumann, henrik.buchholz}@hpi.uni-potsdam.de

1 INTRODUCTION

Virtual 3D city models represent spatial and geo-referenced urban data by means of 3D geovirtual environments that basically include terrain models, building models, vegetation models as well as models of roads and transportation systems. In general, these models serve to present, explore, analyze, and manage urban data. As a characteristic element, virtual 3D city models allow for visually integrating heterogeneous geoinformation within a single framework and, therefore, create and manage complex urban information spaces.

An increasing number of applications and systems incorporate virtual 3D city models as essential system components such as for urban planning and redevelopment, facility management, logistics, security, telecommunication, disaster management, location-based services, real estate portals as well as urban-related entertainment and education products. Consequently, a large number of potential users and usages require an efficient and effective access to and tools for virtual 3D city models and their contents.

The requirements on virtual 3D city models vary between different applications. On the one hand, in the context of tourism, entertainment, or public participation, a high degree of photorealism is required (Fig. 1 left). For instance, if the aim is to give a realistic impression of a planned environment, the quality of a 3D visualization is directly related to the similarity between the virtual city model and the actual result after implementation of the planning.

On the other hand, in applications that attempt to provide analytical and exploratory functionality, visual details of buildings are not of primary interest. Instead, the 3D representation of a city model serves as a medium to convey spatial-related thematic information in a comprehensive way. In the context of urban planning, e.g., thematic building information such as vacancy, ownership, or year of construction have to be considered. As an example, the illustration (Fig. 1 right) created by the Senate Department of Urban Development, Berlin, shows a 3D overview of the ownership structure of an urban area. While in 2D GIS applications exploration and analysis of thematic spatial-related objects and associated thematic information is a common practice, the potential of virtual 3D city models as a medium to communicate complex urban information spaces has not been explored extensively.

Fig. 1: Different design requirements on 3D city model visualization: Photorealistic visualization to give an intuitive impression of existing or planned environments (left) and abstract visualization to encode thematic information (right).

2 GEODATA FOR VIRTUAL 3D CITY MODELS

In practice, the creation and maintenance of virtual 3D city models is based on a number of independent data sources since the sustainable management of 3D city models requires tight links to existing administrative work flows and databases. As a major challenge, these data sources have to be integrated in a systematic and pragmatic way and include:

- Cadastral Data: The cadastral databases deliver the official footprints of buildings and land parcels as well as ownership and address information. Although typical cadastral databases do not contain 3D data, they provide essential input for 3D building models and a kind of official foundation for virtual 3D city models.
- Digital Terrain Models and Aerial Photography: These data sources include, e.g., grid-based DTMs and true-ortho photos. DTMs are used as a reference surface for all geometric objects of a virtual 3D city model, whereas aerial photography provides essential data for photorealistic visualization, e.g., land coverage images and roof textures.
- 3D Building Models: 3D building geometry can be captured and processed by laser-scanning and photogrammetry-based methods. The buildings are represented at various levels of detail (Kolbe et al. 2005), including block-models (LOD-1), geometry-models (LOD-2), architectural models (LOD-3), and detailed indoor models (LOD-4). In addition, continuous level-of-detail buildings as needed during incremental refinement processes are supported, e.g., by SmartBuildings (Döllner et al. 2005). For capturing and processing 3D geodata, several cost-effective methods have been developed (Ribarsky et al. 2002, Förstner 1999).

- Architectural Models: In addition to 3D building models, architectural models can be incorporated such as historic or future ensembles and redevelopment plans. In general, these models include not only buildings but also their surrounding environment at a high level of detail.

There is no widely accepted standardized convention for encoding virtual 3D city models. A first proposal for virtual 3D city models, CityGML, is currently discussed by the Open Geospatial Consortium (OGC). In general, the following data standards are used in practice:

- CityGML, in particular, for building models
- 3D-Studio MAX object files and VRML files
- ESRI Shapefiles with 2D footprint polygons and height values for each building
- ESRI Shapefiles containing an explicit geometric description of each building in the form of boundary polygons.

Apart from the geodata listed above, virtual 3D city models also store or reference classical georeferenced 2D raster-data sources (e.g., land use information) and vector-data sources (e.g., road network, public transportation networks). These data sets are visualized, for example, as an image layer superimposed on the digital terrain model.

Complex urban information spaces refer to virtual 3D city models integrating thematic and application-specific georeferenced information that is jointly presented and related to the geometric entities of virtual 3D city models. For example, a real-estate portal may want to visualize vacancy, year-of-construction, and average monthly rent of buildings within the virtual 3D city model using façade color, façade texture, and roof colors as visual variables to indicate that information.

3 THE LANDXPLORER SYSTEM

In this paper, we introduce the software architecture and system components of a new system for creating, managing, securing, and distributing complex, large-scale virtual 3D city models, called LandXplorer. It has been developed at the Hasso-Plattner-Institute as common software platform for 3D geovisualization techniques and systems. Based on LandXplorer, a number of products for urban planning and city models have been created, including the LandXplorer Studio (3dgeo 2005).

The system supports 3D terrain models, 3D building models, 3D street space models, and 3D vegetation models as so-called first-class objects, that is, they represent primary components in contrast to first-generation, graphics-oriented virtual 3D city solutions. The system facilitates the automated transformation of traditional vector-based 2D planning information into a 3D model based on a heuristic-algorithmic approach.

Besides core functionality for importing, instantiating, and modifying components of virtual 3D city models, the system concentrates on functionality to control usage of distributed virtual 3D city models and to transform contents of virtual 3D city models into a number of different media. For example, the system supports the automated extraction of customer-specific spatial regions and thematic information layers into a self-contained, ready-to-use viewing application, e.g., for Internet download or DVD production. This process relies on a geospatial digital rights management, which enables and simplifies the broad use of digital model contents.

The system architecture is modeled as an open platform to facilitate diverse applications of the virtual 3D city model both in administration and industry. In contrast to previous systems, LandXplorer is considered to act as an integration platform for 2D and 3D geodata and georeferenced data instead of being only a 3D graphics system. Its main objectives encompass the management of the underlying 3D geoinformation and its integration into administrative workflows by a central 3D geo-database; the on-demand, on-the-fly integration of georeferenced thematic data with (parts of) the virtual 3D city model, and the dissemination and distribution of the virtual 3D city models through a number of digital media such as Internet, imagery, video, and DVD. This way, LandXplorer creates complex urban information spaces based on virtual 3D city models.

3.1 System Components

The overall architecture of the system is outlined in Fig. 2. In the project, we identified the following principal system components:

- 3D Authoring System: It is responsible for creating, editing, and versioning of the 3D city models and its components, e.g., importing, exporting, grouping, and annotating buildings, vegetation plans, landscape plans, etc. Technically, it provides an interactive access to the 3D geo-database.
- 3D Geo-Database System: The database for storing and managing 3D city models is based on the logical structure of CityGML, which represents a first XML and GML-based format for storing and exchanging virtual 3D city models (Kolbe et al. 2005). It also supports semantic and thematic properties, taxonomies and aggregations. Its principal object, the city object, represents geo-referenced, geometric entities. Specialized classes of city objects include buildings, green spaces, street spaces, transportation networks, water bodies, vegetation, and plants. It is implemented as an independent subsystem, and it does not provide visualization functionality.
- 3D Editor Systems: These systems are responsible for creating and editing specific 3D objects such as architectural building models or 3D landscape models. We apply both the ArchiCAD editor for architectural models and 3D Studio Max as general-purpose 3D modeler. This approach allows us to support a broad spectrum of digital 3D contents and to fulfill needs of specific applications and users with respect to 3D digital contents.
- 3D Presentation Systems: The presentation systems provide real-time visualization of and interaction with the virtual 3D city model. In contrast to the 3D authoring system, the presentation systems are targeted at specific media (e.g., Internet, DVD) and specific user groups (e.g., general public, experts, and politicians). For example, within a showroom, a large-screen projection can give impressive presentations tailored to the specific needs of clients based on pre-defined 3D points-of-interests.

- Geospatial Digital Rights Management System: As a complementary functionality, a geospatial digital rights system allows for enclosing, compressing, and controlling digital contents of the virtual city model. Technically, a virtual city model can be serialized into a single data stream, compressed, and encrypted for export. In addition, a number of visualization techniques, such as adaptive visual watermarks and user interaction restrictions complement the DRM repertoire.

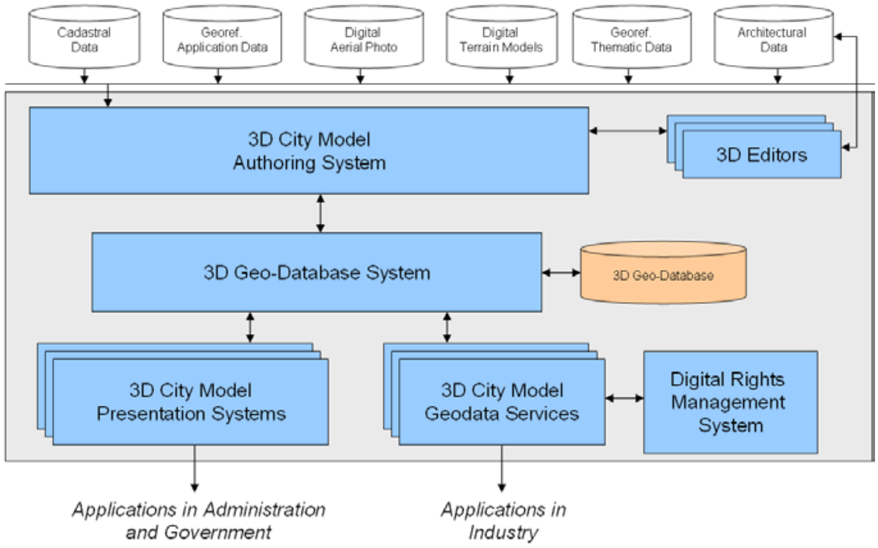


Fig. 2: Architecture and principal components of a virtual 3D city model system such as LandXplorer.

3.2 System Functionality

The LandXplorer functionality can be divided into the following categories:

- Editing Tools: These tools allow for the direct creation and manipulation of 2D vector graphics and 3D graphics objects. As a unique feature, 2D vector objects (points, lines, polygons, etc.) are edited “in situ”, that is, in the 3D view. With the building modeler, the footprints can be directly edited and extruded to 3D block models. As advanced tool, the smart building editor can be applied, which manages LOD-1 to LOD-4 building models based on a per-storey representation.
- Navigation Tools: Include metaphor-based interactive controls such as virtual helicopter, airplane, and pedestrian as well as gaming controls and classical 2D modes such as panning and zooming. The tools are complemented by a list-based selection of points-of-interest.
- Spatial Analysis Tools. Include tools to blend in distance grids and distance concentric circle around a specified location as well as tools to measure height and distance along paths. In addition, the morphology of the digital terrain model (e.g., slope, exposition, form) can be analyzed and visualized by superimposed terrain textures.
- Animation Tools: These tools allow for designing and recording animation sequences within virtual 3D city models. The basis elements represent 3D bookmarks, which capture a camera position and its parameters. A movie is implicitly defined by an ordered sequence of 3D bookmarks that are interpolated in pairs.
- Printing Tools: The system supports high-resolution snapshot generation based on a tiled production of images, e.g., used for poster printing. In addition, virtual panorama images and movies can be generated.
- Import and Export Tools: To transfer common 2D raster data and 2D vector data, the system supports standard GIS and computer graphics formats. For 3D graphics, models given as CityGML, 3DS, VRML, and X3D can be processed. Selected areas and model parts can be exported in common GIS formats and CityGML.

4 VISUALIZATION OF URBAN INFORMATION

Virtual 3D city models, in general, have become generic tools for an increasing number of application areas in administration and industry. For that reason, the requirements made on visualization vary. LandXplorer explicitly supports several visualization strategies and techniques.

4.1 Photorealistic Visualization

In the context of tourism, entertainment, or public participation a high degree of photorealism is required (Fig. 3). For instance, if the aim is to give a realistic impression of a planned environment, the quality of a 3D visualization is directly related to the similarity between the virtual city model and the actual result after implementation of the planning. To enable real-time rendering of large-scale 3D city models, their geometric complexity has to be reduced in order to guarantee high and constant frame rates. For virtual environments, geometry or texture related optimization and multiresolution algorithms and data structures can be applied to achieve real-time rendering even for complex virtual 3D city models (e.g., Beck 2003, Willmott et al. 2001).

Fig. 3: Example of a photorealistic representation of virtual 3D city models. The Berlin 3D model contains true-ortho photography and LOD-3 and LOD-4 building models. The colored lines show part of the underground network.

To extend the scope of photorealistic rendering, the LandXplorer system also provides a specialized rendering engine for 3D vegetation, the LandXplorer Lenné3D module, which also includes a library of 3D plant models. Plant and vegetation modeling represents a challenging task, particularly because botanical knowledge is required and manual processes are involved, for example, to collect images of plant parts, to scan leaf textures, to produce variants of a single plant, and to set up properties for a plant type. To achieve interactive frame rates, we have to solve a non-trivial problem: reduction of the massive geometric complexity. The complexity results from two facts: 1) A single plant model, e.g., a typical tree, commonly contains between 50,000 and 150,000 textured triangles, whereby large parts are spent for tree leafs. 2) The human experience in seeing and realizing plants is highly developed.

The Lenné3D project (Paar 2003) has developed new level-of-detail rendering techniques (Coconu & Hege 2003; Deussen et al. 2005) that drastically reduce the geometric complexity, e.g., by point-based and line-based simplification schemata. Consequently, with Lenné3D technology a high amount of photorealism for vegetation elements in virtual 3D city models becomes possible.

4.2 Information Visualization

For applications in information visualization and data mining, visual details of buildings are not of primary interest (Fig. 4). Instead, the 3D representation of a city model serves as a medium to convey spatial-related thematic information in a comprehensive way (Müller & Schumann 2002). In the context of urban planning, e.g., thematic building information such as vacancy, ownership, or year of construction has to be considered.

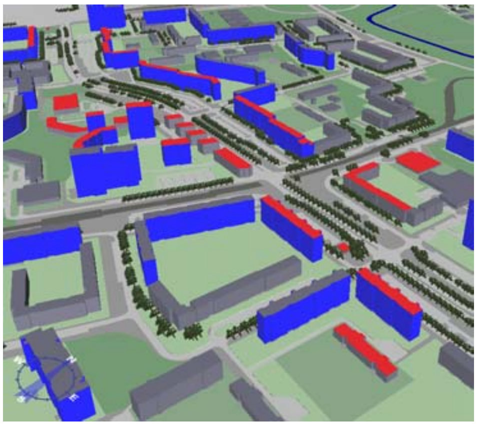


Fig. 4: Example of urban information visualization within 3D city models. Facades and roofs are used to project two independent information variables.

4.3 Illustrative Visualization

Non-photorealistic, interactive 3D city maps lead to a number of new solutions for effective and comprising visual display and user interfaces overcoming restrictions and transcending mindsets of photorealistic approaches (Strothotte & Schlechtweg 2002). Primary application areas include urban data mining, city and landscape planning, cartoon worlds in computer games, urban visual analytics, decision-support systems, and urban information systems. They all benefit from abstracted map-like depictions (Fig. 5) of 3D city models to get insights into complex geospatial and georeferenced urban information spaces. This approach is inspired by the tradition of depictions typically found in bird's-eye views and panoramic maps, and it combines related principles in cartography, geographic information systems, visualization, and arts (Döllner et al. 2005).

Fig. 5: Example of illustrative visualization for virtual 3D city models. Stylized and sketched buildings and facades provide a comprehensive, abstracted view to contents of 3D city models.

5 VISUAL DATA MINING

LandXplorer has been primarily motivated by the requirements of visualization in the context of urban planning and development. For example, in public participation processes such as public discussions between city planners, political decision makers, and the public, 3D city models can be applied to communicate ideas, e.g., where buildings and streets shall be removed, constructed or modified; and to discuss feasibility and consequences of certain plan ideas, e.g., how many people would be affected or which housing companies would be involved if a plan would be implemented.

5.1 Communicating Complex Information Spaces

Classical media such as 2D maps or 3D maps do not provide sufficient support for decision-making because they can only show prepared views. An effective tool for decision-support should permit dynamic adaptation of thematic views to the currently focused aspects of a discussion. That is, there are generally more information dimensions than dimensions currently visualized, and we cannot generally assume that specific dimensions are more important than others, in particular, if experts and non-exports want to explore parts of the information space for the first time. In the case of large-scale data sets, we furthermore need to be able to vary the scales in the visualization to support both locally and globally focused investigations.

As a basis for decision-support tools and other applications requiring insight to thematic data, LandXplorer supports visual data mining in large-scale 3D city models. As stated by Eidenberger (2004) “The main aspect of visual data mining is allowing direct communication of the user with the data space through flexible and easy to understand user interfaces”. The key characteristics of our system are interactivity and flexibility. As Müller and Schumann (2002) point out, “Interaction is crucial for effective visual data mining. The data analyst […] must be able to interact with the presented data and to change the visualizations and the mining parameters”. For this, we support navigating in the virtual space as well as controlling the mapping of thematic information to the city model’s appearance in real-time. Photorealistic detail information such as photo-textures for building facades are not excluded by our system but photorealistic views represent only one of several possible views on an underlying data set.

5.2 Visual Data Mining Using Building Models

For visual data mining, building objects are primary components used to visualize thematic information. Each building object consists of two components: a geometry description and a building-related attribute table storing application-specific information related to the building.

The geometry description contains different parts, each of which can be managed separately for information display. The standard parts include facade, roof, and unknown. The unknown category is used for buildings whose source specification does not provide the required information to separate facade geometry and roof geometry, e.g., if the whole building geometry is defined by a single set of polygonal faces.

The attribute table of a building is a set of key-value pairs. Keys are specified by strings; values can be strings as well, but also floating point, integer, or Boolean values, where all values for a certain key must be of equal type. The attribute table is the representation of thematic information within the 3D city model. These tables are created by filtering, importing, and merging one or more data sets into the 3D city model. The reason for the table is that we require a direct and efficient access to thematic information that potentially has an impact on the appearance of building models.

Each categorized geometric part of each building forms an own entity that can be accessed separately and can therefore be changed independently in its appearance. To be useful for visual data mining, 3D city model visualization must fulfill two fundamental requirements:

- It must provide means to make non-graphics building information visible, e.g., year of construction, vacancy, state of repair, or the importance of buildings.
- Changing the appearance of buildings must be possible interactively.

To meet the first requirement, we consider the graphics variables available for building models, which include:

- Building height
- Facade material, color, and texture
- Facade elements such as doors and windows
- Roof material, color, texture, and type.

These variables can be modified according to thematic data but are frequently needed to support orientation within a city. By integrating different rendering techniques, we obtain additional graphics variables that have no equivalent in photorealistic presentations and, therefore, can easily be perceived as variables for abstract thematic data. Examples include:

- Edge styles applied to facades and roofs
- Transparency of buildings
- Highlights using haloing effects.

For instance, we can map the status of buildings as planned, existing, or torn off by different edge styles to outline the walls of a building. This kind of graphics variables allow for illustrative depictions known from many classical presentations in urban planning and architecture.

To meet the second requirement, visual data mining requires the functionality to interact with a 3D city model in three different ways:

1. Explicit selection: The user can select one or more individual buildings explicitly.
2. Spatial selection: The user can select a group of buildings within a certain area by drawing a polygon onto the terrain.
3. Rule-based selection: The user can specify a selection of buildings by defining a filter condition based on the attribute table of each building. All buildings whose attribute table meet the given filter condition are selected for editing.

A group of selected buildings can be edited simultaneously, either by manipulating their appearance or by changing the attribute table. As a shortcut of rule-based selection and editing, the system also allows for the definition of a color legend: For a certain key of the attribute table, an individual color can be mapped to each occurring value for the key.

6 CASE STUDY: THE BERLIN 3D CITY MODEL

In a three-year case study, we developed and applied the LandXplorer system to visualize complex urban information spaces for a number of cities. The core application areas are business location marketing and urban redevelopment. In our largest project, the virtual 3D city model of the city of Berlin, the LandXplorer system has been deployed by the Business Location Center, which supports companies considering relocating to Berlin-Brandenburg by presenting all key decision-making factors within the 3D geovirtual environment as well as in the Senate Department of Urban Planing, for exploring and evaluating redevelopment plans.

7 CONCLUSIONS

Virtual 3D city models represent a key component for geoinformation infrastructures and serve as basis for urban 3D decision support systems. Advanced virtual 3D city technology enables and provides tools for handling complex urban information spaces, going beyond classical graphics-only applications of 3D city models. 3D city model systems cover functionality such as managing, integrating, and distributing complex geoinformation based on a uniform communication metaphor, the virtual 3D city model.

In our experience, the decoupling of the system's functionality into subsystems for content authoring, editing, storing, and presentation leads to an open, extendible 3D city model system as exemplified by LandXplorer. As a fundamental concept, CityGML as well as a number of identified standard formats provide a high degree of interoperability. Innovative visualization techniques beyond photorealism, such as information visualization and illustrative visualization, allow us to address new application areas and improve the quality and usability of graphics display.

In our current activities, we are developing 3D geodata services to further extend the ways city models can be accessed by third-party applications and systems. In addition, techniques for the automated mapping of 2D landscape plans and architectural plans to 3D geovirtual environments based on a heuristic-algorithm approach are investigated.

8 REFERENCES

3D Geo: "LandXplorer Studio", www.3dgeo.de

Beck, M.: Real-time Visualization of Big 3D City Models. International Archives of the Photogrammetry Sensing and Spatial Information Sciences, Vol. XXXIV-5/W10, 2003.

Coconu, L., Hege, H.Ch.: Hardware-Accelerated Point-Based Rendering of Complex Scenes. Proc. of the 13th Eurographics Workshop on Rendering Techniques, Pisa, Italy: pp. 43–52, 2003.

Deussen, O., Colditz, C., Coconu, L., Hege, H.Ch.: Efficient Modelling and Rendering of Land-Scapes. In: Bishop, I. & E. Lange (Eds.), Visualization in Landscape and Environmental Planning, Spon Press, London: pp. 56-61, 2005.

Döllner, J., Buchholz, H.: Continuous Level-of-Detail Modeling of Buildings in 3D City Models. Proceedings of ACM GIS 2005, pp. 173-181, 2005.

Döllner, J., Buchholz, H., Nienhaus, M., Kirsch, F.: Illustrative Visualization of 3D City Models. Proceedings of the Conference on Visualization and Data Analysis, pp. 42-51, IS&T/SPIE, 2005.

Eidenberger, H.: Visual Data Mining. SPIE Information Technology and Communication Symposium (Internet Multimedia Management Systems), Philadelphia, USA, 2004.

Förstner, W.: 3D City Models: Automatic and Semiautomatic Acquisition Methods. Proceedings Photogrammetric Week, University of Stuttgart, pp. 291-303, 1999.

Kolbe, T. H., Gröger, G., Plümer, L.: CityGML – Interoperable Access to 3D City Models. To appear in: Proceedings of the first International Symposium on Geo-Information for Disaster Management, Springer Verlag, 2005.

Müller, W., Schumann, H.: Visual Data Mining, NORSIGD Info 2/2002, November 2002, pp. 4-7, 2002.

Paar, P.: Lenné3D – The Making of a New Landscape Visualization System: From Requirements Analysis and Feasibility Survey towards Prototyping. In: E. Buhmann & S. Ervin (Eds.): Trends in Landscape Modeling. Proc. at Anhalt University of Applied Sciences, Wichmann, Heidelberg: pp. 78-84, 2003.

Ribarsky, W., Wasilewski, T., Faust N.: From Urban Terrain Models to Visible Cities. IEEE Computer Graphics and Applications, 22(4):10-15, 2002.

Strothotte, T., Schlechtweg, S.: Non-Photorealistic Computer Graphics: Modeling, Rendering and Animation. Morgan Kaufman, 2002.

Willmott, J., Wright, L.I., Arnold, D.B., Day, A.M.: Rendering of Large and Complex Urban Environments for Real-Time Heritage Reconstructions. Proceedings of the Conference on Virtual Reality, Archaeology, and Cultural Heritage, pp. 111-120, ACM Press, 2001.

reviewed paper

Skylight Illumination and Rendering of Urban Scenes

Andreas REICHINGER, Stefan MAIERHOFER, and Robert F. TOBLER

(VRVis Research Center, Donau-City Str. 1/3, A-1220, Wien)

1 ABSTRACT

A realistic visualization of an urban scene can only be complete, if the aspects of illumination by the skydome as well as the direct visual appearance of the skydome are handled. For the visual appearance, panoramic images of skydomes are standard practice, however skydome illumination for urban scenery based on a realistic model is often neglected due to the large computational cost of the necessary simulation.

We demonstrate a workable solution for generating global illumination approximations for urban scenes. The actual illumination simulation is based on the skydome model by Preetham et al. [1999], which is used in an improved version of the photon map algorithm based on Jensens method [1996]. In order to speed up calculation we use an adaptive acceleration algorithm that calculates lightmaps for all buildings in a scene. By providing a viable solution for including realistic skydome illumination in the real-time visualization of urban scenes, we increase the achievable realism and thereby the acceptance and applicability of global illumination methods in applications such as tourism and planning.

2 INTRODUCTION

Interactive walkthrough applications are rapidly becoming a standard tool in urban visualization. Although these applications provide a significant improvement in the way building data is presented to the user — be it an urban planner or a tourist — the resulting experience is still far from reality. Thus there are a number of aspects of the visualization that do not reflect reality accurately. One of these aspects is illumination. Since urban scenes are normally illuminated by daylight, which is composed of direct sunlight and illumination by the skydome, a realistic simulation of typical illumination scenarios needs to reflect both of these illumination types. By providing illumination for urban scenes, the realism of typical walkthrough applications is sginificantly improved, but additional applications that estimate shadowing or illumination at specific times and seasons can be realized.

Due to these reasons we improved the global illumination algorithms that are part of the Advanced Visualization Engine (AVE) to include skydome illumination, and incorporated a number of necessary speedups for making the simulation possible within fairly short timeframes (on the order of a few hours a the most). The following sections give an overview of our solution.

3 GLOBAL ILLUMINATION

Global Illumination is the general term for using algorithms to simulate and approximate real illumination situations in synthetic scenes. In general, this is used to compute static images with realistic illumination. In order to use the results of global illumination algorithms in the context of urban visualization, it is necessary to make the calculation results available in an interactive viewer. To that end, we decided to store the results of the simulation in so-called „light maps“, illumination textures that are used in a renderer with multi-texturing capability and contain the direction-independet illumination for all objects in the scene.

3.1 Photon Maps

In order to precompute these lightmaps a number of algorithms are feasible, however we decided to use a hybrid approach that is based on the photon map algorithm developed by Jensen [1996, 2001, 2002]. The basic algorithm of the photon map is based on the simulation of the propagation of photons starting at the light sources. Each interaction of a photon with a surface is recorded in a data structure that allows fast searches for nearby hits, e.g. a k-d-tree. Once enough photons have been simulated, illumination at each point in the scene can be approximated by retrieving the closest photon hits at the query point. Using the k-d-tree the n closest hits are retrieved, and due to the resulting distance of the n-th closest photon hit a projected surface area can be computed. Dividing the power of the n closest hits by this projected surface area, results in an estimate for the radiance at the query point.

3.2 Heuristics to avoid Light leaks

Although this algorith works fairly well, it is normally used with a so-called „gathering pass“, that computes the illumination for each pixel in the scene by gathering all illumination affecting the closest object visible in that pixel. This gathering pass is very costly and cannot be efficiently used in conjunction with the generation of lightmaps.

Therefore our hybrid algorithm skips the gathering pass and directly uses the photons stored in the k-d-tree to compute the illumination. This works fairly well for a number of scenes, however the k-d-tree does not store any information about the underlying geometry and can lead to light and shadow-leaks for some types of geometry. In order to overcome these problems we introduced two heuristics that improve the quality of the resulting lightmaps.

The first heuristic computes a better estimate of the area of the n closest photons. This is done by computing the area of these photons using an extended, two-dimensional bounding box of the relevant photons using eight instead of four values to represent the area. Thereby, the covered area is approximated using a generalized octagon, leading to an adequate approximation (see figure 1).

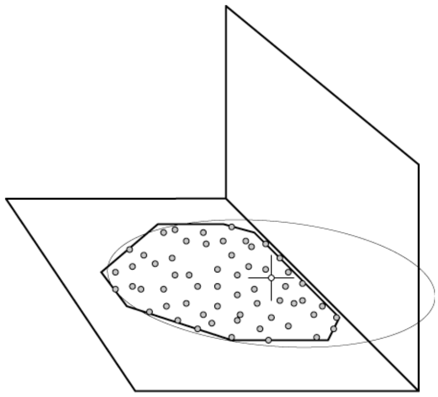


Figure 1: Improved area estimate for computing illumination: the octagon represents a far better approximation than the circle around the query point.

The second heuristic avoids shadow-leaks by casting additional feelers from the query point. These feelers run parallel to the surface and are sent into four or eight equally spaced directions (every 90 degrees or every 45 degrees). By eveluating the extent of free space around the query point in all of these directions, all photons around the query point can be classified if they should actually be used to estimate the illumination. If some photons are outside the region that is covered by the feelers, they are assumed to be behind a wall and discarded from the illumination estimate for this query point (see figure 2).

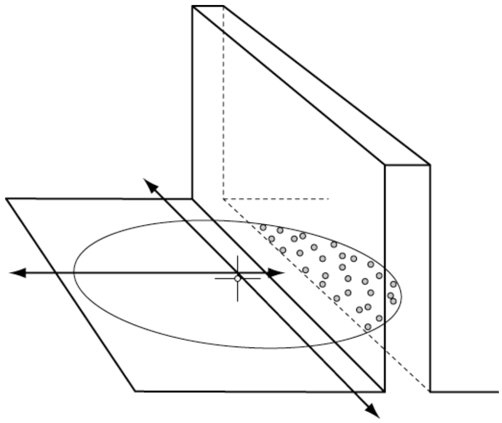


Figure 2: Region feelers are used to discard photons that cannot possible contribute to the illumination at the query point.

3.3 Point light sources

Although point light sources could be handled by the standard photon map algorithm, the speed and quality of the resulting lightmaps could be improved by using direct light source sampling. This is achieved by shooting direct shadow feelers from each lightmap texel to each point light source and thereby calculating whether the corresponding texel is illuminated. By using an adpative version of direct light source sampling, aliasing artefacts in the shadow edges could be avoided.

4 SKYDOME ILLUMINATION

A number of analytical models have been developed to describe sky radiance and its spectral radiance in the context of photorealistic image synthesis; we just give a brief overview over those models.

It should be noted that there exists a significant body of additional work on this topic — such as for instance by Tadamura et al. [1996] or Dobashi et al. [1997] — of which we are well aware, but which we omit in this discussion. These papers also offer valuable insights into the synthesis of absolute skylight radiance values and could equally well have served as base skylight models for our developments.

4.1 Skylight models

For simple sky conditions, the CIE Skylight model [1994] provides satisfying results. An increase in luminance towards the horizon and a bright area around the solar disc can be observed, which result in a quite convincing overall appearance. For higher sun positions this model proves quite useful, however for lower sun positions it lacks the necessary hue variations towards the red part of the spectrum. The model only describes the luminance distribution and a basic color has to be selected, and therefore effects like the red glow of sunset cannot be achieved.

The Perez model [Perez et al., 1993] is similar to the CIE model, but it introduces an additional parameter that accounts for the haze in the atmosphere. The Perez model has been found to be slightly more accurate than the CIE model if its parameters are chosen wisely.

One of the most sophisticated skylight models so far is the one defined by Preetham et al. [1999]. The main improvement offered by their approach is that it provides genuine spectral radiance values for each sample; in this way the varying color hues of natural skies are taken into account. The images produced with this model are very appealing, while the required computational effort is still basically similar to the other models. Due to these advantages we based our skydome illumination on this model.

4.2 Calculating Skylight illumination

The computation of illumination due to a skylight model can be split into two separate tasks: computing direct sunlight illumination and computing the illumination due to the skydome. Direct sunlight can be adequately handeled by approximating the sun with a point light source. The minimal error due to the size of the sun-disk can be neglected in the context of an urban model.

The computation of skydome illumination, however, turns out to be very costly if the standard photon mapping algorithm is used. As this algorithm simulates the photons starting from the light source, it is necessary to target the photons towards the scene. But even with targeting the photons the resulting quality was not satisfying.

For this reason we again used direct light source sampling for the skydome. Thus for each light map texel a number of shaodw feelers are sent towards the skydome, and the radiance of all feelers that are not blocked by geometry is accumulated. Our first approach, using randomly distributed shadow feelers resulted in a high level of noise in the illumination, therefore we switched to quasi-random sampling using a Halton series to compute skydome illumination.

Although the resulting quality was satisfying, the computation time was an order of magnitude to high. This problem was overcome by using a hierarchical sampling approach. First the skydome illumination is computed on a much coarser grid than provided by the lightmap texels, e.g. only one skydome illumination computation for each 16 x 16 lightmap texel. Only if neighbouring computation yield significantly different results, we subdivide and compute the illumination on a finer grid otherwise intermediate pixels are simply interpolated. Only very rapid changes in skydome illumination will lead to computations for each and every light map texel. But since skydome illumination, by ist very nature is varying only very slowly, this hierarchical sampling approach results in impressive speedups.

5 APPLICATION TO URBAN SCENES

In order to demonstrate the presented algorithms for urban scenery, we chose the models provided by the city of Graz. These models are of medium geometric complexity, with most of the visible detail embedded in the textures. This type of model can be generated nearly automatically and can therefore be captured at a moderate cost.

By simulating global illumination in such urban models, a number of new applications for urban models can be realized:

Calculating the impact of shadowing on changes in urban plans: due to the physically based simulation of the illumination a fairly exact estimate of the extent and duration of shadows cast by various buildings can be performed. This can lead to improvements in planning, especially of very large buildings.

The visual impact of new buildings can be more accurately estimated, as their influence on the illumination of nearby buildings can be computed in advance.

The realism of urban walkthrough applications can be increased, thereby increasing their attractivity in e.g. applications for toursim.

6 RESULTS

The following result images show screenshots of an interactive walkthrough of the city of Graz. Figures 3, 4, and 5 show the same scene, rendered with the global illumination information (3), without global illumination information (4), and just the global illumination information without textures (5). Figures 6, 7, and 8 show different screenshots, demonstrating sharp shadows cast from the sun that is handled as point light source (6), the effect of sun and skydome illumination on an urban plaza (7), and the skydome gradient around the sun (8). The illumination in this visualization was precomputed in less than an hour using the described algorithms. The resulting lightmaps were rendered using the multi-texture feature of the Advanced Visualization Engine (AVE) (www.vrvis.at/rendering/research/ave) developed at the VRVis Research Center (www.vrvis.at).

Figure 3: Screenshot from an interactive walkthrough with precomputed illumination and skydome.

Figure 4: The same scene as figure 3, without global illumination calculation.

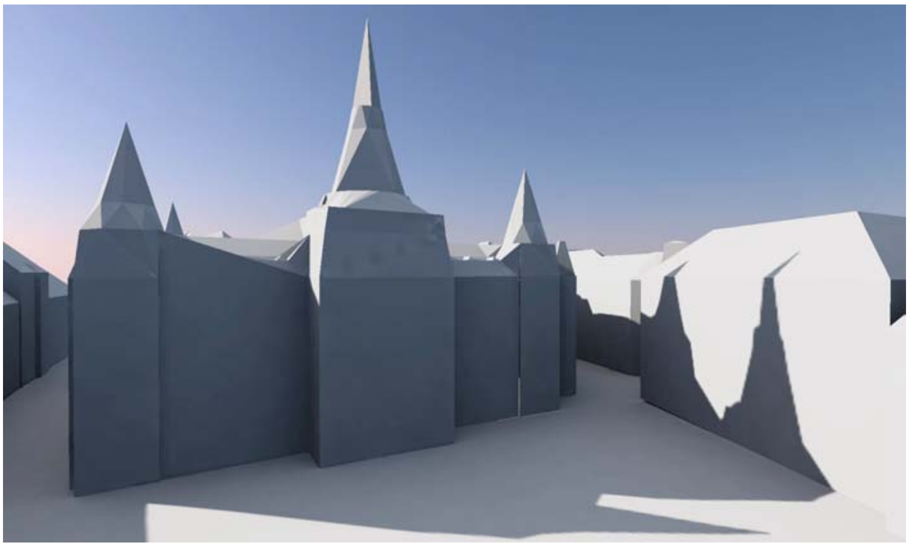


Figure 5: The light maps containing the global illumination information that was used in figure 3.

Figure 6: Sharp shadows cast from the sun, which is handled as point light source.

Figure 7: The effect of sun and skydome illumination on an urban plaza.

Figure 8: The skydome gradient around the sun.

7 CONCLUSION AND FUTURE WORK

We demonstrated the feasibility of applying global illumination algorithms to urban scenery. A number of improvements to standard algorihms were combined to achieve these results, providing a significant speedup in the illumination computation. The resulting interactive visualization shows a significantly higher degree of realism.

The current algorithm is adequate for medium sized urban scenes, containing a few tens of blocks of houses. For these types of scenes the precomputation of the illumination can be performed overnight. For larger scenes additional improvements will be necessary to make global illumination possible: Oftentimes in urban scenes, the same form or type of building is repeated, thus the actual geometric configuration for skydome illumination is very similar. In this case, the lightmap computation need not be repeated, but can be reused multiple times. Although we do not have a general method for automatically determining, if an illumination context is similar to a previously computed one, the effectivenes of this approach is obvious for large areas of repeating building structures.

8 REFRENCES

CIE-11: Spatial distribution of daylight – luminance distributions of various reference skies. TR International Commission of Illumination, 1994.

DOBASHI, Y., NISHITA, T. , KANEDA, K., AND YAMASHITA, H.: A fast display method of sky colour using basis functions. In *The Journal of Visualization and Computer Animation*, John Wiley & Sons, Ltd., N. M. Thalmann, D. Thalmann, S. Y. Shin, T. L. Kunii, and M.-S. Kim, Eds., vol. 8(2), 115–127, 1997.

JENSEN, H. W. Global Illumination using Photon Maps in Rendering Tecniques '96, pp.21-30, June 1996.

JENSEN, H. W. Realistic Image Synthesis using Photon Mapping. A. K. Peters, Ltd., 2001.

JENSEN, H. W. A practical Guide to Global Illumination Using Photon Mapping in Siggraph 2002 Course Notes CD-ROM, Course 43, July 2002.

PEREZ, R., SEALS, R. , AND MICHALSKY, J: All-weather model for sky luminance distribution – preliminary configuration and validation. *Solar Energy 50*, 3, 235–245, 1993.

PREETHAM, A. J., SHIRLEY, P. , AND SMITS., B. E: A practical analytic model for daylight. In *Siggraph 1999, Computer Graphics Proceedings*, Addison Wesley Longman, Los Angeles, A. Rockwood, Ed., Annual Conference Series, ACM Siggraph, 91–100, 1999.

TADAMUR A, K., NAKAMAE , E., KANE DA, K., BABA, M., YAMAS HI TA, H. , AND NI S HI TA, T.: Modeling of skylight and rendering of outdoor scenes. *Computer Graphics Forum 12*, 3, C189–C200, 1993.

Production of Virtual 3D City Models from Geodata and Visualization with 3D Game Engines. A Case Study from the UNESCO World Heritage City of Bambergs

Peter ZEILE, Ralph SCHILDWÄCHTER, Tony Poesch

(Dipl.-Ing. Peter Zeile, cand.-Ing. Tony Poesch, Universität Kaiserslautern, Lehr- und Forschungsgebiet für Computergestützte Planungs- und Entwurfsmethoden in Architektur und Raum- und Umweltplanung (CPE), Pfaffenbergstraße 95, D-67663 Kaiserslautern, Stadtplaner
Dipl.-Ing. Ralph Schildwächter, Schildwächter Ingenieure, Mehlweiherkopf 9, 67691 Hochspeyer
Mail: peter@zeile.net, ingenieure@schildwaechter.name, home: http://cpe.arubi.uni-kl.de, www.schildwaechter.name)

1 INTRODUCTION

In cooperation with the city of Bamberg and the TU Kaiserslautern, a research project on 3D-4Dcity models was founded whose results were presented to the public during this year's conference of the UNESCO Organization of World-Heritage-Cities (OWHC Regional Conference 2004).

For the first time, approaches from the entertainment industry - especially from the computer game industry - have been used besides standard techniques for the preparation of 3D city models. They combine an - until this date - unknown presentation quality with the possibilities of an independent navigation in real-time. Consequently, the virtual walk through the historic part of Bamberg turns into an experience even from your home PC.

2 PROBLEM STATUS / STARTING POINT

Starting point for this project was the idea generated in the spring of 2003 between representatives of the city of Bamberg and the TU Kaiserslautern to build a city-model, not "physically" out of wood (as models have been in the past), but to concentrate the efforts on the attempt of constructing a virtual city-model.

Herein the focus didn't lie primarily on the technical side or the question with which modeling software a virtual 3D city structure would ideally be produced, but it was rather essential to define an optimized workflow to generate preferably inexpensive and high-quality 3D models from already existing local geo-data. The use of surface-covering laser scan recordings, which, besides high expenses during the recording and modelling process, presents a gigantic point-density of frequently already collected data and consequently redundant information, was renounced on purpose. Furthermore, it was important to guarantee the ability to apply and transfer the data for various internal and external users. Hence, it was supposed to supply other user groups, besides the local community offices, such as manufacturers of car-navigation-systems, tourism, location-marketing all the way up to facility management, with accurate city models, consequently allowing local data to grow in economic value.

Thus, the following criterions were central factors for the assessment of the existing data and their application as well as for the preparation of the 3D model itself:

Precision of the model preferably in the centimeter-area;

Simple preparation, modeling from existing data;

High aesthetic ambitions and degree of detailing;

Possibility of swift update and extensive modification of the generated model;

Continuation of the geometric data, preferably at low-cost;

Open data-interfaces and compatibility with current software applications.

Furthermore, the produced "raw-model" should offer the following features:

Detailing degree according to current Level-of-Detail specifications (LOD 0-3) [Gröger et al 2004];
Database interface;
Integration into web browsers and mobile devices;
Integration of laser-scan data.

3 PROJECT COURSE

The quite complex project task to create a city model of the historic city center of Bamberg (after all, its expansion as city-memorial amounts to 425 hectares) as exact as possible and above all extensively , required a project arrangement of several work phases. Besides the procurement and preparation of data groundwork, the main work focus concentrated on the model creation and presentation as well as on interactive navigation of a 3D city model of these dimensions.

3.1 Data groundwork / Preparation of the database

A principle difference was made between data resources that have already existed and such that still had to be collected.

Existing data resources, e.g. the digital elevation model of the Federal State's Surveyor's Office, geo-referenced sewer measurement points, street-surveying points of the city-planning office, the digital cadastral map as basis for the building shapes, aerial pictures from several aerial photos strips etc. were checked on topicality and were supplemented by newly recorded data.

Façade photos, exact heights of respective buildings, and unambiguous building identification numbers were non-existent, however still important fundamentals for a 3D city model. Besides this information, it was particularly essential to survey special points of interest more carefully and, if necessary, to detail them more precisely by means of terrestrial laser scan recordings in another work phase.

The purpose of the model creation was the preparation of wire frame data, which contains the digital elevation model, the buildings placed on the DGM, as well as the roof surfaces cut down to the buildings. The subsequently originated CAD basis of the model creates the foundation for further actions and was returned to the city-planning office of Bamberg in DXF data format. For internal use,e.g. in the land use plan, the integration of reconstruction measures, the filling of gaps, the continuing town planning analyzes etc., this optimized database still offers a valuable support of daily planning practice.

To obtain adequately exact databases in the inner part of town, it turned out to be problematic at first, especially since the existing digital landscape model of the Federal State's Surveyor's Office of Bavaria (DLM / 50m Raster), proved to be too inaccurate. Elevation leaps like edges etc. were only partially recognized in fragments; moreover, many measuring points laid in built-on areas. Hence, faulty measurements in reference to the real world situation existed with deviations up to 10 m, allowing the DLM data to be usable for un-built areas at best. On the basis of self-surveyed street stretches (by the local city planning office), in connection with further stereoscopic evaluations of non-available areas, a degree of detailing could be attained which enabled the creation of a digital elevation model.

The building heights in the world-culture-heritage area were recorded with the help of laser distance measurements. Therefore, an initial virtual city model could be created in combination with the layout plan information of the digital cadastral map. In addition to the exact position and height information the buildings could also be assigned with explicit identification numbers. Consequently, the ID, consisting of landmark numbers, street keys and house numbers, enables an unified access to each single object that would allow georeferencing of all buildings (nationwide). Furthermore, preliminary meta information about recreation, traffic, and tourism etc.was analyzed and catalogued in this work-step.

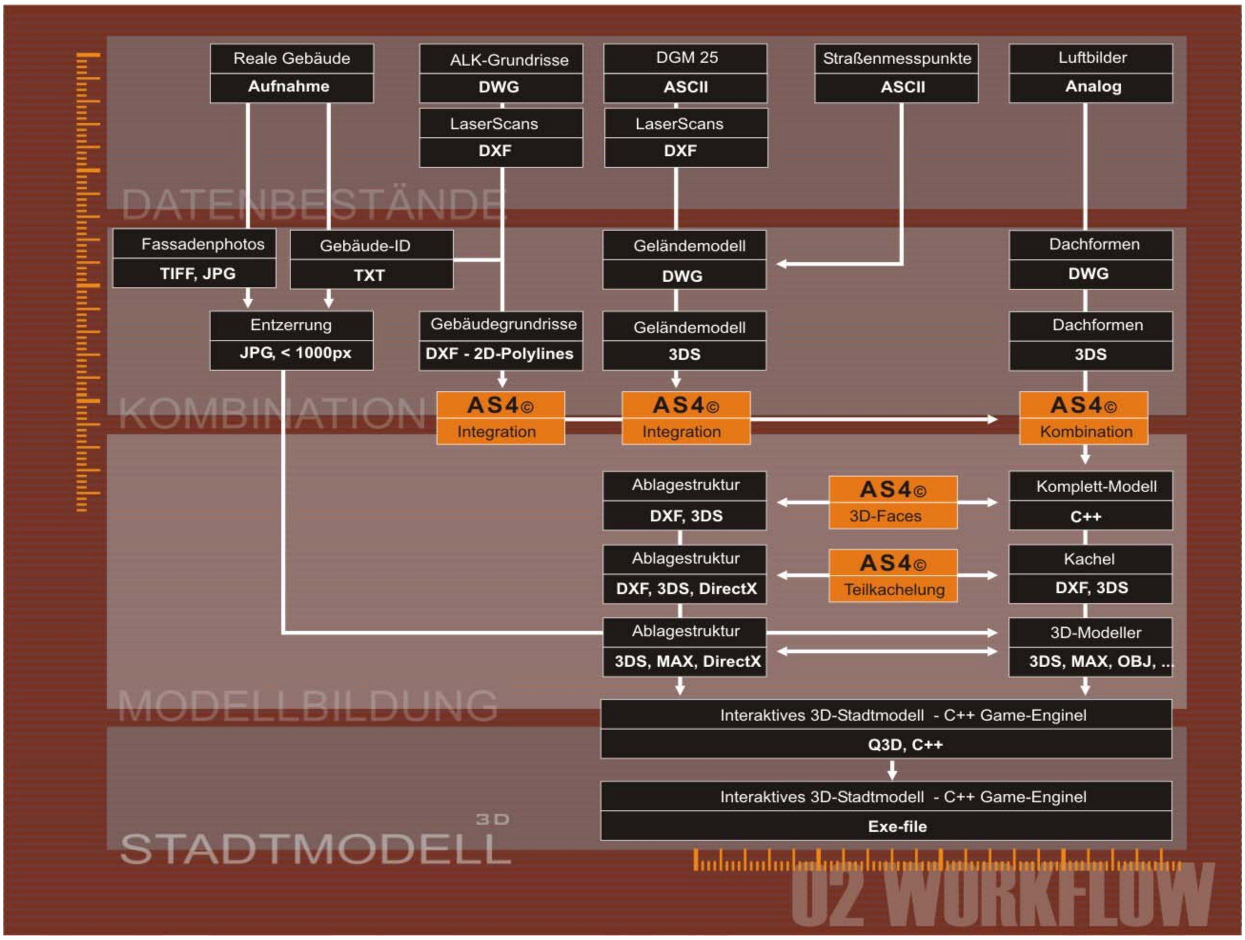


Fig. 1: Workflow of the generation of a 3D city model

The so generated "block model" was combined with the digital elevation model in another work step to adjust the shapes to the terrain's surface. In analogy to further procedures, this step is called "Level of Detail 1" (LOD 1). The next higher detailing degree (LOD 2), contains additional information such as roof shapes, on-roof constructions etc, which were determined by stereoscopic analyzes of available surface-covering aerial photos. This detailing step, in particular, contributes to an essentially higher recognition factor of the 3D model and decisively improves the orientation within the virtual city structure. Consequently, landmarks and prominent buildings etc. in the city area become noticeable.

Nevertheless, it became clear rather quickly that as well as with conventional software as with specialty applications, particularly developed for this purpose, the variety of calculating operations for an entire city model could not be achieved. Besides elementary merger errors, the various systems struggled with export problems and unacceptable processing times. This ledour team to develop a software (ArchitecturalSpace©), which, besides the identified requirements, also enables a segmentation of the total area (small-tiling in any grid-width).

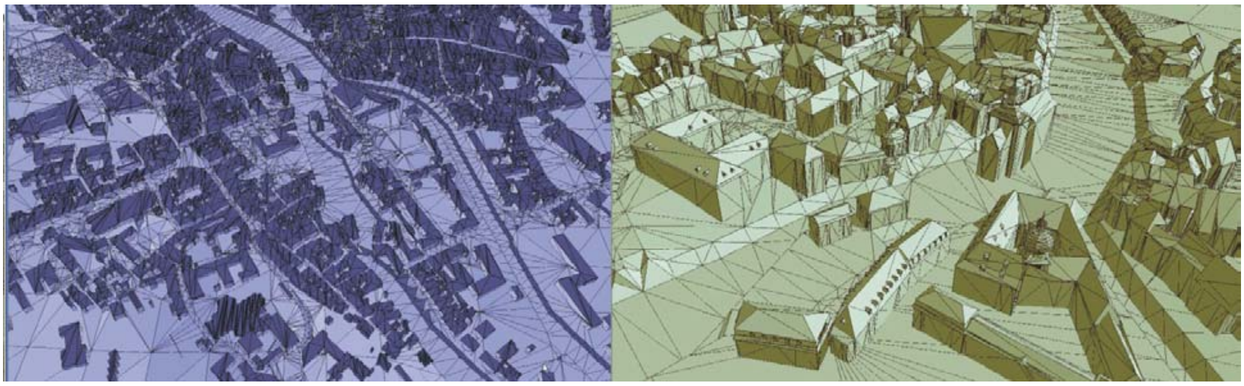


Fig. 2: Detail steps LOD 1 and LOD 2 generated from ArchitecturalSpace©

The highest detailing intensity (LOD 3) was reached by 3D rendering techniques. Façade photos, which were stored in a database, rectified by means of a photo processing program, corrected and modified are mounted (mapped) on the building surfaces. Above all, the photo editing proved to be most labor-intensive during this process. Some buildings are not freely accessible due to their location; facades cannot be photographed orthogonally, or were blocked by scaffoldings, parked cars, vegetation, etc. In order to generate ideal 3D models, such "disturbing factors" must often be edited in strenuous and time-intensive handwork.

Corrected façade mappings Heading 1

4 PRESENTATION OF 3D CITY MODELS

Crucial for the acceptance of 3D city models is primarily the quality of the representation. The detailing intensity achieved with LOD 3, combined with the abovementioned rendering techniques, already allows quite photorealistic scenes. Nevertheless, they offer no more than "static pictures." Each time the model is optimized according to the specific viewpoint in order to control the wealth of details of the representation.

Virtual walks, the so-called "walk-throughs" bring dynamics to the picture. A scene is presented to the observer as an animation, which he may play as often as he'd like, similar to videotape. The route through the virtual model is, however, predetermined. Possible alterations, i.e. scene selection, cruising altitude or even the selection of an alternative route through the city model necessitate considerable work and calculating effort. The modified result will once more be an animation with all above-mentioned restrictions.

Contrary to this, the Desktop-VR presents an extended approach of the three-dimensional representation of geometries. The focus rests less on the large-scale production of photo-realistic still images or virtual round flights through e.g. town-planning situations, but rather on the integration of a multimedia and linked information arrangement with a connection to space/volume. Contrary to independently running film-sequences in high-end rendering, VR-systems allow an individual navigation in the computer-generated world. Besides the established representatives of internet-based visualizing techniques, e.g. VRML, X3D, GML and Java3D, in whose skillful combination enormous potentials may also be found, the focus is directed in a different direction, namely computer games. New approaches for dealing with large quantities of three-dimensional data, which must be processed in real-time, presently mainly derive from just these areas. Consequently, it was obvious to combine these developments with the tasks of city model processing, and to profit from the speed and capability of these ”game-engines“.

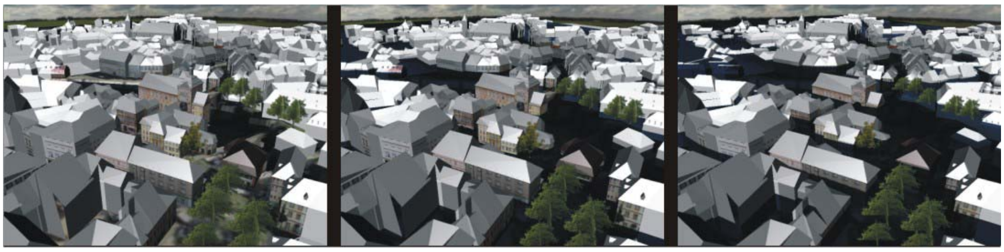


Fig. 4: Flood simulation

5 GAME-ENGINES

3D game-engines offer real-time 3D rendering, coupled with simple and logical navigation assistance and could in particular be utilized for tourism, city and location marketing as well as the reconstruction of vanished historical scenarios. Especially in reference to the performance and handling of large graphic data, the development in game programming has been pressed forward strongly during the last years, using data quantities which are meanwhile comparable with those for CAD programs, or even exceeding those by far in some cases. Merely the effective utilization of game technology for three-dimensional applications outside the entertainment industry (ego-shooter, spaceship-simulators etc) has not yet been achieved until today. Thus, the 3D city model of Bamberg, being based on these techniques, can certainly be regarded as unique.

Fig. 5: LOD 3 – game-engine integration; situations bridge-town hall and view from fruit-market on bridge-town hall

Contrary to products of various software companies, the self-created routines can be adapted to individual needs and be optimized according to their requirements. With this, only the solution for special problems is placed into the foreground and not the general approach, like in other software programs. The generated drawing data is usable as raw data material for further operations in various ways. Since the buildings are available as independent objects, they can receive additional information and titles such as house numbers etc. Moreover, the relatively slim data packages are suitable for visualizing via Internet and mobile devices, which opens a variety of possibilities especially in reference to the new UMTS-net. Besides the accurate 3D representation, precise coordinates, e.g. Gauss-Krüger or WGS84 , are assessable, while new data can be supplemented and existing objects can easily be changed.

Furthermore, there is the possibility to simulate variation comparisons in real-time through the programmable 3D game-engine interface by means of push-button access to prepared, georeferenced single objects. Especially in the town-planning context or in design-sensitive areas, this option is an enormous advantage concerning communication with the public and transparency of the planning decision.

After all, the possibilities of game technologies allow new approaches for the development of 3D city models and can contribute to solving pending (planning) tasks more effectively. On the basis of these techniques, the construction of 3D drawings will become easier, faster, and more flexible in the future, while reality-like scenes – whether they involve existing or planned structures - can virtually be “experienced”.

6 RESULT

The confrontation with the 3D city model topic as well as intensive discussions amongst all project participants have shown that the use of universally employable city-models is considered very helpful and even appears to be unavoidable in the future. Besides diverse possibilities in the planning process itself, potentials are primarily seen in the visualization of spatial contexts of town-planning structures, which are often not perceptible in flat 2D representations. Moreover, the aesthetic attractiveness as well as the high level of detailing will lead to further application of for virtual worldsin urban contexts, adding dynamics as well as fun to the topic “city” itself.

Due to data preparation problems and the consequent high expenditures of the processing and integration into current software applications in particular, questions have been raised increasingly, asking for uniform standards for 3D city models. Furthermore, awareness for the necessity of data administration of existing models must be created. This could be achievable for the communities without any large technological efforts. In this context a 3D monitoring of the city would be desirable in order to document, to archive or to even simulate processes of growth or shrinking, changes of the city shape, etc.

In consideration of scarce city budgets, a 3D city model becomes especially attractive when, besides the diverse internal application areas of the city, external interests are additionally served. Therefore, the focus will rest on an optimization of the workflow, allowing a rather inexpensive preparation of 3D city models, which are actually demanded and also paid by the market due to their quality and breadth of usage options.

7 REFERENCES

Albert, J., M. Bachmann & A. Hellmeier (2004): Zielgruppen und Anwendungen für digitale Stadtmodelle und digitale Geländemodelle – Erhebungen im Rahmen der Arbeitsgruppe „Anwendungen und Zielgruppen“. SIG3D, Initiative GDI-NRW, Düsseldorf.

Besser, T. & R. Schildwächter (2000): VRML in der Bauleitplanung und im städtebaulichen Entwurf, In: M. Schrenk (Hrsg.), 5. Symposion „Computergestützte Raumplanung“ – CORP 2000, Wien, 2000.

Gröger, G., T. Kolbe, R. Drees, A. Kohlhaas, H. Müller,F. Knospe, U. Gruber& U. Krause (2004): Das interoperable 3D-Stadtmodell der SIG 3D der GDI NRW. GDI NRW, Düsseldorf.

Koppers, L. (2002): Generierung von Objekten für 3D-Stadtmodelle. Dissertation an der Universität der Bundeswehr München, Fakultät für Bauingenieur- und Vermessungswesen, München,.

Maar, C. & H. Burda (Hrsg.) (2004): Iconic Turn - Die neue Macht der Bilder. DuMont Literatur und Kunst Verlag, Köln.

Marx, C., A. Oberlinger, & M. Wilke (1999): Das Origin Projekt. Diplomarbeit am Lehrgebiet für computergestützte Planungs- und Entwurfsmethoden in Architektur und Raumplanung, cpe, Prof. Bernd Streich, Universität Kaiserslautern.

Mitchell, W.T.J. (1999): E-Topia: Urban Life, Jim--But Not as We Know It. MIT Press, Boston.

Petschek, P. & E. Lange (2004): Planung des öffentlichen Raumes - der Einsatz von neuen Medien und 3D Visualisierungen am Beispiel des Entwicklungsgebietes Zürich-Leutschenbach. In: M. Schrenk (Hrsg.), 9. Symposion „Computergestützte Raumplanung“ – CORP 2004, Wien.

Poesch, T., R. Schildwächter, & P. Zeile (2004): Eine Stadt wird dreidimensional: 3D Stadtmodell Bamberg, In: M. Schrenk (Hrsg.): 9. Symposion „Computergestützte Raumplanung“ – CORP 2004, Wien.

Schildwächter, R., T. Poesch,P. Wettels & P. Zeile (2004): 3D Stadtmodell Bamberg – Visualisierung mit 3D- Game-Engines. Vortrag im Rahmen der OWHC Regional Conference 2004 in Bamberg, Kaiserslautern.

Streich, B. (Hrsg.) (2000): Kommunale Bauleitplanung durch computergestütztes Projekt-management. Aachen.

Voigt, A. (2001): Raumbezogene Simulation und örtliche Raumplanung, Habilitationsschrift TU Wien.

Weferling, U., K. Heine, & U. Wulf (Hrsg.) (2001): Von Handaufmass bis High- Tech: Messen, Modellieren, Darstellen; Aufnahmeverfahren in der historischen Bauforschung. Interdisziplinäres Kolloquium vom 23.-26. Februar 2000, veranstaltet von der Lehrstühlen Baugeschichte und Vermessungskunde der BTU Cottbus, Mainz.

Wettels, P. (2004): Erläuterungen zur Diplomarbeit. Diplomarbeit, TU Kaiserslautern, Lehrgebiet cpe.

Zeile, P. (2004): Erstellung und Visualisierung von virtuellen 3D-Stadtmodellen aus kommunalen Geodaten am Beispiel des UNESCO Welterbes Bamberg. Diplomarbeit TU Kaiserslautern, Lehrgebiet cpe.

Zipf, A. & J. Strobl (Hrsg.) (2002): Geoinformation mobil, Wichmann Verlag, Heidelberg,

Virtual Reality in 3D-City Development
State-of-the-Art VR-Technology from China.

Erich WOLF, Nadia NÜSSE

(Firma. Righteyes, Alexanderstrasse 166, 70188 Stuttgart)

Based on examples of big data sets from cities as Peking and Hangzhou (Shanghai) and first experiences introducing CityMaker in Europe.

During the last 5 years the population growth in chinese cities was substantial and partly even exponential.

The public administration and all other parties involved in the design of the cities need and require sophisticated assistance to achieve their common goals.

Supported by the work of the well known Tsinghua University in Peking, CityMaker was designed to meet these needs.

Equipped with a powerful rendering engine, the versatility and scalable graphic power of 3D City models is not limited.

With its unique and comprehensive features CityMaker is the basis for modern urban planning design.

CityMaker gives the competent and comprehensive answers to the problems of urban planning departments:

- Interactive modification of building dimensions
- Real time shadow simulation
- Interactive visibility analysis
- Thematic design depending on data base information
- Real time evaluation

This is proven by the successful completion of fast projects with a magnitude hardly known in the rest of the world. Furthermore we show the first experiences of the urban planning department of Stuttgart.

Durch das schnelle Wachstum der Städte in China in den letzten 5 Jahren, gab es die Anforderung der Stadtplanung, die Entwicklung virtuell zu begleiten und zu kontrollieren.

Unterstützt durch die Arbeit der namhaften Tsinghua Universität in Peking und den Vorgaben der Stadtentwicklung wurde eine VR-Plattform entwickelt. Diese ist durch ihre hohe Leistungsfähigkeit in der Darstellung auch großer Datenmengen in der Lage virtuelle Stadtplanung in bisher nicht gekannter Form zu ermöglichen. Weiterhin ist sie durch eine skalierbare Architektur auch in der Größe des 3D-Modells nicht limitiert.

Herausragend sind besonders die Echtzeit-Tools zur Evaluierung verschiedenster stadtplanerischer Fragen wie:

- die interaktive Veränderung von Gebäudemassen
- Verschattungssimulationen in Echtzeit
- interaktive Sichtbarkeitsanalysen
- thematische Darstellungen nach Abhängigkeiten von Datenbankinformationen
- Evaluierung in Echtzeit

An realisierten Beispielen aus Asien und ersten Erfahrungen bei der Einführung von CityMaker im Stadtplanungsamt der Stadt Stuttgart wird die innovative VR-Technologie vorgestellt.

reviewed paper

How to assess urban competitiveness in the ICT age?
Urban competitiveness and ICT

Paul DREWE

(Prof. Paul Drewe, emeritus professor of spatial planning, Delft University of Technology, email: paul drewe@wanadoo.nl)

This article is basically about methodology. Analyzing and evaluating case studies of urban competitiveness requires a framework. Existing approaches such as spatial economics, surveys of location factors, and city rankings fall short of understanding urban competitiveness, in particular because ICT is making a difference. When ICT meets with the 'new science of networks', new perspectives open up. Urban competitiveness can be conceived of as a matching of relevant networks. However, as the 'new science' emphasizes growth and a rich-get- richer phenomenon, questions arise about the sustainability of urban growth: when the 'best cities for business' collide with the 'most liveable cities'. Hence the long-term perspectives may differ radically from the short term. By way of conclusion, some remarks are made concerning the practical approach to urban competitiveness. It does not suffice to propose a methodology that does not, at least potentially, help to prepare the grounds for intervening strategically on the local level. There are still many open questions. But this makes for interesting avenues of research.

1 TO SET THE STAGE

Urban competitiveness ist just like sustainability or globalization: without an explicit definition it leads to verbose debates. 'On s'amuse', as the French say. But if one wants to reach beyond the sound bites, one needs to clarify the meaning of urban competitiveness before any attempt is made to assess it. Competitiveness is not a gospel and cities are not to be confused with business firms. Cities should be assessed in terms of quality of life which includes a certain degree of economic growth. Cities that are stagnating or even shrinking economically find it difficult to offer an acceptable quality of life (more about this later). Hence the issue of urban competitiveness is worth studying.

As a working definition, urban competitiveness can be seen as the ability to attract mobile investment: the creation of new establishments, expansion in existing premises, opening a branch plant, or in-migration. Unlike mergers, take-overs and the rationalization of existing facilities the different forms of mobile investment imply a choice of location for companies on the local level [1].

With this definition, however, we are not opting for a 'best cities for business' approach which only breeds rankings that put cities in a competitive mood. If Montreal/Laval turns out to be last comer in Canada what does this really tell us about its competitiveness? [2].

2 URBAN COMPETITIVENESS – SOME CONVENTIONAL APPROACHES

How to describe and explain urban competitiveness, and how to prepare the grounds for political intervention. Let us have a look at some conventional approaches.

2.1 Spatial economics or regional science

To study the contributions of spatial economics in greater detail is beyond the scope of this article. But perusing, for example, the encyclopedia of spatial economics [3] already provides some important insights.

Spatial economics, being synonymous with regional science, offers abstract mathematical models rather than empirically tested behavioral hypotheses. Among the key words one finds distance and accessibility. The latter is related to cost of transport and choice of location. Time, on the other hand, is not exactly treated as 'quantite negligeable' but is less prominent. What strikes most is the total absence of any reference to logistics which entails a shift from physical to controlled and dedicated logistic accessibility (facilities and services). A basic concept of business logistics is lead-time, the time interval between the placing of an order and delivery. It relateds to rush orders or the usual order-cycle time of 24 hours [4]. The rise of ICT has unleashed a 'logistic revolution', the development of an 'infogistique' [5]. One cannot blame the authors of the encyclopedia for completely ignoring ICT. After all, the encyclopedia was published in 1994. The evolution of business logistics, however, was well under way by then. The authors of the encyclopedia both (mainly) economists and geographers still cherish classics such as Christaller, Losch, Von Thunen and the like. The famous Christaller model refers to medium-size towns in Southern Germany in the 1930s. This is a poor guide to the understanding of urban competitiveness in the ICT age. On needs to rethink the key concepts of spatial economics. Some of them are promising, e.g. networks (Dupuy), graph theory (Auray/Mathis) or innovative milieux (Maillat).

With distance being by far the crucial concept of regional science, one has to prepare for 'the death of distance'. One also has to prepare for practice, the real test of ideas.

2.2 Surveys of location factors

How about surveys of location factors among companies?

The EU has commissioned a study of new location factors for mobile investment in Europe, published in 1993 [6]. Even if it is not up-to-date, it is representative of its kind.

The study informs about companies identifying factors as critical or important to choice of country or region, by broad group of economic activity. the most critical location factors on the regional level.

What lessons are there to be learned from this purely descriptive approach?

- A single overriding location factor does not exist (which precludes the construction of a simple location model)

- Types of economic activity matter
- There are also critical factors at country level: in 75% of the cases, a country was chosen first, followed by a region; in 25% of the cases, the final choice was made between regions in different countries.

But even if competitive adavantages of nations exist, it is still vital to focus on urban competitiveness. Porter, focusing on the national level, had to admit that the competitiveness of clusters of economic activities on the world market were positively influenced by local advantages [7].

The location factor coming closest to ICT is called quality telecommunications. It features among the top-critical factors for offices and services in table 2a and is expected to become increasingly critical for offices (European headquarters), European distribution and services.

The EU survey does not explain actual decisions about various forms of mobile investment. Modeling can provide a value added to data collected from individual companies. This has been demonstarted by Mignolet way back in 1984 for the agglomerations of Antwerp, Brussels and Liege [8]. Mignolet has quantified three partial probabilities which together determine the probability of an autonomous renewal of industrial structures. The partial probabilities relate to access to a new idea, access to an investment, and access to a region. Each probability has an objective and a subjective component. Only if the two match, will there result a probability of access: availability must meet with receptiveness among business firms. The individual variables that make for both availability and receptiveness allow for identifying potential political interventions. Liege scored the lowest probability of autonomous industrial renewal in the 1980s. In 2005 not much progress has been made (recently a 'Marshall plan' has been launched for Wallonia). The model could have provided a source of inspiration for the right interventions.

2.3 Ranking cities

Another approach to urban competitiveness is the ranking of cities. It is referred to as the top-of-the-pops school of geography. Rankings are not necessarily scientific products as consultants and journalists can do them, too.

The key word here is 'best cities for business'. A search for the key word on Google yields about 925 hits which testifies to the popularity of this kind of rankings.

At the outset we have already mentioned the 'sad' position of Montreal/Laval in a ranking produced by Canadian Business: number 41 out of 41 major urban centers (table 1). While the top-rank cities usually love the ranking and use the outcome for their marketing, the 'losers' usually cast doubt on the method. The latter come down to two choices: the choice of indicators and the choice of weights attached to them.

Canadian Business has selected five indicators. Two relate to economic cost, one to economic benefit and one or two to social cost. This is an ad hoc choice. No theoretical background is provided and the question is whether competitiveness can be reduced to these five indicators, compared e.g. to the factors listed in table 2a. The five indicators selected by Canadian Business are 'apples and oranges'. In order to arrive at an overall score, weights need to be attached to them (of course, the indicators can be considered as being of equal importance). The weighting procedures of city rankings are not always made explicit. According to Canadian Business 'the final ranking weights each factor based on a North American survey of more than 5,000 people rating the importance of various site selection criteria'.

A secondary multivariate analysis can throw more light on hitparades of cities or regions, provided one is guided by a working hypothesis. See, for example, earlier analyses of rankings from Germany, France and the United States: looking into the limits of urban growth [9]. More about the results later.

The ranking of cities is also very popular in France thanks to the studies commissioned by Datar. In 1989 and 2003, respectively 165 and 180 European cities (agglomerations) have been described and ranked of different 'trump cards': the more trumps, the higher the rank with equal weights attached to each kind of city endowment[10]. The magic word is 'rayonnement européen'. How does the French government react to this picture of urban competitiveness? First, there is the more or less explicit disappointment with regard to the position of Paris compared to London (in particular with respect to the number of headquarters of big European companies). London is clearly the number one in Europe. This is corroborated by a survey of Europe's major business cities. Senior executives from 501 European companies gave their views on the the top European cities in which to locate a business [11]. Second, the French government has expressed its concern about the fact that no French cities are found in either class 2 or 3. That is why in 2003 a policy has been launched strengthen the European impact of the French metropoles [12].

The role of ICT is marginal in the the Datar ranking and absent in the one published by Canadian Business. However, according to the 501 senior executives in Europe communication factores continue to be 'extremely important'. If one wants to take ICT really serious, a completely different approach is needed as Keynote has demonstrated [13]. This firm has developed the Keynote Business 40 Internet Performance Index measuring and ranking the average download time for the home pages of 40 important US-based business web sites; from ABC to Yahoo! Keynote also provides a Benelux 40 and a French Business 40 performance index.

'Measured performance depends on factors such as geographic location, backbone connectivity, and network infrastructure at each measurement location'. By the way, there are two measurement locations in Canada: Toronto with corresponding backbone provider Bell and Vancouver with Telus.

3 HOW ABOUT THE 'NEW SCIENCE OF NETWORKS'?

It looks as if a new approach to urban competitiveness is called for as the regional science, surveys of location factors or city rankings fall short in the ICT age.

What about the 'new science of networks'? The contribution made by Barabási can serve as a source of inspiration [14]. It results from a physicist's work on complex networks. It is multidisciplinary and has been applied, among others, to the network economy.

What is new about this? It implies a departure from the aggregate view of the economy where the individual actions of companies and consumers do not count as they only interact with the mythical entity of 'the market' which really is nothing but a directed network composed of:

nodes, i.e. all potential economic players such as business firms, financial institutions and governments

links, quantifying various interactions between economic players dealing with purchases and sales, R&D, design, marketing, logistics and the like.

If the links are weighted in terms of value added per receiver and, subsequently aggregated, one arrives at macroeconomic entities used to measure the wealth of nations.

The construction and structure of graphs is the key to understanding the network economy.

Applying a network approach to the economy leads to an 'unblackboxing' of economic behavior. A macroeconomic investment rate is just an abstraction from what is in reality a weighted and directed network that determines competitiveness or the ability to attract mobile investment Competitiveness, seen from a network angle, in general manifests a power-law degree distribution: there are many nodes with only a few links and, consequently, a low degree of competitiveness, but only a few highly competitive nodes with a large number of links.

4 THE SPATIAL DIMENSION OF COMPETITIVESS: A MATCHING OF NETWORKS

The next question is whether competitiveness has an urban or spatial dimension and, if yes, what it is like.

Are there hubs of urban competitiveness? The location of the top-1000 business firms in Europe e.g. or the location of headquarters of Europen companies seems to confirm the existence of this kind of hubs [15]. This implies that cities, generally speaking, offer what companies need. It is not exactly new to view a a locational decision as a match between company profiles and city profiles. The location factors listed in table 2a represent company profiles by type of economic activity. In order to complete the picture, on need to construct city profiles based on endowment with the very factors that companies find critical (or at least important) to their choice of location. But this tradional approach still treats firms as black boxes.

Seen as nodes, however, with various links, the matching of profiles is replaced by a matching of networks. From a spatial point of view, a network(ed) firm can operate on different levels: agglomerated, deagglomerated, dispersed within countries or even worldwide. This only works if the firm network is matched by a network of ICT infrastructure or to a lesser extent by networks of traditional infrastructure such as road, rail or seaports and airports. Similarly, knowledge-based companies depend on networks of R&D creation or the external acquisition of economically relevant knowledge. Research has shown that the relevant networks also tend to manifest a power-law degree distribution or, to put it differently, that they manifest a relation with the urban hierarchy. This holds for the Internet infrastructure [16] and is certainly reflected by Keynote's choice of measurement locations (which, in turn, matches the location of the Business 40 companies). On the other hand, backbone connectivity has moved to those cities that already were hubs of the old infrastructure if only to minimize risk (Cohen). As to networks of R&D creation, affecting innovative capabilities, the European Commission had to admit that 'islands of innovation' still exist. There is a wide gap in innovative capacity between the capital city regions of the EU and the other regions [17].

If firms networks are to be matched with networks of ICT infrastructure, networks of traditional infrastructure, and networks of R&D creation, could one also imagine a match with quality of life, perceived as a network? Does this not require an application of the 'new science of networks' to cities in the ICT age? Some examples already exist, targeted at urbanists and architects [18]. But this issue touches the core of the entire debate about urban competitiveness. To be really competitive, a 'city' must be innovative, i.e. a place where new or improved products, services and production processes are created in an agglomerated way. Urban competitiveness is about 'fabriquer le futur'[19]. Does the urban quality of life boost innovation? 'All in all, F2F contact is at the heart of a key advantage of the city today, its "buzz"[20].

Buzz has less tangible not to say mythical connotations such as 'urbanism as a way of life', a 'plea for congestion' or 'the valuable ineffeciencies and impracticalities of cities'. Whether the popular concept of the creative class can shed more light on this and guide interventions depends on its theoretical basis (beyond the '3 T's of economic development' and the empirical evidence [20a]. The urban quality of life – related to social networks – is at least a fascinating hypothesis.

The best way to summarize the spatial dimension of urban competitivess is perhaps by 'le territoire aménagé par les réseaux [21]. And as far as ICT is concerned, it means 'the death of distance but not the end of geography'(Gorman).

5 A WORD ABOUT THE 'NEW ECONOMY'

ICT or the Internet are usually associated with the so-called new economy. This term is misleading as '...the "new economy" appears less like a new economy than like an old economy that has access to a new technology...The old economy of established companies and the new economy of dot-coms are merging and it will soon be difficult to distinguish them [22]. Five years after the downturn, dot-coms such as Google, Yahoo!, Amazon, Monster etc, make profit and eBay continues to do so [23]. Moreover, the '...real legacy of the Internet is not the birth of thousands of online companies but the transformation of existing businesses. We can see ist signature on everything from mom-and-pop stores to multinational agglomerates'[24].

An alternative to the term new economy could be a classification of economic sectors according to their ICT sensitivity. In a Dutch study the ICT-sensitive sectors are, in decreasing order of sensitivity: communication (post and telecom); commercial services; publishing and graphic industry; insurance; media and culture; banks; transportation services; wholesale; research [25]. (By the way, the spatial distribution of ICT-sensitive sectors in the Netherlands mirrors the urban hierarchy.)

6 LIMITS TO URBAN GROWTH & THE CHALLENGE OF SUSTAINABILITY

How do networks evolve? This is where another concept of the 'new science of networks' comes in: preferential attachment, meaning that links are added at a higher rate to those nodes that are already heavily linked. Moreover, one has to take into account that every network has its own fitness distribution which is related to competition in complex systems (or urban competitiveness for that matter). A so-called fitness connectivity product stand for the product of a node's fitness and its number of links. It is preferential attachment that induces 'a rich-get-richer' phenomenon that helps the more connected nodes to grab a disproportionately large number of links at the expense of the latecomers'(Barabási). And – in the case of a power-law degree distribution 'networks display a fit-get-richer behavior, meaning that the fittest node will inevitably grow to become the biggest hub'.

This is all about growth, i.e. relative growth of the 'rich' versus the 'latecomers'. But can the biggest hub keep on growing for ever? Or – applied to big cities – aren't there limits to growth?

'Living and producing in cities (regions) of high population density –seen from an aggergate point of view – is advantageous as far as economic benefits and certain social or public-good benefits are concerned, but only at the price of high social and high economic costs (the reverse hold for cities or regions of lesser density)'.

This working hypothesis, based on empirical analyses in Germany, France and the US, testifies to the existence of a price to be paid for urban growth [26].

Instead of using the proxy of population density, a network view on urban form would allow for pinpointing the incidence of benefits and costs throughout cities that tend to be marked by socio-spatial segregation. Social costs can e.g. be crimes or various environmental damages (it could also useful to measure the so-called ecological footprint of cities). As cities obviously have become more vulnerable to catastrophies, man-made or others, this could be another meaningful indicator of social cost. Moreover, the question rises who is paying the price for a high level of economic benefits. There may be a hidden tax of urban competitiveness to be paid by those who are the least well-off.

Economic costs and benefits are easily measured, but neither social benefits nor social costs. Quality of life can be seen as an aggregate expression of public-good benefits or of the absence of social costs. So far quality of life has been treated as a factors which favors urban competitiveness. But as 'best cities for business' may collide with 'most liveable cities', it is preferable to adopt the concept of sustainable urban development: a balanced development of society, economy and environment (a concept adopted by the European Union [27]). Sustainability introduces a time dimension to the debate about urban competitiveness. It is a long view, a far cry from snapshot surveys rankings or short-term projects. Our worst enemy is the short term (Pisani).

'When we cross over intoa new region of time, ...the immediate past is usually a poor guide to the future, abd we need to look for corresponding episodes in the more distant past' [28]. This leads us to long-wave theories and the geography of innovation [29]. The latter is of prime importance if a city must be innovative in order to be really competitive.

7 'SAVOIR...POUR AGIR' - BY WAY OF TENTATIVE CONCLUSION

Comte has once coined the phrase 'savoir pour prevoir et prevoir pour agir'. If a better understanding of urban competitiveness in terms of networks can be achieved, then it also needs to be put the test. This is another article. But if one accuses the regional science of abstaining from practice, one should at least present a few reflections on the practical approach to urban competitiveness – even if only by way of tentative cobnclusion.

'Agir' is a matter of governance. 'The market' cannot solve the problem as social benefits and social costs are not simply 'externalities'. A sustainable urban development requires their internalization. To find the right mix of governance one, first, has to identify the relevant actors, players or stakeholders. The task is far from easy with ICT making a difference to the ways in which urban space is used: '...geographical scales are dilating to the edge of infinity; technology is developing at ever faster speeds; and with the liberalisation of the network utilities' monopolies are giving way to almost uncontrollable competition' [30].

The 21st century will be a century of uncertainty and therefore of scenarios. To practice 'the art of the long view', it is crucial to identify those areas that can be controlled by means of strategic interventions. This is a matter of 'maîtrise' as the French call it in attempt at scenario building for the France of 2020 [31].

There is, first of all, the 'Global' scenario ('global marchand') introducing the external shock of globalization. It depicts a world dominated by globalized market forces and networks of transnational companies. "Global' stresses the weakening of nation states which prove to be too small for the problems engendered by the global forces. However – according to the French historian Bayart, the nation state is rather the product than the victim of globalization. Hence one might also consider another another possible future, to wit the scenario of 'National preference' ('L'état nation revisité'). Urban competitiveness, after all, is also influenced by factors identified by companies as critical or important to the choice of country. And competitive advantages as the rankings of the most competitive countries suggest although these rankings imply a high level of blackboxing the complex, networked phenomenon of competitivity.

One way of reacting to the external shock of globalization is described by the 'Glocal' scenario ('glocal coopétitif'), a dual world of top companies and local innovative milieux. It is the latter that provide an important lever of action for cities and regions, a practical way of managing uncertainties. The work of the'late' Gremi has mapped innovative environments in Europe with the fifth edition of Gremi focusing on the urban milieux [32]. If strategic interventions are to achieve a sustainable urban development, then they cannot be limited to technological innovations, but need to boost social innovations, too. The need for social innovations in urban revitalization is extremely urgent today.

8 REFERENCES

Commission of the European Communities (1993) *New location factors for mobile investment in Europe*, Brussels and Luxembourg, Directorate-General for Regional Policies, 157 p.
[2] http://www.canadianbusiness.com/bestcities/ranking.jsp
[3] Auray, J.-P., A.Bailly, P.-H. Derycke and J.-M. Huriot (eds) *Encyclopédie d'économie spatiale,* Paris, Economica, 427 p.
[4] Drewe, P. and B. Janssen (2001) Seaports and airports in Europe – where do we go from here? Design Studio 'The Network City', Faculty of Architecture, Delft University of Technology, 24 p.
[5] Irepp, Institut de Recherches et Prospectives Postales (2000) *Infogistique,la logistique, nouvelle frontière du commerce sur Internet*, Paris, Médiation, 187 p.
[6] See note [1].
[7] Porter, M. (1990) *The competitive advantage of nations*, New York, Free Press.
[8] Mignolet, M. (1984) *Innovation technologique et redéploiement industriel régional: un outil d'évaluation et d'analyse,* Namur, Facultes Universitaires Notre Dame de la Paix (Ph D thesis).
[9] Drewe, P. And H. Rosenboom (1993a) *« Limites à la croissance urbaine en Europe?Exploration »*, Revue d'Economie Régionale et Urbaine, 4, p. 615-631.
[10] Brunet, R. et al (1989) *Les villes 'européennes'*, Paris, La Documentation Francaise (Datar) & Rozenblat, C. and P. Cicille (2003) *Les villes européennes, analyse comparative*, Paris, La Documentation Francaise (Datar).
[11] http://www.citymayors.com/business/euro_bizcities.html
[12] Datar (2003a) Pour un rayonnement européen des métropoles francaises, Paris, 35 p. & Datar (2003b) 50 grand projets pour une France attractive dans une Europe dynamique, Paris, 72 p.
[13] http://www.keynote.com
[14] Barabási, A.-L. (2002)*Linked, the new science of networks*, Cambridge, Mass., Perseus Publishing, 280 p. See also Watts, D.J. (2004) *"The 'new' science of networks"*, Annual Review of Sociology, 30, p. 243-279.
[15] Goddecke-Stellmann, J. and V. Schmidt-Seiwert (2002) "*Unternehmenssitze in Europa*", Informationen aus der Forschung des BBR, 3, p. 4-5 & Datar (2003a), op.cit.
[16] Drewe, P. (2002) "*Understanding the virtual space of the Internet, a network approach"*, in M.Carmona and M. Schoonraad (eds) Globalization, urban form & governance, globalization & urban transformation, Delft, DUP Science, p. 135-142.
[17] European Commission (2004) *A new partnership for cohesion, convergence-competitiveness-cooperation*, Luxembourg.
[18] Drewe, P. (2003) ICT and urban form, 'old dogma, new tricks': http://www.networkcity.bk.tudelft.nl ;
Salingaros, N.A. (2005) *Principles of urban structure*, Amsterdam, Techne Press, 252 p. ;
Drewe, P. (2005) *"The 'network city', a new old way of thinking cities in the ICT age"*, in L. Albrechts and S.J. Mandelbaum (eds) *"The network society: a new context for planning",* Routledge.
[19] Musso, P., L. Ponthou and E. Seulliet (2005)*Fabriquer le futur, l'imaginaire au service de l'innovation*, Paris, Village Mondial, 232 p.
[20a] Florida, R. (2002) *The rise of the creative class,* New York, Basic Books. See also Florida, R. (2005) *The flight of the creative class,* New York, Harper Collins.
[20] Storper, M. And A.J. Venables (2002) Buzz : the economic force of the city. Paper presented at the DRUID Summer Conference on 'Industrial Dynamics of the Old and New Economy – who is embracing whom? June 6-8, Copenhagen/Elsinore.
[21] Musso, P. Y. Crozet and G. Joignaux (2002)*Le territoire aménagé par les réseaux, énergie, transports et télecommunications*, La Tour d'Aigues, l'aube datar, 278 p.
[22] Porter, M. (2001) *« Strategy and the Internet »*, Harvard Business Review, March, p. 78.
[23] Macke, G. (2005) Les stars du Web gagnent enfin de l'argent, Le Monde, mardi 5 avril, II. See also the other articles of the 'dossier', e.g. Delhommais, P.A., La belle santé de la 'nouvelle' nouvelle économie.
[24] Barabási, op. cit., p. 216.
[25] Louter, P. (2001)*Ruimte en digitale economie*, Delft, TNO Inro.
[26] See note [9] ; Drewe, P. and H. Rosenboom (1993b) Indicators of the quality of life, with special reference to France. Paper presented at the 'Colloque Réseau des Villes Européennes, état des Recherches Comparatives', Equipe P.A.R.I.S., CNRS & Université de Paris I, 21-23 October, Saint-Cloud & Drewe, P. And H. Rosenboom (1992) Ville et qualite de vie : « Qui vit où le mieux en France ? Paper presented at the 'Table Ronde Penser la Ville', Saint-Dié.
[27] Commission européenne (1999) *SDEC, Schéma de développement de l'espace communautaire*, Luxembourg.
[28] Boulding, K.E. (1985) *»Regions of time »*, Papers of the Regional Science Association, 57, p.19.
[29] Drewe, P. (1987) The coming economic cycle and the built environment, conjectures without refutation, working paper, Delft University of Technology. See also Drewe, P. (1990) *The coming economic cycle and the geography of innovation*, in A. Kuklinski (ed) *Globality versus locality,* University of Warsaw, Institute of Space Economy, p. 167-182.
[30] Dupuy, G. (2005) "*Networks in urban planning: the evolution of a two-way relationship"*, in E.D. Hulsbergen, I.T. Klaasen and I. Kriens (eds) *Shifting sense, looking back to the future in spatial planning*, Amsterdam, Techne Press, p. 129.
[31] Musso, P. and Y. Crozet (2003)*Réseaux, services et territoires – horizon 2020* -, La Tour d'Aigues, l'aube datar, 263 p.
[32] Crevoisier, O. And R. Camagni (eds) (2000) *Les milieux urbains : innovations systèmes de production et ancrage*, Neuchatel, EDES, 360 p.

Information Society – Sustainable or Not?

Christian FUCHS

(Center for Information and Communication Technologies & Society, University of Salzburg, Sigmund Haffner Gasse 18, 5020 Salzburg, Austria, christian.fuchs@sbg.ac.at)

1 ABSTRACT

The development, diffusion, and adoption of new ICTs doesn't automatically result in ecological sustainability, it poses both new opportunities and risks. Embedded into the antagonism between capital and economy it seems like the logical of profitability frequently offsets ecological awareness and hence has negative effects on the realization of positive potentials of ICTs on the environment. Environmental problems are social problems, not technological problems, they are neither caused by science or technology as such, nor can they be solved by science or technology as such.

2 INTRODUCTION

Related to the rising production, use, and diffusion of ICTs there are a lot of hopes, dreams, and myths. This also applies for the ecological subsystem of society where discussions focus on the question if ICTs can advance ecological sustainability, i.e. biological diversity and environmental protection. "Our contention is that, as ICT becomes more sophisticated and more embedded in our organizational structures and everyday life, we are in a better position than ever before to make sustainable development work" (Alakeson/Aldrich/Goodman/Jorgensen 2003: 5). Counter to this quotation I don't think that ICTs automatically advance ecological sustainability, but that ICTs pose both new opportunities and risks for the ecosphere. There is a positive and a negative tendency: ICTs allow the reduction of travelling by doing parts of necessary communications online, it is a medium of ecological communication and the communication and co-operation of the ecological protest movement, but it also contributes to ecological degradation e.g. in the form of computer scrap and the waste and emissions generated in production processes of ICTs. I will discuss the implications of ICTs for sustainability in the areas of transport, business, ecological activism, and developing countries.

3 ICTS, TRANSPORT, AND ECOLOGICAL SUSTAINABILITY

"Fast, cheap global communications could reduce the need for travel, so pollution levels would fall. (...) The ability to transfer information virtually, at high speed and almost no cost, and to communicate effectively at a distance would allow companies to locate away from established economic hubs, free workers to work from anywhere and, in doing so, reduce the environmental impact of goods and people moving from place to place" (Alakeson/Aldrich/Goodman/Jorgensen 2003: 3f, 9). The question is whether private and business Internet communication automatically reduces the need for travelling. This can be the case if people consciously choose to avoid unnecessary travelling and transport by plane and car, but Internet communication also makes it easier to connect people globally and to initiate and maintain social relationships and hence it can also raise the desire or need to meet people face to face more frequently.

Some scientists argue that due to the fact that telework allows knowledge workers to overcome spatio-temporal distances and to work from home the need for transport and hence environmental pollution would be reduced. The same argument can be employed for teleconferencing saying that by substituting personal meetings by teleconferences travelling can be reduced. But teleworkers normally don't work full time at home because they need to stay connected personally and face to face with their social work environment, the number of teleworkers is generally relatively low (in Europe the share of teleworkers in the total labour force ranges from less than 2 per cent to more than 10 per cent, cf. Schallaböck et al. 2003: 9), travelling to work produces only a relatively small share of total carbon dioxide emissions, and working from home doesn't automatically imply less transport because online work can produce new contacts that might generate the need for meeting people personally. Working at home can have negative environmental effects, e.g. people can't go shopping on the way home from work, but might take an extra trip by car from home to shops and supermarkets.

Companies often paint an optimistic picture of the effects of teleworking on the ecosystem, but studies show that although teleworkers frequently reduce their commuting distances "the overall distance travelled for commuting is growing though not very fast. That the last three years represent the highest figures, does not support the thesis which suggests that transport savings have been made because of telework" (Schallaböck et al. 2003: 26). A study of the Wuppertal Institute for Austria, Germany, Japan, the Netherlands, and the US, concludes that "the general experience shows, that growing functionality of and access to ICT correlates with growing demands for business travel. (...) Although the advantages provided by mobile telework are very clear, it obviously may contribute to an expansion of both the number of hours worked, and the number of hours travelled. (...) Individual case studies and panel surveys which are mostly based on small quantities of teleworkers show that teleworkers typically work about 1,5 full days per week at home as an average. As a result they save about 2 500 kilometres distance travelled for commuting annually. This is based on single commuting distances, which are estimated to be rather high and far above the average for all employees. (...) Looking from a macro perspective at passenger transport does not reveal a significant influence from home-based telework on the number of commuting trips nor the commuting distances travelled. (...) From the macro view on passenger transport, business trips (and in particular the respective distances travelled) prove to be increasing in number significantly. This does not support the hypothesis of transport saving due to teleconferencing, but emphasises the impression that business trips and the use of enhanced ICT in business grow together" (Schallaböck et al. 2003: 35, 52f).

The European reality seems to be that telework and teleconferencing are simply too unimportant for having positive effects on transport savings and that there are rebound effects from online communication on the increase of travelling. About 5 per cent of the labour force in Europe can be considered as teleworkers, roughly 10 per cent of the working days of the complete European labour force can be considered as home-based telework (Schallaböck et al. 2003: 52). The result of another study is that "homeworkers are spending more time travelling than conventional workers" (Marletta et al. 2004).

Telework and teleconferences certainly pose an opportunity for reducing travelling, but this opportunity has thus far not been adequately realized. What is needed is a conscious commitment of business and individuals to reduce the amount of travels by car and plane. ICTs alone don't solve the problem. The reality of work and life today is that in a flexible economy and society individuals have to be flexible and have to travel long-distances in order to maintain work-related and private social relationships.

4 4 ICTS, BUSINESS, AND ECOLOGICAL SUSTAINABILITY

Some scientists argue that the shift from the "industrial society" to the "information society" means that the economy becomes less resource-intensive and that hence there is a "dematerialization" of production that creates a "weightless economy" (Coyle 1997, Kelly 1999, Leadbeater 2000, Quah 1999) that advances ecological sustainability. "On the one hand, there are (in the service sector) the traditional occupations that statisticians call 'community, social and personal services': haircuts, cleaning, babysitting, teaching, nursing, government administration and so on. On the other there are 'high value added' services such as currency trading, creating financial derivatives, software development, gene research or making programmes for satellite television. Most of these are high-technology, depending for their existence on modern computer power and telecommunications. They are also dematerialised, or weightless" (Coyle 1997: 2). The argument here is that knowledge-based industries and services are less resource intensive than industrial production, that ICTs can reduce negative environmental impacts of traditional industries by allowing more efficient ways of production and distribution, that certain products and services could be dematerialized/virtualized which would reduce their environmental impact, that such goods are traded and transported over the Internet which would reduce the amount of physical transport, and that ICTs can increase the efficiency of transportation.

A study of the Wuppertal Institute concludes: "The ICT sector's resource productivity (as measured by several ratios) is clearly higher than the resource productivity of the total economy – for direct as well as cumulated environmental pressures, i.e. the ICT sector is significantly 'cleaner' per unit value added generated. CO2-emissions and energy use per unit gross value added generated is comparably low in the ICT sector. (...) The ICT sector's (...) contribution to overall value added is moderate, ranging from five to eight per cent. The 'old' economy is still significant. (...) Regarding product-based ecommerce, the possible dematerialisation potentials appear to be small. The case study findings suggest that product-based ecommerce might even be more resource intense than traditional retailing business. While information-based ecommerce has the potential to decouple economic growth from resource consumption, significant savings on a macro scale are not expected, for various reasons. First, up to date ecommerce is just another sales channel, built-up and maintained in parallel with the traditional channels. Second, the number of products that can potentially be reduced to an 'informational core' is limited. In the sectors of building, food, clothing and community as well as large parts of health and leisure most products can not be digitised. This leaves only a fraction of the total material intensity, in which information-based ecommerce can potentially contribute to a decoupling. Third, consumer habits and rebound effects are likely to have a counterbalancing influence. Whether, with changed framework conditions, the benefits can outweigh the risks, remains to be seen. (...) Teleshopping (B2C) only has the potential to generate small transport savings. This is because shopping travel represents only a small portion of the overall distances travelled, teleshopping generates additional delivery transport, bigger potential for additional transport due to possible compensating passenger transport and rebound effects" (Kuhndt et al. 2003: 23, 60, 81).

A study of the World Resource Institute concludes: " These findings indicate that technological progress and restructuring toward service-based economies in the study countries have substantially weakened the link between economic growth and resource throughput. The development of new patterns of economic growth, such as e-commerce, may weaken the link further. However, actual dematerialization has not been achieved. We see here that, despite decoupling between growth rates in GDP and material throughput, quantities of wastes and emissions generated by the study countries have increased in absolute terms over the 21-year study period. (...) Part of the explanation for the continued increase in overall waste quantities lies in the fact that traditional industries, despite their declining relative economic importance are not necessarily declining in terms of their physical operations. In addition, even economies with sophisticated high technology sectors continue to use older generation, inefficient technologies where they represent low-cost options. (...) Fossil fuel combustion is the dominant activity of modern industrial economies and is the single largest contributor to material outflows to the air and on land. Most of these flows are hazardous to human health or the environment. Technological advances and economic restructuring have contributed to significant decoupling between rates of economic growth and material throughput but they have not achieved any overall reduction in resource use or waste volumes" (WRI 2000: 19, 41).

The reality of dematerialization seems to be that fully virtualized products and the ICT sector constitute only a small portion of the economy, that the total resource use of the economy is constantly rising, and that hence thus far there has not been a massive "greening" of production and consumption induced by knowledge products and ICT. It is not true that "economic value is dematerialising" (Coyle 1997: 1). Postindustrial capitalism as a dematerialized ecologically sustainable economy is a "dangerous myth" (Foster 2002: 24). Alain Touraine has argued in this context that the information society is a "hyperindustrial society" (Touraine 1988). It is not a new society that is characterized by immaterial goods, but a new phase of development of capitalism that is both continuity and discontinuity of industrial capitalism and has emergent qualities such as the central importance of cognitive, communicative, and co-operative labour.

The knowledge economy is not an economy of invisible and intangible goods, there indded are many physical information commodities that are transported and sold. Ursula Huws (2001) argues that in capitalism there is a major tendency to transform services into physical products (commodification, cf. Fuchs 2005b, Fleissner 2005) because with the help of the latter capital accumulation would be easier to achieve than with the first due to higher potentials for technological rationalization and outsourced/globalized production.

Another argument is that certain products and services can be entirely virtualized and transported in digital format over the Internet and that hence material and energy savings can be made. E.g. the Wuppertal Institute (Türk et al. 2003) found out in an analysis that downloading a CD over the Internet is 2,5 times as resource efficient as buying it in a music store. This way savings concerning energy and matter in production and transport surely can be made. But many users have the habit of not only storing files on their computers, they rather choose to burn music files on CDs because they prefer to play music on their CD players. Hence there are again material and energy impacts. MP3 players that are portable and can be connected to a hi-fi system surely pose a good alternative that to a certain extent allows resource savings, but the example shows that virtualization doesn't automatically result in ecological sustainability. The same is true for books, journals, and newspapers. If they are distributed in digital format online resource savings in production and distribution can be made. Also new flexible production technologies that are based on just-in-time-production (e.g. books on demand) allow resource savings. But almost no one wants to read a book or a whole newspaper online because it is not very comfortable to read on screen, therefore many people print out articles or whole books which results in a high consumption of paper, toner, and ink. There are certain alternatives such as e-paper that can be reused, but companies thus far have not widely supported reusable or eco-friendly equipment (such as e-paper, the "green PC", or refillable ink cartridges for printers) because reusable computer equipment is not only less resource-intensive, but might in the long-term also be less profitable. "The PC as the modern form of a typewriter and in particular the PC used as a medium to access e-mail, WWW and other Internet services do in fact have the potential to reduce paper consumption. (...) However, as the reader may know from every-day experience, the induction effect offsets the other effects by far, because today's PC and printer technology enables the user to print out hundreds of pages with just a few mouse clicks. Therefore, all in all, ICT contributes to the same general trend for paper that has been observed for the past 60 years" (Hilty/Ruddy 2000: 6). The antagonism between capitalism and ecology has thus far also had negative influences on companies' support for ecologically sustainable ICT equipment. The use of recyclable and reusable equipment could indeed reduce the environmental impact of ICTs, but for doing so the logic of capital accumulation needs to be subordinated under ecological and social awareness. The relationship of ICTs and sustainability is not only a question of ethical consumerism, but also one of corporate social and ecological responsibility. In capitalism not those technologies that most benefit society and ecology are promoted, but those that enable capital accumulation. Hence it is e.g. not solar or wind energy or the reusable computer that are promoted, but nuclear energy, fossil fuels, the automobile, and non-renewable computer equipment. "In recession times, decision-makers try to survive. Questions beyond the survival of their companies do not interest them at all; most common recipe: replace people by machines and save money, i.e.: jobs are played against profits and (ecological) reforms" (Mettler 1997: 7). As long as a company is profitable, it might be open-minded for ecological and social goals, but capitalism is based on competition and economic crisis is an inherent feature of the system, hence in the end in many cases the logic of profit will outstrip social and ecological awareness.

Moore's Law says that the speed of computers doubles every 18 months. Thus far this law has proven true. It results in a fast moral depreciation of computers and people frequently buy new computers in order to participate in technological progress. For ecological sustainability we don't necessarily have to slow down technological progress, but the way hardware is manufactured and diffused surely have to change because millions of people continuing to buy a whole new computer each two or three years is detrimental to reaching ecological goals. Advances in chip technology today (under capitalist conditions) result in an increasing reduction of the life span of computers. The average lifetime of a business PC is 2-3 years, the one of a mobile phone 18 months in Europe (EITO 2002: 256). What is needed are reusable, recyclable, and upgradeable computer hardware and periphery.

One should also add that ICTs are industrial products, their production and disposal generates waste and emissions. The knowledge society is not an immaterial society, but a new phase in the material reality of capitalism. It requires a large material infrastructures made up by computers, periphery, servers, routers, switches, network cables, etc. The hardware industry makes profit by selling computers and periphery. If computers were used for a longer time or if it were increasingly possible to renew only certain parts in order to come up to date with technological progress and not having to buy a whole new computer, environmental improvements could indeed be made. But his would require a step away from the logic of profitability towards the logic of ecological sustainability. Hence it would mean to accept lower profits in order to protect the environment. Such moves are possible, but they contradict the dominant economic logic. If corporate social responsibility shall not only be ideology, corporations must be ready to go beyond and to question to a certain extent capitalist logic.

The Internet runs only by consuming energy. The Wuppertal Institute found that in 2000 the Internet accounted for 5 per cent of Germany's total energy use (Barthel et al. 2000). The Internet not only is based on a material infrastructure, it also consumes energy that constitutes another material aspect of the information society. A study by the Fraunhofer Institut für Systemtechnik und Innovationsforschung in co-operation with the Centre for Energy Policy and Economics (2005) has found out that ICTs in business and households account for about 8% of total energy use in Germany. It is estimated that until 2010 ICT energy use will rise from 38 TWh (2001) to 55,4 TWh (ibid.: 275). Especially television sets, hi-fi systems, computers, servers, mobile phone infrastructure networks, mobile phones and fixed phone lines are considered as being very energy-intensive (ibid.). There are technological possibilities to reduce the energy consumption of television sets and monitors (by using LCD monitors and television sets and selling such machines at reasonable prices) as well as computers (by including components that automatically detach computers from energy supply if they are not used for a certain time, Switched Mode Power Supply). But the interests of the energy industry might be detrimental to establishing "green ICTs" because high amounts of energy use mean high profits, what is needed are political pressure and unified laws that define minimum standards of energy efficiency of ICTs and require producers to include energy consumption labels on ICTs. This might have negative consequences on profitability, but if sustainability shall be achieved the domination of society by economic logic must be challenged.

The miniaturization of ICTs doesn't automatically result in less environmental impacts because ICT production itself produces wastes and toxic emissions. ICT equipment such as personal computers or mobile phones contains toxic substances such as lithium or cadmium batteries. Environmental performance assessments of computer technologies show that the latter doesn't heavily reduce material outputs, the production of one PC requires 16-19 tonnes of material resources and more than 5000 kWh energy, the emission of the production of one piece include 60 kg waste, 1850 kg carbon dioxide, 2 kg sulfur dioxide, and 1 kg nitrogen oxide (Grote 1996). "One study showed that the production of the average computer chip requires 45,46 litres of water, used primarily for washing. One chip plant in the USA uses between 4,5 and 13,5 million litres of water a day. (...) A study for the European Union in 1998 suggested that the production of a personal computer, including material production, manufacture and distribution, would lead to the release of 0,19 tonnes of greenhouse gases, 36 kg of overall waste, and require 3,6 GJ of energy" (EITO 2002: 255). In

Germany 15 per cent of electronic waste is computer waste (Briefs 2000: 19), the EU produces 6 million tonnes of waste of electrical and electronic equipment a year (EITO 2002: 256). “Der Gesamtprozess der Informatisierung (...) ist durch ein Dilemma geprägt: Einerseits erlauben die IuK-Techniken, vor allem in den Betrieben einen wirksameren Umweltschutz zu erreichen. Andererseits tragen ihre produktivitätssteigernden Effekte zu weiterem Wachstum und damit zur Umweltbelastung und -zerstörung bei. (...) Festzuhalten ist, dass – im Gegensatz zur gelegentlich geäußerten Ansichft – die IuK-Techniken nicht an und für sich saubere, oder gar umweltfreundliche Techniken sind“ (Briefs 2000: 10, 20).

5 5 ECOLOGICAL ONLINE-COMMUNICATION AND ECOLOGICAL CYBERPROTEST

The ecological movement like other protest movements makes use of ICTs in order to spread environmental information, raise environmental consciousness, co-ordinate environmental protest online, and protest against ecological degradation online. Hence there is a cognitive, a communicative, and a co-operative dimension of cyberprotest (Fuchs 2005a). With the help of the Internet NGOs can organize protests against environmental degradation offline and online.

Also companies are increasingly providing information and reports on their environmental and social performance online because they are pressured by civil society to show ecological awareness. It remains an open question to which extent such information is ideological or reflects real material changes in patterns of production and consumption. The problem with eco-reports of companies published on the Internet frequently is that these analyses are not conducted and written by external observers such as NGOs, but by representatives of the companies themselves. Furthermore there is often a difference between ideas and material reality, companies often argue that they support ecological and social sustainability, but ideas are easily voiced, real changes much harder to achieve.

Fig. 1 shows an example of ecological cyberprotest: On the website of Friends of the Earth UK it is possible to sign online petitions (in this case one that calls Tony Blair for ending G8 subsidies for oil and redirecting this money to providing renewable energy) that are automatically sent to the relevant stakeholders per e-mail. The Green Peace Cybercentre is the online-community of Greenpeace (http://act.greenpeace.org, http://act.greenpeace.org/cl2/de/de/actions), on this website cyberactivists can sign online petitions, send e-cards, and discuss Greenpeace-related topics in online discussion boards. In the petition section it is possible to generate petition letters that are sent per e-mail (cf. fig. 2). These examples show that NGOs belonging to the ecological movement increasingly make use of cyberprotest. Cyberprotest seems to be an aspect of the information society that has positive influence on the societal diffusion of ecological information.

Strategies for sustainable development “depend critically on awareness, trust, coordination and mechanisms for dialogue“ and hence are in need of “effective communication“ (Dalal/Bass 2002: 226). Environmental Informatics is concerned with developing computer applications that allow the monitoring, simulation, modelling of environmental processes and the storage, assessment, and communication of environmental data with the help of databases (environmental information systems) (Junker/Lang 2002). Environmental information system, environmental reporting, and environmental information on the World Wide Web can provide public information to environmental issues, concerns, and data and support learning and education strategies for making the ideas and possible practices of sustainable development more widely known. “In order to improve awareness, change attitudes and encourage action on sustainable development, various information products will be required, notably: documents and audio-visual, events, networks, databases, electronic media, and mass media“ (Dalal/Bass 2002: 236).

Reports on Shell’s environmental and social impacts are available on the company’s website. In the “Shell Report 2004” (http://www.shell.com/home/Framework?siteId=shellreport2004-en) the corporation e.g. argues: “In 2002, the most recent year for which international data is available, the Group produced energy products that delivered nearly 11.7 exajoules of energy. That was 20 times the power needed to provide electricity, heating and transportation for London, and equivalent to 3.9% of the world’s final energy consumption. Our customers emitted an estimated 763 million tonnes of CO2 using these energy products. We released a further 111 million tonnes of CO2 and other GHGs making them. This is calculated on an equity ownership basis, including our share of joint ventures which we do not operate. Together, this is equivalent to 3.6% of global CO2 emitted from the combustion of fossil fuels. We recognise that our response to climate change means more than reducing our own emissions. A shift to lower carbon-emitting energy products is also needed, so the rapid rise in energy use does not bring an equally big increase in GHG emissions. Expanding our natural gas business will help. In the longer term, so will our efforts to lower the costs and increase the use of biofuels, wind and solar power, and hydrogen, and to develop efficient ways to capture and safely store the CO2 from fossil fuels But both meeting the energy supply challenge and first slowing, and then eventually reversing, the rise in carbon emissions will remain a major challenge for energy producers and users alike“. Shell admits that CO2 emission is a serious environmental problem and promises that its won CO2 emissions will be 5% lower in 2010 than in 1990. It also realizes that alternative energy forms are needed and argues that it will support alternative technologies in the long-term. The latter could be empty promises because it is obvious that the consumption of fossil fuels produces money profits for Shell, hence the company benefits from the ecological degradation caused by fossil fuels. Shell presents itself in this report as a company that is concerned for ecological and social sustainability. Greenpeace in its report on corporate crimes paints a much less optimistic picture of Shell: “Shell Chemicals started production of the “drins” (endrin, dieldrin and aldrin) in 1952 - ending completely in 1990. [...] As a result of drin production in Pernis, the Netherlands, river sediments, residential areas and several dumpsites were severely polluted. The production of drins by Shell in the US at the Rocky Mountain Arsenal has also led to a huge pollution scandal. Leaking basins and pipes have contaminated 70 square kilometres of land. The pollution caused by the Shell drins-producing plant in La Paulínia, Brazil, is described in separately in this report. Exposure of people to drins has led to many poisonings and deaths. Many incidents have been reported, for example the consumption of bread made from endrin-contaminated flour that affected at least 936 people and caused 26 deaths. Large quantities of expired, prohibited and unwanted drins are in storage world-wide8. In many cases the storage facilities are inadequate and packaging of the drins are in very bad condition. Exposure of workers, local communities and the environment to these very toxic pesticides cannot be excluded and accidents with these old pesticides can easily happen. Although the use of drins has been virtually banned in the USA and the Netherlands since the late 1970s due to known toxic effects, Shell continued the production and sales to industrialising countries up until 1992. Today, the drins are also banned by the United Nations (UN) because they are associated with the incidence of cancer and reproductive, endocrine and immune system dysfunctions. [...] The existence of stockpiles of these banned and obsolete pesticides in deteriorating conditions is known to Shell and other pesticide producing companies. Shell has removed some of the drin stockpiles and drin waste from several African countries. But the pesticide companies including Shell refuse to take full responsibility for the complete removal of stockpiles. Several known stockpiles, including drins, have not been treated and continue to put local communities and environment at great risk. Only in the US and partly in the Netherlands has Shell had to pay a share of the costs. As far as is known, Shell has not been held liable for poisoning or for the costs of removal of obsolete pesticide stockpiles. This case shows that Shell continued the production and sales of drin pesticides long after the company knew the product was very toxic and affected peoples' health. However, it seems almost impossible now to hold Shell liable for the negative impacts of the product. There is no global instrument available to make Shell accountable to the removal of banned and obsolete pesticides stockpiles including drins. Pesticides companies should be obliged to take full responsibility for the removal and safe destruction of the obsolete pesticides in industrialising countries" (Greenpeace 2002: 68f). Virtual reality produces a difference between actual and virtual reality, what exists in virtual reality must not necessarily correspond to actual reality, but can be as Jean Baudrillard (1983) has stressed a simulation and hyper-reality. Due to the information overload, information found in the World Wide Web is not automatically true (according to facts), but can be a simulated reality. Corporate online reporting shed a positive light on certain companies by leaving out certain information and emphasizing other information. The Shell-example shows that Internet reporting is related to the problem of simulation and hyperreality in Cyberspace.

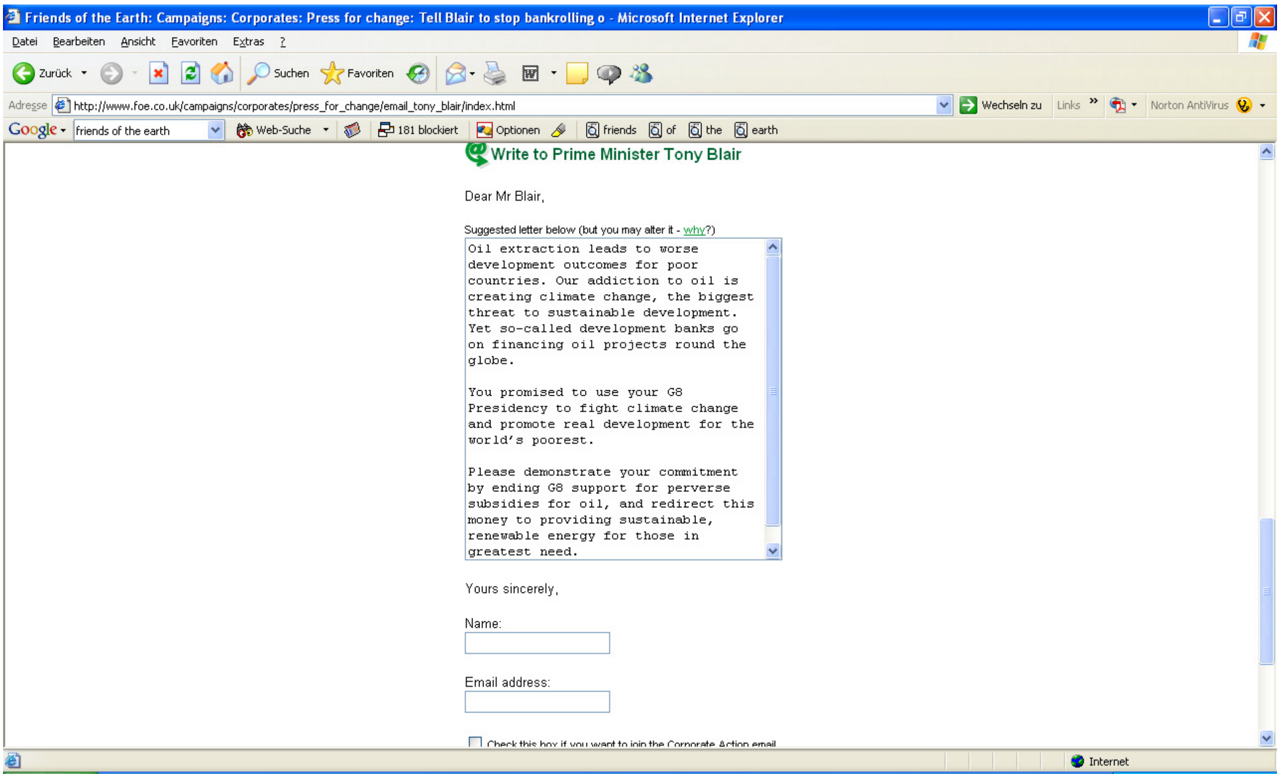


Fig. 1: Friends of the Earth: Environmental Cyberprotest

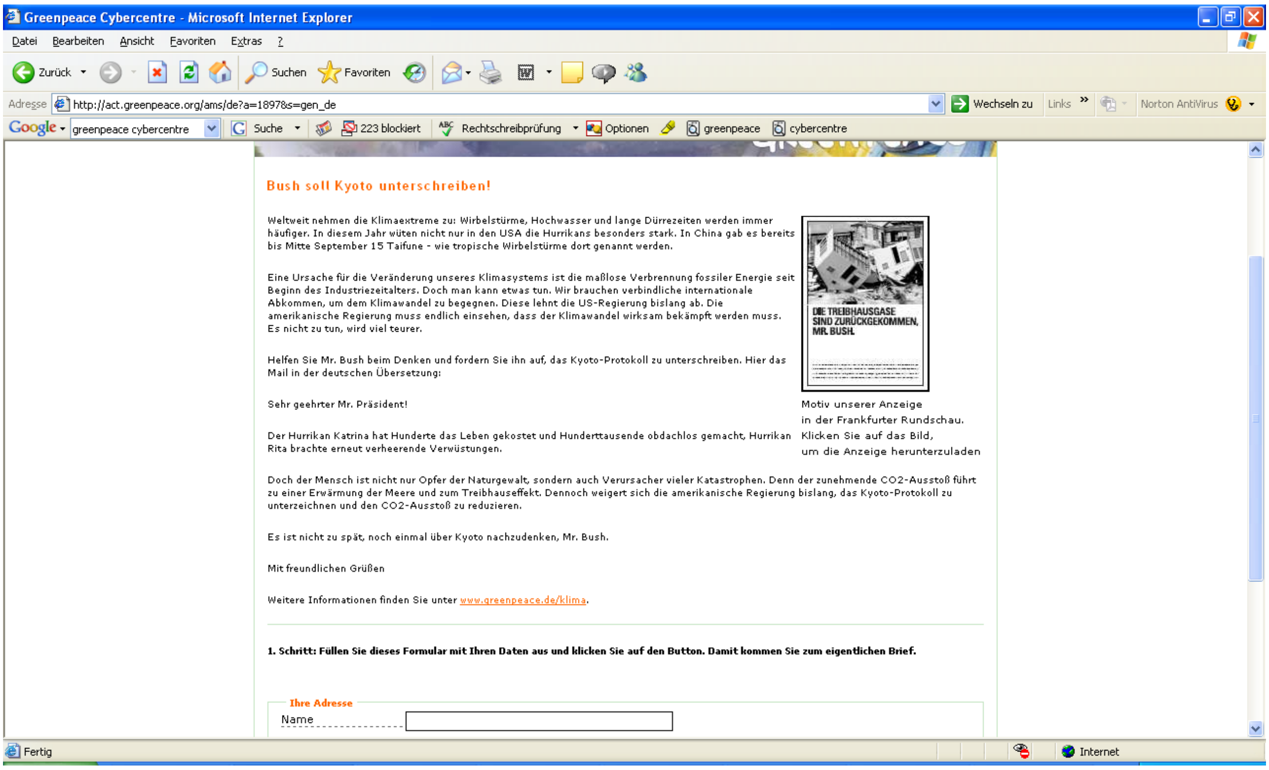


Fig. 2: Greenpeace Germany Cybercentre: Online Petition ("Bush Shall Sign Kyoto!")

Marletta et al. (2004) have shown in a study that political participation, education, and Internet usage are positively related to environmental sensibility and that "those internet users with the strongest environmental sensitivity are those who are most likely to have used the net to access environmental information". The Internet is mainly a sphere of commerce, sex, and entertainment where ecological information and communication is only a minority issue. Hence I think that ecological knowledge on the Internet is today more an insider affair than one of raising public ecological consciousness.

6 ICTS AND THE THIRD WORLD

In the book "Knowledge Societies. Information Technology for Sustainable Development" edited by Robin Mansell and Uta Wehn there is a chapter on "The Potential Uses of ICTs for Sustainable Development" that wants to focus on ICT applications that could assist developing countries to reap the "social and economic benefits associated with extremely rapid innovation in advanced ICT-based goods and services" (Mansell/Wehn 1998: 82). Sustainable development is here understood as social and economic development. The chapter lists and discusses a number of ICT applications in the areas of e-travelling, e-government, e-transport, e-health, e-education, e-inclusion, and e-learning. These are technologies that today are mainly developed in Western countries and benefit the latter. The Third World is not only largely excluded from wealth, but also from technological progress. In 1999 there was 56 billion dollars in Western foreign aid for the Third World and the latter paid 136 billion dollars debt service to Western countries (Fuchs 2002: 370). Hence in total there was a value transfer from developing countries to developed countries and hence human aid in its current form is more ideology than real help. Although Africans make up 14,0% of the world population, Africa only accounts for 1,7% of the number of global Internet users (data from July 2005, source: World Internet Usage Statistics, http://www.internetworldstats.com/stats.htm).

I think what is needed for improving the situation of developing countries is on the one hand radical global redistribution of wealth starting with measures such as the increase of human aid, basic income for the absolute poor in the world, the elimination of debt burdens on Third World countries, and on the other hand a non-colonizing technology that is adapted to the needs of people in Third World countries and integrates their traditional knowledge and technologies. The authors of the chapter mention that "policy measures are needed to address the key areas within each country's overall development strategy that could benefit from the use of ICT applications to promote initiatives that will generate financial resources" (Mansell/Wehn 1998: 95) and that "a major goal of initiatives to implement ICT applications in developing countries is to help to alleviate poverty" (ibid.: 98). But this chapter creates the image that solutions to the problems can be provided by Western technologies that are applied in Third World countries. This position is one of cultural imperialism that neglects that local and traditional ideas are of high cultural importance in solving the problems of the Third World and to avoid creating the impression of cultural imperialism. Western habits, colonialism, and post-colonial practices are part of the causes of the problems that Third World countries are facing today. What is hence needed in addressing issues such as poverty and ICTs in the Third World is unity in diversity management.

In the Declaration of Principles of the World Summit on the Information Society (WSIS) passed in Geneva in 2003 technology transfer and ICT manufacturing is understood as a means for achieving a sustainable information society for developing countries: "33. To achieve a sustainable development of the Information Society, national capability in ICT research and development should be enhanced. Furthermore, partnerships, in particular between and among developed and developing countries, including countries with economies in transition, in research and development, technology transfer, manufacturing and utilization of ICT products and services are crucial for promoting capacity building and global participation in the Information Society. The manufacture of ICTs presents a significant opportunity for creation of wealth. [...] 43. Sustainable development can best be advanced in the Information Society when ICT-related efforts and programmes are fully integrated in national and regional development strategies. We welcome the New Partnership for Africa's Development (NEPAD) and encourage the international community to support the ICT-related measures of this initiative as well as those belonging to similar efforts in other regions. Distribution of the benefits of ICT-driven growth contributes to poverty eradication and sustainable development." (WSIS 2003a, Principles 33, 43). A sustainable information society is here considered as one where ICTs promote participation and poverty eradication. Furthermore sustainable production and consumption patterns, usability, e-health, and e-learning are considered as aspects of a sustainable information society: "51. The usage and deployment of ICTs should seek to create benefits in all aspects of our daily life. ICT applications are potentially important in government operations and services, health care and health information, education and training, employment, job creation, business, agriculture, transport, protection of environment and management of natural resources, disaster prevention, and culture, and to promote eradication of poverty and other agreed development goals. ICTs should also contribute to sustainable production and consumption patterns and reduce traditional barriers, providing an opportunity for all to access local and global markets in a more equitable manner. Applications should be user-friendly, accessible to all, affordable, adapted to local needs in languages and cultures, and support sustainable development. To this effect, local authorities should play a major role in the provision of ICT services for the benefit of their populations" (WSIS 2003a, Principle 51).

The WSIS Plan of Action (WSIS 2003b) argues that for achieving a sustainable information society governments, businesses, civil society, and international and regional institutions must take responsibility. WSIS argues in favour of a mixed strategy of political practice and economic investment for achieving a sustainable information society. Government should devise national strategies for digital inclusion, promote public access, e-government, e-business, e-learning, e-health, e-employment, e-environment, e-agriculture, e-science, etc. For achieving a sustainable information society in developing countries, the WSIS Plan of Action argues on the one hand that debt cancellation is needed, on the other hand that more private national and international markets for ICTs should be provided by developing countries. "D2. c. For those developing countries facing unsustainable debt burdens, we welcome initiatives that have been undertaken to reduce outstanding indebtedness and invite further national and international measures in that regard, including, as appropriate, debt cancellation and other arrangements. Particular attention should be given to enhancing the Heavily Indebted Poor Countries initiative. These initiatives would release more resources that may be used for financing ICT for development projects.d. Recognizing the potential of ICT for development we furthermore advocate: i. developing countries to increase their efforts to attract major private national and foreign investments for ICTs through the creation of a transparent, stable and predictable enabling investment environment; ii. developed countries and international financial organisations to be responsive to the strategies and priorities of ICTs for development, mainstream ICTs in their work programmes, and assist developing countries and countries with economies in transition to prepare and implement their national e-strategies. Based on the priorities of national development plans and implementation of the above commitments, developed countries should increase their efforts to provide more financial resources to developing countries in harnessing ICTs for development; iii. the private sector to contribute to the implementation of this Digital Solidarity Agenda" (WSIS 2003b).

What is missing here is the insight that markets don't automatically eliminate poverty because they don't determine how wealth is distributed. Hence what is needed are regulatory practices that ensure that the benefits from ICT and economic production can be shared by all. Capital here is assessed only as a positive factor in achieving sustainable development. WSIS assesses IC markets as very positive means of advancing social sustainability, it neglects aspects of political regulation of the economy and income distribution and gives priority to economic logic.

7 ICTS AND ECOLOGICAL AND SOCIAL SUSTAINABILITY

During the last decade there has been a shift from considering sustainability as a purely ecological concept to defining it in broader societal terms. Hence the discourse on ICTs and sustainability shouldn't halt at ecological issues. I have argued that there are ecological, technological, economic, political, and cultural aspects of sustainability and that goals of sustainability are biological diversity, technological usability, economic wealth for all, political participation and justice for all, and cultural wisdom and unity in diversity management. ICTs pose both new opportunities and risks in all of these subsystems of society, it is antagonistic and produces in parallel various tendencies that run counter to and contradict each other.

Depending on how ICTs are socially designed and applied they can have positive and/or negative effects on society. They can either have positive or destructive effects on the ecosystem, they can be designed in user-friendly ways or not, can be treated as free goods available to all for free or as commodities that are unequally accessed and distributed (the same is true for knowledge), can either support political participation or surveillance, can advance participatory online-media and the plurality of political information and communication or one-dimensional mass media, can foster a higher publication rate and speed in science (scientific online journals and reviews) or have due to the increasing publication speed negative effects on quality standards provided by the peer-review system, can put forward new forms of art (cyberart, electronic art) that involve audience-participation or have negative influences on the authenticity of artworks, they can support more co-operative or more individualized forms of learning and ethics, can foster both cultural diversity or fundamentalism, can have positive or negative effects on health and medical awareness, can advance and socialize or individualize and limit physical activity and games, and they can be helpful in advancing friendships and love or the sowing of hate (as in the case of right-wing extremists using the World Wide Web). In all cases today ICTs don't either have solely positive nor solely negative effects, but both positive and negative ones at the same time. There are enabling and constraining tendencies of ICTs in society and ecology today, it is a political task to advance and realize opportunities and to avoid risks that are related to ICTs.

Dimension	Quality	ICT-related Opportunities and Risks
Ecological Sustainability	Biological Diversity	Ecologically Sustainable vs. ecologically destructive ICTs
Technological Sustainability	Usability	User-oriented, user-friendly, enabling vs. Unusable, constraining ICTs
Economic Sustainability	Wealth for All	Free knowledge and ICTs vs. Knowledge and ICTs as commodity and private property
Political Sustainability	Participation of All	Participation vs. Control enabled by ICTs
Cultural Sustainability	Wisdom	Wisdom vs. False Consciousness advanced by ICTs
Sustainability of:		
Mass Media	Wise Knowledge and Media	Participatory, wise Online-Journalism vs. Manipulative, one-dimensional Online-Journalism
Science	Truth	Speed vs. Quality of E-Science
Art	Beauty and Imagination	Aura Gain and participatory art vs. Aura and authenticity loss of works of art in cyberspace
Education	Literacy and Good Skills	Co-operative vs. Individualized E-Learning
Ethics	Openness, Unity in Diversity of Values and Rights	Open VS. Fundamental Cyberethics
Medicine	Health	Positive vs. Negative effects of ICTs on health
Sports	Fitness	Advancement/socialization vs. limitation/individualization of physical activity and games
Social Relationships	Love and Understanding	Cyberlove vs. Cyberhate

Tab. 1: Dimensions of ICTs and Sustainability

8 CONCLUSION

The development, diffusion, and adoption of new ICTs doesn't automatically result in ecological sustainability, it poses both new opportunities and risks. ICTs advance governance processes (cyberprotest) and require new regulations. Embedded into the antagonism between capital and economy it seems like the logical of profitability frequently offsets ecological awareness and hence has negative effects on the realization of positive potentials of ICTs on the environment. What is needed are conscious decisions and political practices that put human interests first and create a social context where ICTs can be used in socially and ecologically sustainable ways.

Environmental problems are social problems, not technological problems, they are neither caused by science and technology as such, nor can they be solved by science or technology as such. Science and technology have due to their unsustainable social design contributed to environmental degradation, they have been turned into destructive forces by social forces. Heavy promotion of computer usage is not an appropriate means and automatism for achieving ecological sustainability, the latter requires alternative models of economic production. If humankind is interested in a sustainable society, the destructive character of the economy must be sublated, new models of economic production and social relationships are needed.

9 REFERENCES:

Alakeson, Vidhya/Aldrich, Tim/Goodman, James/Jorgensen, Britt (2003) Making the Net Work. Sustainable Development in a Digital Society. Teddington. Forum for the Future.
Barthel, C. et al. (2000) International Climate Policy & the IT-Sector, Japan & Germany. Wuppertal. Wuppertal Institute.
Baudrillard, Jean (1983) Simulations. New York. Semiotext(e)
Briefs, Ulrich (2000) Ökologische Produktion und Neue Medien. Produkte der Zukunft auf dem Gebiet der Informations- und Kommunikationstechniken. Bonn. Friedrich Ebert Stiftung.
Coyle, Diane (1997) The Weightless World. Strategies for Managing the Digital Economy. London. Capstone.
Dalal, Barry/Bass, Stephen (2002) Sustainable Development Strategies. A Resource Book. London/Sterling, VA. Earthscan Publications Ltd.
European Information Technology Observatory (EITO) (2002) Jahrbuch 2002. Frankfurt/Main. EITO.
Fleissner, Peter (2005) Commodification, Information, Value and Profit. In: Poiesis & Praxis: International Journal of Technology Assessment and Ethics of Science. Vol. 3 (2005), published online at: http://dx.doi.org/10.1007/s10202-005-0007-y
Foster, John Bellamy (2002) Ecology Against Capitalism. New York. Monthly Review Press.
Frauenhofer Institut für Systemtechnik und Innovationsforschung (ISI)/Centre for Energy Policy and Economics (CEPE) (2005) Der Einfluss moderner Gerätegenerationen der Informations- und Kommunikationstechnik auf den Energieverbrauch in Deutschland bis zum Jahr 2010. Möglichkeiten zur Erhöhung der Energieeffizienz und zur Energieeinsparung in diesen Bereichen. Abschlussbericht an das BM für Wirtschaft und Arbeit. Karlsruhe/Zürich.
Fuchs, Christian (2002) Krise und Kritik in der Informationsgesellschaft. Norderstedt. Libri.
Fuchs, Christian (2005a) The Self-Organization of Cyberprotest (publication forthcoming)
Fuchs, Christian (2005b) Wissenskapitalismus und Bedingungsloses Grundeinkommen. Contribution at the Conference "Grundeinkommen 2005", October 7-9, 2005, Vienna. Online Proceedings: http://www.grundeinkommen2005.org
Grote, Andreas (1994) Grüne Rechnung. Das Produkt Computer in der Ökobilanz. In: CT, 10/1996.
Hilty, Lorenz M./Ruddy, Thomas F. (2000) Towards a Sustainable Information Society. In: Informatik/Informatique, No. 4, 2000. pp. 2-7.
Huws, Ursula (2001) Der Mythos der New Economy. In: Das Argument, Vol. 42, No. 5/6. pp. 646-660.
Junker, Horst/Lang, Corinna V. (2002) Betriebliche Umweltinformatik, Nachhaltigkeit und Informationsgesellschaft. In: Floyd, Christiane/Fuchs, Christian/Hofkirchner, Wolfgang (Eds.) Stufen zur Informationsgesellschaft Festschrift zum 65. Geburtstag von Klaus Fuchs-Kittowski. Frankfurt/Main. Peter Lang. pp. 349-372.
Kelly, Kevin (1999) New Rules for the New Economy. New York. Viking.
Kuhndt, M. et al. (2003) Project Theme Report: Virtual Dematerialisation. eBusiness and Factor X. Online: http://www.digital-eu.org/uploadstore/theme_reports/dematerial_report.pdf
Leadbeater, Charles (2000) The Weightless Society. New York. Texere Publishing Ltd.
Mansell, Robin/Wehn, Uta (Eds.) (1998) Knowledge Societies. Information Technology for Sustainable Development. Oxford. Oxford University Press.
Marletta, Piercarlo et al. (2004) The Environmental Impact of ISTs. E-Living Project Report. Online: http://www.eurescom.de/e-living/deliverables/e-liv-D14-Ch3-Environment.pdf
Mettler, Peter H. (1997) Sustainable Technology – Sustainability of What? FUTU Publication 3/97. Finland Futures Research Centre. Online: http://www.tukkk.fi/tutu/Julkaisut/futu/FUTU_3_97.pdf
Quah, Danny T. (1999) The Weightless Economy in Growth. In: The Business Economist. Vol. 30. No. 1. pp. 40-53.
Schallaböck, Karl Otto et al. (2003) Telework and Sustainable Development. Online: http://www.forumforthefuture.org.uk/uploadstore/GeSI_case_study.pdf
Touraine, Alain (1988) Return of the Actor. Minneapolis. University of Minnesota Press.
Türk, V. et al. (2003) The Social and Environmental Impacts of Digital Music. A Case Study with EMI. Wuppertal Institute.
World Resource Institute (WRI) (2000) The Weight of Nations. Material Outflows from Industrial Economies. Developing Environmental Indicators. Washington, DC. WRI.
World Summit on the Information Society (WSIS) (2003a) Declaration of Principles. Building the Information Society: A Global Challenge in the New Millennium Online: http://www.itu.int/wsis/docs/geneva/official/dop.html
World Summit on the Information Society (WSIS) (2003b) Plan of Action. Online: http://www.itu.int/wsis/docs/geneva/official/poa.html

🏆 reviewed paper

Urban and technological developments
Why is it so hard to integrate ICTs into the planning agenda?

Rodrigo J. FIRMINO; Alessandro AURIGI, Azael R. CAMARGO

(Post-Doctorate Fellow, E-urb Research Centre, Departamento de Arquitetura e Urbanismo, Escola de Engenharia de São Carlos, Universidade de São Paulo – São Carlos, Brazil. rfirmino@sc.usp.br
Lecturer and member of Global Urban Research Unit (GURU), School of Architecture Planning and Landscape, University of Newcastle – Newcastle upon Tyne, U.K. a.aurigi@ncl.ac.uk
Professor of Architecture and Urbanism, Coordinator of E-urb Research Centre, Departamento de Arquitetura e Urbanismo, Escola de Engenharia de São Carlos, Universidade de São Paulo – São Carlos, Brazil. azaelrca@sc.usp.br)

1 INTRODUCTION

Recent definitions of theories and concepts attribute social and cultural aspects to the shaping and organisation of space, and deny the idea of space as an aseptic container where social interactions simply take place. However, new elements also need to be taken into account in the struggle for the comprehension of contemporary urban society; elements related to the latest developments of ICTs.

The aim of this paper is to critically discuss some of these prominent notions of urbanity which consider not only the social and cultural aspects of space, but also the articulations of its virtual and physical characteristics. We explore and relate concepts of recombinant space, and cybernetic or symbiotic urbanisation, with the understanding that these are an inherent part of the constant and unstoppable process of actualisation of our cities. According to this standpoint, we argue that the so-called 'virtual city' is only one of the elements that characterise the contemporary city, which is an 'augmented' city itself.

In this sense, a few questions need to be considered: what kind of places can be considered under the lens of the 'recombinant' space concept? How are physical and virtual spaces reacting to what has been called symbiotic (or infinite) urbanisation? How can we define the city under these cybernetic relations between physicality and virtuality? What is the augmented city within the scope of these concepts? And finally, what is the relation between virtual cities and symbiotic urbanisation?

We address these questions in three steps. First, we discuss the way in which ICTs are challenging traditional notions of space, territory, region, and city, introducing the way the activities of architects, designers, planners and city-makers are equally being challenged by these technologies. In the second part we deal with many of the new concepts responsible for the re-conceptualisation of urban space, and the idea of an augmented space and city. The alternative views of recombinant places, cybernetic or symbiotic spaces, are knitted together to enhance our understanding of the process of contemporary urbanisation. The third part draws some conclusions and suggests directions for the contextualisation of urban technology within the evolutionary process of urban space.

2 SPACE AND THE RAPIDLY-CHANGING WORLD OF ICTS

The transformations imposed by new telematics technologies or ICTs have been threatening all concepts about space, time and cities, and this in turn affects notions about region, nation state, place, boundary, distance, concentration, decentralisation, physicality, virtuality, and territoriality, just to name a few.

Different concepts that underpinned urban society and urban studies in the past are called into question by new spatial relations directly influenced by new technological, economic, political, social and cultural paradigms. These paradigms are however dominated by a simultaneous complexity and vagueness.

According to Michael Batty, the uncertainty about the relation between ICTs and cities 'is increasing at a faster rate than our ability to adapt research methods to these new circumstances' (Batty, 1990).

With no stable reference-point to facilitate understanding of the new conditions of space and time, metaphors are often used rather arbitrarily to fill the conceptual gaps left by a lack of consistent and grounded studies of ICTs and cities.

Expressions like tele-port, cyber-space, cyber-café, super-highway, web-sites, to name but a few, are common labels for what is thought to be a new dimension of space. The indiscriminate use of metaphors only makes things more complicated, and may even block the development of more comprehensive theories and concepts. In other words, as Graham argues:

> "Too often […] the pervasive reliance on spatial and technological metaphors actually serves to obfuscate the complex relations between new communications and information technologies and space, place and society. In the simple, binary allegations that new technologies help us to access a new 'electronic space' or 'place', which somehow parallels the lived material spaces of human territoriality, little conscious thought is put to thinking conceptually about how new information technologies actually relate to the spaces and places bound up with human territorial life." (Graham, 1998)

The possibility of communicating with virtually anywhere in the world within seconds or even fractions of seconds – overcoming the friction of distance for economic transactions and human interactions – poses a powerful challenge to the comprehension of space and its relation with time. According to Skeates (1997), paradigms of the organisation of space and territory are 'under threat'. Yet according to him, many of the terms which refer to space are being misused.

> "We are beginning to understand that there has been a shift, a break with the past that means that we can no longer use the term 'city' in the way that it has been used to describe an entity which, however big and bloated, is still recognisable as a limited and bounded structure which occupies a specific space." (Skeates, 1997)

Many of the previous theories of urban studies rely on notions of space and time strongly dependent on physical distances. There are still references to distance as a strict space and time condition when it is said, for instance, that Newcastle is at five hours' drive from London. Yet catching a train from Newcastle to London would entail a different way of referring to the 'distance'.

However, what if there is no need to travel from one place to another – for actually 'being there'? What if it is possible to do those things in London in a matter of minutes or seconds without physically leaving Newcastle? This is what, according to some commentators, is happening with distance (see for example Skeates, 1997; Crang, 2000; Ezechieli, 1998; May, 1998; Sikiaridi and Vogelaar, 2000; and Baker, 1999). Harvey (1989) calls this phenomenon 'space-time compression', where distance is said to be increasingly shrinking by the development of more efficient technologies of communication. This immediately affects perceptions and concepts of space and time, as the two start to converge into one single entity:

> "Traditionally architecture was place-bound, linked to a condition of experience. Today, mediated environments challenge the givens of classical time, the time of experience […] Architecture can no longer be bound by the static conditions of space and place, here and there." (Peter Eisenman, 1991 quoted by Crang, 2000)

These tendencies in the organisation of space, and its perception in relation to time and distance, also contribute to the complexity and vagueness of the new paradigms. Scholars are now starting to understand this new reality and to formulate more comprehensive theories, while, to date, just a few people would be able to follow these ideas in the planning and governance fields.

Traditional concepts can no longer fully explain the current interplay of space and time. Euclidean theories of space based so much on linear and logical arrangements of the territory according to modernist industrial ideas seem to be exhausted within urbanism and geography. Hierarchical space concepts like region and national state are also seriously challenged by the new patterns of territorial organisation. Theories like Christaller's central place or Webber's industrial location – very much centred on rational and hierarchical behaviours of people, institutions and places – seem unable to cope with current complexities of relations between different actors and interactions.

The simultaneous complexity and vagueness of ICTs often generate confusion about their use, application and comprehension; especially regarding the future of built urban space. And if we do not understand space and the elements that constitute it, how can we plan and manage it?The challenge for urban planning as well as local governance is mainly based on two broader aspects: the transition from the industrial to the networked city; and the fragmentation and disconnection of ICTs and planning.

1.1 From the industrial city to the networked city

Perhaps the biggest and most important dilemma for planners and planning departments is a transition from traditional practices in urbanism and planning (strongly centred on technical and design sciences) to a broader model increasingly committed to social sciences and qualitative research and instruments. It is exactly the same transition that cities and concepts of space and time are now experiencing, but in a more specific perspective.

The challenge here is to understand that the subject of urban planning is being transformed, to find the best way to comprehend and analyse it, and to re-think the methods and instruments for intervening in it. This is a hard task, without doubt, especially considering the current levels of co-involvement between planning practices and notions of linear Euclidean space. Planners still seem to refer to cities as aseptic external containers for urban life. The idea of space as a social entity is not taken into account in the majority of the cases. Graham and Marvin (1996) attest:

> "The conceptual and policy-making frameworks built-up since the nineteenth century to deal with the physical, geographical, social and environmental aspects of the industrial city still tend to underpin – at least implicitly – a large proportion of urban analysis and policy-making." (Graham and Marvin, 1996)

ICTs are seen as no more complex than any other technical element, with no account taken of the implications they might have upon the complex chains of political and social relations in the city. In general, planners seem to have been reluctant to recognise that new technologies have profound relations with the spatial organisation of our cities. Planning is very rarely involved in more strategic urban actions with regards to the implementation of ICTs. Is this because planners are not interested in combining strategies of urban technology? Or is it because people and other departments responsible for such strategies do not see planners as key players?

Phenomena like decentralisation, centralisation, and urban enclaves (Ezechieli, 1998) are faced as normal spatial behaviours and treated with methods and instruments such as zoning strategies, transportation efficiency, development projects, and so on. Drewe (2000) prefers to call planning into question by asking: 'how can the urbanism of networks be changed into a sustainable network urbanism?'

Therefore, the transition from the modernist to the post-modern city is a crucial and necessary step forward for planning towards the networked city, where planners, as I will argue, have a fundamental role to play.

1.2 The 'distant' worlds of ICTs and planning

Planners and planning departments are increasingly loosing their importance within contemporary public administration, as exaggerated reliance on technical and design practices continues to fragment the public treatment of space.

This process is being affected in such a way that only urban design, transportation and infrastructure issues are entrusted to planning departments, with little or no consideration of social and cultural implications. Koolhaas and Mau (1995) argue that planners and, in fact, urbanism are outdated, and that both failed to keep pace with the rapid modernisation of urban space. Ultimately, they argue, planners simply cannot cope with the complexity of the contemporary city.

This seems very contradictory when compared with the important role that planners should be playing. In fact, the point is that, while hardly working on their daily activities, planners have been acting more as technicians than as social scientists because of limited resources, restricted conditions and a general unawareness of the concepts and consequences linked to the development of ICTs in cities.

Many studies (Graham and Dominy, 1991; Spectre 2002a, 2002b; Aurigi, 2003; Firmino, 2004) show that 'proactive' planning initiatives related to ICTs, tend to appeal to the ill-grounded utopianism of technological deterministic approaches. This, in turn, tends to create more distrust and scepticism from other municipal departments and civil servants about the involvement of planning in urban-technological strategies.

Distinct departments in the city have, obviously, different notions about ICTs and their influence on urban affairs, which leads to a weakened planning department that forms a smaller part of an administrative structure that may itself be fragmented.

So perhaps planning and planners are not to blame; alternatively, no-one may be to blame. Can organisational fragmentation in fact be traced to the variety of visions and interpretations? Can such variety be the cause of the fragmentation of the very notions of space, time, technology and governance themselves, reflecting on the process of policy-making?

The consequences of such a fragmentation may be on the one hand a failure to understand the city in the light of the transformations brought about by the development of ICTs, and, on the other, neglect of the complex economic, political, and social and cultural relations present in the urban space on the part of planners.

The contemporary city has new elements that need to be considered in the arrangement of urban space. Planners and planning officers are still trying to catch this momentum. Commentators like Koolhaas and Mau (1995) maintain that new methods, instruments, organisation, and indeed a new urbanism have to emerge to cope with the complexity, flexibility, and new concepts inherent in contemporary urban space:

> "If there is to be a 'new urbanism' it will not be based on the twin fantasies of order and omnipotence; it will be the staging of uncertainty; it will no longer be concerned with the arrangement of more or less permanent objects but with the irrigation of territories with potential; it will no longer aim for stable configurations but for the creation of enabling fields that accommodate process that refuse to be crystallized into definitive form; it will no longer be about meticulous definition, the imposition of limits, but about expanding notions, denying boundaries, not about separating and identifying entities, but about discovering unnameable hybrids; it will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions – the reinvention of psychological space." (Koolhaas and Mau, 1995)

1.3 Governance, planning and regulatory changes

Within the sphere of public administration there is, obviously, a diversity of opinions and visions as to what ICTs and virtual cities might be. The picture of the development of ICTs is not a unitary one, either in government or in planning.

However, interestingly, studies by Aurigi (2003) and Firmino (2004) show that some visions have been more common than others. Economic models that emphasise the entrepreneurial and commercial sides of public initiatives seem to be a very common driver. Infrastructure and 'visible' elements of ICTs, then, gain more relevance than those elements and infrastructure which cannot be seen. Invisibility plays its part on the way ICTs are generally interpreted by planners and local authorities.

Perceptions and interpretations as to what ICTs and the virtual city are, are therefore usually vague, fragmented, and embedded in standard technological deterministic discourses. Infrastructure is thus often the first step towards planning, governance and regulatory shifts, immediately followed by administrative improvements. Local authorities clearly perceive the potential of cables and fibre optics to facilitate the delivery of services by both providing internal communications and facilitating communications between themselves and its residents:

> "Cable is perceived as potentially playing a valuable role in both community and economic development. However, there are real fears that the commercial imperatives driving the development of cable will mean that this potential will not be exploited." (Graham and Dominy, 1991)

Back-office reformulations through a massive introduction of telematics equipment, networks, and new practices tend to lead most of the public initiatives. Businesses and city departments are reformulated to improve communications between them and access to common databases. At the same time, spaces are created for 'public customer services' with the help of the Internet for delivering the same or part of the services and information. In sum, Intranets and websites/portals on the Internet along with (mainly) cable infrastructures constitute the state-of-the-art developments in the public sphere.

Other tools are also part of the package, such as CCTV coverage and Geographical Information Systems (GIS). These initiatives are normally considered as public top-line actions 'towards the 21st century'. In reality, this all seems very fragile compared with what the private sector is doing at the same time.

Governments everywhere tend to adopt the discourse of building a new relationship between citizens and authorities, between governments themselves and common residents through better ways of communication and improved systems and services. This type of initiative looks like the right choice, but the speed of changes and the passivity of local authorities when compared with the aggressivity of the private sector show how public initiative tends to be handicapped in the attempt to construct a more democratic virtual city:

> "While these technologies are seemingly attractive given their inherent power to deliver existing services more efficiently as well as provide new services, they also represent a potential for creating a fundamental change in the nature of government as well as change in the relationship between the government and the governed. These changes may not always be what we expect and may not always be for the betterment of our society." (Baker, 1999)

Part of this handicap comes from an extremely limited power to deal with regulatory issues, as well as certain commercial, industrial and business aspects of cities. One can even say that to some extents, local authorities have been privatised, which for Monbiot (2001), is a 'corporate control of the means of government, as well as its implementation'.

The fragmentation between urban issues and telematics technologies appears to come – at least from the point of view of control and management – from the POTS/PSTN era (respectivelly Plain Old Telephone Service and Public Switched Telecommunications Networks), when local authorities had very limited or no power over telecommunications networks.Urban planners and policy-makers could not take part in the telecommunications decision-making process at this time, as it was nationally or regionally standardised.

The shift from public PTTs (Postal Telegraph and Telephone) to private operators of telecommunications was also the first signal for local authorities, urban planners and urban researchers to pay more attention to ICT issues. The regulation of telecommunications now tends to follow market forces rather than collective interests. Furthermore, knowledge levels between the public sector and ICT operators as regards the specific technologies and systems involved tends to be asymmetric. Faced with a new competitive scenario, and without a proper understanding of the telecommunications impacts, the question is how planners and local authorities can have any sort of public control over it, or know what it is used for and by whom.

According to Castells (1989), this current manifestation of global technological development as an intensification of capitalist forces leaves little margin of manoeuvre for local governments and democracies:

> "In the end, even democracies become powerless confronted with the ability of capital to circulate globally, of information to be transferred secretly, of markets to be penetrated or neglected, of planetary strategies of political-military power to be decided without the knowledge of nations, and of cultural messages to be marketed, packaged, recorded, and beamed in and out of people's minds." (Castells, 1989)

Mixed initiatives such as partnerships are a common way found by local authorities to conciliate both public and private interests in the attempt to amplify their power of intervention. Obscure contracts and deals without close public inspection may open, at least, strange possibilities for the private sector to gain control of what was supposed to be exclusively public:

> "The overwhelming importance of the economic imperative in cities means that the increasing emphasis of urban governance is on public-private partnerships oriented towards an explicit economic development agenda rather than the social, redistributional one that characterised the post-war period (Healey et al., 1995) […] the talk is now to reinvent government more along business lines and to use telematics innovations as the new mechanism for delivering services with minimum costs and maximum flexibility." (Graham and Marvin, 1996)

1.4 ICTs as economic leverages

The invisibility of ICTs causes planners to be especially anxious to produce physical results. They normally need to translate to politicians and local authorities what is invisible and virtual into something visible and tangible.

Invisibility along with technological power, high-standard private innovations and market representativeness make ICTs a powerful symbol of inventive and proactive management, control and commitment to the future. This is, at least, the way politicians seem to look at new information and communication technologies.

The very term ICT is full of meanings due to a number of possible interpretations one could have for what 'information and communication technologies' may represent. At the same time, it is also a key term for current governance and planning practices. The symbolic meaning is so powerful that even 'fake' projects are built to exhibit a high-level use of ICTs in the attempt to attract companies, business people, funds, or simply attention. Graham and Marvin (1996) prefer to call it a 'cosmetic reason':

> "In fact efforts often have to be made to increase the visual and physical impact of telecommunications in cities, as when prominent satellite dishes are developed to boost the image of high-tech office development and teleports. In one case, for example, such a dish has been proposed purely for cosmetic reasons, even though no satellite facilities were actually technically required."

This happens when ICTs become a commodity and their economic status is externalised as globalised, 'super-capitalist' instruments. The hidden competition between local authorities and the private sector, and between cities themselves to attract inward investment clearly exposes this economic connotation of being proactive with regard to urban-technological policy-making. In the end, every initiative related to new technologies 'allegedly' seeking more democratic ways of governance is threatened by the purely economic and commercial imperative of ICTs. Thus, in many public administrations, ICTs are symbolically dealt with as a sophisticated commodity.

Graham and Dominy (1991) verify that most British cities and, especially what were at that time assumed to be the advanced cases of Edinburgh, Manchester and Sheffield, were motivated to deal with telecommunications issues mainly by economic reasons, chiefly to enhance the access to the Single European Market. Over ten years later, Firmino (2004) showed an almost unchanged situation while surveying more than one hundred members of TeleCities (a consortium of European cities dealing with ICTs as a public matter), and in the case studies of Newcastle upon Tyne (U.K.) and Antwerp (Belgium). ICTs were still pictured as a powerfull economic leverage, with little or no consideration for social and cultural issues.

2 CONCEPTUALISING CONTEMPORARY URBAN LIFE AND THE IDEA OF AN AUGMENTED CITY

Conceptually speaking, there have been few efforts to break the traditional modernist/industrial paradigms of space and time that govern perceptions of the city, urban, and region.

The most noticeable advance in notions of space may be the inclusion of a powerful social/cultural aspect to the construction and organisation of spaces and places. According to these ideas, space cannot be analysed or even understood just as a physical entity, separated from time and, consequently, separated from social aspects of particular communities or societies.

The urban milieu seems to function as a symbiotic space where elements from other periods in urban and social history intermingle and interplay with new functions and elements introduced by the emergence of information and communication technologies in the process of the actualisation of space (Santos, 1997).

These new notions of space and time, all point in the same direction. They are all abnegations of the vision of space as an aseptic stage for urban life and human interactions. They reinforce the need to consider that this 'stage' interacts with urban life and with time, in a complex and dialectical process of construction and reconstruction in different economic, social and cultural aspects. This is made even more complex and non-linear by the emergence of the multi-layered space enabled by ICTs.

Reflecting on the association between space and society is a fundamental step if we wish to understand the relations between space and technology, as technologies are themselves part of a process of socio-technical construction (Bijker, 1987). What can be learnt from this association is that the only way to make sense of the trinomial space, time and technology is through the comprehension of the political and social relations behind these elements.

Furthermore, new concepts of space and time directly affect the way to approach and understand the city and the urban, with important consequences for previously well-established ideas of region and the national state. Facing the threatening ideas of aterritorial cities (Painter, 2001), unbounded space, and virtual cities, these concepts seem to still exist and to be now underpinned only for political reasons and administrative conventions. In this sense, the so-called phenomenon of 'distance-shrinking' seems to be dominating discussions about space and time:

> "The idea of telecommunications as 'distance-shrinking' makes it analogous to other transport and communiccations improvements. However, in so doing the idea fails to capture the essential essence of advanced telecommunications, which is not to *reduce* the 'friction of distance' but to render it entirely meaningless. When the time taken to communicate over 10,000 miles is indistinguishable from the time taken to communicate over 1 mile, then 'time-space' convergence has taken place at a fairly profound scale. Because all geographical models and our contemporary understanding of geographical relationships are based, implicitly or explicitly, on the existence of the friction imposed by distance, then it follows that the denial of any such friction brings into question the very basis of geography that we take for granted." (Gillespie and Williams, 1988 quoted in Graham and Marvin, 1996)

2.1 Pervasive technology

Telematics technologies have been represented and interpreted as the most pervasive and ubiquitous set of technologies ever. To name this symbiosis between electronic and traditional elements Mark Weiser (1991) coined the terms 'embodied virtuality' and 'ubiquitous computing', which also diverges from the well known virtual reality. While the formers attempt to conceptualise the physicality of ubiquitous computing, the latter tries to explain the virtuality of our physical reality. The difference is a significant one, in that embodied virtuality and ubiquitous computing articulate the incredible pervasiveness and power of ICTs of 'melting into air' and blending with other things of our daily lives:

> "There will be profound ideological significance in the architectural recombinations that follow from electronic dissolution of traditional building types and of spatial and temporal patterns." (Mitchell, 1995)

A concrete example of this phenomenon of technological embodiment is shown on a story published by BBC on September 2004 ("Barcelona clubbers get chipped"), where clients of a night club in Barcelona were getting a microship implanted under their skins for access to VIP lounges and a debit account for the bar. VeriChip is the company offering this sort of high-tech service of identification and information access through RFID, or radio frequency identification (figure 1).

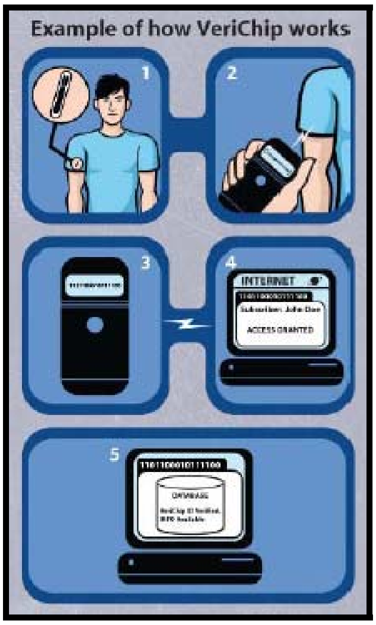


Figure 2: VeriChip, radio frequency identification. Source: www.4verichip.com.

According to Cuff (2003) embodied virtuality has four major implications for the way we perceive and interact with space. First, comparing with Bentham's panopticon and George Orwell's big brother, she argues that contemporary urban space is now part of an extremely controlled environment which she calls 'enacted environment'.

Secondly, Cuff highlights the issue of visibility or, in the case of ICTs, invisibility, where what "was solid and opaque becomes transparent, yet what makes the hidden accessible is itself invisible" (Cuff, 2003).

The third implication concerns conflict between public and private matters. The argument is that surveillance and control redefine our perception to what is public, private and, what she calls, semi-public. Shopping malls are a classical example here, where controlled and private-owned places become popular symbols of public spaces.

Finally, and directly linked to these issues of public and private spaces, the fourth implication relates to notions of civility or public life, which are said to be affected by the increasing security and surveillance of the urban space. North-american's policy against terrorism is the example here: the so-called 'Patriotic Act' is said, by civil and human rights organisations, to be seizing many civil rights and civil liberties (freedom of expression).

Cuff calls this increasingly controlled and surveilled space cyburg, and argues that "if cyberspace is dematerialized space, cyburg is spatially embodied computing, or an environment saturated with computing capability." (Cuff, 2003). This notion of a cybernetic or symbiotic space directly relates to what Mitchell (1995, 2000, 2003) and Horan (2000) have called, respectivelly, 'recombinant architecture' and 'recombinant design'. These concepts are used to reinforce the idea of an existent space being (conceptually) melted by new paradigms and recombined with the new elements of information and communication technologies. The notion of a hybrid, symbiotic, cybernetic urban space is, therefore, totally embedded in the term 'recombinant'.

It is however crucial to note that the notion of recombinant space denies the technological deterministic ideas of replacement and physical substitution as if virtual environments, spaces, interactions, transactions and remote communication were replacing face-to-face interactions and physical public places. Rather than substituting anything, today's symbiotic or cybernetic city is seen, under the lens of recombinant space, as a consequence of the coexistence of virtual and physical layers of the same space, or the articulation of traditional and electronic elements of the city.

The notion of space has already crossed the frontiers of the physical territory by considering space as a social by-product. Moreover, this notion now has to incorporate the complexity of virtual, remote and distant interactions. This is what concepts such as 'cyburg' and the 'recombination' of space are trying to do.

2.2 The augmented space

Scholars, researchers and practitioners, such as the architects Marcos Novak and Lebbeus Woods are quoted by Crang (2000) as formulators of new ideas of cities and new visions of architecture and urbanism. Novak, for example, coined the terms 'liquid architecture' and 'transarchitecture' to try and envisage a new approach to designing the complex relations between the physical space and networks of interactions in cyberspace:

> "The architect Marcos Novak offers one way of thinking through these issues in his projects to create, first, a liquid architecture of cyberspace, which he suggests offers an 'augmented space', that is thinking through what worlds of information might be shaped like, and, second, a 'transarchitecture' of their intersection with material world […] Novak suggests that both mean redefining the urban field by challenging three deeply embedded assumptions of urban studies. First, that space is three-dimensional and shared between actors. Second, space is either solid or void. And, third, you can only be in one place at one time." (Crang, 2000)

Woods is referred to by Crang (2000) as someone whose work claims the existence of a parallel city, or even parallel cities, called 'centri-cities'. Centri-cities would be made of complex interactions and differences. As Crang puts it:

> "From the mid-1980s he [Lebbeus Woods] produced the idea of 'centri-cities', formed of overlapping interference wave patterns expressing life in a multi-polar urban city. Urban multiplicity stands in opposition to the classical city – where the acropolis represented the single centre of authority that worked hierarchically through the polis […] Instead of utopian monologue producing the hierarchical city (organized around the one principle) he looks for a heterarchical city of dialogue that is necessarily incomplete and incoherent." (Crang, 2000)

There are other innovative ideas by which the concept of 'city' is challenged by assumptions that consider urban space to be completely unbounded and aterritorial, stimulating new ways to interpret and act upon urban space. Some commentators defend the idea of a networked city (Batten, 1995; Drewe, 2000; Townsend, 2003) as an evolution of the concept of the polycentric city – which is in turn already an alternative to Christaller's 'central places' theory. According to this idea, "dealing with networks as central concepts means dealing with mesh or web, sectoral topological subdivision, attraction, contact, orientation, territorial dynamic and hierarchy related to a network" (Drewe, 2000).

Rather than trying to establish a single definition or concept for the contemporary city, it is important to recognise that new elements play now an important role in the configuration of urban space. We need to understand the new rules, the new elements that define the nature of the contemporary city. We also need to reflect on where telematics technologies play such a significant role. Batten (1995) argues that the characteristics of the networked city are far more pervasive than the ones of Christaller's central place theory. He argues that although "some larger cities possess both network and central place characteristics, it is the smaller network cities that have counteracted the central place trend towards primacy and contributed to the size-neutrality or urban growth" (Batten, 1995).

Enjoying relative freedom from major material limitations and functional constraints, artists are usually more advantaged and better equipped than architects, designers and planners for producing schemes that reflect the merge of physical and digital experiences.

Among many very active artists, currently experimenting the possibilities of interaction between ICTs and space – in other words, practicing what Novak calls transarchitecture – we can highlight three examples.

First, an interesting work of art and architecture that follows this pattern is Lars Spuybroek's intervention for the city of Doetinchem in the Netherlands, called D-Tower (figure 2), constructed between 1998 and 2003 (Cuff, 2003). During these five years, a website surveyed participants' emotions every month to transform their sensations into an unstable and colourful tower in a public square. In this way, passers-by would notice what the artist/architect supposed to be the mood of the city.

Figure 3: D-Tower, measuring the city's humour.

Secondly, the Mexican artist Rafael Lozano-Hemmer, uses ICTs and interaction as his major instruments for his interventions. His works also assume an augmented, urban notion of transarchitecture: what Brower and Mulder (2002) call transurbanism. In one of his most celebrated works, Vectorial Elevation, Lozano-Hemmer arranged several searchlights on the top of buildings surrounding the Zocalo Square in Mexico City. For about 10 days in 1999/2000, people were able to configure a design through the Internet for the beams of the robotic lights to change every 6 seconds. The result was a vivid dance of lights which could be seen from as far as 15 kilometres (figure 3). Since then, he has repeated this installation in Spain (2002), France (2003), and the Republic of Ireland (2004).

Figure 4: Vectorial Elevation, re-thinking public space. Source: Lozano-Hemmer, 1999.

Finally, the Austrian movie-maker Andreas Traint developed what can be considered a possible version of teletransport and telepresence. His Tholos System extrapolates the idea of interaction and remote communication. Tholos System consists on a series of kiosks mounted with a sophisticated aparathus of cameras, screens and projectors, and that can be installed simultaneously in two or more cities. The system allows people in public places of different cities to interact in real time and with a real sense of presence (figure 4).

Figure 5: Tholos System, a possible teletransport. Source: Wired, 2003.

According to Horan (2000), these three types of space intervention presented by Lars Spuybroek, Lozano-Hemmer and Andreas Traint, can be considered representatives of a very particular type of recombinant design: what Horan would call 'transformative spaces', in which there is an extensive influence of ICTs on the appearance, construction and use of the space.

A second type of recombinant space is called, by Horan, 'adaptive design', seen as a transitory type between traditional and new cybernetic spaces, in which traditional elements of construction and architecture are retrofitted or changed to accommodate new electronic equipments and activities.

Horan also talks about a third type of recombinant design, in which telematics technologies do not produce major impacts in terms of appearance and construction. These he calls 'unplugged spaces'.

These three types of design for places are, according to Horan, representative of a type of 'evolutionary line' in which:

> "At one end of the digital place continuum are 'unplugged' designs that manifest little or no digital technology in their appearance and construction. Toward the middle of the continuum are various 'adaptive' designs, representing modest attempts to visibly incorporate electronic features into physical spaces. Occupying the far end of the spectrum are 'transformative' designs: room, buildings, or communities composed of truly interfaced physical and electronic spaces." (Horan, 2000)

Horan's classification of recombinant space (design)1 has steered the discussion in the direction of differentiation between traditional adapted spaces and completely new spaces where the symbiosis would already affect the conceiving process, methods, construction and use of places. In other words, Horan's classification of spaces as unplugged, adaptive or transformative, ultimately has served to classify and acknowledge the level of symbiosis between traditional elements – bricks and mortar – and telematics elements – networks, bits and bytes (figure 5).

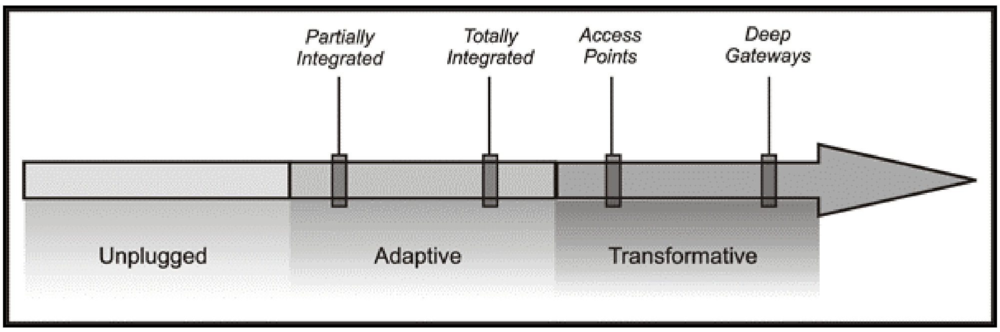


Figure 6: Horan's continuum of recombinant design. Source: Firmino, 2004.

[1] For a more detailed discussion of Horan's classification of recombinant spaces see Firmino (2003).

The way our public places are conceived and constructed, both virtually and physically, is a key issue for problems of access, democratic design, governance, life style, and the interplay between virtual and physical elements of space. It is widely accepted that we still need assembly places, face-to-face communications and a physical dimension to our lives, but these public interactions can now be augmented by digital technologies. The public space still exists, but perhaps endowed with more meanings and possible configurations.

3 CONCLUSIONS

Despite many uncertainties about the impacts of ICTs upon urban space, at least one thing seems to be clear: that in the light of the natural process of evolution and actualisation of our cities, the contemporary space is not the same space once characterised by the industrial city and the modernism of the nineteenth and twentieth centuries. New elements with different characteristics have emerged and need to be considered. Distance, once a significant limitation and decisive factor on the organisation of space, no longer represents a barrier for many aspects of today's activities, especially in the economic domain.

As a consequence, it seems to be clear that space and the organisation of territory cannot continue to be interpreted and modified according to concepts and methods evidently dated, which were mainly developed for the Fordist city.

Koolhas and Mau are amongst the commentators who have argued that professionals involved in urban planning are struggling to grasp and respond properly and proactively to this ever changing reality:

> "The transition from a former position of power [during the industrial and the modernist era] to a reduced station of relative humility is hard to perform. Dissatisfaction with the contemporary city has not led to the development of a credible alternative; it has, on the contrary, inspired only more refined ways of articulating dissatisfaction. A profession persists in its fantasies, its ideology, its pretension, its illusions of involvement and control, and is therefore incapable of conceiving new modernities, partial interventions, strategic realignments, compromised positions that might influence, redirect, succeed in limited terms, regroup, begin from scratch even, but will never re-establish control" (Koolhaas and Mau, 1995)

It is down to these professionals to understand better this moment of spatial redefinition, and to embody information, mobility, integration and other characteristics of the symbiotic and recombinant space in strategies for the augmented city. Only this process of increasing awareness would allow city-makers to consider what Horan (2000) refers to as recombinant landscape, or "a collage of settings which, properly designed, will advance the symbiotic relations between people and technology".

Planners and city-makers do not seem particularly conversant, or keen to be, with these developments in terms of space, time and technology. It seems that there is a certain incompatibility between the actual hybrid ways in which space is evolving and being socially constructed and the ways in which it is being traditionally interpreted and assessed by planners and local authorities.

The power of 'real city-makers' once attributed to planners under the modernist aspirations of the industrial city, is now shared by other professionals and forces. One could say that planners are keeping themselves disempowered to deal with some of the emerging factors that are shaping today's cities. Other specialists, such as IT consultants and bureaucrats demonstrate greater control of elements such as telecommunication-based networks, services and community initiatives, which are contributing to the reshaping of spaces and places.

The questions are: what type of relationship can be established between planners and the technologies which are revolutionising spatial concepts? Are planning attitudes and methods capable of dealing with today's ICT-influenced developments in cities? How can the notions of a new symbiotic, recombinant and cybernetic space be incorporated into planning and governance practices?

The neglect of the characteristics that make space a hybrid and cybernetic entity, as well as its new principles and values such as mobility, control and information, may represent a threat to what should be the basis for planners and local authorities' practice: the current use and shape of urban space.

Possibilities and approaches that are not in any way related to traditional patterns of physical construction of space seem to be ignored by planners. Above all, what is missing here is the acceptance of the fact that urban space is a multi-dimensional reality, embedding high technologies as something that cannot be seen as a separate reality. What we would like to argue is that cities do not need a brand new form of cyber-urbanism sporting totally new rules. They need a more holistic approach to planning and urban design, an approach able to embed ICTs within up-to-date, effective strategies for the improvement of civic spaces and places. Why exactly does it matter in the end? Mitchell (1995) has his own answer:

> "It matters because the emerging civic structures and spatial arrangements of the digital era will profoundly affect our access to economic opportunities and public services, the character and content of public discourse, the forms of cultural activity, the enaction of power, and the experiences that give shape and texture to our daily routine."

4 REFERENCES

Aurigi, A. (2003). 'The First Steps of Digital Cities' (unpublished doctoral thesis, University of Newcastle, 2003), 314

Baker, P. (1999). 'Governance, Policy and Place in an Age of Technologically Mediated Interaction', *Public Policy APSA meeting*, Atlanta GA.

Batten, D. (1995). 'Networked Cities: Creative Urban Agglomerations for the 21st Century', Urban Studies 32(2), 313-327.

Batty, M. (1990). 'Intelligent Cities: Using Information Networks to Gain Competitive Advantage', *Environment and Planning B: planning and design* 17(2), 247-256

Bijker, W. (1987). Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change, Cambridge MA, MIT Press.

Brower, J. and Mulder, A., Eds. (2002). Transurbanism. Rotterdam, V2_Publishing/NAI Publishers.

Castells, M. (1989). The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process, Oxford, Blackwell.

Crang, M. (2000). 'Urban Morphology and the Shaping of the Transmissable City', City 4(3), 303-315.

Cuff, D. (2003). 'Immanent Domain: Pervasive Computing and the Public Realm', Journal of Architectural Education 57(1), 43-9.

Drewe, P. (2000). ICT and Urban Form, Urban Planning and Design: Off the Beaten Track. Delft University of Technology, Delft, 37.

Ezechieli, C. (1998). 'Shifting Boundaries: Territories, Networks and Cities', *Telecommunications and the City*, Athens GA, University of Georgia.

Firmino, R. (2003b). '"Not Just a Portal" - Virtual Cities as a Complex Sociotechnical Phenomenon', *Journal of Urban Technology* 10(2)

Firmino, R. (2004). 'Building the Virtual City: the Dilemmas of Integrative Strategies for Urban and Electronic Spaces', (unpublished doctoral thesis, University of Newcastle, 2004), 351.

Graham, S. (1998). 'The End of Geography or the Explosion of Place?: Conceptualizing Space, Place and Information Technology', *Progress in Human Geography* 22(2), 165-185.

Graham, S. and Dominy, G. (1991). 'Planning for the Information City: The Uk Case', *Progress in Planning* 35, 169-248.

Graham, S. and Marvin, S. (1996). Telecommunications and the City: Electronic Space, Urban Places, London, Routledge.

Harvey, D. (1989). *The Condition of Postmodernity*, Oxford, Blackwell.

Horan, T. (2000). Digital Places: Building Our City of Bits, Washington, DC, ULI - the Urban Land Institute.

Koolhaas, R. and Mau, B. (1995). Small, Medium, Large, Extra-Large: Office for Metropolitan Architecture, New York, Monacelli Press.

Lozano-Hemmer, R. (1999). Vectorial Elevation <http://www.alzado.net> [accessed 15 October 2003].

May, G. (1998). 'New Technology and the Urban Environment', *Futures* 30(9), 887-899.

Mitchell, W. (1995). City of Bits: Space, Place and the Infobahn, Cambridge, MA, MIT Press.

Mitchell, W. (2000). E-Topia: 'Urban Life, Jim - but Not as We Know It', Cambridge, MA, MIT Press.

Mitchell, W. (2003). Me++: the Cyborg Self and the Networked City, Cambridge, MA, MIT Press.

Monbiot, G. (2001). Captive State: The Corporate Takeover of Britain, London, Pan Books.

Painter, J. (2001). 'The Aterritorial City: Diversity, Spatiality, Democratization' Mimeo. Durham, 47.

Santos, M. (1997). A Natureza do Espaço: Técnica e Tempo, Razão e Emoção, São Paulo, Hucitec.

Skeates, R. (1997). 'The Infinite City', City 8, 5-20.

Sikiaridi, E. and Vogelaar, F. (2000). 'The Use of Space in the Information/Communication Age - Processing the Unplannable', *Working Paper*. 24.

Spectre (2002a). 'Strategic Planning Guide - Dealing with ICT in Spatial Planning: A Guide for Pratictioners', Haarlem, Provincie Noord-Holland.

Spectre (2002b). 'Vision on ICT and Space - Vision on the Relationship Between Information and Communication Technologies and Space', Haarlem, Provincie Noord-Holland

Townsend, A. (2003). 'Wired/Unwired: The Urban Geography of Digital Networks' (unpublished doctoral thesis, Massachusetts Institute of Technology, 2003), 206.

Weiser, M. (1991). The Computer for the Twenty-First Century. *Scientific American*. September 1991, 94-104

GIS-based spatial decision support systemfor landscape planning
New system of analysis for decision making

Ana PICHER, Raul ROMERO-CALCERRADA

(Facultad de Ciencias Jurídicas y Sociales, Departament of Economics Applied and Natural Resources for Life Sciencies, Universidad Rey Juan Carlos, Pso Artilleros s/n 28032, Madrid, ana.picher@urjc.es
Escuela superior de Ciencias Experimentales y Tecnología, Universidad Rey Juan Carlos, Tulipán s/n, 28933, Madrid, raul.romero.calcerrada@urjc.es)

1 ABSTRACT

The risk of landscape impacts is subject of studies from different disciplines, but the integration of environmental and socio-economic factors has received relatively little attention. This paper discusses the main issues integrating a landscape analysis with an economic evaluation. The results are displayed in a GIS model. Additionally results and specific risk valuation problems are discussed in a detailed way.

This paper combines geographic and socio-economic data for social impact assessment. Socio-economic factors play an important role in the development of landscapes. The aim of this article is to assess the changing naturalness and biodiversity values under varying external human impacts.

Miscellaneous future scenarios of the main socio-economic factors and landscape changing models are considered and integrated. The methodology enables an assessment of the naturalness and biodiversity values of landscapes under changing socio-economic parameters.

A case study in a Spanish Nature 2000 site was developed. The visual landscape encompasses the aesthetics and the capacity of perception of the observer. In order to evaluate a landscape there are several methods and procedures discussed. A mixed method is proposed with direct valuation of representative subjectivity and a subsequent indirect analysis with an analysis of main components. This modified method attempts to solve the problem of subjectivity with groups of evaluators whose global opinion is representative, and is valuated using a survey that contains a list of adjectives with numeric values to facilitate its processing. A panel of experts will participate in the analysis of the main components. The technique of valuation of the landscape is the analysis of preferences that regards the value of a landscape as a function of the number of individuals who prefer it. The results of this assessment are integrated with the results of a contingent valuation over landscape at the time. The final result of this research is to gain the effective cost the population pressures over the landscape.

One of the main goals of this work is to evaluate effectively satellite information in connection to field sampling schemes. This will be archieved by linking interdisciplinary methods like spatial statistics, spatial landscape indexes, economic methods and geographical information.

To resolve the complex relations between the landscapes and socio-economic factors, the research work focuses on

- finding and describing operative indicators of sustainability
- suggesting future protective functions for cultural landscapes (e.g. agricultural and forest areas)
- determining the economy market value of natural resources and how could it be applied in the future.

2 INTRODUCTION AND PROBLEM DEFINITION

Sustainable development has become important in all aspects of political and scientific life. The European Union and other international organizations are trying to make sustainable development more effective through the use of indicators as measures of the environmental and sustainable development and by the incorporation of this measures into spatial planning. Nevertheless, although these tools provide data at municipal, regional or national scales wich are useful the political level, they are less useful for local use managers and decision makers because they lack a spatial component, below municipal level and are scale sensitive.

A key step in Spatial Regional Planning is the deliniation of land units that are similar relative to economics, social and environmental charactericts within a region.

The risk of landscape impact is subject of studies from different disciplines, but the integration of environmental and socio-economic factors has received relatively little attention. In this work the main issues integrating a landscape analysis with an economic evaluation is discussed. The results are displayed in a GIS model. Additionally results and specific risk valuation problems are discussed in detailed.

3 STUDY AREA

The agro- and natural ecosystems of the Special Protection Area (SPA) Encinares de los Ríos Alberche y Cofio –Fig. 1- (Holm-Oak woods of Alberche and Cofio Rivers) in Central Spain have an important role for wildlife conservation.

However, socio-economic changes in agricultural communities, urban development and uncontrolled recreational and tourist use of the landscape, have lead to altered disturbance regimes. As consequence of socioeconomic changes, land use changes, landscape configuration, patch structure and composition may change. A probable outcome of these changes is a loss of traditional activities and biodiversity.

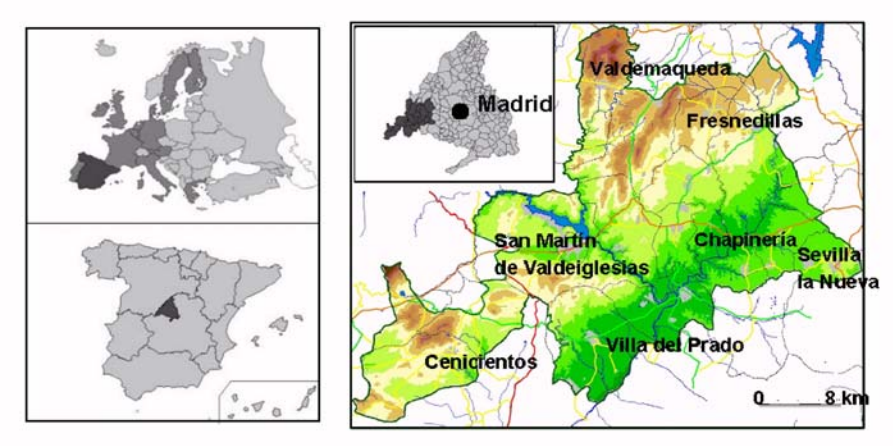


Figure1: Holm-Oak woods of Alberche and Cofio Rivers

4 GOALS

The main goal is the calculation of effective costs originated by the population pressures over landscapes, in other words, the willingness to pay for the conservation of the landscape relationated with the quality and fragility value. Evaluate effectively satellite information in connection to field sampling schemes. This will be achieved by linking interdisciplinary methods like spatial statistics, spatial landscape indexes, economic methods and geographical information.

5 METHODS

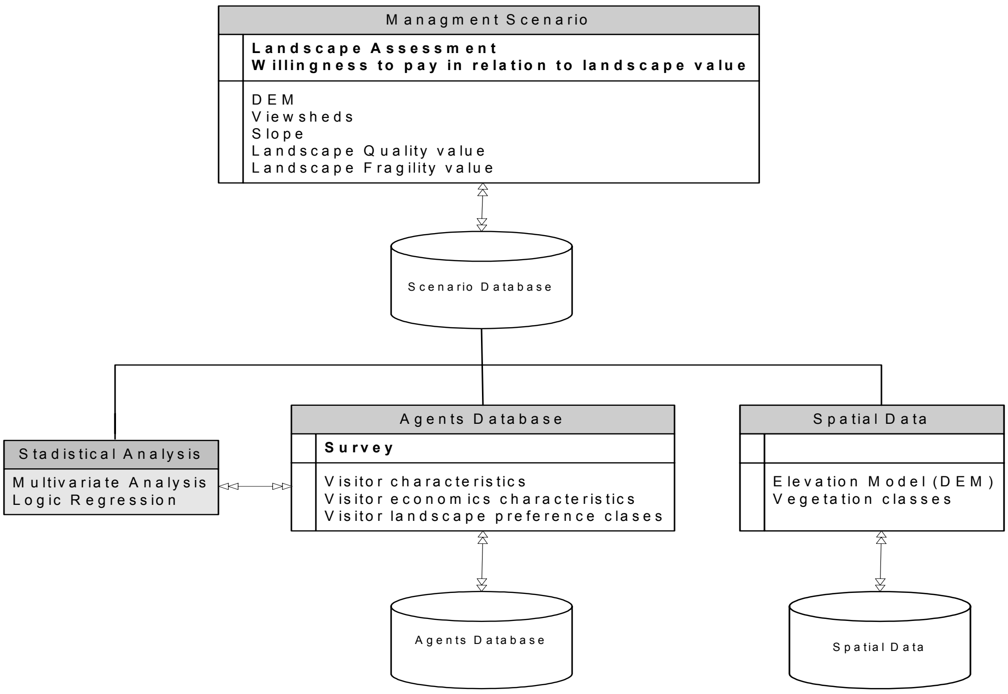
The method uses autonomus agents to simulate the willingness to pay for the conservation. Franklin and Graesser (1996) define an autonomus agent as follows:

"An autonomus agent is a system situated within and a part of an environment that senses the environments and acts on it, over time, in pursuit of its own agenda and so as to affect what it senses (an acts on in the future."

The agents are autonomus because once they are programmed they can move around their environment, ghatering information and using it to make decisions.

This is important because much of the economic value research is based on interviews or surveys, but this information fails to inform the manager/researcher how different management options might affect the overall experience of the user. By combining human agent and statistical analysis with geographic information systems, it is possible to study all these issues simultaneously and with relative simplicity.

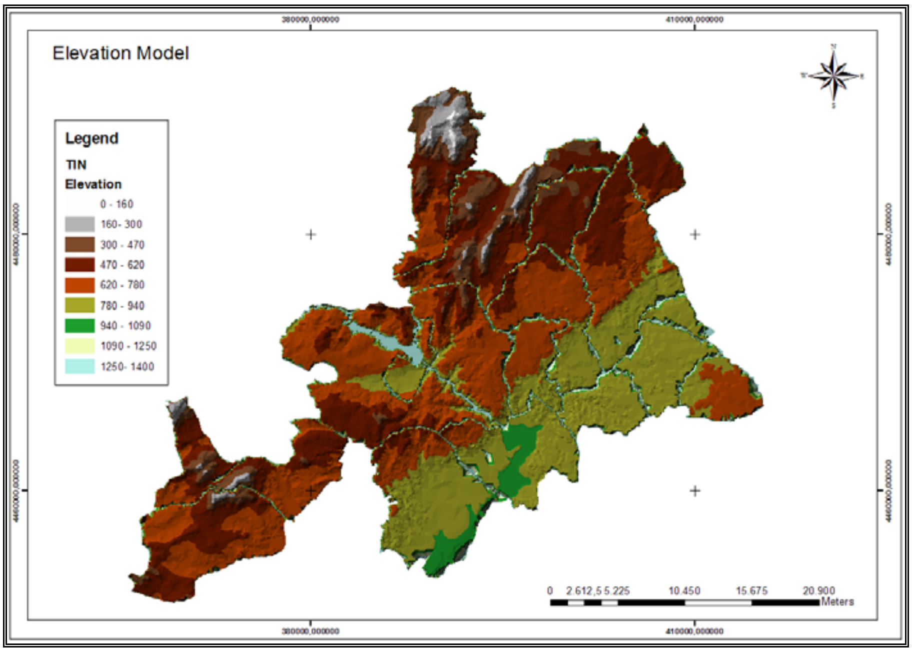
Figure 2 shows the relationships of the major componentes hierarchy of the spatial decision support system object. The spatial support system is comprised of the following components:



5.1 Spatial Data

Elevation Model (DEM)

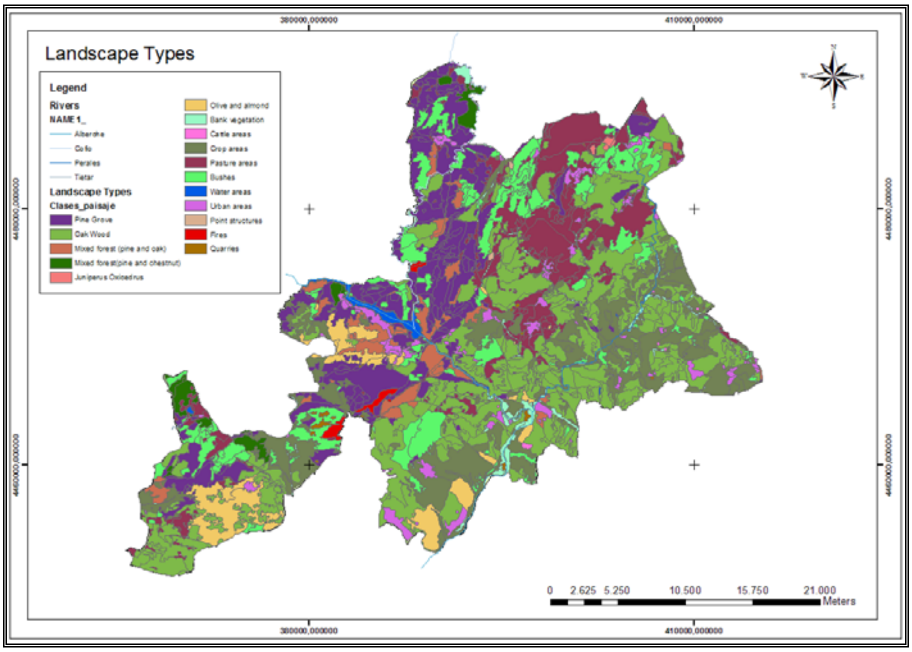
Elevation data is represented in a regular grid of elevations –Map 1-. They are used to assign elevations to the network and to calculate intervisibility between differents points.



Map 1: Elevation Model (DEM)

Landscape types

Landscape types are from a map of land uses. Lanscape types are defined by visiting the study area and with the map of land uses -Map 2-.



Map 2: Landscape Type

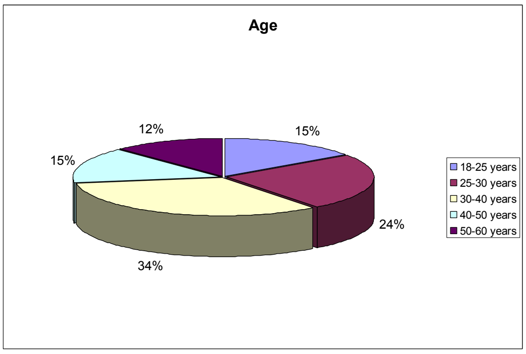
5.2 Agents Database

8.1.1 Survey

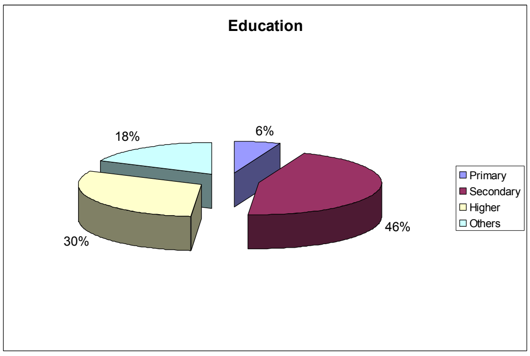
First, fotographs were taking in the study area from differents points wich were georeferenced with GPS in the study area. 500 fotographs were taking during sommer 2005 in the study area.Then, a questionary was designed and face-to-face interviews were conducted on individuals in the study area who were surveyed about their ladscape preferences and some personal socioeconomical aspects. The design of the questionnaires relate to actual and perceived causal relations among attributes and the level of the disggregation with wich attributes are specified. The purpose of these questionnaires is to explore the potencial for using stadistical preferences analysis to estimate the economic value of non.market environmental goods (Blamey, B y R.K., Rolfe, J.C. (1997)).

Visitor characteristics

56% of the surveyed are men and 44% are women. The most of the surveyed are ages between 30 and 40 years old –Graph 1- 46% of the surveyed finished their secondary education and 30% have finished higher education –Graph 2-.



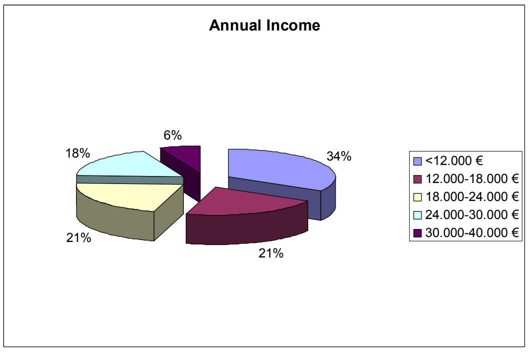
Graph 1: Age of the surveyed



Graph 2: Education

Visitor economics characteristics

34% of the surveyed have an annual income smaller than 12.000 €, 21% of the surveyed population have annual income between 18.000 € and 30.000 € - Graph 3-.



Graph 3: Annual Income

Visitor landscape preference classes

Preferences of the visitors related to the landscape are firstly for oak wood, juniperus oxicedrus areas, mixed forest (pine and oak), water areas and mixed forest (pine and chestnut). Negative preferences are for point structures as big aerial anntenas, urban areas, fire areas and quarries. In Table 1 the canonical discriminatory functions calculated with factor multivariate analysis are shown.

Landscape classes	Function	
	1	2
Crop areas	-,044	,214
Point structures	-1,205	,171
Urban areas	-,979	-,053
Pasture areas	,562	,099
Water areas	,392	-,276
Mixed forest(pine and chesnut)	,745	,050
Juniperus Oxicedrus	,807	,163
Mixed forest(pine and oak)	,773	,033
Bank vegetation	,764	,123
Pine grove	,502	-,130
Oak wood	1,066	,134
Fires/quarries	-,810	-,049

Table 1: Canonical discriminatory functions

5.3 Statistical Analysis

Statistical package (SPSS) has been used to analyse the landscape attributes. Multivariate analysis was used determining visual quality and visual fragility in relation with landscape classes. It is shown in the table 2.

Logic regression was used to determine the willingness to pay. The bid was included as explanatory variable of yes or no. The bid-rent approach was first developed by Alonso (1964). A comprehensive description of the bid-rent model and some of its extensions in a static framework can be found in Fujita (1989). Some of the attributes and the levels used in the analysis are showed in table 2

Attributes	Levels
Pine Grove	Visual quality Visual fragility
Oak Wood	Visual quality Visual fragility
Mixed Forest (pine and oak)	Visual quality Visual fragility
Bank Vegetation	Visual quality Visual fragility
Pasture areas	Visual quality Visual fragility
Water areas	Visual quality Visual fragility
Urban areas	Visual quality Visual fragility
Point structures	Visual quality Visual fragility
Fires	Visual quality Visual fragility
Quarries	Visual quality Visual fragility
Annual income	<12.000€ 12.000-18.000 € 18.000-24.000€ 24.000-30.000€ 30.000-40.000€ >40.000€
Annual willingness to pay	0€ <6€ 6-12€ 12-18e 18-24€ 24-30€
Additional Attributes	
Sex	Male Female
Age	18-25 26-30 31-40 41-50 51-60 >61
Studies level	Primary education Secondary education Higher education Others

Table 2: Levels and Attributes in the stadistical analysis

The results of the logic regression are showed in table 3; there are some attributes that stadistical result is very near to zero, so they have been eliminated of the regression model.

Variable/Attributes	Choice Model (B value)
Pine Grove (VQ)	3,65
Pine Grove (VF)	2,36
Oak Wood (VQ)	3,52
Oak Wood (VF)	2,41
Mixed Forest (pine and oak) (VQ)	3,3
Mixed Forest (pine and oak) (VF)	3,03
Mixed Forest (pine and chestnut) (VQ)	3,29
Mixed Forest (pine and chestnut) (VF)	2,43
Juniperus Oxicedrus (VQ)	3,39
Juniperus Oxicedrus (VF)	2,49
Bank Vegetation (VQ)	3,34
Bank Vegetation (VF)	2,47
Crop areas (VQ)	2,73
Crop areas (VF)	2,94
Pasture areas (VQ)	3,29
Pasture areas (VF)	2,5
Water areas (VQ)	2,92
Water areas (VF)	2,29
Urban areas (VQ)	2,712
Urban areas (VF)	2,27
Point structures (VQ)	2,26
Point structures (VF)	2,29
Fires/quarries (VQ)	2,37
Fires/quarries (VF)	2,73
[€willingness=1]	42,48
[€willingness=2]	42,48
[€willingness=4]	42,48
[€willingness=5]	42,48
[annual income=1]	-2,01
[annual income=2]	-2,05
[annual income=3]	-1,95
[annual income=4]	-2,02
Log-likelihood	2811,428
Log-likelihood Rest	2969,156
$\chi 2$	157,722
Rho^2	0,744

Value of t statistical aren't included because are all of them significant.

Table 3: Choice Model Coefficients

$$\text{Log } (P\ (y=1)/P(y=0)=\text{Log } (P_i/P_{(i-1)})=X^T{}_i\, B$$

The model assuming that the probability of choosing the alternative y=1, the willingness negative to pay for the conservation is:

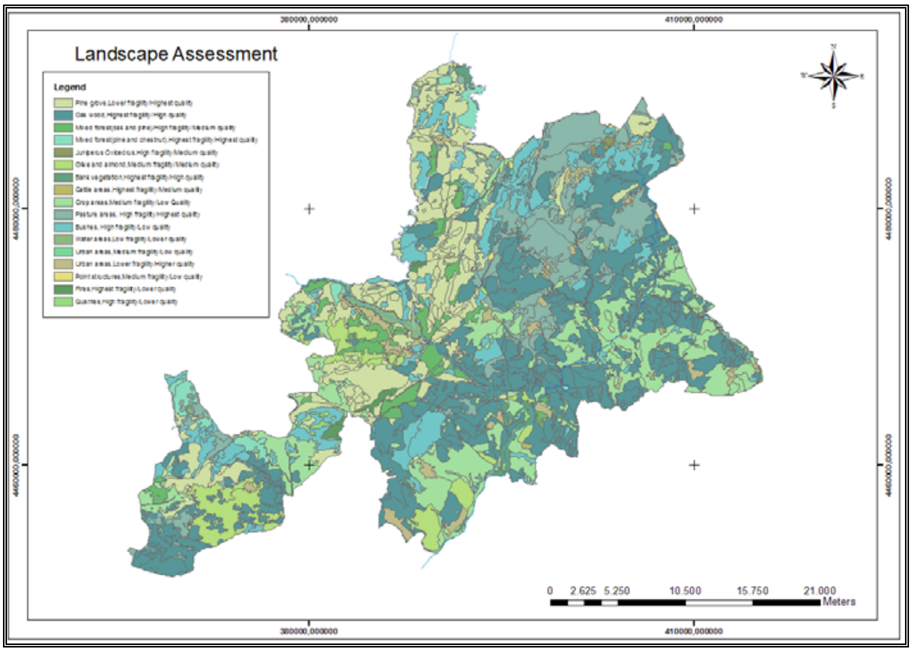
5.4 Managment Scenario

The management scenario is an aggregation of the DEM, a series of agents rules obtained in the statistical analysis and a set of runtime simulation conditions. Rules are assigned to each class of landscape defined related to the agents preferences and the willingness to pay.

The data are processed and the results are obtained wthin the management scenario.

5.4.1 Landscape assessment

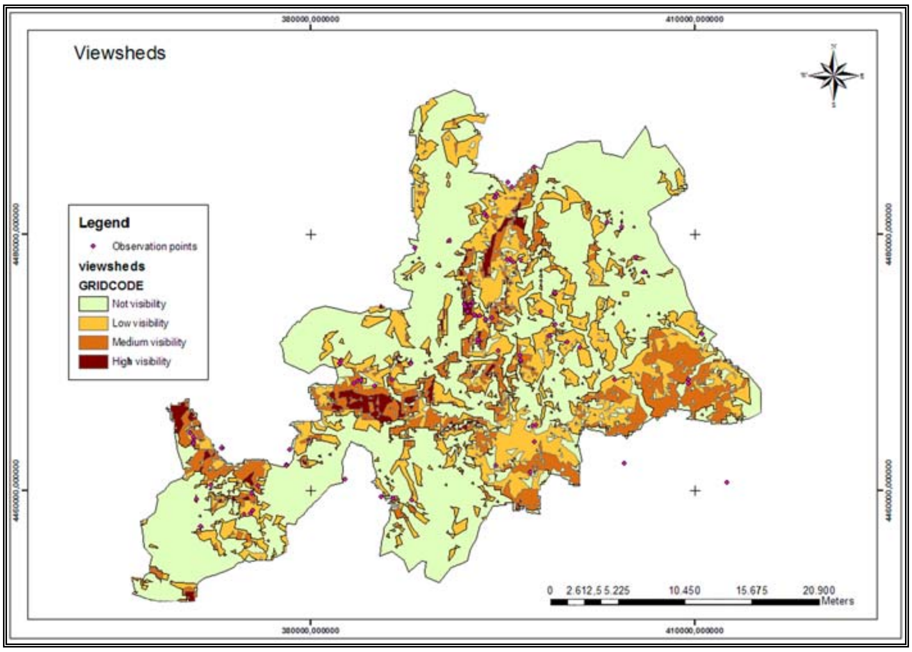
The Landscape assessment is the spatial integration between landscape classes, their quality and fragility value as shown in Map 3.



Map 3: Landscape assessment.

Viewsheds

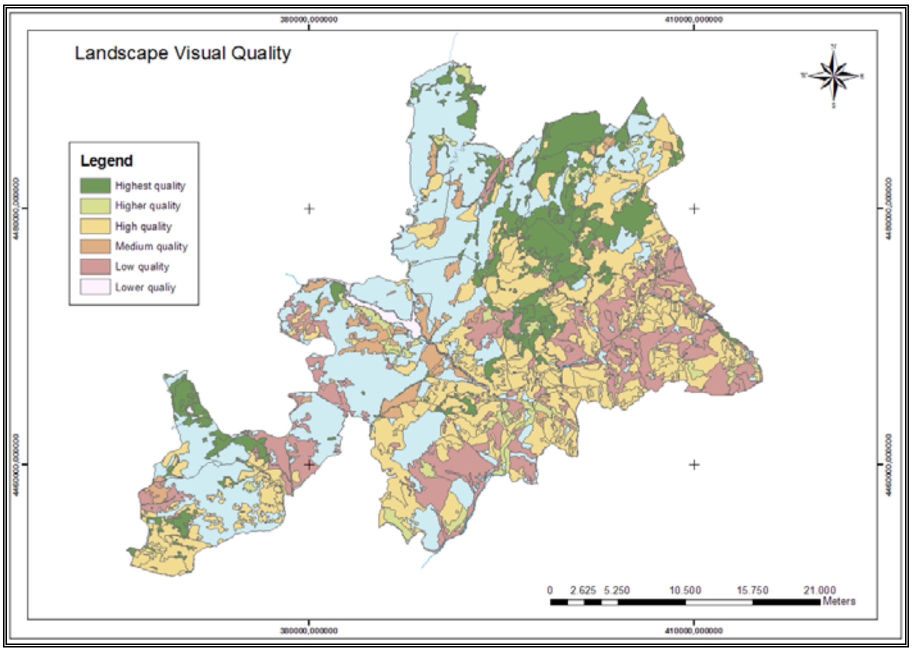
Viewsheds were calculated using the DEM from the points were the fotographs are taken. In Map 4 shows the different grades of visibility in the study area.



Map 4: Viewsheds

Landscape quality value

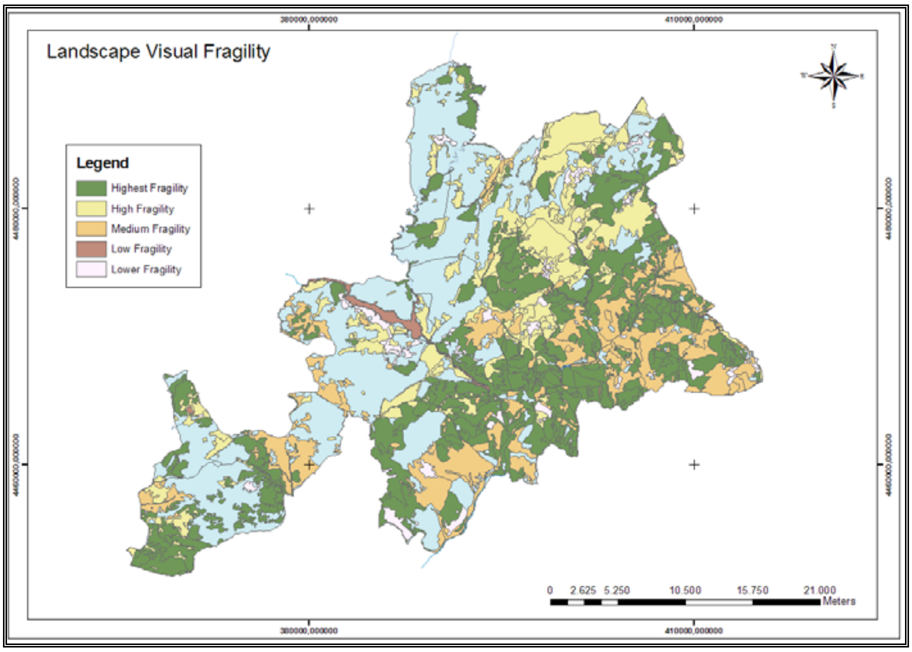
The Landscape quality value is calculated by using the DEM, viewsheds and preferences analysis. In Map 5 the different grades of the landscape visual quality in the study area are displayed.



Map 5: Landscape visual quality.

Landscape fragility value

The Landscape quality value is calculated by using the DEM, viewsheds and preferences analysis. In Map 6 the different grade of the landscape visual fragility in the study area are displayed.

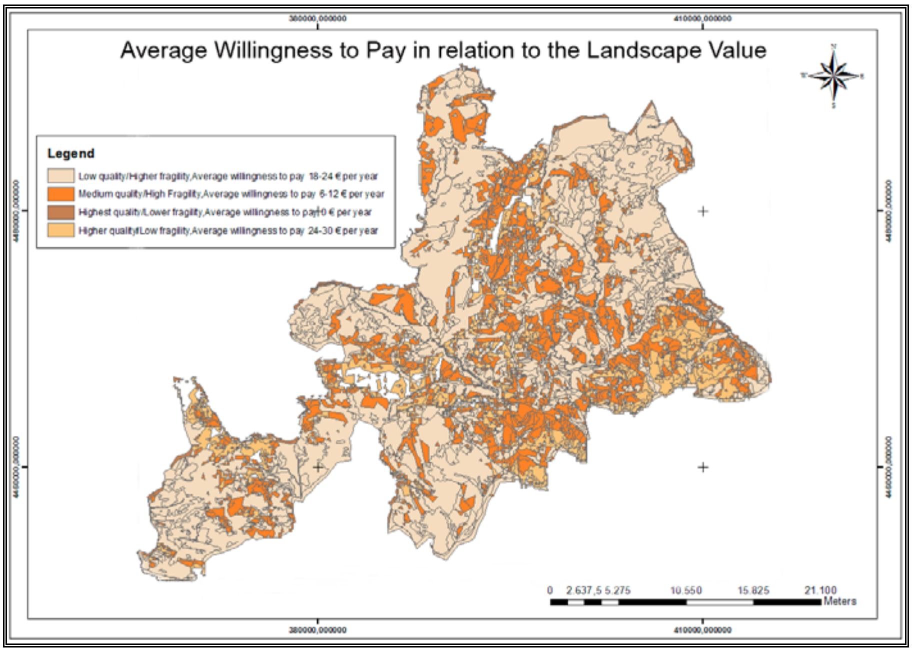


Map 6: Landscape visual fragility

5.4.2 Willingness to pay relationated with landscape value

Willingness to pay is calculated combining the landscape assesment, multivariate analysis and preferences analysis (logic regression). The willlingness to pay of the population is the higher (24-30 € per year) in areas with higher quality value and low fragility value. In contrast to this, in areas with medium quality value and higher fragility value, the population only has a willingness to pay 6-12 € per year. In Map 7 the different willingness to pay in the study area is shown.

It is interesting, that the areas, where the population would pay the highest quantity, are the smallest zones. The population is willing to pay in the most of the study area between 18-24 € per year in areas with low quality and higher fragility.



Map 7: Average willingness to pay relationated with landscape value.

6 CONCLUSIONS

Nowadays are required more intensive and innovative management techniques. Without a doubt, the development of these tools will significantly improve the ability of decision makers and users to use land units.

This decision making model is a general agent-based model for simulating the willingness to pay related with the landscape value for visitors and population in the study area.

This new decision model making model is designed as a management tool, manager can examine a broad range of management options, compare and contrast differents strategies.

The component architecture described in this paper allows us to build additional agents as a new components, change present components and integrate in the decision making model.

This paper is the considerable interest in integrating the behavioural decision modelling with traditional geographical information systems ecosystems models to provide the economy market value of the natural resources, moreover, develop temporal environmental economics models.

As discussed, the calculation of effective costs of the population pressures over the landscapes is very important for the management of natural protected areas.

7 REFERENCES

ALONSO, W. (1964). : Location and Land Use, Harvard University Press, Cambridge, M.A.

BLAMEY, B y R.K., ROLFE, J.C. (1997). : Issues ans Qualitative Insghits, Choice Modelling Research Repor No 4, University College, The University of New South Wales, Canberra.

FUJITA, M. (1989). : Urban Economics Theory, Cambridge University Press, Cambridge Massachussets.

FRANKLIN, STAN AND ART GRAESSER (1996).: Is it an Agent, or just a program?: A Taxonomy for Autonomus Agents,Proceedings of the Third International Workshop on Agent Theories, Architectures, and Languajes, Springer Verlag. http://www.msci.memphis.edu/frankling/Agent.prog.html

🏆 reviewed paper

What is the Social Memory to which the Information Technologies are useful?

Olivier LEFEBVRE

(Dr Olivier Lefebvre France Telecom Finance 6 Place d'Alleray 75505 Paris Cedex 15 France olivier1.lefebvre@francetelecom.com)

We could start from the ideas of the French sociologist Tarde. At the beginning, there is a fact: the development of the human brain is not oriented towards any direction. The problem is solved thanks to imitation. Some societies are tradition-oriented, people imitate the past. Other societies are fashion-oriented, people imitate the fashions. Of course, the consumption society is fashion-oriented. Therefore, there is no role for Social Memory.

At the opposite, the French sociologist Halbwachs said: «behind any social activity, there is a Social Memory». Any social group needs strong beliefs to be stable, hence a sort of «tradition», or Social Memory.

Indeed, in the consumption society, some Social Memory remains. At least, examples are: religious memory, the Nation, institutions (Justice), Cultural Heritage …

According to Halbwachs, institutions or some social groups need a Memory for two reasons:

Besides the technical skills, the tasks to carry out require personal qualities. Of course, it is at a high level. For instance, it concerns the personal qualities of a Judge. Concerning the social classes (aristocrats, bourgeoisie) the Halbwachs 's remark is obvious. The group 's memory highlights the personal qualities of a remarkable person belonging to the group in the past.

An institution displays the Order which has been brought by itself (according to its doctrine), opposed to the Disorder before. An «analytical space» (Foucault), useful to control its own activity, is not sufficient. There is also the use of Symbols in the space. In France, the courts are in the cities which are prefectures (chosen at the time of the French Revolution) by opposition to the old cities where the courts of the monarchic regime were and to show that all the territory is under control (by opposition to the past). Westminster in London symbolizes several political compromises which have saved the unity of the Kingdom in the past, hence the choice of this place for the Parliament.

There is an other reason, to pose the question of Social Memory and the impact of Information Technologies on it. We are not sure that the «widening of the mind» (Crooney) which is caused by Information Technologies does not change the activities. It depends on the activity. Photography and cinema have changed Painting, but not so much Architecture.

The main idea is that in the Social Memory, the past is re-constructed. According to Halbwachs, an individual who makes efforts to «localize» a remembrance (seeking to obtain accurate details) uses «landmarks» which exist in accordance with social life. These landmarks exist because of the re-constructed past in the memory of some group to which the individual belongs. They are explained by the stakes, the goals, the action, in the present, concerning this group. Otherwise, the landmarks do not exist, and an individual is unable to localize a remembrance. Not only the past is re-constructed, but it is permanently re-constructed.

1 THE PECULARITIES ARE PRESERVED THANKS TO A DELIBERATE CHOICE, AND CHANGED

The «globalization» could be presented as a «field of forces» (François Perroux). Anywhere, pressures trigger the adaptation to a competitive economy. The pecularities originating in the past should disappear.

Now, who could propose a plan for a city imitating the old Muslim city? According to Braudel, in the center was the Mosque and the Prince's palace, then was the caravanserai, the quarter of the merchants, then the ordinary crafstmen and finally the «dirty» crafstmen (butchers, those working on leather …). Outside the city, poor people and the market gardeners. As it has been noticed by the French sociologist René Caillois, the center of the city was the place of Holiness and the periphery, the place of damnation. Of course, there is not a city in Arabic countries imitating this plan, even a little. Only are possible architectural details evoking the past (shapes), or patios, with the justification of climate.

The same remarks hold for the Jews. At the beginning, in European cities, there was the Jew in the Court and the Jew advising the Prince. According to Werner Sombart (we refer to his book «The Jews in the economic life»), they had a stimulating role in finance and trade, in the cities where they were accepted. It ended around 1850. After this date, in Vienna, for instance, they were an important part of the elite (entrepreneurs, intellectuals, artists). They inhabited a modern quarter where the unique peculiar feature was several synagogues. They were accepted, but having abandoned many of their customs. They conformed to the rules of Austrian Empire: civil status, degrees (in the University), laws … They could maintain their cult, in private. This is an example of changes in Social Memory. There were two changes, among Austrian citizens and Jews in Austria. The Austrian people changed their remembrances on Jews, in the sense of tolerance («Jews are useful to our country»). The Jews changed their remembrances on «Goy» (adaptation to the social life in Austria). In these conditions, a minority, with its pecularities, is accepted. It is a kind of deliberate choice, and Social Memory is changed. However the pecularities of this minority change, also.

When Internet and easier and cheaper trips trigger more and more migrations (international or inside a country), this problem of Social Memory changing is posed. In general, two changes are required, if migrants are accepted. There is a change of Social Memory among the people inhabiting the country and an other among the migrants. In each case the question is: «What is our tradition?». The question concerns many topics: religion, customs, authority, gender, and even details (clothes …).

According to Halbwachs there is not only a spatial stream, but also a social stream. Collective representations in each country allow, explain the migration. There are two opposed forces: representations retaining people in their country and taking them away from the foreign country, representations pushing off people. The existence of a migration depends on the stronger representations. During the trip, representations (of it) appear, and certainly remembrances. When the migrants have arrived, there are two possibilities. Either the Social Memory of the group vanishes and the migrants stay in the country. Either it remains vivid, and the migrants will return to their country, after many years.

2 THE IMPACT OF INFORMATION TECHNOLOGIES ON PAINTING AND ARCHITECTURE

Here we use the Malraux's book «Le musée imaginaire». The museums appeared two centuries ago in occidental countries. They transform the works of art they display. They are no more a decor in a palace or a holy means for a cult in a cathedral, they become works of art. First, the museums have glorified the «great occidental oil painting». At the beginning there was the finding of the blurred contour by Leonardo da Vinci. He created an impression of depth, an immense Space that things and persons fill. Other findings will be the use of Light and Shade, the foreshortening, the trompe l'œil (a minor finding). Oil painting brings Illusion, Spectacle, Fiction. Soon it will appear as boring. The museums display these works of art, only. It is restrictive academism. In the middle of the 19th century, Photography has an enormous impact (according to Malraux). People like these simple, clear pictures showing a familiar reality (landscapes, portraits). The painter's rebellion begins. In the era of bourgeoisie, the world becomes more practical, there is no more a Myth (the King, the Religion) to glorify. There is an indifference to Style. The old collusion of painters with rich and powerful people (artistocrats were Art lovers and knew it), ends. It was a rebellion in aesthetic matters and even in the lifestyle(1). The transition corresponds to Courbet, Manet. Modern Painting starts from Cézanne. What is refused is: Spectacle, Illusion, Fiction, the Topics, the constant reference to Nature. What is promoted is: abstraction, intellectualization, moving paintings, the way in which the painter paints, various sources (arts from other places and times). An other list of opposite choices is: achieved, rendered, imagination, affirmation, and: sketch, made, creation, interrogation. The goal is no more to imitate a Genius, but a constant personal creation. What matters is to create a «style». The photographic album and easier trips allow to know more works of art than before, and to compare them. It is the birth of the Musée Imaginaire. Are discovered Roman and Gothic sculptures(2), arts from ancient Egypt, Mexico, Persia and Asia (Japan, China, India …). Other artefacts than paintings are discovered and liked, as sculptures but also mosaics, frescoes, stained glass, tapestries … People are interested in «minor arts». The artists work for the Musée Imaginaire. According to Malraux, a work of art belonging to the Musée Imaginaire passes through metamorphosis. It is liked, then forgotten and re-discovered etc … It is «eternity» and no more «immortality». This is explained by the existence of Universal Languages, involving Shapes.

The modern art lover has personal tastes(3) and takes pleasure in seeking and finding works of art he likes, in the Musée Imaginaire. He will find works of art he likes in various cultures and styles (many countries, many times). Photographic albums and Internet are useful to him. Also, he travels to look at the works of art in the Museums. It is the end of the old Museum. Today, spectacle is displayed by cinema, no more by Painting. The Musée Imaginaire has become the new «encompassing», that is to say the place where works of art have their sense and value, together with other ones. And the works of the painters of the Museum are liked as paintings, no more admired as masterpieces. They have become paintings.

The painter's rebellion continued after the end of the 19th century(4).

The same did not happen to Architecture. According to Malraux, Photography has been unable to render the «depth» of houses and monuments, and perspectives in the cities. Perhaps software and computers could remove this obstacle, today. Ond could admire a monument, looking at it as if one was moving in a three dimensional space, zooming on a detail, casting a glance at an interesting place etc … thanks to synthetic images. However other reasons would remain, preventing Architecture to enter the Musée Imaginaire.

3 THESE OTHER REASONS ARE:

- There was not the architect's rebellion. In Paris in Montparnasse around 1900, there were mainly painters and poets. There were a few architects. Rarely painters are also architects(5). The customer of a painter buys a painting for his pleasure. The customer of an architect buys a house to live in it. There are more constraints for an architect, even if the modern building techniques (steel, concrete) are at disposal. The search for new shapes is easier for painters. While painters rejected the «reat occidental oil painting», the Painting of the Museum, and invented new shapes and a new use of colour, the architects only proposed «historical styles». Only around 1900, some architects adopted the findings of Cubism and it was the beginning of Modern Architecture: «invention of the wall», geometric shapes, use of volumes and surfaces etc … (6).

---

(1) The painter's rebellion is described in the Zola's novel «L'œuvre». Perhaps the «model» was Cézanne. In fact, Cézanne suffered to paint according to his will, did not commit suicide and succeeded. His paintings are the very beginning of the Musée Imaginaire. Zola made a mistake on Painting. He wished large paintings showing the real social life. A few paintings have corresponded to his wishes.

(2) It was ignored by Viollet le Duc, who destroyed the gothic sculptures of Notre Dame de Paris, when he restored it.

(3) Malraux liked the «severe style» (opposed to Illusion), the clear (not the «asphalt» described by Zola), simple (opposed to the «brilliant style») colours allowing a dissonant harmony. Taste is personal. The general theories of Malraux on the Musée Imaginaire are often accepted.

(4) The French painter Marcel Duchamp stopped painting. He also wanted to exit from style and even sense. Wanting to not imitate himself, he made replicas of his own works. He sold ready-mades. A ready-made is a (fictitious) object for the everyday life, manufactured by industry, and a little changed. Often a message is added (a wink, a play on words) and it is signed.

Duchamp posed the question of the impact of reproduction techiques on Art. It is worth to define some words:

- Replica. An artist obtains a new work by changing an old work (for instance, colours). It is signed. It is sold.
- Copy. An imitation of the work of a dead artist.
- Multiple. Just similar to a work, without modification. Possibly, many.
- Appropriation. An artist re-makes the work of an other artist, in his own way.

Also, these details show the complexity of the market of works of art. Walter Benjamin thought that a work of art looses its «aura» when it is reproduced. It is not the opinion of Duchamp, since he considered his replicas as having value.

(5) The Mexican painter Diego Rivera was also an architect. He designed the Anahuacalli museum in Mexico City, to display his own collection of Aztec artefacts. It is an imitation of an Aztec pyramid. The idea could not be applied to an other project. Indeed, the Anahuacalli museum belongs to the Musée Imaginaire.

(6) According to Francastel, the earlier work in Modern Architecure is a house in Vienna, which was designed by Loos around 1900. Loos refused any ornementation (the «floral style»).

- Paintings and sculptures are more flexible objets than buildings. If you live in a big city, if you wait some time, you can always look at the paintings you like. If you want to look at monuments, you have to travel.

- Each city is unique. We do not choose a return to Nature, or immortal rules of Beauty, speaking of the «Soul» of a city. An historical city is unique if we consider its history, its Art, its present atmosphere and its Social Memory. We refer to what is said by Max Weber on the history of cities. Two cities differ by the «great consumers» (the rich people benefitting from rents and spending their money in the city), the social classes which were allies or struggling one against the other, the political institutions, the aesthetic tastes and the successes in art etc … The present atmosphere, which is in part explained by the past and tradition, is displayed only by some famous novelists(7).

The pecularity of some cities is obvious:

Paris. The capital of France, the world capital of luxury during centuries.

Vienna. Habsburg dynasty, baroque, brilliant intelligentsia around 1900.

Naples. Powerful aristocracy, christian mysticism.

Etc…

No wonder that the Social Memory on each of these cities is built locally. If you like one of these cities and want to look at it, you have to come into the city. It is uneasy to transfer an architectural solution from one of these cities to an other, given the peculiar, unique, social environment of the city. It is obvious concerning the climate, but concerns the social environment, history, aesthetic styles, the atmosphere etc … It is not the same for paintings. Perhaps it is one of the reasons why an international style in architecture appeared late. That was already found by Cubist painters was adopted.

- There is not the equivalent of «past cultures» as in Painting. We refer to what remains of the art of ancient Egypt, or Aztec art etc … Now it is part of the Musée Imaginaire. There is not the equivalent in Architecture. There are only a few «dead cities», as the «ghost cities» in USA, Macchu Picchu, Pompei, Herculanum etc … The interesting architectural remains are often in the big cities of today. It is because the development of big cities is often in the same place, where they are located today(8). They are part of the Social Memory of these cities. The end of a city is considered only as a sad event. A city is not a decor that one could replace advantageously. When in some novels the destruction of a city is described, it is only a sad event. Zola has described the destruction of Paris («La débâcle»), Sienkiewicz the destruction of Rome («Quo Vadis?»), Margaret Mitchell that of Atlanta («Gone with the wind»), Malaparte that of Naples («La pelle») etc … Perhaps an explanation is that the «right to conquer» is no more accepted. It has been highlighted by the American historian Prescott in his book on Cortes, written in the middle of the 19th century. If we believe Max Weber it was admitted in the city of ancient Greece. We do not admire an Alexander the Great, destroying cities but creating Alexandrias by tens. Perhaps it is linked to the present refusal of the use of nuclear weapons (or other terrible arms), which exists in the opinion. In many parts of the world, it is no more admitted to destroy a city to exert pressures on people(9). When there are architectural remains in a big city, it is uneasy to imitate them to build an international style. What is possible is historical styles. Probably, at the same time, representations concerning Society are diffused. Of course, as other works of art than paintings, other cultures (in other societies, in other times) were discovered, vernacular architecture has been discovered. However imitating it was possible only when it concerned architectural details. In particular, the plan of houses and buildings expresses social and religious collective behaviours, and cannot be transferred into a Modern Architecture.

We find in the Francastel's book «Art et Technique au 19 ème et 20 ème siècles» the confirmation of the Malraux's ideas. According to this author, there is at a given time and in any society, a «figurative competence», thanks to some artists. They invent new aesthetic shapes. It is an «operational activity» which can be compared to mathematics. First, there is a search, then there are findings. It is like a kind of experiment. New problems are posed, there is a new search etc … The findings of artists are «parallel» to those in science and technology, but there is not a transfer from an activity to the other(10). There is a kind of «analytical approach», at a given time, in a society, which is common to Art, Science and Technology. For instance the Cubist Painting breaks up and recomposes objects along geometric lines (cubes) like technicians break up and recompose the human work (when technology replaces the ancient methods of crafstmen). Or sculptures made of wires suggest the scientific notion of field of forces.

The Cubist painting brought the novelties:

Perspective. It is not the traditional perspective. The «bird's eye view» and the view from above are invented.

Speed. As speed becomes omnipresent in the world, it is also present in paintings.

Internal structure. The importance of the internal structure of an object (an idea which exists in science and technology also) explains that details of an object are in evidence, of that the same details of objects which are far one from the other, are displayed.

Later Cubist painters have chosen an other style: planes the positions of which are relative one to the other, appear in the paintings. Volumes and surfaces are displayed. The fact that architects have borrowed shapes from Cubist painters is apparent, when we consider the two trends of Architecture after 1900: the cult of the «lightened room» (Le Corbusier), and the taste for freed volumes and surfaces.

Around 1930, Abstract Art brings other novelties:

(7) Zola for Paris, Malaparte for Naples, Margaret Mitchell for Atlanta and the south of USA etc …

(8) The French economist Sauvy has called «syndrom of the plane tree» this phenomenon.

(9) The «right to conquer» and its end are topics concerning the «social morphology» according to Halbwachs. It concerns the distribution of the population in Space, and the representations (the «collective psychology»), also.

(10) It is not the thesis of «Art impliqué» («involved art»). This art is linked to Industry. The shape of an object is beautiful if it displays the technology used to produce it («the Shape expresses the function»).

Colour. A new way of using colour is invented (Gauguin). It is a two-dimensional painting (Malraux), but an impression of depth is obtained thanks to colour. It is the end of the «local tone».

Rythm. It is not, as before, a rythm the measure of which is Man. The rythm is anywhere in the Cosmos. It is present in all the phenomena.

Material. It concerns the sculptors. They use the suggestive power of emptiness. They invent the tension of inside and outside. Sculptures in wires suggest a shape which is an empty volume. This use of material is new (the traditional sculptures displayed nice shapes, only).

Having painted the «Nature», then what is seen, one paints a construction.

These findings have influenced architecture.

Francastel does not speak of Information Technologies(11). He poses the question of the links of Technology in general, and Art. We live in a world full of objects produced by Industry. Are they nice? The only finding of figurative (plastic) Art adopted by Industry has been aerodynamism. The shapes of many objects produced by Industry are aerodynamic, the surfaces are smooth and polished. Perhaps an effort to educate the public is necessary. In the past, often, the patterns which were used by crafstmen were brought by artists.

The «figurative activity» is a social activity. Thanks to this activity, the meanings of shapes are chosen, inside a culture. It is partially determined by the past (for instance the letters of alphabet in occidental countries). It is also invented. This activity is neither totally autonomous (specific), neither the mere reflection of an other activity. Benedetto Croce is right when he highlights the role of geniuses in Art, but he insists on Spirit too much. The development of Art is «parallel» to that of Society. Francastel cites Halbwachs: Art is necessary because it is common to individuals belonging to groups which do not communicate one with the other.

4 THE SOCIAL MEMORY ACCORDING TO HALBWACHS

Halbwachs has examined the Social Memory in some institutions: Religion, Family, Social Class. Take the example of the Christian Church. It is uneasy to it to explain the Revelation, or the Moral Revolution (the other is an equal) because all happened a long time ago, in the first century. It was more and more uneasy, after more time, because the social environment of the events was more difficult to understand for people. The first recourse was the dogma, with its rigour, well controlled, but also triggering a few sentiments. The second recourse is the words of Saints and Mystics. These words are not a well controlled discourse, but they trigger a strong sentiment of the presence of God. Often, but not always, the Church has accepted the words of the Saints, even if there was some opposition from the proponents of the dogma (the Saints often knew theology, and this helped the Church to accept what they told). In general, the two recourses for Social Memory are objectivity and seduction. There is a kind of dilemma, because these means are of opposite kinds, and you cannot use one of them too much, because it would make impossible to use the other.

To sum up what we have said on Social Memory:

Often an institution needs a Social Memory. Halbwachs has examined Religion, the Family and the Social Class. We could find examples concerning professional groups (Justice …). The Nation is an other example. Of course, the Cultural Heritage needs a Social Memory.

A recourse is to tell the exact story. The risk is that it is not very «appealing». It is more uneasy to explain facts when they are far away in the past. The discourse which is chosen is well controlled.

An other recourse is to accept the role of imagination. One chooses words which are seductive. It is not a very much controlled discourse. If people like «embellishments» too much, they will refuse any exact story. An institution wants to be attractive, but also to be able to give explanations. If there are too many embellishments, it triggers a reaction from the proponents of objectivity. However, seduction (appealing to imagination and sentiment) will be tried if objective explanations are not well understood.

There are conflicts, the stake being the re-construction of the past. It depends on how the present stakes (for the institution) are considered. There are proponents of objectivity and proponents of seduction. It is similar to the dilemma (for institutions) described by Foucault. Any institution needs a doctrine, and there are two opposite goals. The institution wants to explain its ability, its performance, its goals to people inside and outside. It also wants to influence representations to be acceptable. None of these means, objective explanations or attractive words, can be used too much. For instance, a professional milieu can recognize difficulties (because it is better to avoid promises which will not be kept), but not too much (because it would be to allow doubts in the opinion). There is the same for Social Memory. To embellish remembrances very much is to encourage dreams (it could be out of control). However, only objective explanations could trigger indifference.

Concerning Social Memory there are conflicts, mystifications, utopias (as the picturesque novel of D H Lawrence on Qelzatlcoatl). There is often a polarity: Social Memory, in two groups, evolves towards tolerance or hostility, at the same time.

What will change, at the time of Internet? Of course, it will be one of the battlegrounds, concerning Social Memory. It will be used by the proponents of objectivity and the proponents of seduction. There will be two kinds of Internet sites. Some will expose rational arguments, referring to Science and Knowledge, seriously. Other sites will appeal to sentiments, using simple words and images.

Concerning Cultural Heritage, Internet will allow experts a better (more efficient) formation. Some sites (in countries, in cities) will diffuse an objective information on the local cultural heritage. They will present the local history, concerning Art, with objectivity. Other sites will have more commercial goals. They will present the sites to visit, in a country or a city, without many explanations,

(11) Except a few times. Le Corbusier wanted to suppress nomadism, the consequence of an «excess of communication», according to him. Cinema familiarized people with speed (in Art). An Italian writer, Ragghianti, showed that photography has destroyed naturalist art, around the middle of the 19th century.

but insisting on «sensations». There are two means to strenghten Social Memory: objective information and appeal to imagination. Internet sites (it is the same for guidebooks or presentations by tour operators etc …) will propose two kinds of visits: one for those having an interest in Cultural Heritage, an other for those searching sensations and spectacles.

5 CONCLUSION

Technology, activity and Social Memory are intertwined. The example of the effects of Photography and Cinema(12) on Painting and Architecture shows that. The effects of Information Technologies depend on the activity, and are often complex. Sometimes the effects which are triggered are simple (only a growing productivity). They are often more complex. In the case of archeology, the effect is a growing productivity: the work on the sites of the excavations is carried out more rapidly, computers allow to design an ancient building on the screen thanks to the data collected on the site of the excavations. Concerning the museums, too, the productivity is growing: the formation of experts is more efficient, software is used to manage some historical sites (as castles). However, in the case of museums, there are other effects. Information Technologies could be used to format the behaviour of those visiting museums, too much.

Sociologists have described how the behaviours of «users» in the city, are formatted by various kinds of specialists(13). These professionals collect information on the networks they manage, the behaviour of the users etc … and return services for the users: water flows from the tabs, electricity and gas are provided, safety is real, traffic is easy etc … This «analytical space» (Foucault) involves signs, orders, constraints … The behaviour of the walker, the driver, the buyer etc … is formatted. There are so many signs to inform the user, and orders for him, that his brain is near from saturation. To stroll while enjoying some pleasure is possible only in parks. Otherwise the walker has to watch his itinerary, the traffic lights, the orders for him (choose this sidewalk, walk in the underground passage etc …). Or he cannot walk. The behaviour of those visiting sites could be formatted too much, also. The decisions concerning Social Memory are somewhat imperative. Therefore one can decide what will be displayed in some museums, in what order, what explanations will be given, how the works of art will be lightened etc … The risk is to influence the «customer», to saturate his brain. Even if some education of the public is good, one should let the visitor have his own opinion, choose what he looks at etc … Of course, Internet can be used to influence the tourists who visit a city, or to allow them some freedom. For instance, the mobile giving access to explanations for the tourists visiting a city, could allow to choose the sites which are visited, to obtain information on some topics if one needs it, to choose one’s itinerary etc …

In some regions and cities in Western Europe, but not everywhere, there is a consensus, concerning the quality of landscapes. It is not conservative, but it is to preserve the Cultural Heritage, to be aware of a stake, the aesthetic quality of rural or urban landscapes. In the country, it is, say, to avoid a pink coloured rococo villa in a Swiss pastureland(14). In the cities, it is to preserve the historical sites, to choose a nice modern architecture, to maintain and create parks. Will Internet strenghten this consensus, or not? There will be two kinds of Internet sites:

Those stressing the Social Memory, exposing arguments to justify the choices which are made. The customers will be lured if they accept, or like these choices.

Those proposing entertainment in a decor. They will not insist on the local tradition, except folklore.

In principle, the Internet sites of the first kind will be located in regions where a consensus to preserve the quality of landscapes, exists. They will present photos of monuments and landscapes. They will give explanations on local sites. The Internet sites of the second kind will be located in the other regions.

---

(12) The Ragghianti’s book «Les chemins de l’art» is on the movies showing works of art. He describes what technical means a cameraman can use to show works of art. A story is not told. The essential is images, the resources of the language of cinema used to show the works of an artist. The goal is to show a dynamics, a process, the «way of doing» of an artist. A movie corresponds to the book. It has been directed by Ragghianti. The movie shows what is explained in the book.

(13) For instance, this is described in the case of Paris in the Bruno Latour’s book «Paris ville invisible».

(14) And ads alongside the roads etc …

Integrated Transportation Planning and Information with PTV Vision Technology

Thomas FRIDERICH

(Dipl. Tech. Math. Thomas Friderich, PTV AG, Stumpfstr. 1, 76131 Karlsruhe, thomas.friderich@ptv.de)

1 INTRODUCTION

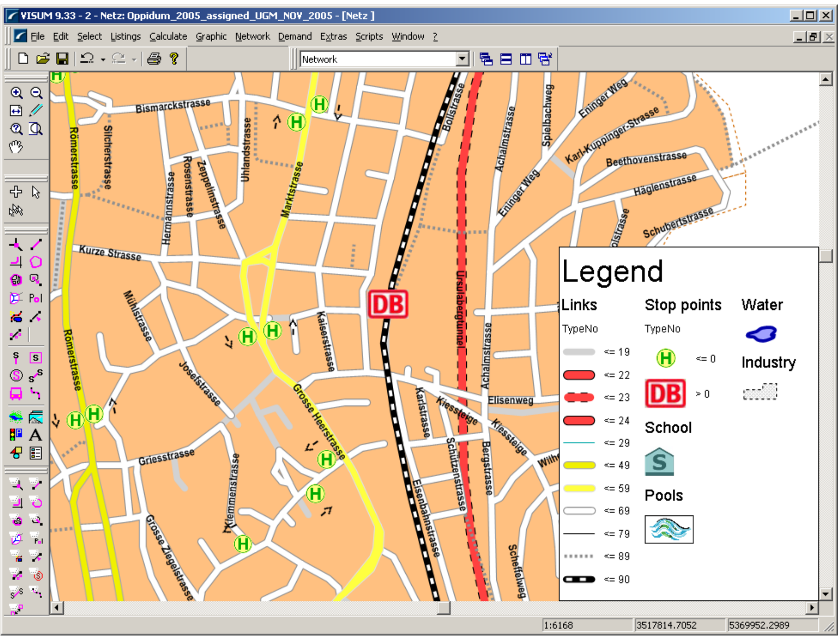
The availability of data has improved tremendously through the introduction of IT tools in the last decade leading us into an information society. The main goal in the growing amount of information is to find a common base and reference system for the data collection and to provide an adequate communication channel to the user of the processed information.

Integrated transportation planning – understood not as a secluded science for experts, but as a service to the public – can profit from the new possibilities in an information society twice. While building up the transportation model supply and demand data can be obtained and integrated in a very efficient way. The application of the results from the planning process – information on the current or predicted traffic situation – can be extended into new public services.

2 GEOINFORMATION IN TRANSPORTATION PLANNING

The base of each transportation model is the traffic supply and demand. For both existing data from systems can be utilized.

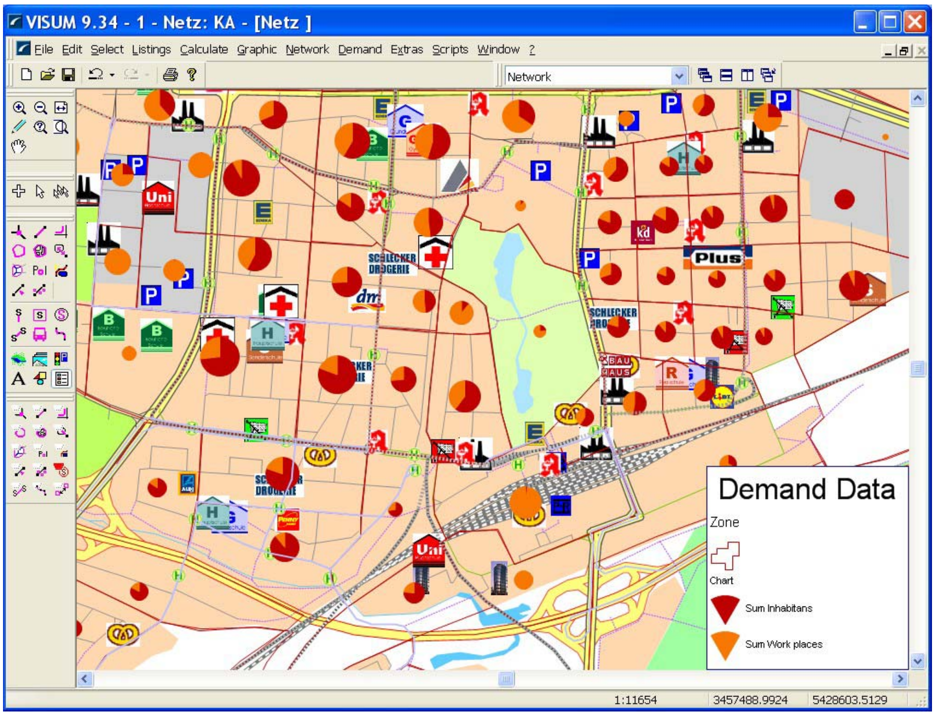
The network can be based on a completely new data source: car navigation. In this rapidly growing market providers make a great effort in the digital data collection. Already today there is a large coverage of Europe, the US and the middle east with highly detailed car navigation networks by the major providers NAVTEQ and Tele Atlas. The advantages are the detailed topology, the continuous updates and good coverage of attributes, which contain all necessary information that is needed to start a macroscopic simulation (linktype, free flow speed and capacity). The accuracy and attributes also allow a display which is comparable to city maps.



Graph 1: Display of a NAVTEQ network in the transportation planning tool VISUM

The data model for the public transportation in the PTV Vision products has been extended to a level of detail which corresponds with the operational systems. The entire timetable can therefore be easily exchanged between the planning tools and the travel information systems.

For the demand model the major source are statistical data, like inhabitants or work places per traffic zone. But the model can be lifted to a new level of accuracy if not only average values per geographical unit, but also singular traffic attractors like schools or shopping possibilities are introduced to the model as points of interest (POI).



Graph 2: Display of demand data in the transportation planning tool VISUM

A transportation model is gathering a lot of information as input data, but the transportation planning process also produces valuable results for other applications. The most common output of a traffic simulation are:

The origin and destination matrix expressing the transportation demand.

The utilized paths through the network to travel from A to B, which result in the turning volumes at each intersection.

The number of vehicles using a certain road expressed as the link volumes (Veh/hour).

Saturation of links and intersections calculated as the volume capacity ratio.

As a result of congestion a predicted time loss for travel time according to the saturation.

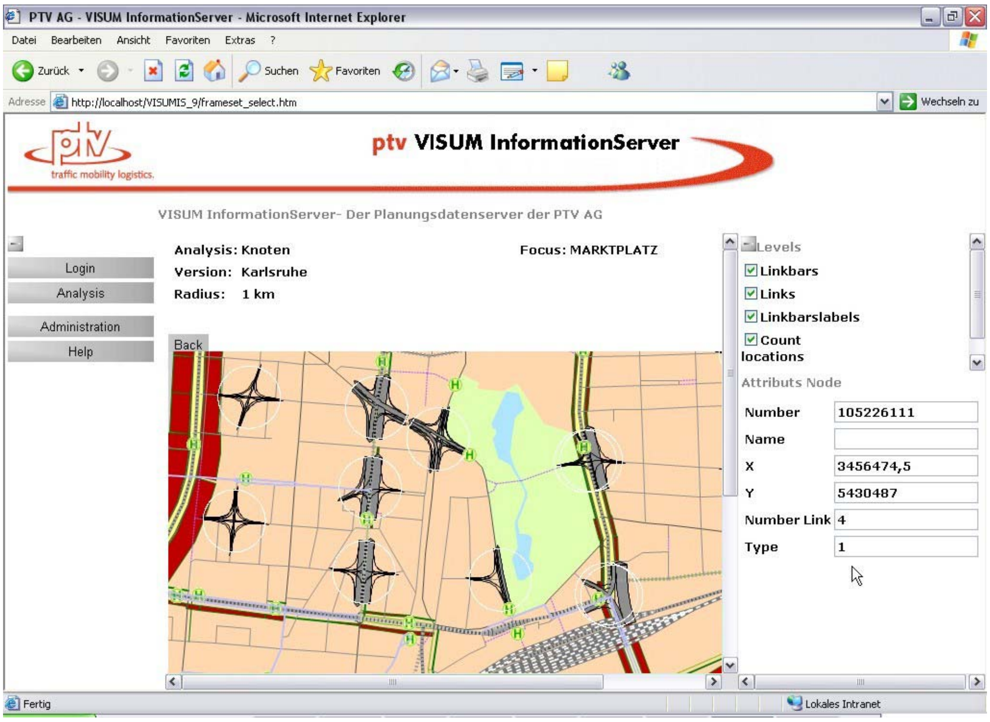
All this information can not only be used for planning new transportation infrastructure but is also useful for the analysis of accessibility, route guidance and traffic information.

3 INFORMATION PLATFORMS

The software products for transportation planning are very powerful tools combining mapping and GIS functionality, complex mathematical algorithms for traffic simulation and a sound data model (was ist das?) to manage a seemless data flow. These applications are expert systems and even sophisticated user interfaces will not abolish the need for a training to apply the software. Therefore other channels and information platforms have to be used.

3.1 Information flow for professionals

To share the information among a group of professionals, e.g. different departments of a regional administration, the web-based application VISUM InformationServer is appropriate. Its simple user interface allows the access to all results of the transportation model without deeper knowledge of the modelling software. A client can request a user defined evaluation, specifying the geometrical extension. The results are produced on the server on demand and displayed in the browser as a listing or a vector graphic. SVG (Scalabale vector graphic) does not only enable zooming and layer control, but also gives the possibility to display detailed information for each object in the graphic interactively. E.g. by clicking on a node the corresponding attributes like node ID, node type and coordinates are displayed. Furthermore, detailed model results like turning volumes can be accessed by the user of the internet tool.



Graph 3: Example of display of turning volumes in the VISUM InformationServer

An administration interface to define the different evaluation types and control the access to certain data sets for the individual user is a standard feature of the VISUM InformationServer.

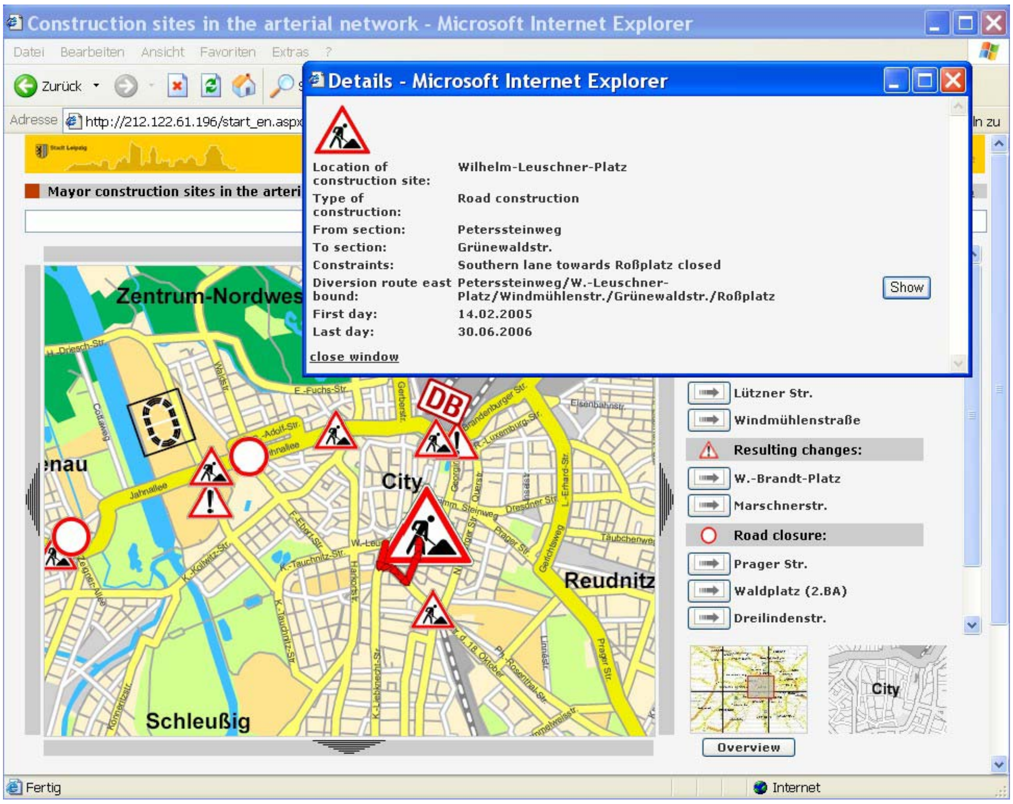
3.2 Information for the public

When providing information to the broad public the most important requirements for internet applications are quick response times and an intuitive user interface.

An example of truly integrated transportation planning is the PTV Vision model which was developed by Dr. Auspurg in the City of Leipzig in the year 1993. Leipzig has undergone a massive structural change in the past decades and the transportation model was updated and extended accordingly.

After the emphasis on transportation planning with long and short term prognosis, the task in the recent years focused on the analysis of complex road work situations. This included the macroscopic simulation of the effects of the urban network, the planning of deviations, the analysis of current road works and timing of different construction stages to minimize the obstruction. For complex intersections additional microscopic simulations were conducted, to prove the performance.

With the preparation for FIFA world cup 2006 and the Confederations Cup in 2005, the idea was born to use this existing data platform for the information of the citizens and tourists via the internet and linking it to www.leipzig.de.



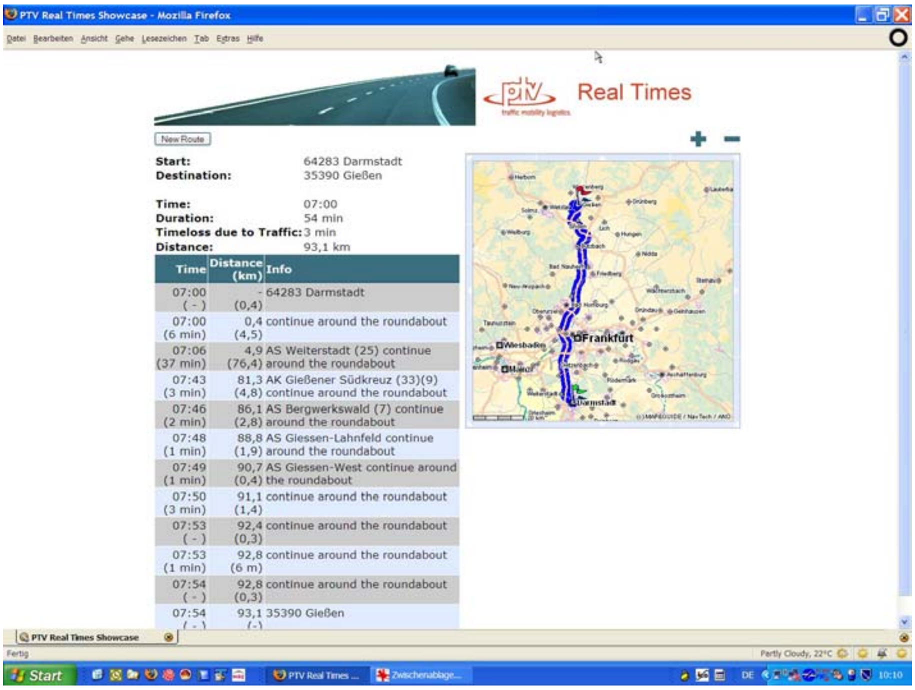
Graph 4: Roadwork information system in Leipzig

This internet site informs citizens and tourists about the current road work situation in the arterial network. All the data is directly exported from the transportaion model and is regularly updated, at least once a week and on a daily base during major events.

3.3 Information through service providers

The planning authority is not necessarily the institution which will provide the information to the public. The data can also be handed to a professional service provider who will process the data further and will set up the according service platform.

One advantage of using car navigation networks for transportation planning is that the results of the modelling work can easily be fed back to the car navigation. The estimated travel time in navigation systems is usually calculated based on average speeds. But the travel time observed in reality varies significant during different times of the day. This effect is well known in transportation planning and special model runs are usually conducted for the morning and evening peek.

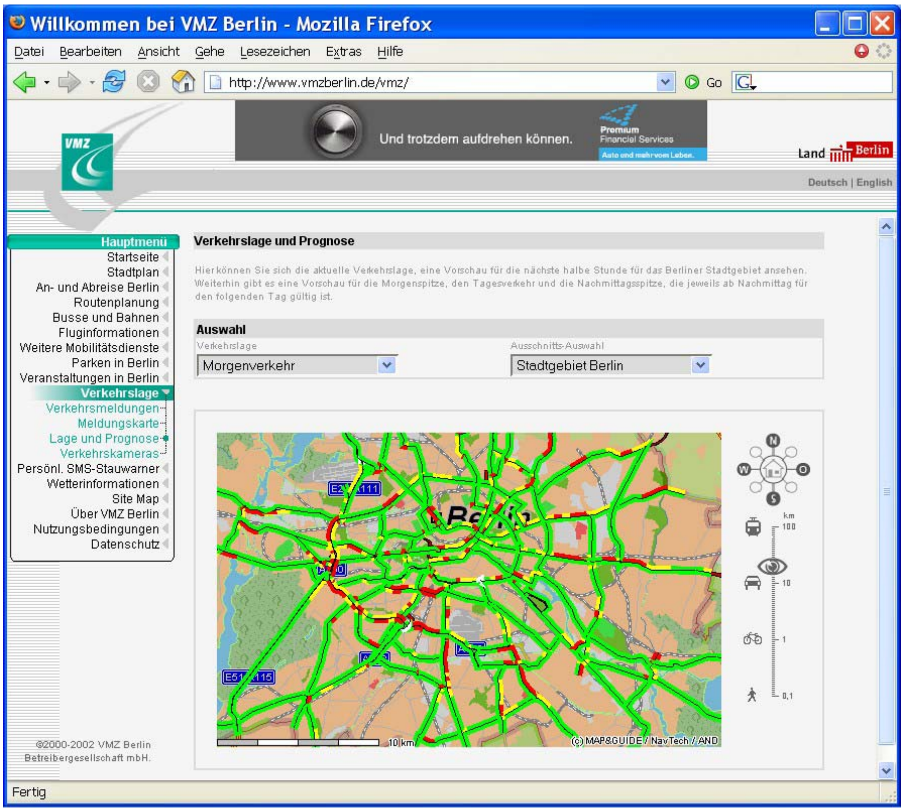


Graph 4: Showcase of route guidance based on predictive travel times

PTV has carried out a show case in the greater Frankfurt area which models the travel time on all major urban and surrounding roads for 24 hours a day and seven days a week. This predictive travel time will be integrated in a navigation prototype system in 2006.

3.4 Information traffic management

Linking the information of a transportation model to online detectors and traffic messages carries the idea of predictive travel times even further and allows to give a current level of service and a short term forecast for an entire network.



Graph 5: Propagated level of service for the urban area of Berlin

Using the origin-destination matrix and the preferred routes from the transportation model it is possible to propagate the information of the traffic detection to the entire network. In this way reliable information can be obtained even for streets that are not covered by detectors.

4 SUMMARY

Transportation planning profits from the improved GIS data availability and the technical developments for information interchange. Choosing an adequate technology (open interfaces, common reference system, web publishing) can improve the quality of the output of a transportation model and gives a much wider use to the results into the field of traffic information and traffic management (ITS). This emphasises the sustainable use of transportation models and bringing them to internet application with userfriendly interfaces meets the needs of the information society.

Transport policy contribution to Sustainability in Madrid. A new assessing framework.

Miguel MATEOS, Paul PFAFFENBICHLER, Alfredo SÁNCHEZ

(CEDEX, Centro de Estudios del Transporte, c/ Alfonso XII, 3-5, Madrid, España, miguel.mateos@cedex.es
Technische Universität Wien, Institut für Verkehrsplanung und Verkehrstechnik, Gußhausstr, 30/231 A-1040, Wien, paul.pfaffenbichler@tuwien.ac.at
Universidad Politécnica de Madrid (UPM), TRANyT, c/ Profesor Aranguren s/n, Madrid, España, asvicente@ceminos.upm.es)

1 INTRODUCTION

Sustainability is one of today's major challenges. Numerous studies provide evidence that cities worldwide do not fulfil the requirements of sustainability. The work presented here investigates whether transport policies of the municipality of Madrid contribute to the high level objective of sustainability.

The case study Madrid region covers an area of about 8,000 km2 with around 5 million inhabitants. Land use is characterised by a rapid development of housing and businesses in the outskirts. As a result a high share of people commutes between the periphery and the core city, causing high levels of peak hour congestion. Indicators show that the land use and transport system do not fulfil the requirements of sustainability.

Different policy instruments were proposed to improve the situation. One is the extension of the metro line number 9 which was opened in 1999. Another is the current proposal to install bus lanes on all radial highways. One bus and high occupancy vehicle (HOV) lane already exists on the highway A6.

A framework to assess the contribution of these instruments to sustainability is suggested. It consists of an indicator based approach and a modified cost benefit analysis. The strategic, dynamic land use and transport interaction model MARS (Metropolitan Activity Relocation Simulator) is the core of the assessment framework. Effects on land use, regional travel patterns and transport emissions can be predicted with it.

Results are summarised and discussed. Conclusions are drawn and policy recommendations are given. Potential weaknesses and ways to overcome them are identified. Topics for future research are highlighted.

2 THE OBJECTIVE OF SUSTAINABILITY

A possible definition of sustainability is equity between today's and future generations (May, et al. 2003). I.e. the activities of today's generation should not limit or hinder the opportunities of future generations. Another definition is that a sustainable system *"does not leave any negative impacts or costs for future generations to solve or bear – present builders and users of the system should pay such costs today"* (Schipper, et al. 2005) Furthermore the use of a set of sub-objectives and indicators is suggested to make the general definition operational (May, et al. 2003, Schipper, et al. 2005): "Careful treatment of non-renewable resources", "Protection of the environment" or "Equity and social inclusion" (May, et al. 2003).

This paper focuses on these three sub-objectives because the corresponding indicators can be calculated directly with the integrated land use and transport model MARS. Other sub-objectives like "Contribution to economic growth" cannot be taken into account. Macro-economic development is not within the scope of a regional model like MARS. Due to the strategic character of MARS it is not possible to calculate local indicators like noise and pollutant imissions. To overcome these limitations it is suggested to link MARS to models covering other levels of dis-aggregation.

2.1 Indicators of sustainability

(Minken, et al. 2003) and (Schipper, et al. 2005) suggest a wide range of indicators to assess sustainability towards its sub-objectives. Consumption of land, consumption of fossil fuels and atmospheric emissions are amongst them. Land and fossil fuel are non renewable resources. Hence their consumption is suitable as an indicator to measure the sub-objective "Careful treatment of non-renewable resources". Local atmospheric emissions endanger the environment and are therefore suitable to represent the sub-objective "Protection of the environment". Accessibility is seen as a proxy for the sub-objective "Equity and social inclusion".

3 THE CASE STUDY AREA

Madrid is situated in the heart of Spain, covering an area of about 8,000 km2, and a population of around 5.4 million inhabitants, 2.9 million of them in the core city. Land use is characterised by a rapid development of housing and businesses in the surroundings. The population living there steadily increases. As a result a high share of people commutes between the outskirts and the core city. The share of car trips is higher during the peak period than during the rest of the day. Although Madrid has an efficient metro line system and 55% of the people commute into the city using public transport (CRTM 1996), this results in a high level of peak hour congestion. Both the land use and the transport system does not fulfil the requirements of sustainability.

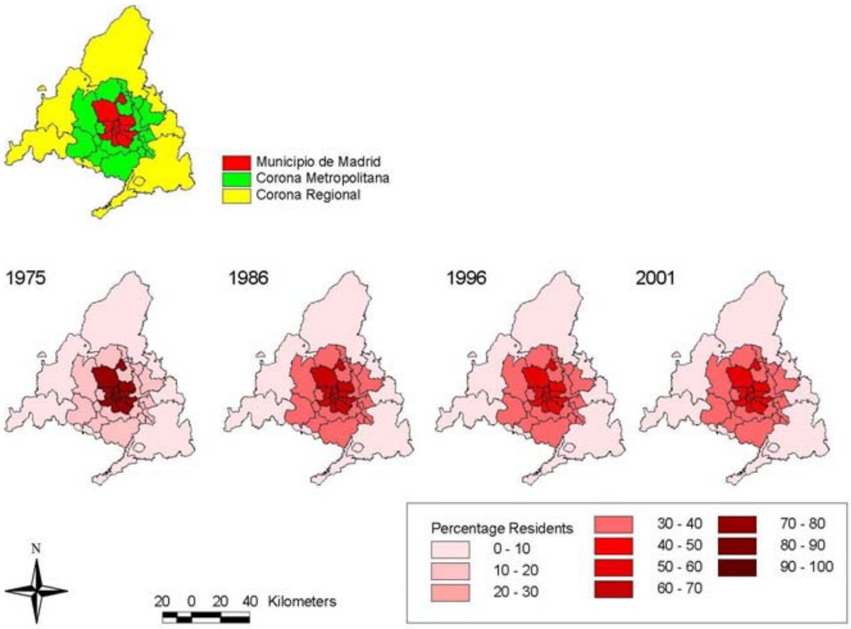


Figure 1: Development percentage of residents city centre and outskirts (CAM 2001)

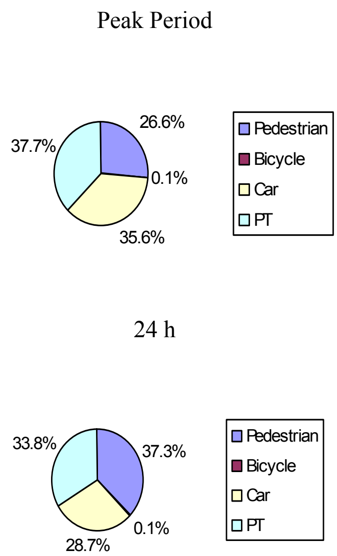


Figure 2: Modal share "Comunidad Madrid" in 1996 (CRTM 1996)

4 TRANSPORT PROJECTS

Different policy instruments have been proposed (and realised) to improve the situation described above.

4.1 Metro line extension

Rivas-Vaciamadrid and Arganda del Rey are situated in the corridor of the highway A3 in the southeast of the core city (see Figure 3, detail X). Due to the relative proximity many residents commute into the city of Madrid. As public transport was solely bus based the share of public transport trips was only about 21% in 1996 (CRTM 1996). The traffic situation was worsened by a rapid development of housing, service sector business and industry. Figure 4 shows the development of the number of residents.

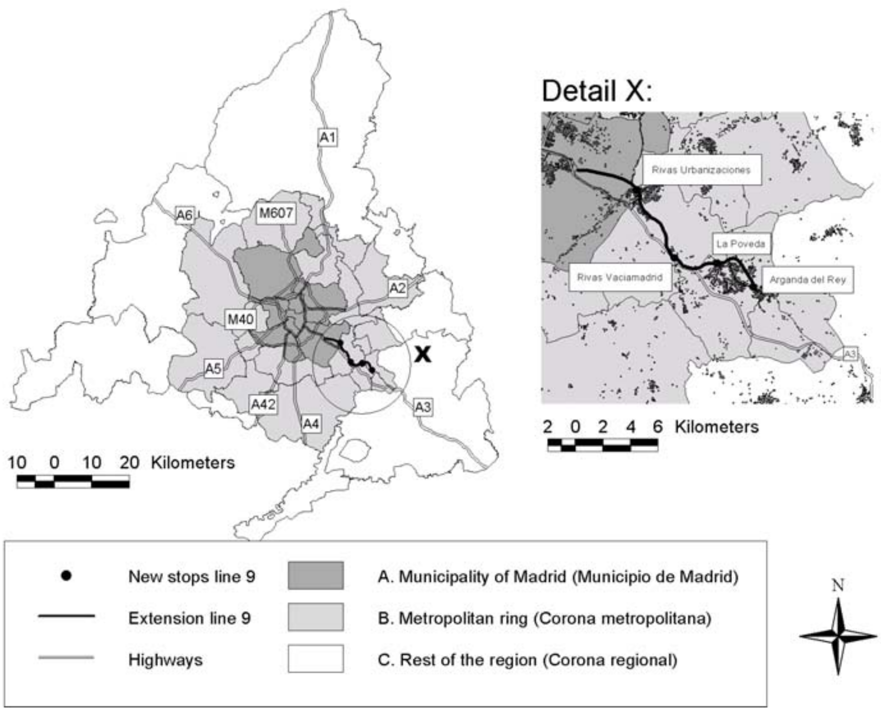


Figure 3: Extension of the metro line number 9

The municipality of Madrid reacted by deciding to extend the metro line number 9 from its former end station Puerta de Arganda until Arganda del Rey (Figure 3). This extension, opened in 1999, brought four new metro stations: Rivas Urbanizaciones, Rivas Vaciamadrid, Poveda and Arganda del Rey. Details about the planning process and funding have been published elsewhere (Monzon 2003, Monzon and Gonzalez 2000). A more detailed description is also given in (Vieira 2005).

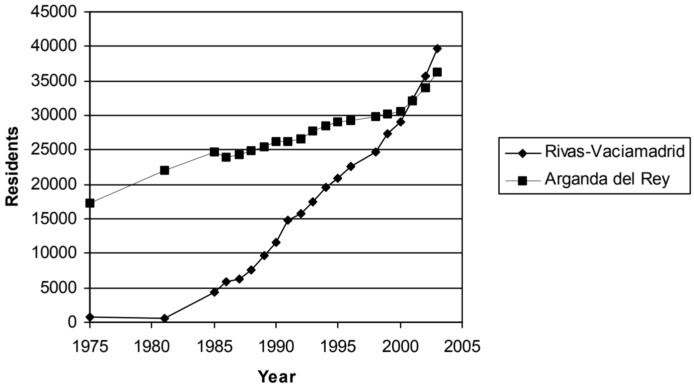


Figure 4: Residents in the corridor A3; Source: Instituto de Estadístico de la Comunidad de Madrid (Vieira 2005)

4.2 Bus and high occupancy vehicle lanes

A bus and high occupancy vehicle (HOV) lane exists on a 16 kilometres long stretch of the highway A6 (Figure 5). It consists of a 12.3 km reversible double lane from Las Rozas to Puerta de Hierro and a 3.8 km bus-only lane from Puerta de Hierro to the Moncloa interchange.

The system operates in a reversible basis with the following timetable:

Restricted access to buses and HOVs:

Inbound Madrid: from 6:00h to 12:30h Monday to Friday

Outbound Madrid: from 13:30h to 22:00h Monday to Friday

Unrestricted access on holidays and weekends.

There are three entries – inbound – or exits – outbound (Figure 5). Prior to the implementation of the bus/HOV facility, the A6 corridor was chronically congested. The opening of the bus/HOV lane in 1995 improved the situation. Peak travel times for bus and HOV lane users have decreased substantially (Figure 6 and Table 1). Greater reliability of suburban bus services has fostered their use. Bus patronage has increased significantly - from 24% in 1991 to 36% in 2001. The costs for the construction were about 56.6 million Euros (Pozueta Echavarri 1997), which equals 3.3 million Euros per kilometre.

Figure 5: Bus/HOV lane, stretches and access points (Monzón, et al. 2003)

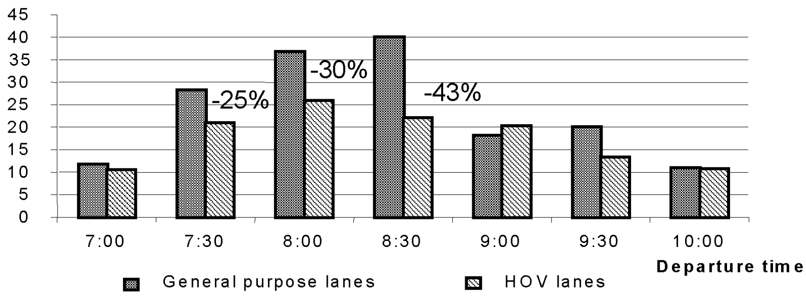


Figure 6: Travel time (minutes) for 15 km access road; A6 morning peak, 2001 (Monzón, et al. 2003)

Table 1: Travel time bus Las Rozas – Moncloa, average working day (Pozueta Echavarri 1997)

Period	1991	March 95		June 95		Nov. 95	
		(min)	(%)	(min)	(%)	(min)	(%)
07:00 – 08:00	26	11	-57.7	13	-50.0	16	-38.5
08:00 – 09:00	32	12	-62.5	14	-56.3	17	-46.9
09:00 – 10:00	27	12	-55.6	10	-63.0	11	-59.3

Recently the Spanish minister Magdalena Álvarez presented plans to construct more than 100 kilometres two-way bus lanes on all radial highways (Javier Barroso 2005). Details can be seen in Figure 7. There are two principle possibilities to construct bus lanes: either to build extra lanes or to dedicate existing lanes to bus use only. While capacity for cars stays the same with the first possibility, it is reduced with the second one. Both possibilities were used later in the case study. The scenarios are named “New Lanes” and “Replace Car Lanes” respectively. Currently no official cost estimates for the new bus lanes exist. The investment costs for building the bus lanes in the scenario “New Lanes” were estimated with 722 million Euros using costs of 3.3 million Euros per kilometre (Pozueta Echavarri 1997). The investment costs for the scenario “Replace Car Lanes” will be lower and were roughly estimated with 300 million Euros.

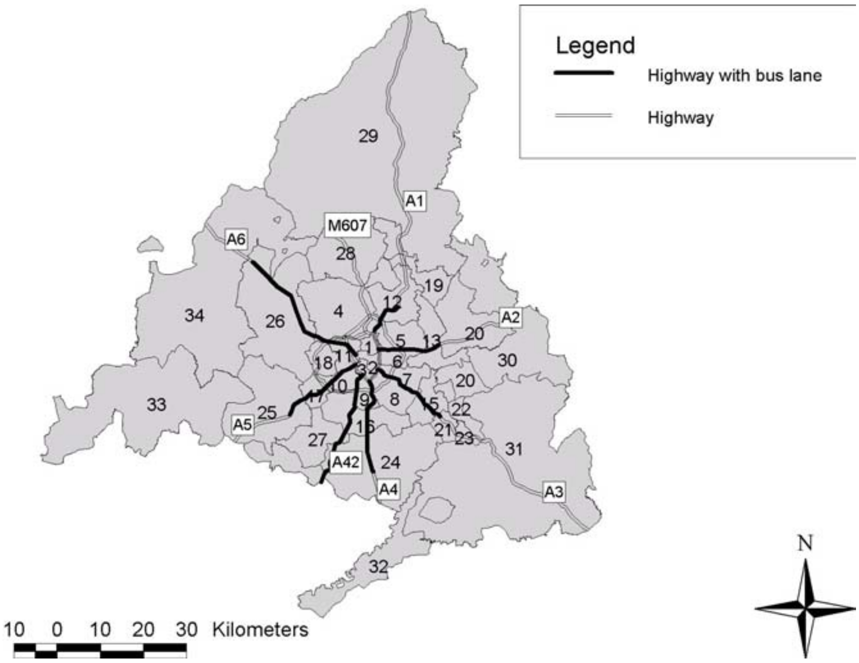


Figure 7: Proposed bus lanes in Madrid (Javier Barroso 2005)

5 THE INTEGRATED LAND USE AND TRANSPORT MODEL MARS

MARS is an integrated strategic and dynamic land-use and transport model. The basic underlying hypothesis is that settlements and the activities within them are self organising systems. Therefore it is sensible to use the principles of synergetics to describe collective behaviour (Haken 1983a, 1983b).

MARS assumes that land-use is not a constant. It is rather part of a dynamic system that is influenced by transport infrastructure. Therefore at the highest level of aggregation MARS can be divided into two main sub-models: the land-use model and the transport model. The interaction process is implemented through time-lagged feedback loops over a period of 30 years.

Two person groups, one with and one without access to a private car are considered in the transport model part. The transport model is broken down by commuting and non-commuting trips, including travel by non-motorised modes. Car speed in the MARS transport sub-model is volume and capacity dependent and hence not constant. The energy consumption and emission sub-models of MARS utilise speed dependent specific values. The land-use model considers residential and workplace location preferences based on accessibility, available land, average rents and proximity to recreation areas. Decisions in the land-use sub-model are based on random utility theory. Due to its strategic characteristic a rather high level of spatial aggregation is used in MARS. In most case studies this means that the municipal districts are chosen as analysis zones. The outputs of the transport model are accessibility measures by mode for each zone while the land-use model yields workplace and residential location preferences per zone.

MARS is able to estimate the effects of several demand and supply-sided instruments whose results can be measured against targets of sustainability. These instruments range from demand-sided measures, such as with public transport fare (increases or decreases), parking or road pricing charges to supply-sided measures such as increased transit service or capacity changes for road or non-motorised transport. These measures, furthermore, could be applied to various spatial levels and/or to time-of-day periods (peak or off-peak).

To date the model MARS was applied to seven European case study cities Edinburgh, Helsinki, Leeds, Madrid, Oslo, Stockholm and Vienna. Currently a MARS model of Lisbon, Portugal is set up within a PhD-thesis. Within the ongoing project SPARKLE (Sustainability Planning for Asian cities making use of Research, Know-how and Lessons from Europe) MARS is adopted and applied to the Asian cities Ubon Ratchasthani, Thailand and Da Nang, Vietnam (Emberger, et al. 2005). To test the model MARS an extensive back casting exercise was carried out with data of the city Vienna (Pfaffenbichler 2003). A full description of MARS is given in (Pfaffenbichler 2003).

A calibrated and extensively tested MARS model covering the “Comunidad Madrid” was set up in a PhD-thesis (Vieira 2005). As an example for the model testing the comparison of the MARS results for total daily trips with the results of the 1996 Madrid travel survey is shown in Figure 8. As well the fit as the slope of the linear regression between the MARS result and the statistical data is satisfying. This model was utilised for the case study presented in the following sections.

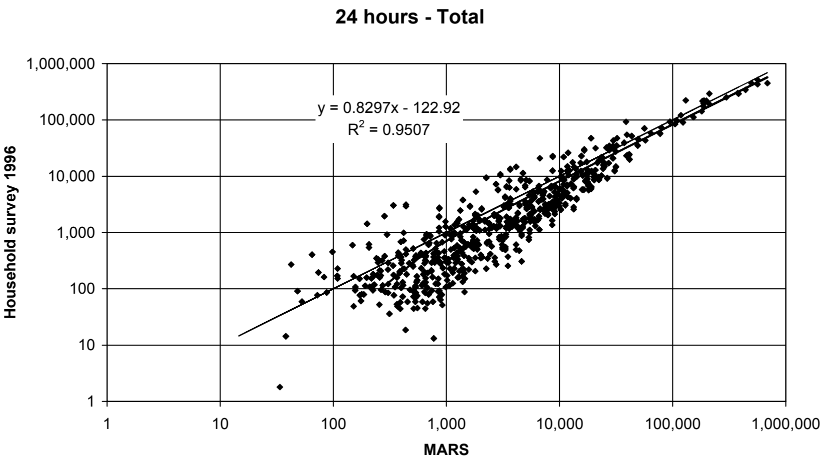


Figure 8: Comparison of the MARS model results with the results of the 1996 household survey (CRTM 1996) – daily trips total

6 RESULTS

A modified cost benefit analysis as laid out by (Minken, et al. 2003) was used to assess the effects of the transport projects towards the objective of sustainability. Furthermore the following indicators are used:

local emissions (NOX, VOC),

greenhouse gas emissions (CO2),

number of residents per zone and

accessibility per zone

6.1 Cost benefit analysis

Table 2 summarizes the results of the cost benefit analysis. The effects are assessed for the period 1996 to 2026. The interest rate was estimated with 6%.

The result of the scenario “extension of the metro line number 9” is slightly positive. The group, which receives the highest benefits, are public transport users. They gain time savings worth about 220 million Euros which is about 2/3 of all benefits generated. The group, which pays for the strategy, are public transport operators. They bear about 60% of total costs while receiving just about 7% of total benefits. Concerning land use property owners gain additional profit while property users have to bear higher costs. The environmental benefits account for about 5% of the total benefits.

Both bus lane scenarios result in a welfare surplus. But nevertheless there are differences. Both have in common that the positive result is driven by a highly positive value for public transport user time savings. Car user time savings are positive in the scenario “New lanes” and negative in the scenario “Replace Car Lanes”. The same is true for car user costs. In both scenarios public transport operators create about the same revenues from additional fares. The government finances the investments in both scenarios. The total external costs are negative for the scenario “New Lanes” and positive for the scenario “Replace Car Lanes”.

The present value of finance is negative for all three scenarios, i.e. they increase public spending compared to “Do minimum”.

Table 2: Results of the cost benefit analysis (million Euros)

Source of costs and benefits			Value (million €)		
			Metro	Bus Lanes	
			Line 9	“New Lanes”	“Replace Lanes”
User	Public transport	Time savings	221.5	1,181.8	1,140.8
	Car	Time savings	-3.5	112.7	-255.1
		Money	4.0	33.3	-81.2
	Residences	Rent, mortgage	-123.5	-148.0	-340.7
Operator	Public transport	Investment	-113.3	-722.0	-300.0
		Operating costs	-77.6	-5.9	0.0
		Revenues	22.4	141.4	123.8
	Road	Maintenance	-0.4	0.0	0.0

	Residences	71.1	151.1	346.3
Government	Fuel tax, Parking	-8.5	1.3	17.7
Society (external costs)	Accidents, local emissions	10.2	-36.0	-5.5
	Greenhouse gas emissions	5.2	6.9	12.7
Total Objective Function		**16.6**	**716.6**	**658.8**
Present Value of finance (PVF)		**-177.4**	**-585.2**	**-158.5**

6.2 Metro line extension

The potential of the metro line extension to reduce overall atmospheric emissions is limited. For the local pollutants NOX and VOC it is only about -0.1% to -0.2%. The potential to reduce CO2-emissions is of the same order of magnitude. The reduction is about –0.2% in the years following implementation but decreases continuously to about –0.1% in the long run. At first sight results for local levels of NOX and VOC emissions are contradictory. Yearly emissions are reduced in the short term but increase significantly in the long term. There are two reasons for this effect. First more residents move into the corridor in the scenario “Line 9” than in the scenario “Do Minimum”. Therefore the number of trips and car trips increases to higher levels than in the scenario “Do Minimum” in the long term. Additionally car speed increases in the short run years due to the reduced number of car trips. Thus making travel by car more attractive and stimulating car use.

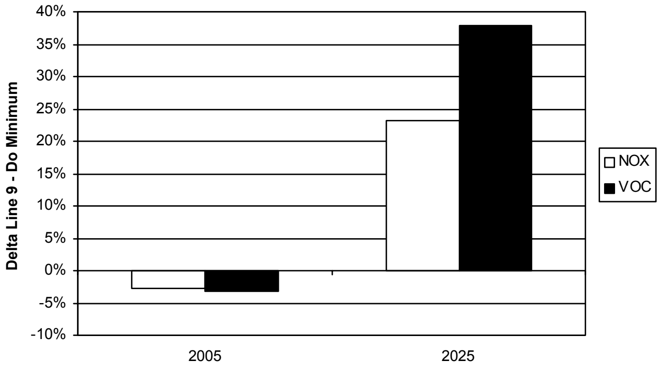


Figure 9: Difference in emissions caused by trips originating in the corridor A3

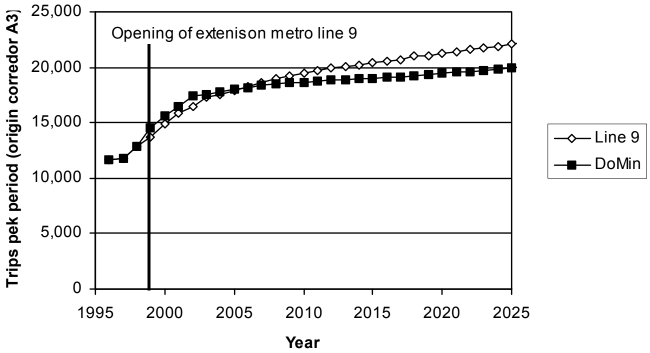


Figure 10: Number of car trips originating in the corridor A3

The metro line extension increases the attractiveness of Rivas and Arganda as a living place. In the scenario “Line 9” more people move into the corridor to live there (Figure 11). The decision where to settle within the corridor is determined mainly by two factors: the availability of land and the proximity to the metro line stations. Overall land consumption increases slightly due to the fact that development densities are lower in the corridor A3 than in the core city.

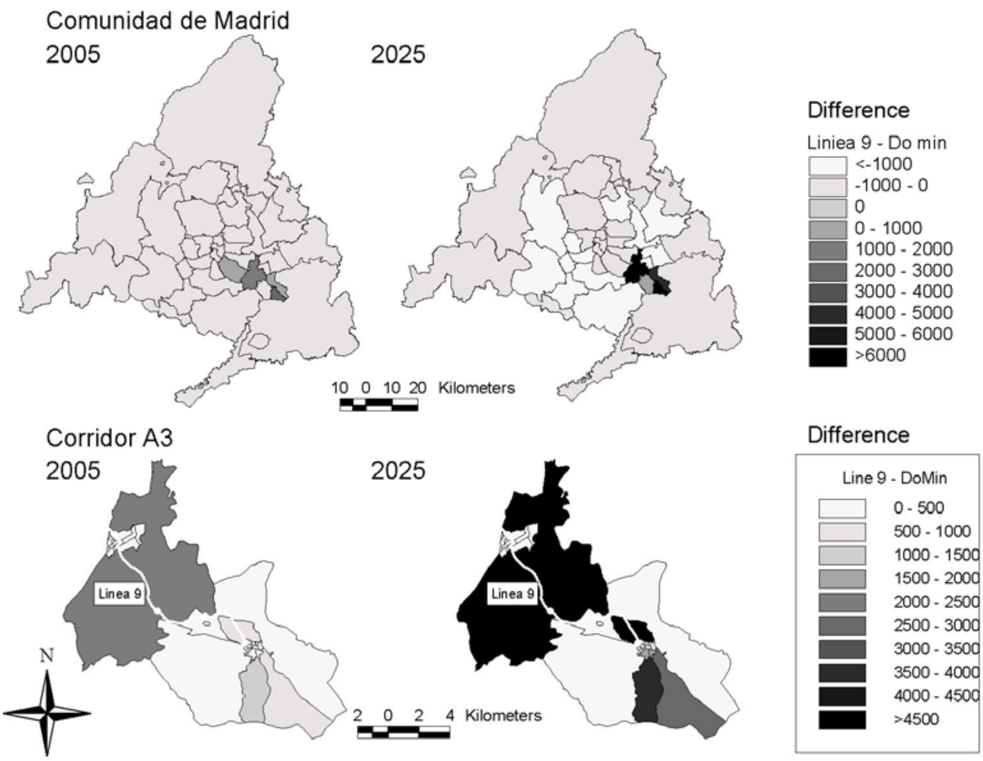


Figure 11: Difference in the number of residents by zone between the scenarios metro line extension and do minimum

Accessibility is measured as the number of working places which can be reached within a weighted time. The difference in accessibility by public transport between the scenarios „line 9“ and „do minimum“ is shown in Figure 12. Of course the metro line extension increases the public transport accessibility of the corridor significantly.

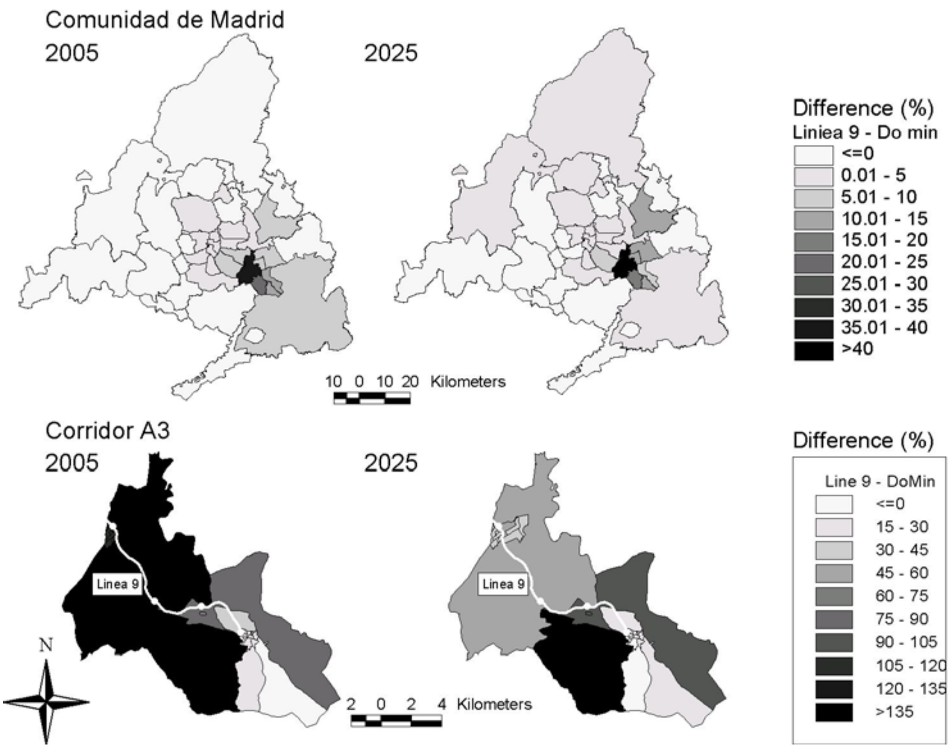


Figure 12: Relative change in the accessibility of working places by public transport between the scenario metro line extension and do minimum

6.3 Bus lanes

The total number of trips is growing in both scenarios due to the overall growth of population. As a result of the bus travel time reduction during peak period the number of public transport users increases significantly compared with the “Do Minimum” scenario. Due to the additional effect of the road capacity reduction the increases are higher in the scenario “Replace Car Lanes”. The situation for the inter peak period and 24 hours is more complex. No travel time savings for bus users occur during the inter peak period. But as MARS is based on the assumption of constant travel time budgets, the time savings from the peak period will be partially spent during the inter peak period. Therefore the total number of trips in off peak increases. In the scenario “Replace Car Lanes” car trips are reduced due to the effect of the reduced road capacity.

In the short run the bus lanes increase the modal share of public transport significantly. In the long run the modal share of public transport goes back to about the initial value. This behaviour coincides with the observations in the aftermath of the installation of the bus/HOV system on the A6 (Monzón, et al. 2003). Nevertheless it remains significantly higher than in the scenario “Do Minimum”. The scenario “Replace Car Lanes” significantly decreases NOX and VOC emissions, while the scenario “New Lanes” only has significant effect on VOC emissions (Figure 13).

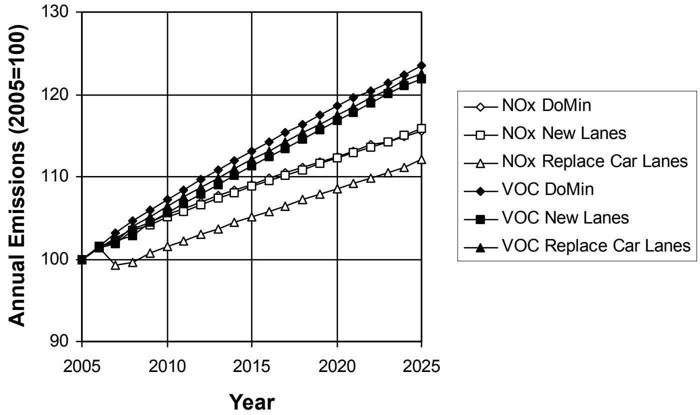


Figure 13: Annual local emissions by scenario (2005 = 100)

Both bus lane scenarios reduce CO2-emissions (Figure 14 and Figure 15). But the relative amount is very small: about -0.3% for the scenario “New Lanes” and about -0.5% for the scenario “Replace Car Lanes”. Even these small reductions are in danger of being lost in the long term. Especially in the scenario “New Lanes” the additional road capacity is filled up again and CO2-emissions are above the “Do Minimum” levels in the years 2023 and 2024. The instrument “bus lanes” is by far not sufficient to achieve the overall CO2-emission targets.

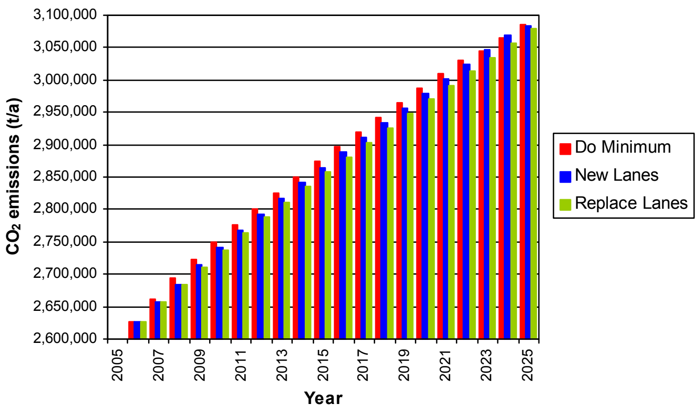


Figure 14: Yearly CO2-emissions by scenario

The bus lanes also affect land use. On the one hand directly due to land consumed by additional highway lanes, on the other hand indirectly due to changed location choices. Figure 16 illustrates this with the difference in the number of residents by zone. Accessibility is the link between transport and location decisions. In the scenario “New Lanes” highways are less congested at least in the short term. In combination with changes in rent and land price this increases the relative attractiveness of the zones in the “Corona Regional”. Population therefore increases in these zones in the scenario “New Lanes”. This is not the case in the scenario “Replace Car Lanes” and therefore the outermost districts loose population. Nevertheless the pattern of land use changes caused by the bus lane system is not very clear. The location decisions are determined by relative differences between zones rather than absolute changes. Therefore it is possible that one zone with bus lane connection looses population while another one gains population. A more detailed future analysis is needed to clarify this issue. One reason for the unclear picture might be that the bus lanes are quite evenly distributed around the city centre.

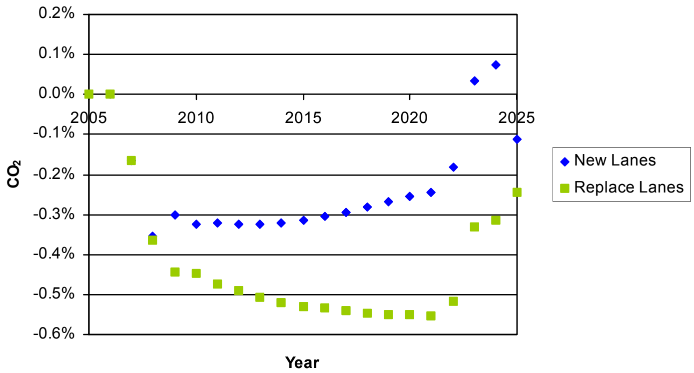


Figure 15: Percentage change of CO2-emissions relative to “Do Minimum”

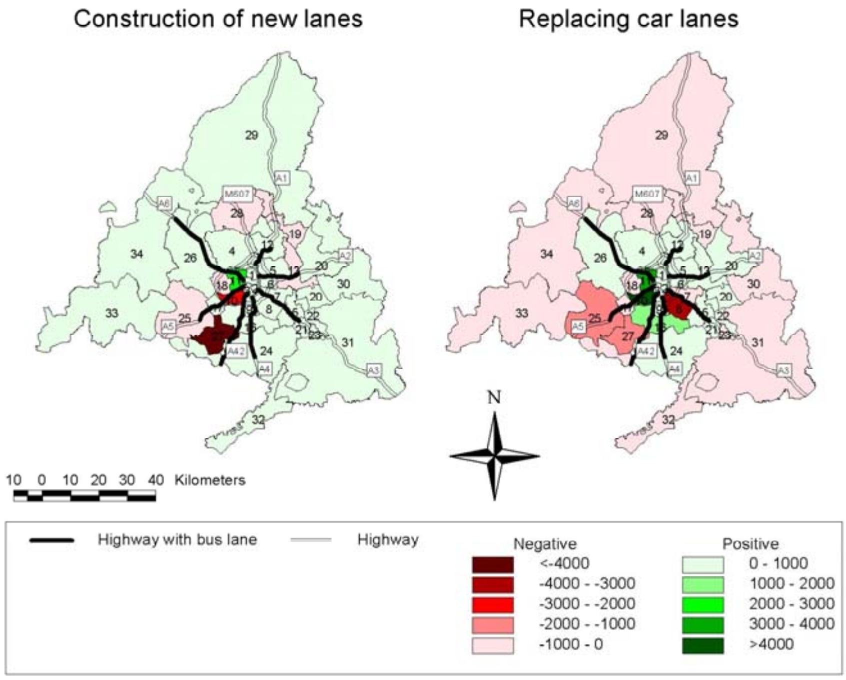


Figure 16: Difference in the number of residents per zone scenario – do minimum

Accessibility changes as expected (Figure 17). Accessibility by public transport increases in both bus lane scenarios. The increase is highest in the bus lane corridors. In the scenario “New Lanes” accessibility by car increases in the whole study area. The increase is highest in the bus lane corridors. In the scenario “Replace Car Lanes” accessibility by car decreases in the bus lane corridors where road capacity for cars is reduced. Due to the overall reduction in car trips it increases in the other zones.

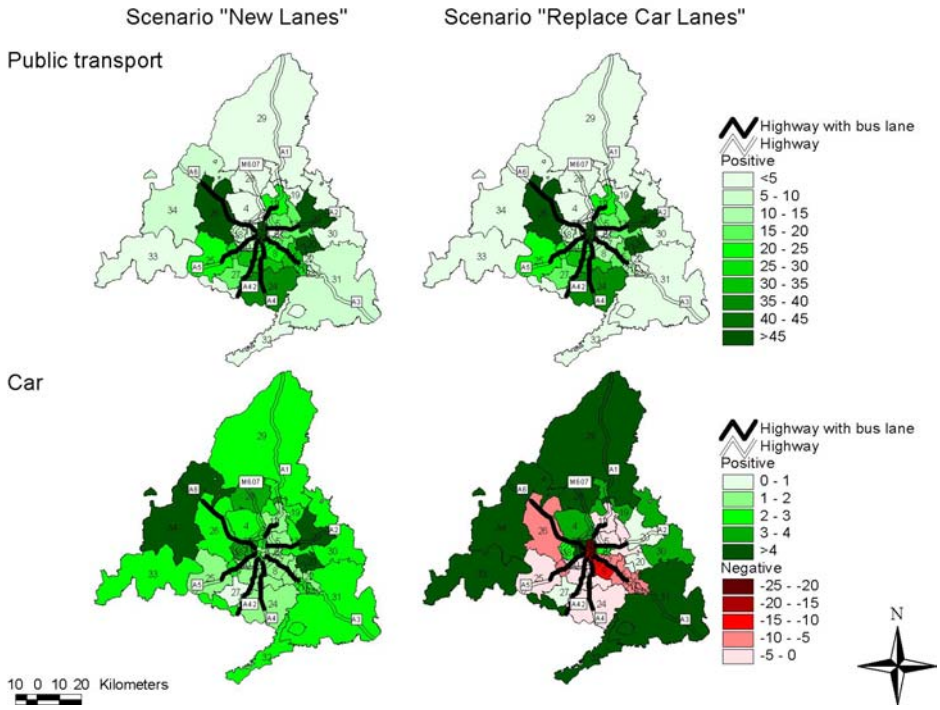


Figure 17: Percentage change of accessibility of workplaces in the year 2025 relative to the scenario “Do Minimum”

7 CONCLUSIONS

7.1 General

The dynamic transport and land use interaction model MARS was employed to assess the effects of two transport infrastructure projects against the overall objective of sustainability: the extension of the metro line number 9 in the southeast of the city of Madrid and a proposal to install bus lanes on all radial highways leading into the city of Madrid.

7.2 Outlook

The work presented here raises several issues for additional future research. Even quite big transport infrastructure projects like the extension of the metro line number 9 have rather limited overall effects for a huge region like Madrid. (Vieira 2005) therefore proposes a hierarchical approach to assess transport and land use projects. This approach will make use of simulation models on different spatial and functional levels. As a starting point (Vieira 2005) has linked the strategic model MARS with a detailed transport demand model of the corridor A3. In ongoing and future research projects the model MARS will be linked on the one hand to detailed assignment models and on the other hand to macro-economic models like ASTRA or POLES (Eijkelenbergh, et al. 2004).

Currently the possibilities to represent public transport infrastructure projects are limited. E.g. in the current version it is not possible to combine the instruments “metro line extension” and “bus lanes”. Adaptations within an ongoing research project (Emberger, et al. 2005) offer an opportunity to improve the model with respect to this issue.

Additionally there were some shortcomings concerning data availability. There was no information available about the positions of entry and exit points or bus stops within the proposed bus lanes. Therefore all zones crossed by bus lanes benefit to a certain extent. If there will be no entry/exit point or bus stop in the zone this will definitely not be true. Furthermore assessment results are highly sensitive to investment costs. These costs should be examined in more detail to get a clearer picture.

Finally the land use response pattern of the bus lane scenarios is a bit unclear. It would be useful to analyse the causes for the location choices in more detail. To gain better insight it is suggested to model and analyse each radial highway separately and in combination.

7.3 Assessment results

7.3.1 Metro line extension

The metro line extension creates a small welfare surplus. Public transport users receive the highest benefits in form of time savings. These represent about 2/3 of all benefits generated. Public transport operators and the government are the ones who finance the policy. They bear about 60% of the total costs while receiving just about 7% of the benefits. Concerning land use, property owners gain profit while property users have to bear higher costs than in the do minimum scenario. The environmental benefits account for about 5% of the total benefits. The attractiveness of the corridor A3 clearly benefits from the expansion of the metro line number 9. Accessibility by public transport improves significantly. More investors are attracted to develop living space and more residents are attracted than without the metro line. The results for environmental effects in form of NOX and VOC emissions are a bit ambiguous. Although they decrease in the short term, they increase in the long term. The main reason is the growth in population mentioned above. This demonstrates that the use of a land use and transport interaction model is essential when assessing sustainability.

7.3.2 Bus lanes

The welfare surplus created by the bus lane scenarios is higher than that of the metro line extension. As the bus lane scenarios cover all corridors this is in line with expectations. About 70% of the benefits are created by time savings. Again public transport operators and the government are financing the surplus. They bear about 30% (“Replace Car Lanes”) to 80% (“New Lanes”) of all costs. The reduction of greenhouse gas emissions is very small for both the “New Lanes” and “Replace Car Lanes” scenario. They make up less than 1% of the benefits. The total external costs of the scenario “New Lanes” are even negative due to increased accident costs caused by higher car speed. Accessibility by public transport improves significantly within the bus lane corridors. The bus lanes increase modal share of public transport in the short term but it goes back to initial values in the long term. Which nevertheless is still higher than in the scenario “Do Minimum”. The scenario “Replace Car Lanes” significantly decreases NOX and VOC emissions, while the scenario “New Lanes” only has significant effect on VOC emissions. The increase in accidents caused by higher car speeds offsets these improvements in the category external costs. The effects on land use are a bit unclear and need more investigation (see 7.2 Outlook). The option “Replace Car Lanes” has to be favoured from a sustainability point of view.

7.3.3 Summary

Finally it can be concluded that all three investments tested create a surplus in welfare. Nevertheless they require higher public spending than in “Do Minimum”. The positive results are in any case driven by the time savings of public transport users. The use of time savings is not undisputed (Emberger, et al. 2004). Without time savings all results would be negative. Furthermore the contribution to the overall objective of sustainability is rather small. The potential of the investments to reduce negative environmental impacts is limited. As a general conclusion it can be stated that no single project will be able to achieve the goal of a sustainable urban region. A comprehensive strategy including other complementary instruments like pricing is necessary to achieve the objective of sustainability.

8 REFERENCES

CAM (2001) *Censos y Padrones oficiales*, Consejería de Economía e Innovación Tecnológica, Instituto de Estadística de la Comunidad de Madrid, Madrid.

CRTM (1996) *Encuesta Domiciliaria de Movilidad en la Comunidad Madrid 1996*, Consorcio Regional de Transportes de Madrid, Madrid.

Eijkelenbergh, P., Burgess, A., de Jong, G., Williams, I. and Schade, W. (2004) *Policy Support Tools for Transport Issues*, Joint Research Centre, Institute for Prospective Technological Studies, Seville.

Emberger, G., Ibesich, N. and Pfaffenbichler, P. (2005) Die Entwicklung eines integrierten dynamischen Siedlungsentwicklungs- und Verkehrsmodells für Asiatische Städte, **Proceedings** *CORP 2005*, Wien.

Emberger, G., Pfaffenbichler, P. and Shepherd, S. (2004) The impact of small time savings in transport appraisal, **Proceedings** *10th World Conference on Transport Research*, Istanbul.

Haken, H. (1983a) *Advanced Synergetics - Instability Hierarchies of Self-Organizing Systems and Devices*, Springer-Verlag,

Haken, H. (1983b) *Erfolgsgeheimnisse der Natur - Synergetik: Die Lehre vom Zusammenwirken*, Deutsche Verlags-Anstalt, Stuttgart.

Javier Barroso, F. (2005) *Fomento construirá 120 kilómetros de carriles bus en las autovías de entrada en la capital*, Madrid.

May, A. D., Karlstrom, A., Marler, N., Matthews, B., Minken, H., Monzon, A., Page, M., Pfaffenbichler, P. and S., S. (2003) *Developing Sustainable Urban Land Use and Transport Strategies - A Decision Makers' Guidebook*, Institute for Transport Studies, University of Leeds, Leeds.

Minken, H., Jonsson, D., Shepherd, S. P., Järvi, T., May, A. D., Page, M., Pearman, A., Pfaffenbichler, P. C., Timms, P. and Vold, A. (2003) *Developing Sustainable Land Use and Transport Strategies - A Methodological Guidebook*, Institute of Transport Economics, Oslo.

Monzon, A. (2003) Integrated Policies for Improving Modal Split in Urban Areas, **Proceedings** *16th ECMT Symposium*, Budapest.

Monzon, A. and Gonzalez, J. D. (2000) Travel Demand Impacts of a New Privately Operated Suburban Rail in the Madrid N-III Corridor, **Proceedings** *Eurpean Transport Conference*, Cambridge, UK.

Monzón, A., Puy, J., Pardillo, J. M., Cascajo, R. and Mateos, M. (2003) *Modelización y evaluación de medidas de gestión en corredores urbanos*, CICYT Spanish National R+D Programme, Madrid.

Pfaffenbichler, P. (2003) *The strategic, dynamic and integrated urban land use and transport model MARS (Metropolitan Activity Relocation Simulator) - Development, testing and application*, Beiträge zu einer ökologisch und sozial verträglichen Verkehrsplanung Nr. 1/2003, Vienna University of Technology, Vienna.

Pozueta Echavarri, J. (1997) Experiencia Española en carriles de alta ocupación. La Calzada bus/VAO en la N-VI: Balance de un año de funcionamiento, **Cuadernos de Investigación Urbanística, Escuela Técnica Superior de Arquitectura, Madrid**, (16)

Schipper, L., Huizenga, C. and Ng, W. (2005) Indicators: Reliable signposts on the road to sustainable transportation - The partnership for sustainable transport in Asia, **Proceedings** *eceee 2005 Summer Study Proceedings*, Volume 2, Mandelieu, France.

Vieira, P. (2005) *Modelización de la interación de usos del suelo y transporte. Aplicación al corredor de la A-3 de Madrid*, PhD-thesis, Universidad Politécnica de Madrid, Madrid.

WCED (1987) *Our Common Future. The Report of the World Commission on Environment and Development*, Oxford University Press, New York.

Ecological improvement and sustainable development in European skiing resorts by adapting the EU-Eco-Audit

Ulrike PRÖBSTL

(Prof. Ulrike PRÖBSTL, Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung , Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur, Peter-Jordan-Straße 82, 1190 Wien, ulrike.proebstl@boku.ac.at)

1 ABSTRACT

The range of environmental problems in European skiing resorts caused by winter sports, agriculture and summer tourism are all well known. The issues and management challenges relate to sensitive ecological conditions, construction activities, deficiencies in visitor management and an land use conflicts during summer.

One new approach to manage these problems is the EU-Eco-Audit. In test sites in Switzerland, Liechtenstein and Austria a successful adaptation of the EU-Eco-Audit framework to ski resorts has been developed. The implementation of the Audit framework at these test sites led to positive effects concerning visitor and ecological management. One influencing factor for the future development is the positive public image concerning environmental aspects. Crucial to the implementation of the Eco-Audit-framework is whether it will assist ski resorts in their competition with other destiantions for hosting international events.

Finally the acceptance of the certificates or awards by skiers is discussed. It will be argued that due to the increasing relevance of information provision and marketing of wintersport destinations via the internet, the auditing or award concept contributes to a positive image of these enterprises and destinations in the market place.

2 INTRODUCTION

Over the entire alpine region in the centre of Europe, downhill skiing is one of the main tourist attractions, and therefore one of the major economic sectors of the region. During the 1980´s, downhill skiing started to be perceived as a contentious activity because of its negative effects on the natural environment. When ski slopes are developed, problems arise with regards to erosion, degradation of the natural vegetation and disturbance of animals. Several studies, which analysed a total of 32 ski resorts in the Bavarian Alps (Pröbstl et al 2000, Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen 1997) showed an additional factor of concern: the overlapping of wintersport, the agricultural use and summer tourism. In these studies it was demonstrated that if these different forms of landuse are not coordinated, increasing charges are to be expected.

On the other hand, there are several studies which discribe how an improvement of the natural integrity of wintersport resorts can be achieved (see Ammer, Pröbstl 1991, Leicht, Dietmann, Kohler 1993, Ammer, Pröbstl 1997, Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen 1997, Roth 1997). The main recommodations range from the restoration of small areas of threatened vegetation to a longterm strategy of enhancing the entire management concept of the slopes in summer and winter.

The challenge is how the responsible enterprices can be encouraged to start those measures or to implement a new sustainable landuse management

To improve the situation, two options have been considered in the past:

certificates or awards for skiing resorts with good condition, and

restrictions and regulations based on environmental and nature conservation legislation.

Under the system of awards and recognition, ski resorts with fairly natural slope conditions receive awards for ecologically sound management practices.

On the other hand, resorts that introduced heavier disturbances when constructing ski slopes, such as intensive levelling of the slopes and heavy earth movement, will not receive any of these rewards.

Management approaches relying on restrictions and regulations alone, such as nature conservation legislation, lead only to a few changes, but not really to a more advanced ecological management of the ski resort.

3 THE EU-AUDIT-PROCESS

A new approach for managing ski slopes and mitigating their ecological effects is the adaptation of the EU-Eco-Audit framework to the environmental management of ski resorts (Pröbstl, et al. 2000). This framework represents a market-based economic instrument, which enables companies in different sectors to show environmental awareness and adopt environmentally responsible behaviour, while at the same time the companies strive to optimise their operational procedures. The EU-Eco-Audit system represents a less forceful approach than traditional regulations to monitor and guide the further development of ski resorts in an environmentally sound manner. By adopting that system, a ski resort needs to accept its own role and responsibility in environmental management. Crucial to this audit framework is a permanent monitoring system. The framework has already been implemented in several industrial and administrative applications (e.g. breweries, senior homes), and appears to be sufficiently flexible to be adjusted to almost any situation. Also, any operation under the EU-Eco-Audit needs to repeat its evaluation and redefine its evaluative framework every three years. These efforts are also likely to have positive effects on publicity and attract new target groups. In contrast to North American auditing-systems, the EU-Eco-Audit represents a proactive environmental management system with a more preventative perspective (Williams et al. 1997).

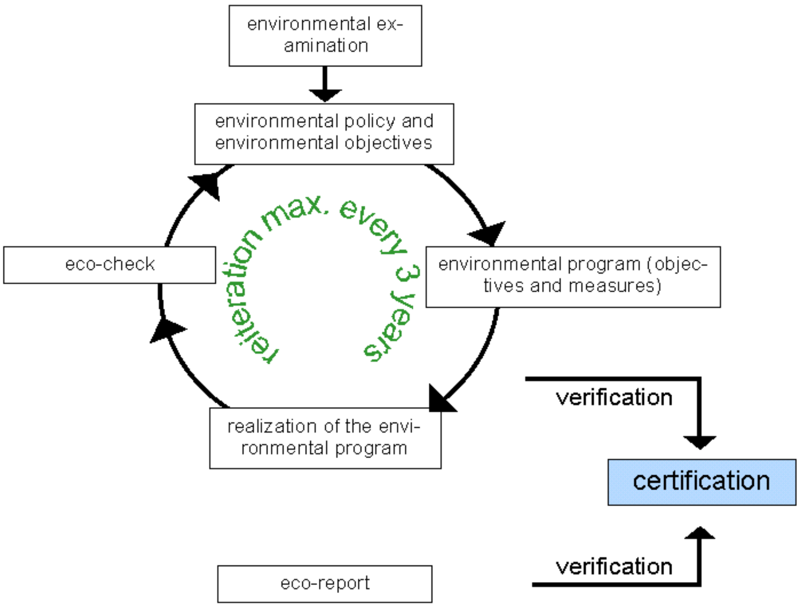


Fig. 1: Model of the EU- Eco Audit process

In order to test the applicability of the EU-Eco-Audit framework to downhill skiing operations, an international collaborative project was initiated and supported by the foundation „pro natura pro ski" of Liechtenstein (Pröbstl, et al. 2003). Three representative areas in three different alpine countries (Schladming, Austria; Adelboden, Switzerland; Malbun, Liechtenstein) were selected to adapt and test the directive. Additional scientific knowledge was available from past ecological research in several skiing resorts of Bavaria.

It was shown, that the enterprises profit from the Eco-Audit in different ways (see fig 2):

Positive effects for the ski resort

Competition	**Reduce cost**	**Reduction of risk**	**Improved organizational structure**
increased attractivity for environmentally aware clients environmental concerns are positioned as key criteria for the company improved positive image with resource management agencies improved competitive position during applications for mega-events	reduced cost for compiling support materials for permits reduced insurance premiums lower bank rates reduced requirements of expensive recultivation in case of wider damages	increased knowledge of potential damages over entire ski area more thoroughly documented chain of decisions in case of legal challenges	increased knowledge of grooming personal more detailed knowledge about the affects of management on nature and landscape reduced bureaucratic efforts increased knowledge about contribution of winter- and summer tourism

Fig. 2: Potential advantages for ski resorts when adapting the EU-Audit framework (SCHNEIDER et al. 2002)

4 EXPERIENCES WITH THE IMPLEMENTATION OF THE AUDIT IN WINTERSPORT RESORTS

Our investigation revealed that the main difficulty was to increase the level of awareness about ecological issues with the employees of the various enterprises, and to identify the responsible departments within the enterprises and to initiate the actual auditing process. It is important that employees of all levels and all departments of the company participate in the process. This needs to include slope grooming, as well as advertising and marketing, and service and management. All participated in an analysis of strengths and weaknesses, and in a discussion to determine an environmental policy for the company, and the formulation of goals and principles for environmental management. This broad participation in the initiation of the auditing framework is essential for its successful implementation. Thereafter it is essential to develop a framework specific to the peculiarities of a ski resort. Beyond the analysis of ski slopes and lifts, the framework should account for the entire affected area beyond the slopes. For example, noise affects a much larger area, as do off-piste skiers. Therefore we decided in the implementation of our framework that it is essential to map the following ecological phenomena and human influences for each ski area: geology and soils, climatic issues, hydrology, vegetation, fauna, building measures, damages distinguished by causes and land use all the year round. In addition, visitor management and ecological information offers were evaluated to learn about the already existing environmental activities of the skiing resort.

In the three ski resorts that we analysed, the implementation of the audit framework leads to the following improvements:

enhanced consideration of habitats for bird species that are particularly sensitive to disruptions during the winter season, i.e. the capercalli and black cock;

eliminate intensive agriculture in sensible higher alpine areas;

changed summer uses (e.g. hiking, mountain bike on the ski slopes) for improved regeneration;

protected valuable habitats;

improved management of water resources;

Besides the ecological improvements, which, in mountain environments will become obvious only after many years, the adoption of the auditing framework also leads to significant short term improvements to the organisational structure, in data capturing and analysis, as well as to a reduction of cost of slope maintenance and other improvements. For example the contracts with farmers concerning the maintenance of the ski resorts include special clauses to consider ecological requirements. At the same time such actions reduce total maintenance costs. A more sophisticated data capturing system of water management concerns, such as snow making, contributes to a more sustainable use of water resources.

Furthermore, the auditing system also leads to an introduction of environmental concerns to the image and the advertising strategies of the company. This approach is enhancing new ideas and innovation within the enterprice. Implementation of the auditing framework also increased the sense of belonging for employees, and increased their motivation to work for the corporation.

5 ACCEPTANCE OF AUDITING AND CERTIFICATION BY WINTERSPORTS CLIENTS

The main idea of the auditing process is that for the wintersports clients it makes a difference to ski in a resort that is managed sustainably and is controlled by a certification. But does this marketing effect really occurs in practise?

Schmid (2003) tried to find out whether the client is recognizing the certification or ecological awards and whether the skiers are attracted by these offers. For the study in the winter season 2003 in the ski ressort 284 skiers have been asked to answer a questionnaire. About 80 % of them were tourists, 20% were daily visitors. The main questions have been whether

a certified destination is more attractive for its clients, and

the certification has a positive effect on the decision making process if it is communicated via marketing and advertising differently.

To answer these questions the questionnaire included several questions to differentiate between different types of skiers. For example, they were asked about their favorite wintersport resort, their environmental attitude and important attributes of a wintersport resort.

The main finding can be summarized as follows (see fig.3). Three main types of skiiers can be differenciated:

Type 1: The motivated one. This group of clients are highly motivated to take certification into consideration. If there is an environmental certification they tend to chose the certified offer. In the test site (Schladming, Planai Bahn) about 16% of all the respondents belong to this type.

Type 2 The interested one. These group is basicly interested in environmental certification. They may take it into consideration if the concept is well communicated and the effects clearly stated. In the test site (Schladming, Planai Bahn) about 30% of all the respondents belong to this type.

Type 3 The indifferent one. These group is not much interested in environmental information or certifications. Even with additional information it cannot be expected, that members of this group will consider the certification of a ski resort when selecting the destination. In the test site (Schladming, Planai Bahn) about 42% of all the respondents belong to this type.

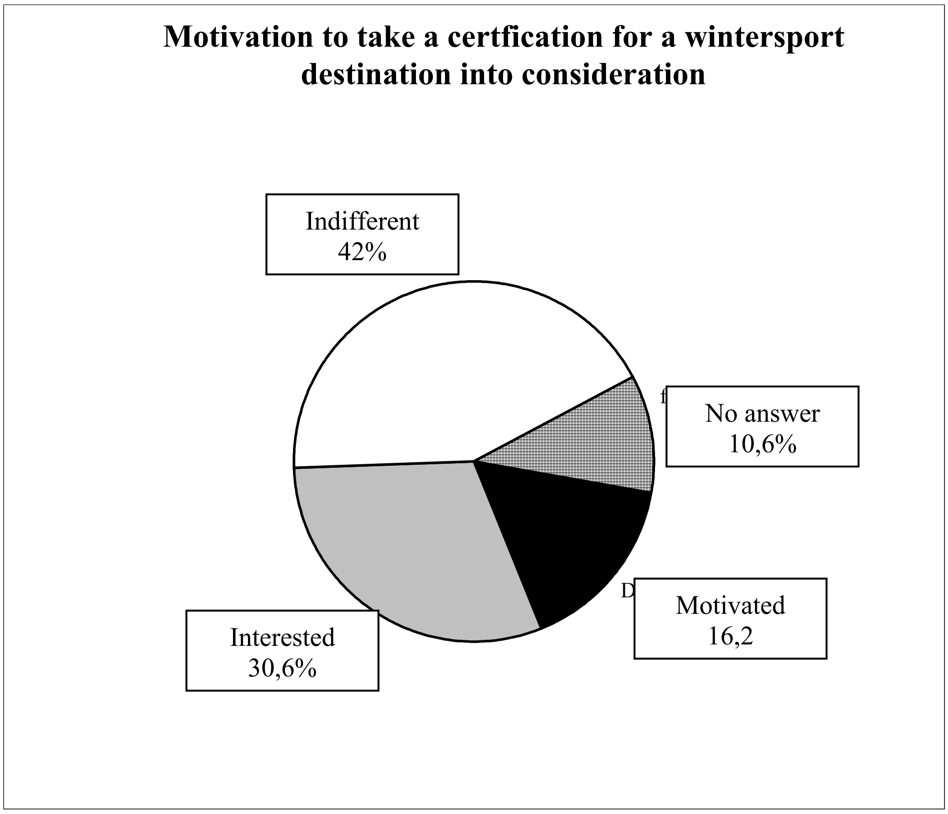


Fig. 3: Only about half of the visitors of a skiing resort will consider a certification when they choose a destination.

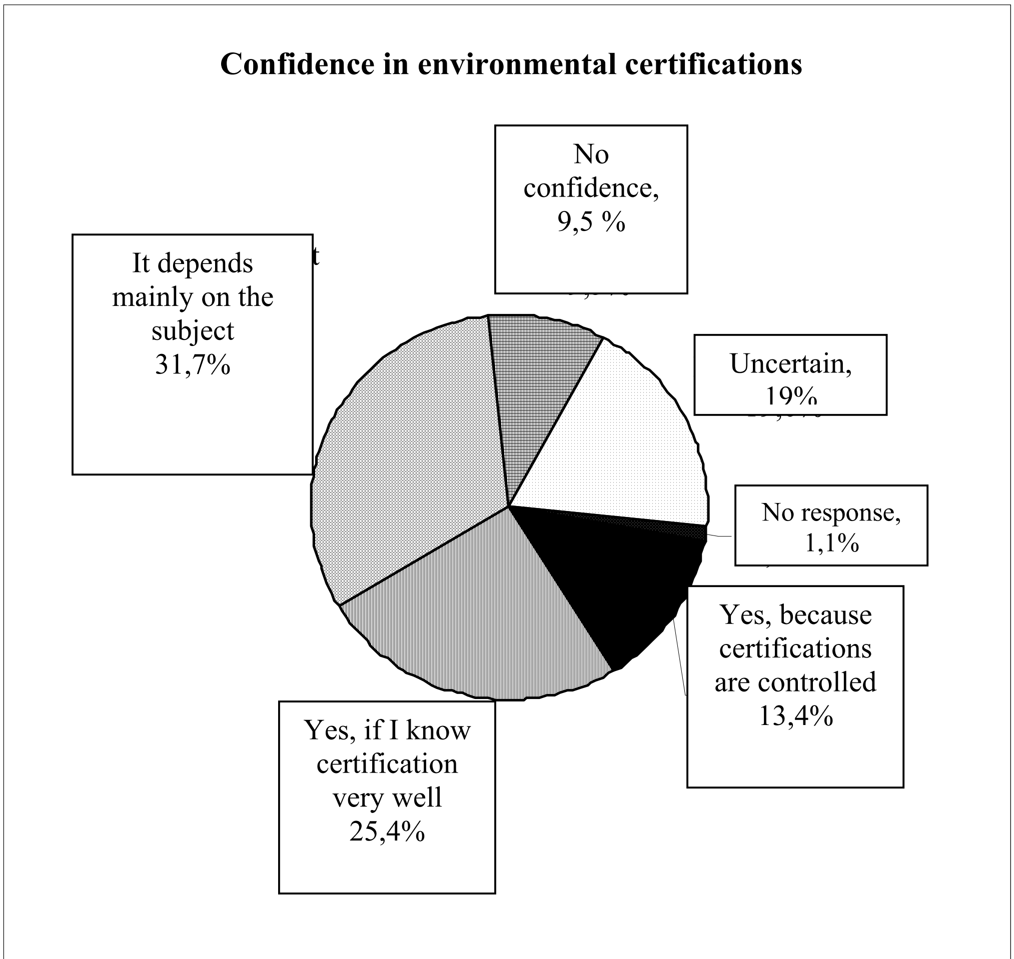


Fig. 4:The confidence in environmental certifications depends on its recognition.

One reason for this low rate of acceptence could be the general attitude towards awards and certifications. Fig. 4 shows that more than the half of all respondents only trust certification if they have additional information.

Related to the EU-ECO-Audit we see, that competitive advantages for those enterprices which join the auditing process can only be expected if it is accompanied by an intensive marketing effort illustrating the main idea, the effects on the environment, the involved experts and clealry stating who is responsible for the certification process. Despite all this effort one must keep in mind that for most winter clients the environmental certification is only one additional attribute of a winter destination and not an essential one (such as snow assurance).

Due to the increasing relevance of information on wintersport destinations via the internet, the auditing and award program can increase in significance for the enterprse. More than 75 % of the skiiers in this test site stated that they regularly check the internet to get more and updated information on the ski resort. Therefore the internet should be used to introduce this new tool for an ecological improvement and sustainable development for European skiing resorts.

6 SUMMARY AND OUTLOOK

Combined with a Geographic Information System, the EU-Eco-Audit proves to be an excellent method for undertaking an ecological improvement close to practice. In contrast to more conventional restrictions and regulations, the audit process entices the enterprise to become pro-actively involved in environmental management on a continuous basis and to make it an integral component of their management routine. This may also lead to reduced costs and improvements in the organizational structure.

Furthermore the Audit contributes to a positive, “green” image of the ski resort and increases its attractivity during international competitions to host mega events.

Despite this positive balance that can be drawn from working in different regions, a widespread realisation of this idea will depend on the question, if the immediate benefits of managing ski runs and marketing also will be profitable to local tourism. Also, it is to be expected that the awarding of international skiing competitions will more and more be associated with the existence of a credible ecological concept and a sustainable management. At the same time, the importance of the Audit for sport competition venues will gain in significance. This is especially valid because of the rating that competition venues grab with international sport contests, considerable for the weight and the touristic commercialisation within international comparison.

The participation of the FIS (Federation internationale du ski) in the design and implementation of these new Audit-guidelines indicates that the Auditing process may play a most significant role in the future.

To start the process of a widespread implementation in the alpine chain the newly developed framework for the auditing process for skiing resorts have been translated in all languages of the alpine chain as well as into English. A detailed teaching and dissemination concept is in preparation and will be supported by the Alpine Convention.

With this financial and political support of all alpine countries and a clear marketing concept we hope that the auditing will help both the enterprices and the alpine environment.

7 REFERENCES

AMMER, U., PRÖBSTL, U. 1991, Freizeit und Natur, Hamburg, Berlin.

AMMER, U., PRÖBSTL, U. 1997, Ökologische Untersuchung von Skigebieten, Ergebnisse, in: Forum für Skisport und Umwelt. Hrsg. Umweltbeirat des Deutschen Skiverbandes und der Stiftung Sicherheit im Skisport, Band 1, Planegg

BAYERISCHES STAATSMINISTERIUM FÜR LANDESENTWICKLUNG UND UMWELTFRAGEN (HRSG.) 1997, Landschaftsökologische Untersuchungen in den bayerischen Skigebieten – Skipistenuntersuchung – Zwischenauswertung nach 24 Skigebieten, Materialien Umwelt & Entwicklung Bayern, Band 130

PRÖBSTL, U., ROTH, R. SCHLEGEL, H., STAUB, R. 2003, Auditing in Skigebieten, Leitfaden zur ökologischen Aufwertung, pro natura - pro ski foundation (editor.), Postfach 885, FL - 9490 Vaduz. 109 S.

PRÖBSTL, U., PIHUSCH, T., 2000: GIS für Monitoring und Auditing in Skigebieten, in: Angewandte Geographische Informationsverarbeitung, **XII,** S. 395-406, Heidelberg

ROTH, R. 1997, Ökologische Begleituntersuchung zum Bau einer Beschneiungsanlage an der FIS-Abfahrt, Feldberg/Fahl, in: s+b, Heft 6, 31. Jahrg., Hrsg.: IAKS.

LEICHT, H., DIETMANN, TH., KOHLER, U. 1993, Landschaftsökologische Untersuchungen in den Skigebieten des bayerischen Alpenraums – Darstellung und Methodik, in: Jahrbuch des Vereins zum Schutz der Bergwelt, München, S. 147-196.

Schmid B., 2003 Umweltzertifizierung von Schigebieten - Chancen und Hemmnisse auf kommunikationspolitischer Ebene. Eine Empirische Untersuchung am Beispiel der Planai-Hochwurzen-Bahnen in Schladming/Österreich.

SCHNEIDER, P., FÜRNROHR, G. 2002: Möglichkeiten eines umweltverträgliche Flächenmanagements im Skigebiet Langenstein Kanzel Nationalpark Stilfser Joch, Diplomarbeit an der FH-Freising, unveröffentlicht, Freising

STIFTUNG PRO NATURA – PRO SKI 2003: Auditing in Skigebieten.Vaduz.

WILLIAMS, P. W., TODD, S. E., 1997, Towards an Environmental Management System for Ski Areas, Mountain Research and Development, **Vol. 17**, Nr. 1, pp. 75-90

MARS in Asia
How a model can help and influence decision makers

Günter EMBERGER, Nikolaus IBESICH

(Dr. Günter Emberger, Institut für Verkehrsplanung & Verkehrstechnik, Technische Universität Wien, Gusshausstrasse 30/2, A-1040 Vienna, Austria, guenter.emberger@ivv.tuwien.ac.at)
(Dipl.-Ing. Nikolaus Ibesich, Institut für Verkehrsplanung & Verkehrstechnik, Technische Universität Wien, Gusshausstrasse 30/2, A-1040 Vienna, Austria, nikolaus.ibesich@ivv.tuwien.ac.at)

1 INTRODUCTION

The overall objective of modelling should be to help decision makers in a way J.D. Sterman put it: "The goal of modelling and of scientific endeavour more generally, is to build shared understanding that provides insight into the world and helps to solve important problems" [Sterman 2000].

The Institute of Transport Planning and Traffic Engineering (TUW-IVV) is working in the field of land use and transport modelling for now more than 10 years. As part of the Asia Pro Eco project SPARKLE, TUW-IVV developed the MARS (Metropolitan Activity Relocation Simulator) flight simulator (MARS FS). The central idea of SPARKLE is the transference of existing European research in the field of transport policy-making to South East Asia. One concept within SPARKLE is to provide technical training to local planners and decision-makers on how to use scientific and logical approaches to formulate a sustainable land use and transport policy. This training is done through seminars in Bangkok and Hanoi and six three-day-workshops in Thailand, Laos, Cambodia and Vietnam. These events are supported by adapted and translated guidance manuals and by using the MARS FS, which was adapted to Asian conditions.

This paper explains the idea behind the MARS FS and shows how the MARS FS is used for training purposes within the SPARKLE context. It explains in brief the structure of the MARS land use and transport model and in more detail the handling and output interpretation of using the MARS FS application.

2 THE "TYPICAL" DECISION MAKING PROCESS IN LAND USE AND TRANSPORTATION PLANNING

The "typical" decision making process was explored in detail within the EU-project PROSPECTS [PROSPECTS 2000-2003]. It consists of the following steps:

1. Identification of objectives / setting targets
2. Identification of possible instruments and combinations of instruments (strategies)
3. Assessing and appraising of the outcome of the instruments/strategies against the objectives/targets including identification of barriers to implementation
4. Can the objectives/targets be met?

    If yes → strategy found – implementation of strategy

    If no → go to step 2[1]

Within the above-described decision making process, the MARS model/flight simulator is used to assess the impacts on land use and the transport system of either a single instrument or a set of instruments combined to a strategy. As can be imagined to assess impacts of a wide set of instruments a complex model (= MARS model) is necessary. On the other hand, transport planners and decision makers want to have a simple tool to test easily and explore the impacts of their strategies. For this reason the MARS FS was developed.

3 MARS LAND USE AND TRANSPORT MODEL

MARS is an integrated strategic and dynamic land-use and transport (LUTI) model. The basic underlying hypothesis of MARS is that settlements and activities within them are self-organizing systems. Therefore MARS is based on the principles of systems dynamics [Sterman 2000] and synergetics [Haken 1983]. The development of MARS started in the year 2000. A comprehensive description of MARS can be found in [Pfaffenbichler 2003]. Recently the model has been transferred to another software basis called Vensim®.[2]

3.1 Mars – Overall software system

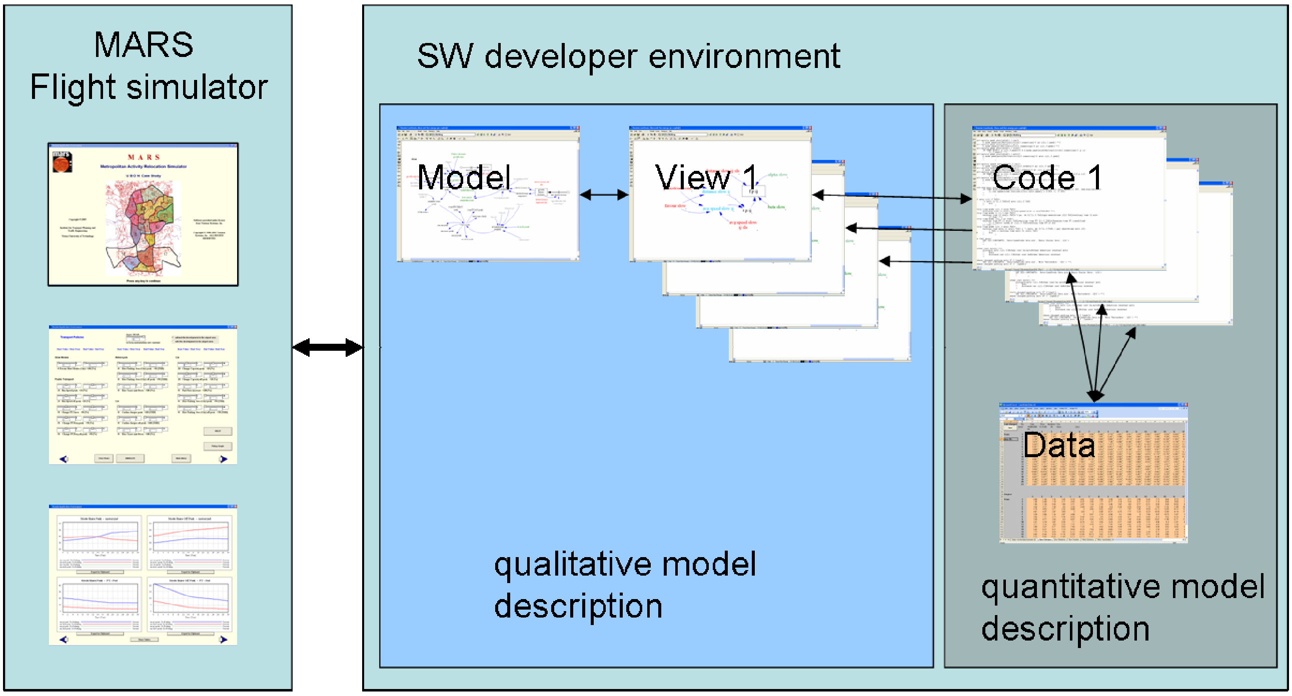
In Graph 1 the overall software system of the MARS model is shown. As can be seen the system consists of two main parts:

- the MARS flight simulator (left hand box) and

[1] Simplified version - for a comprehensive description of the decision making process please see [May, et al. 2003], page 11.

[2] Vensim® is a visual modelling tool that allows you to conceptualize, document, simulate, analyze, and optimize models of dynamic systems. Vensim® provides a simple and flexible way of building simulation models from causal loop or stock and flow diagrams. By connecting words with arrows, relationships among system variables are entered and recorded as causal connections. This information is used by the Equation Editor to help you form a complete simulation model. You can analyze your model throughout the building process, looking at the causes and uses of a variable, and also at the loops involving the variable. When you have built a model that can be simulated, Vensim® lets you thoroughly explore the behaviour of the model [Ventana-Systems 2003].

- the MARS software developer part (right hand box)



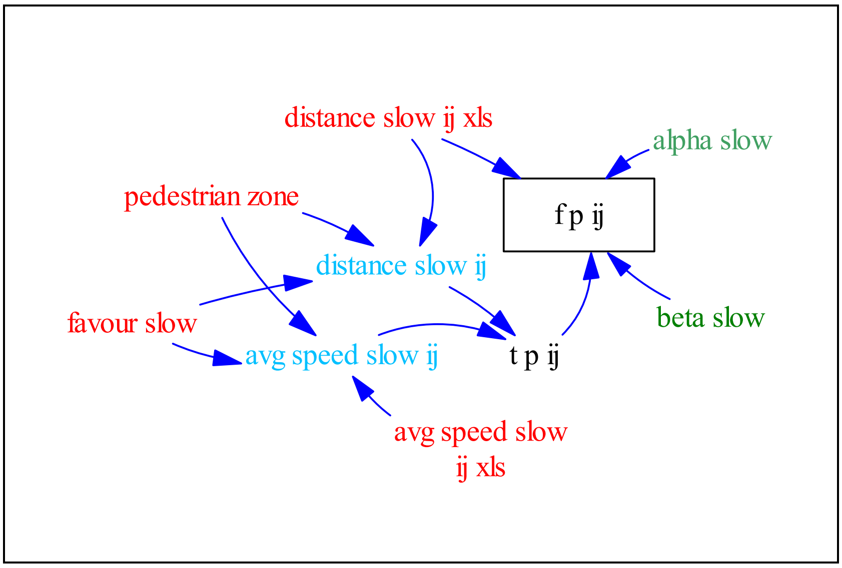
Graph 1: MARS – flight simulator – software system overview

3.2 SW-Developer environment

The SW developer part of the MARS model is using the Vensim® programming environment. Not going into too much detail it can be said that within this environment different abstraction levels are combined and linked together as depicted with the arrows in Graph 1 right hand side.

The top level called "Model" is the level where all information of the underlying "problem" is tied together. More information regarding the transport planning and land use planning issues implemented within MARS can be found in [Pfaffenbichler and Shepherd 2002, Pfaffenbichler 2003]. Information about land use and transport related applications of MARS can be found in [Pfaffenbichler 2001, Emberger, et al. 2003].

The second level called "View" is a place where a single thematic issue of the underlying problem (e.g. the calculation of generalised costs or the development of population over time, etc…) is represented in an intuitive understandable syntax. This level is used to describe the structure of a thematic issue and shows the existing cause-effect relations between model entities in a qualitative way. An example of a thematic issue (generalised cost calculation for slow mode users) in view mode is given in Graph 2:



Graph 2: Generalised costs for slow modes in graphical view

Within a view, the different colours used help the user to identify different types of variables. Red variable names indicate external inputs, such as the distance between traffic zones (distance slow ij xls) or the average speed (avg speed slow ij xls). The light blue colour is used to depict where and how policy instruments (distance slow ij and avg speed slow ij) influence the variables calculated within MARS. Generalised costs are stored for slow mode users between different zones in the variable f p ij.

The next level is the so-called "Code"-level where the mathematical formulations of all the cause-effect-relations depicted in the "View"-level have to be specified.

Table 1 shows the corresponding code to Graph 2:

```
alpha slow= 0.206
beta slow= 0.695
distance slow ij xls[i,J]= GET XLS
CONSTANTS('Data\CaseStudy Data.xls','Slow
Distance','c5')
pedestrian zone[i,J]=  GET XLS
CONSTANTS('Data\CaseStudy Data.xls','Slow
Pedzone','c5')
favour slow[i,J]= GET XLS
CONSTANTS('Data\CaseStudy Data.xls','Slow
Favslow','c5')
distance slow ij[i,J]= IF THEN
ELSE(Time<startyear[favslow], distance slow ij xls[i,J],
distance slow ij xls[i,J]*(favour slow[i,J]-pedestrian
zone[i,J]*policy profile\[favslow]/200) )

avg speed slow ij xls[peak]= GET XLS CONSTANTS
('Data\CaseStudy Data.xls','Basic Scalar Data','b12')
avg speed slow ij xls[opeak]= GET XLS
CONSTANTS(Data\CaseStudy Data.xls','Basic Scalar
Data','b13')
avg speed slow ij[i,J,ToD]= avg speed slow ij
xls*(1+(favour slow[i,J]/2+pedestrian zone[i,J]/2)* policy
profile[favslow]/100)
t p ij[i,J,ToD]= (distance slow ij[i,J]/avg speed slow
ij[i,J,ToD]*60)
f p ij[i,J,ToD]= IF THEN ELSE(distance slow ij
xls[i,J]>10 , 0 , alpha slow*t p ij[i,J,ToD]*EXP(beta
slow*distance slow ij xls[i,J]))
```

Table 1: Friction factor for slow modes in text view

Finally, to complete the system, problem specific data (in the case of MARS in EXCEL file format) has to be linked to the code. In the MARS case the problem specific information contains data describing the land use und transport system of the city. E.g. as mentioned before the distance between two zones – variable distance slow ij xls.

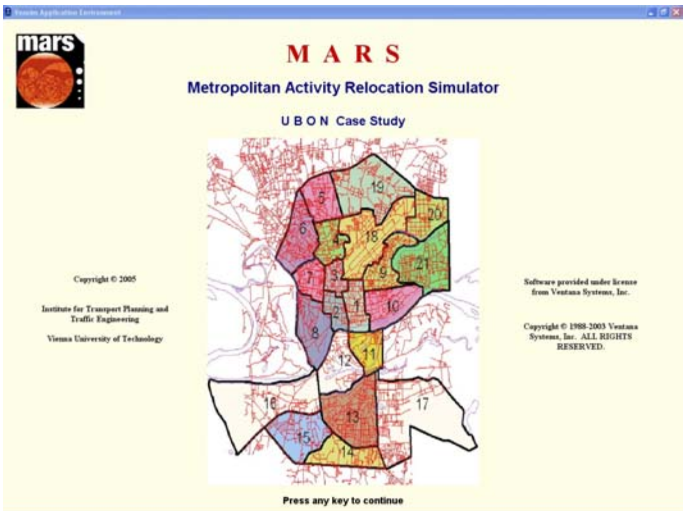
What is important to mention here is that all these different abstraction levels and city specific data is linked together within the VENSIM® environment. This linkage is useful if one wants to communicate the "problem" on different abstraction levels for different groups of people such as politicians, transport planners or software developers.

4 MARS APPLICATION – FLIGHT SIMULATOR

The MARS model was intentionally designed to be a "white box" model, but as every model, over time it became more and more a "black box" model. The complexity of the MARS model was increased over the last five years significantly so there was a need to make it useable and user-friendly for a certain group of stakeholders, the transport experts working at local authorities. Fortunately, the VENSIM® programming environment includes an extension called VENSIM APPLICATION to develop a graphical user interface for the existing MARS model. This feature was used to implement a user interface that reflects the needs of decision makers and enables them to operate and run the MARS model for their own specific purposes with a relative short settling-in period of less than 20 minutes.

In the following sections, this user interface is introduced by going through a typical task a transport planner has to deal with in his daily business.

4.1 Introduction



The MARS FS application is designed to support decision makers to assess case study specific transport and land use strategies. The MARS FS is a simple to use push button interface for the MARS land use transport model. The application uses a set of commands to give users simplified access to the model. To the user, the MARS FS appears as a series of buttons, menus, or a sequence of screens allowing him or her to use and analyze the MARS model in a straightforward and meaningful way. [Ventana-Systems 2003]

Decision makers can themselves tryout their policies and see the consequences immediately.

To navigate through MARS FS you have to operate the appropriate buttons, just like in any other Windows® application.

When opening the MARS FS the first screen you see is the area of the case study with its zones (Graph 3). This screen gives you an impression how the underlying city looks like and how it is split up in zones.

The main menu (**Fehler! Verweisquelle konnte nicht gefunden werden.**) lets you choose

to review the model structure,

to simulate the model or to

request help how to operate the MARS FS.

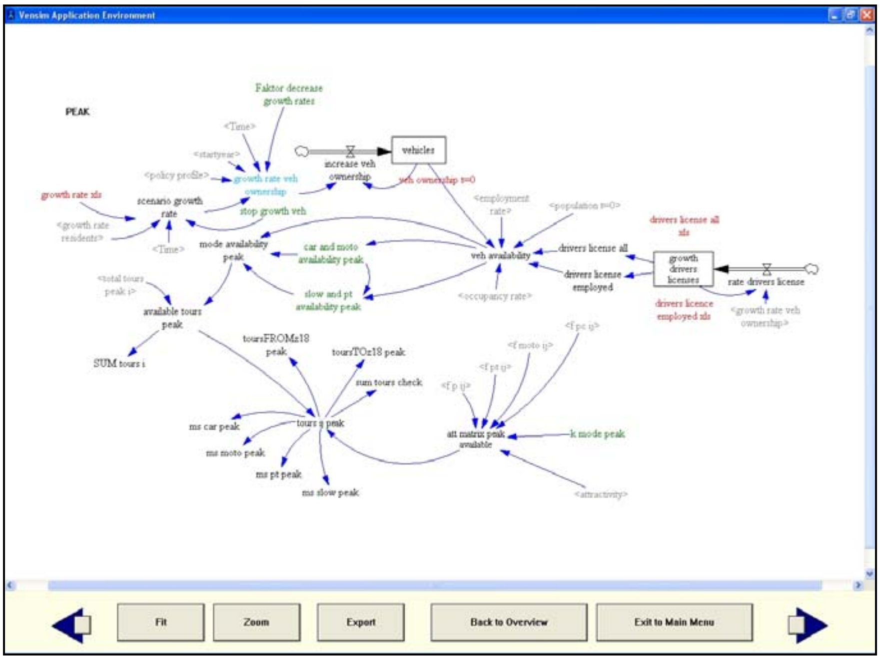
The Help pages cover the most urgent matters, e.g. how to review the model, how to simulate with different policies and how to use the output pages.
Every graph, table or document window in the application can be exported to the clipboard for further use.

4.2 Review of the model structure

The button “Review Model Structure” leads the user to a section of MARS FS where he can explore the model inherent cause-effect relations. To be able to do so two different ways are offered:

4.2.1 View mode

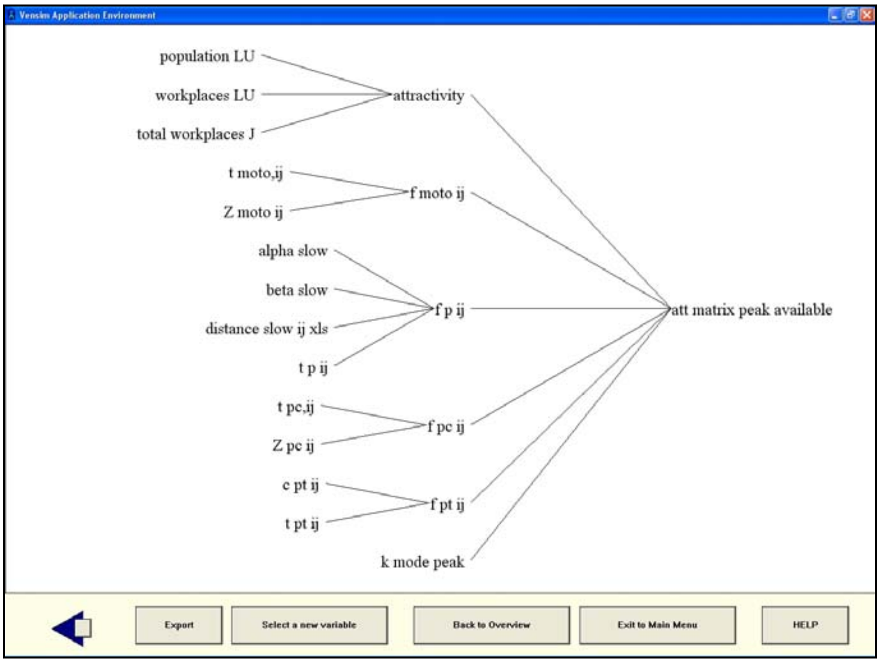
The model is split up into different views, which in turn depict specific thematic issues within the land use transport system. To review the model structure with the MARS FS application, you can go through every single view, and zoom in and out as necessary (Graph 4).



Graph 4: MARS FS – review model structure

4.2.2 Causes Tree mode

Another way to review the relationships between the model variables is to use the Causes Tree function. Here a tree-type graphical representation is created showing the causes of the chosen model variable (Graph 5). By clicking on a variable name, the causes tree can be expanded until the final cause is reached.



Graph 5: MARS FS – Causes Tree

4.3 Simulation of the model

The core of the MARS FS is the simulation set up screen (Graph 6). On this screen, all implemented transport policy instruments are represented with so-called "sliders". For example in the upper left corner, there is a slider headed "slow modes". Here the user has the possibility to test the impacts of a policy favouring the slow modes (pedestrianisation of the city centre zones). To set up a scenario the user can either pick up the slider with the mouse and moves it to the desired numerical value or keys in a target value in the box below the slider.

This has to be done for a start year (in this case for the year 5 of the simulation as shown with the number on the right hand side of the slider) and for an end year (in the shown example year 20 of the simulation). After the entered end year, the level of the instrument stays constant for the rest of the simulation period. Of course, it is also possible for the user to vary the values for the start and the end years between 0 and 30.

There are different policies for each mode implemented within the MARS model and can be simulated using the MARS FS:

Slow Modes

If you think of implementing pedestrian zones or bicycle lanes; you can input how much of the zone will be pedestrianized. This will also lengthen the distance to or from the parking place.

Public Transport

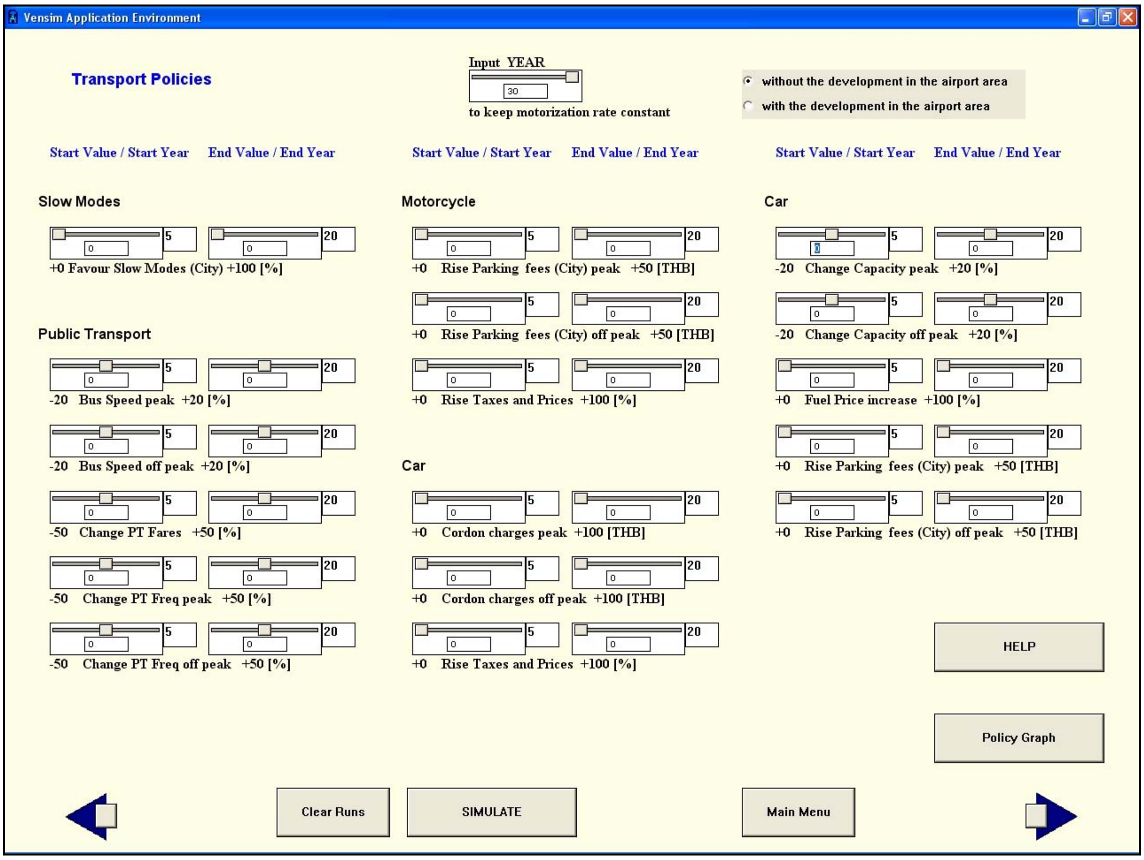
Decrease or increase bus speeds, bus fares or the bus frequency.

Motorcycle

Change the fees for motorcycle parking and change taxes and costs for the purchase of a motorcycle.

Car

Charge cars and motorcycles if they enter the cordon, change taxes and costs of a car purchase, offer cars more or less infrastructure, which has influence on the speed, change the fees for car parking and change the prices for fuel.



Graph 6: MARS FS – input policies and scenarios for simulation

As soon as the desired policy levers are set, the simulation of the model can be invoked by pressing the "SIMULATE" button.

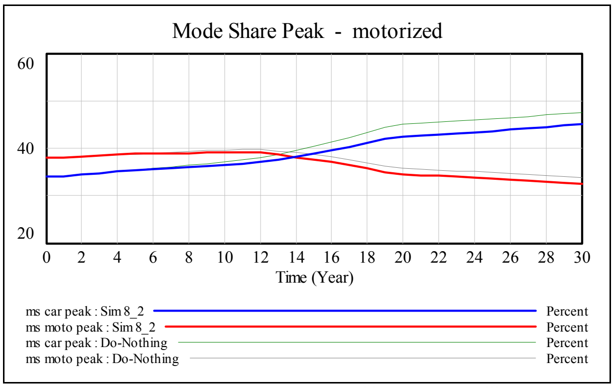
4.4 Output

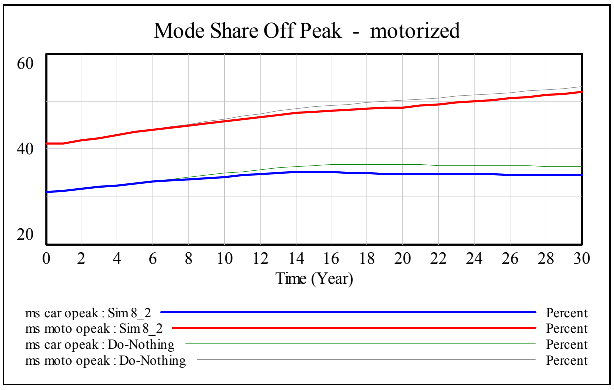
After the simulation (which takes about 20 seconds on a standard PC), the user can immediately switch between different output variables and formats. Within the existing MARS FS, the following variables are shown in graphs for a "do-nothing" scenario and the user defined "do-something" scenario:

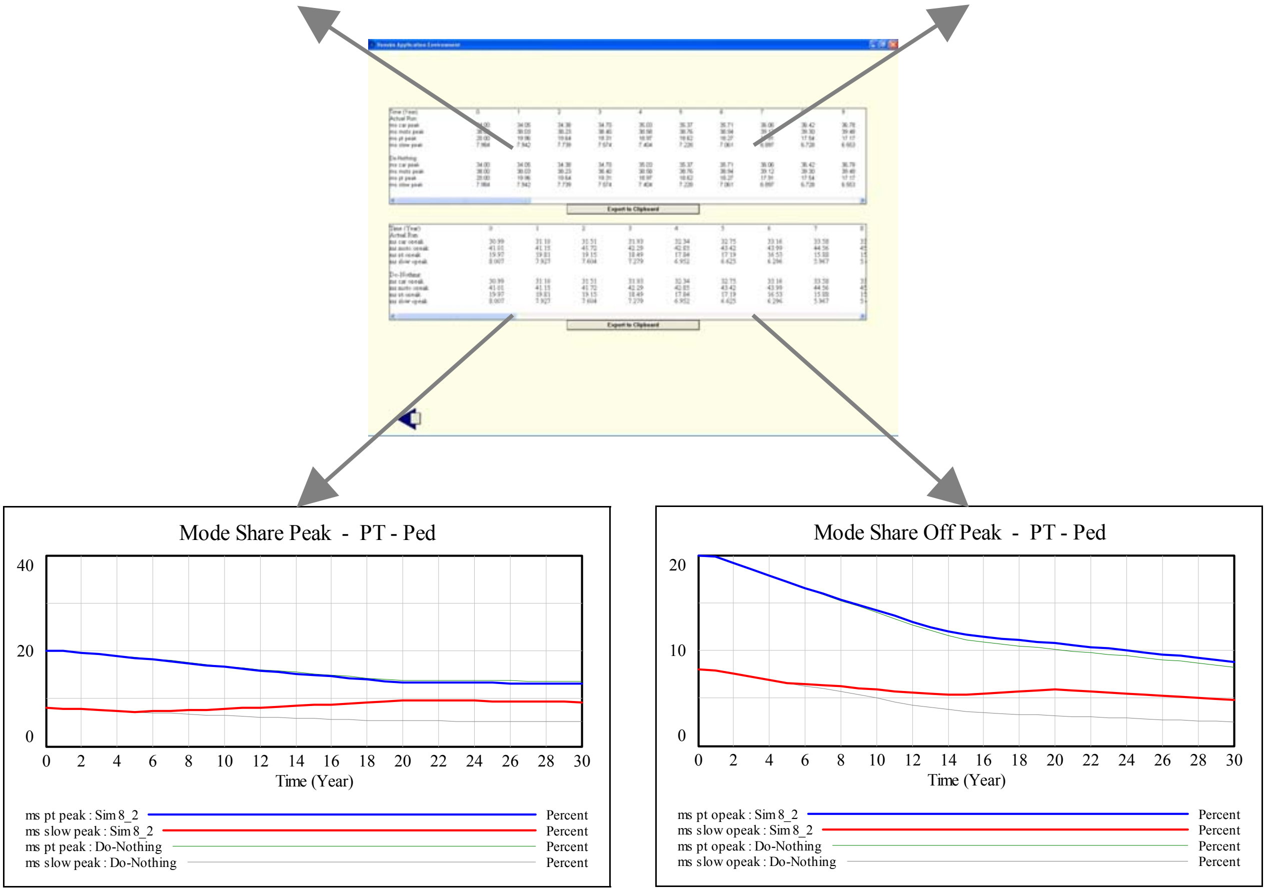
- Mode share in peak and off peak
- Population, workplaces
- Total vehicle km motorized
- Average commuting distance motorized and non motorized
- Total CO2 emissions for car and motorcycle
- Average commuting speed per mode.

The simultaneous display of the "do-nothing" scenario and the "do-something" scenario shows the user the impacts of his tested policy instrument in a clear way.

Analyzing graphs is a good way to get the overall picture, you can see immediately if, for example CO2, increases or decreases. For the ones interested in absolute numbers, there is also option to present for every graph an according table (Graph 7).



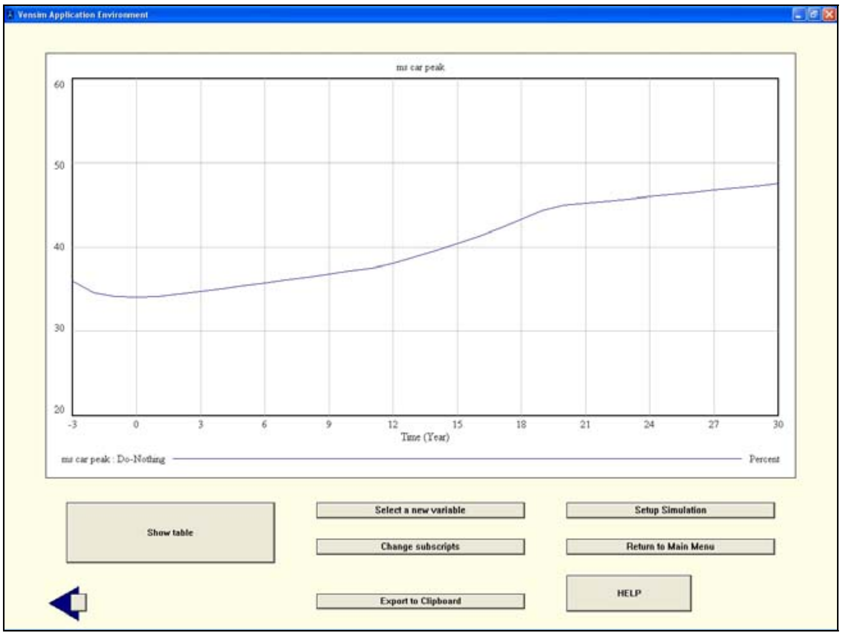




Graph 7: MARS FS – Output Mode Share

4.4.1 Individual Output

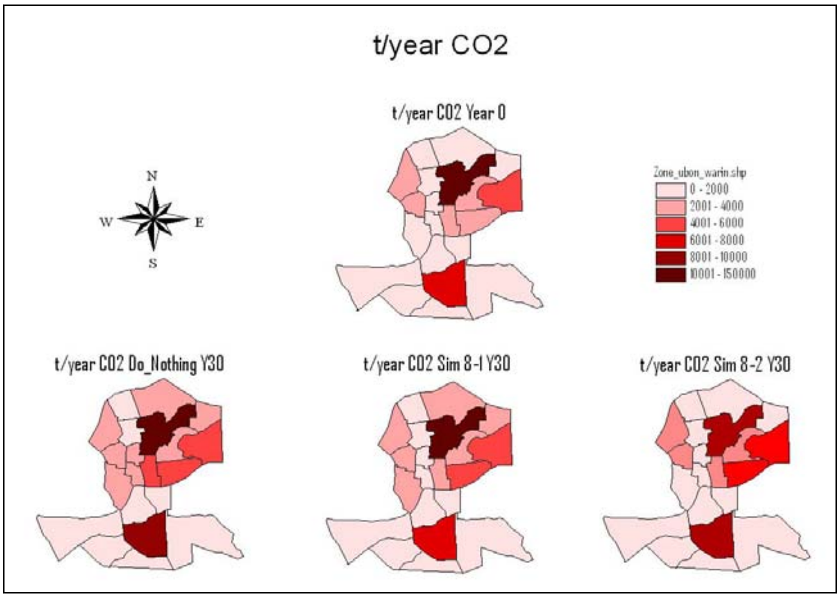
If the MARS FS user wants to go into even more detail of analyses, there is the possibility to choose from a list any variable within the model and display it as graph or as a table. This feature also enables the user to display and export information for a certain range of zones, for specific modes, or for specific trip purposes, etc. (Graph 8).



Graph 8: MARS FS – Individual Output

After simulation, MARS FS can be set up to export the values for a set of predefined variables in formats like dbase. These data can then be used in a GIS application to produce coloured maps or short movies to make it even simpler for decision makers to analyse the results (Graph 9)

4.4.2 GIS – Output



Graph 9: GIS output – example difference CO2 emissions “do-nothing” vs. “do something” in [t/year]

5 CONCLUSION AND OBSERVATIONS

Up to now, the MARS FS has been used as a decision support tool in two workshops in Thailand. More than 40 high and medium level decision makers took part in these workshops. The feedback was positive and encouraging. All users found it easy to navigate within the MARS FS application. During the debriefing session interesting questions and discussions arose regarding the implemented land use and transport interactions of MARS.

The causes-tree tool was found to be extremely useful to understand some of the behaviour of the model output, which was not anticipated at first. In that way, it increased the understanding of the complex interactions between land use and transport system over time.

The possibility for the participants to work interactively with the LUTI-model and test the outcome of single policy instruments provided them with knowledge about the impacts of each instrument individually. The opportunity to combine these individual instruments to strategies allowed them to explore synergetic effects of combining different instruments. Furthermore it was appreciated that all produced output can be viewed either as graph or as a table and that it is possible to export all information to other software packages to carry out more detailed investigations.

A minor point of criticism was the chosen list of pre-prepared indicators depicted in the graphs. Although there is a feature implemented, which enables the user to generate a graph or a table of every individual variable, users preferred to have a fuller set of pre-prepared graphs to click through. This will be improved before our next set of workshops held in Vietnam in March 2006.

Summing up, the MARS model is a land use transport interaction model, which can be used by experts to explore the interactions between these two systems. The modular and open structure allows adding on additional parts to the MARS model easily.

The MARS FS, as a graphical user interface, was assessed to be useful for easy access to the MARS model. The feedback from users at the workshops proved that the combination of the MARS model and the MARS FS is a useful tool to support the decision making process and encourages us to improve the software in future.

6 REFERENCES

Emberger, G., May, A. D. and Shepherd, S. P.: Method to identify optimal land use and transport policy packages, Year.

Haken, H.: Advanced Synergetics - Instability Hierarchies of Self-Organizing Systems and Devices, Springer-Verlag, 1983.

May, A. D., Karlstrom, A., Marler, N., Matthews, B., Minken, H., Monzon, A., Page, M., Pfaffenbichler, P. C. and Shepherd, S. P.: Developing Sustainable Urban Land Use and Transport Strategies - A Decision Makers' Guidebook, Institute for Transport Studie, Univerity of Leeds, 2003.

Pfaffenbichler, P.: The strategic, dynamic and integrated urban land use and transport model MARS (Metropolitan Activity Relocation Simulator) - Development, testing and application, Beiträge zu einer ökologisch und sozial verträglichen Verkehrsplanung Nr. 1/2003, Vienna University of Technology, 2003.

Pfaffenbichler, P. and Shepherd, S. P.: A Dynamic Model to Appraise Strategic Land-Use and Transport Policies, 2002.

Pfaffenbichler, P. C.: Analysing the driving forces behind decision-making processes for the (new) location of businesses, Year.

PROSPECTS: PROSPECTS - Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems, 2000-2003.

Sterman, J. D.: Business Dynamics - Systems Thinking and Modeling for a Complex World, McGraw-Hill Higher Education, 2000.

Ventana-Systems: Vensim DSS Reference Supplement, 2003.

European Spatial indicators – temporal development and quality aspects

Klaus STEINNOCHER, Gebhard BANKO, Mario KÖSTL,
Frederic PETRINI-MONTEFERRI

DI. Dr. Klaus Steinnocher, ARC systems research, A-1220 Wien; klaus.steinnocher@arcs.ac.at
DI. Gebhard Banko, Umweltbundesamt, A-1090 Wien; gebhard.banko@umweltbundesamt.at
Mag. Mario Köstl, ARC systems research, A-1220 Wien; mario.koestl@arcs.ac.at
Dipl.Geog. Frederic PETRINI-MONTEFERRI, GeoVille Information Systems GmbH, Museumstr. 9-11, A-6020 Innsbruck, Austria, petrini@geoville.com Heading 1

1 ABSTRACT

The Spatial Planning Observatory, which is part of the Integrated Project **geoland**, funded within the 6th framework program of the EC, will generate products and services based on EO data, geo-spatial and statistical data, fulfilling the demand of spatial planning as guided by European, national and regional regulations and policies. The products and services comprise indicators, spatial typologies as well as models and scenarios, which are presented in tabular, graphical and map forms.

In this paper we will present the temporal development of spatial indicators for a central European test site that includes former Eastern bloc countries (CZ, SK, H, SLO) as well as Western European countries (D, I, A). The time span analysed ranges from 1990 to 2000. Data sets used for the derivation of the indicators comprise CORINE land cover data as well as socio-economic data (e.g. population) from Eurostat. Using this dataset a first European wide cross-border analysis on the main changes on landscape level is enabled. The second part of the paper will concentrate on quality aspects of the indicators. This includes discussion on the quality of the base data – in particular the limitations of the CORINE land cover data – and an estimation of the accuracy of the resulting indicators by comparison with detailed reference data.

From the analysis performed it can be concluded that the indicators not only represent a significant improvement compared to the traditional statistical representation but also allow for a spatially refined analysis of temporal developments. Regarding the quality of the indicators there is a certain limitation that derives from the methodological characteristics of the CORINE land cover map. These limitations refer both to spatial as well as to thematic generalisation aspects. Restrictions also result from lacking harmonisation of the socio-economic data on a European level. However although these data show considerable limitations, they are the only ones being available on a European scale. The restricted access to more accurate data like those being generated in the process of controlling agricultural subsidies (e.g. INVEKOS-GIS1) prevent more accurate analysis. By beginning of next year INSPIRE2 will be more developed and hopefully will provide a standardised access to core data sets.

2 INTRODUCTION

The Observatory Spatial Planning (OSP), which is part of the Integrated Project **geoland**, funded within the 6th framework program of the EC, will generate products and services based on Earth Observation (EO), geo-spatial and statistical data3. The project aims at developing a project portfolio that covers some key issues of spatial planning frameworks and concepts, especially the ESDP (European Spatial Development Perspective) as well as national and regional spatial planning directives and sustainability strategies. The products and services comprise indicators, spatial typologies as well as models and scenarios, which are presented in tabular, graphical and map forms.

Widely used frameworks for indicator development are the Pressure-State-Response framework of the OECD and the DPSIR (Driving Forces-Pressure-State-Impact-Response) framework of the European Environment Agency (EEA). Land cover change as derived by EO-based methods, has been related to the DPSIR as a "pressure indicator", which characterises the depletion of natural resources. At the same time, the status of land cover (that characterizes the intensity of land use) and of the depletion of natural resources can be regarded as indicators for state and impact. Both frameworks do not explicitly include the aspect of land potential, which may be expressed as land attractiveness for people or as the degree of (potential) biodiversity. Land potential, however, can be considered a loop factor in the DPSIR framework in the sense that it is on the one hand impacted (to a variable degree) by driving forces/pressure/state factors, and on the other hand constitutes a driving force by itself by attracting people or companies to certain places where landscapes attractiveness is high. The indicators conceived on the basis of user requirements take this effect into account.

An overview of all indicator groups derived for European, national and subnational level can be found in Steinnocher et al. (2005). In this paper we will concentrate on a selection of European indicators and their change over time. These indicators relate to the DPSIR framework and include in addition aspects of land potential. They characterize driving forces and pressures related to demographic developments and their manifestation in land consumption per capita. State of and impact on the environment is represented by land

[1] Integriertes Verwaltungs- und Kontrollsystem (engl.: IACS = Integrated Administration and Control System): established by the EC in 1992 to administrate and control agricultural subsidies.

[2] INSPIRE (Infrastructure for Spatial Information in Europe) is a recent initiative launched by the European Commission and developed in collaboration with Member States and accession countries. It aims at making available relevant, harmonised and quality geographic information to support formulation, implementation, monitoring and evaluation of Community policies with a territorial dimension or impact. (http://www.ec-gis.org/inspire/)

[3] http://www.gmes-geoland.info/OS/OSP/index.php

cover/use patterns, agricultural intensity, and availability of recreational areas. These indicators form the basis for spatial typologies and scenarios to be developed in the course of the **geoland** project.

Besides these aspects on the supply side of the products and services there is the question of how users actually digest and utilise the provided information for spatial planning decisions or other purposes, such as reporting obligations. The EO based products and services constitute not only information from another than conventional data source, but also in some respects a new type of information, i.e. spatially explicit information. This offers not only additional application potentials, but also bears the necessity to adapt to their utilisation. In addition, the information provided is directly linked to concepts such as the DPSIR and sustainable development, and thus has to be evaluated and used in this context.

3 DATA AND TEST SITE

The European indicators were developed in cooperation with an end user consortium comprising DG Regio, Tor vergata (project leader of ESPON 3.3), Metrex and Eurocities4. All indicators are based on aggregated CORINE land cover data (see 3.1) and statistical information.

For demonstrations on a European scale an area of approximately 420.000 km2 located in central Europe has been chosen as test site, covering several nations including new EU member states. The test site represents a wide range of heterogeneous geographic landscapes including Alpine areas, costal zones as well as flat terrain with urban and rural areas. It comprises the Czech Republic, Austria, Slovenia and parts of Germany, Slovakia, Hungary and Italy. Figure 1 gives an overview of the European test site.

3.1 Land cover data

CORINE Land Cover (CLC) is a compilation of national land cover inventories, which are integrated into a seamless land cover map of Europe. The land cover information is derived mainly from satellite imagery and ancillary data sources such as maps. Its production is based on a standard methodology and nomenclature (EEA, 1999), resulting in a digital vector data set where each polygon represents one of 44 land cover classes that are organised in a hierarchical structure with three levels of detail. The scale of the cartographic representation is 1:100.000 with a minimum mapping unit of 25ha, i.e. single land cover objects smaller than 25 ha are not represented in the data set. In order to cope with heterogeneous landscapes the nomenclature includes several mixed classes. At European level the data base is also available in a 100m grid format, representing the first two levels of the three level nomenclature (see Fig. 1 left).

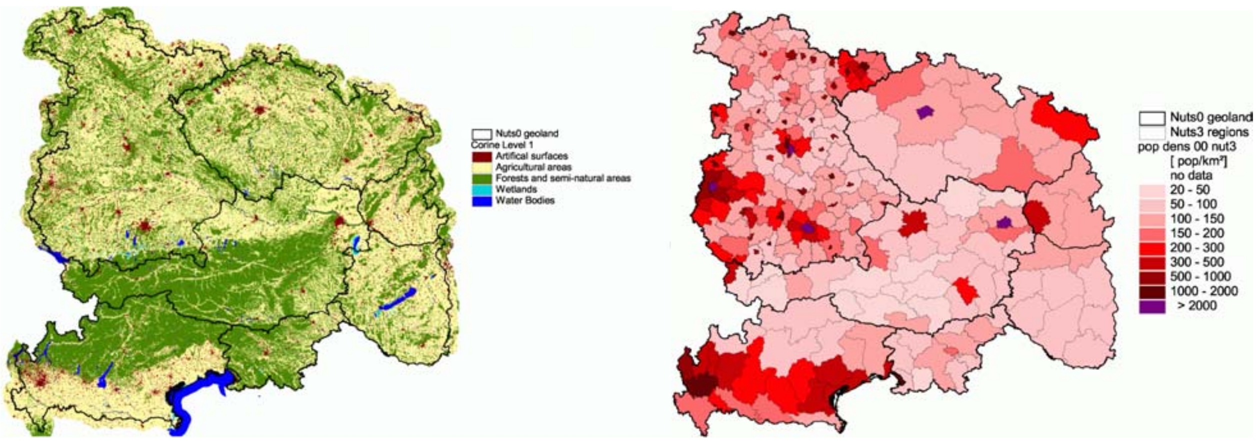


Fig.1: European test site. Left: CORINE land cover level 1 (2000), right: Population density per NUTS 3 area (2001)

In spring 2005 an update (CLC 2000) of the first data base (CLC 1990) was finished by the national teams of the participating countries. In the course of the update process the original data base (CLC 1990) was revised and corrected in order to obtain consistent and comparable data sets. This correction ensures that differences between the two data sets refer to actual changes in land cover rather than to interpretation errors and geometric inaccuracies.

In terms of data quality the grid representation of CLC (major CLC class per 1 ha cell) was found not to be sufficient for all analyses. This is less due to the spatial resolution of 100m – which seems to be appropriate when working on a European scale – but more related to the minimum mapping area of 25ha, which is defined within the standardised methodology. In particular for small built-up areas but also for certain agricultural structures the level of spatial detail is too coarse to reflect the full range of scales where landscape changes appear. This has an effect on both the spatial and temporal variability and significance of the indicators. Many land cover changes are not recorded because they are below the minimum mapping unit; likewise, the character and diversity of landscapes – as far as it is related to smaller land cover objects - is not expressed in the data. In all the subsequent analysis one has to

[4] DG Regio: EU Directorate-General 'Regional Policy' - http://europa.eu.int/comm/dgs/regional_policy/index_en.htm
ESPON 3.3: European Spatial Planning Observation Network project 3.3: territorial dimension of the Lisbon/Gothenburg process - http://www.espon.lu/online/documentation/projects/cross_thematic/cross_thematic_147.html
Metrex: The Network of European Metropolitan Regions and Areas - http://www.eurometrex.org/
Eurocities: Network of major European cities - http://www.eurocities.org/_INDEX.php

bear in mind that the interpretation is only valid for those changes that manifest in landscape changes that can be observed within the landscape scale defined by CORINE land cover (app. 1:100.000).

3.2 Statistical data

The statistical data at European level are derived from the REGIO database, Eurostat's harmonised regional statistical database. REGIO is a domain of the General Statistics of the New Cronos database (Eurostat 2004). It contains 14 different collections, such as agriculture, demographic statistics, economic accounts, education statistics, environment statistics, community labour force survey (annual average and second quarter), migration statistics, science and technology (research and development, patents), structural business statistics, health statistics, tourism statistics, transport and energy statistics and unemployment. These data are available at NUTS3 level which is used as spatial reference on the European scale (see Fig. 1 right).

Besides the complex structure of this data base – requiring interactive data retrieval in order to produce GIS compatible attributed polygon layers – problems occurred when searching for historic data. Linking land cover with statistical data requires more or less identical acquisition times of both data types. As the reference year for CLC is 1990 statistical data from that time are needed. Unfortunately statistical data from the New Member States are not available before the mid 1990s.

Another difficulty arises from the varying sizes of the NUTS3 areas in different countries. While in the New Member States the size of NUTS3 areas averages out to about 5.000 km2, in Germany they come down to 1.000 km2 in rural areas and to 100 km2 for urban areas. The smallest NUTS3 area of the European test site has a size of less than 36 km2, the largest a size of more than 11.000 km2. Comparison of statistical data is somewhat hampered by these disparities but the introduction of land cover data and the referencing of land cover based indicators to a common European grid can help to improve the situation.

4 TEMPORAL DEVELOPMENT OF INDICATORS

The three European indicators discussed in this study comprise *population density in urbanized areas, recreational areas within citizen reach,* and *agricultural intensity*. The methodology for deriving these indicators is based on GIS functions, especially intersections of EO data with other geo-spatial data and statistical information (Steinnocher et al., 2005a).

Representation of the indicators can be based on polygons or a regular grid. For the first approach the land cover layer is intersected with NUTS3 polygons, the proportion of the relevant land cover classes per polygon is calculated and the population data divided by it. This approach gives one value for each NUTS3 polygon. The grid-based approach goes one step further by mapping the calculated density measures on the relevant land cover units leading to a spatially refined density map. This layer is then intersected by regular grid allowing to calculate a density measure for each grid cell. In this paper we will confine ourselves to the grid representation.

All indicators were calculated for the reference year 1990 and the update year 2000. These dates refer to the production of the CLC land cover data. However, it is to be noted that the actual acquisition dates for CLC 1990 range from the mid 1980ies to the beginning of the 90ies. The CLC 2000 is mainly based on data from the year 2000. A similar problem occurs with the socio-economic data. While the up-to-date information refers mainly to 2001, the reference data come from a period between 1991 and 1995. The inconsistency resulting from these temporal differences in the data sources are accepted assuming that the main trends can still be derived. Furthermore, the major emphasis of this study lies in the methodology and its potential for the future, where it is expected that data collections will provide temporal concurrence as was the case in 2000/2001.

Fig. 2 shows the temporal development between 1990 and 2000 of two base data sets: the change of the proportion of residential areas per grid cell (given in percentage points) and the change of population per NUTS 3 area (given in absolute numbers).

4.1 Population density within urbanized areas

This indicator refers to the actual population density that occurs within built-up areas in contrast to the traditional measure that refers to population per statistical area, such as NUTS3. Assuming that people mainly live in residential areas – as observed by CORINE land cover - rather than in the agricultural or forested areas the population number of a statistical unit can be assigned to the actual built-up areas within this unit. Calculation of this indicator requires information on land cover – in particular on artificial surface types (CLC class 1 and sub-classes) – and on population statistics as provided by Eurostat on a NUTS3 level.

The indicator can be based either on the entire artificial surface areas or limited to residential areas. The first approach represents the general land consumption per capita, including commercial, industrial and transport related areas etc., while the second approach gives an indication on the density of housing within residential areas. In this paper we will refer to the second approach, population density in residential areas. Fig. 3 shows the indicator for 2000 and the absolute change between 1990 and 2000.

4.2 Recreational areas within citizen reach

This indicator represents the proportion of attractive landscapes (as potential recreational areas) within a specified distance from residential areas. For each "residential cell" the amount of "recreational areas" within its reach is calculated, for instance within a circle of 10 km, to express residential area attractiveness for short one-day or weekend trips.

Recreational areas are defined as green urban areas, permanent crops such as vineyards, forest and semi-natural areas, wetlands and water bodies within a specified distance from residential areas. In order to calculate this indicator raster representation of the land cover map is required (as e.g. provided by the CLC100m grid). First the amount of recreational area in a circular neighbourhood of each residential cell is calculated, resulting in a general availability of recreational areas in the surrounding of residential areas. In a second step this availability is weighed by the population density in residential areas, resulting in an availability of recreational areas per capita. While the first result represents land cover patterns only the second approach introduces population distribution thus indicating potential land use. Fig. 4 shows the second approach for 2000 and the absolute change between 1990 and 2000.

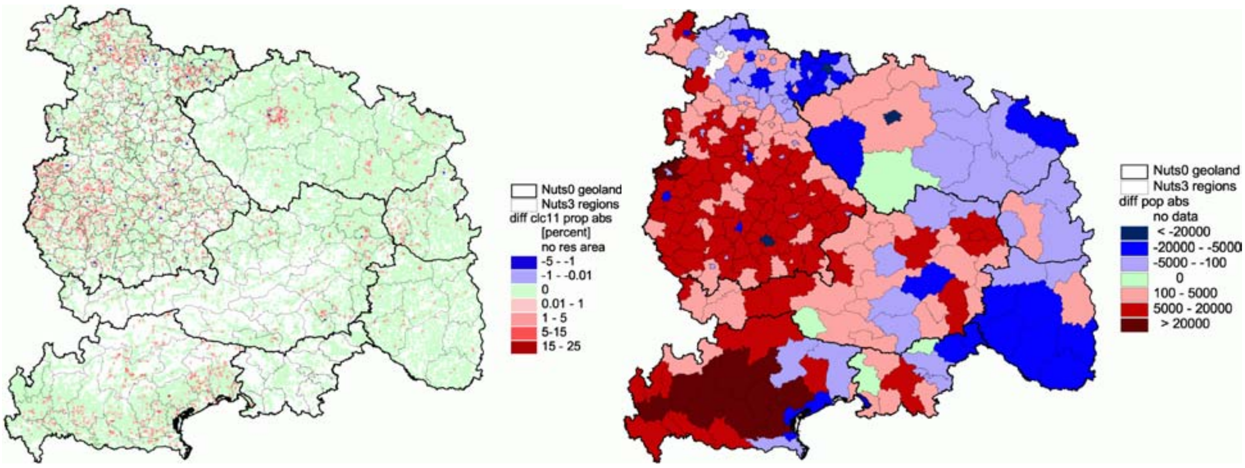


Fig.2: European test site. Left: absolute change of residential areas (1990/2000)), right: absolute change of population on NUTS 3 level (1993/2001)

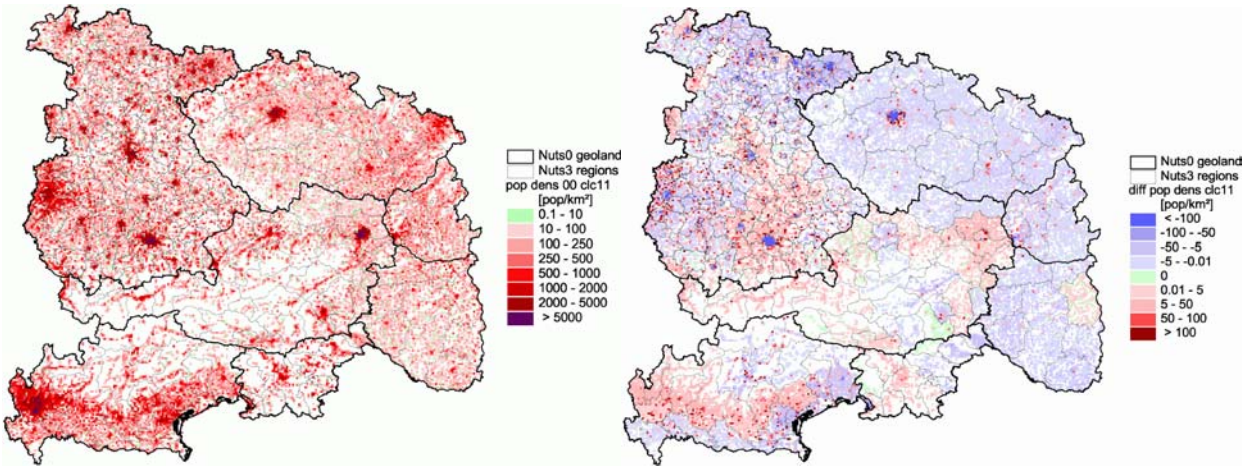


Fig.3: Left: population density per residential area (2000), right: absolute change of population density (1990/2000)

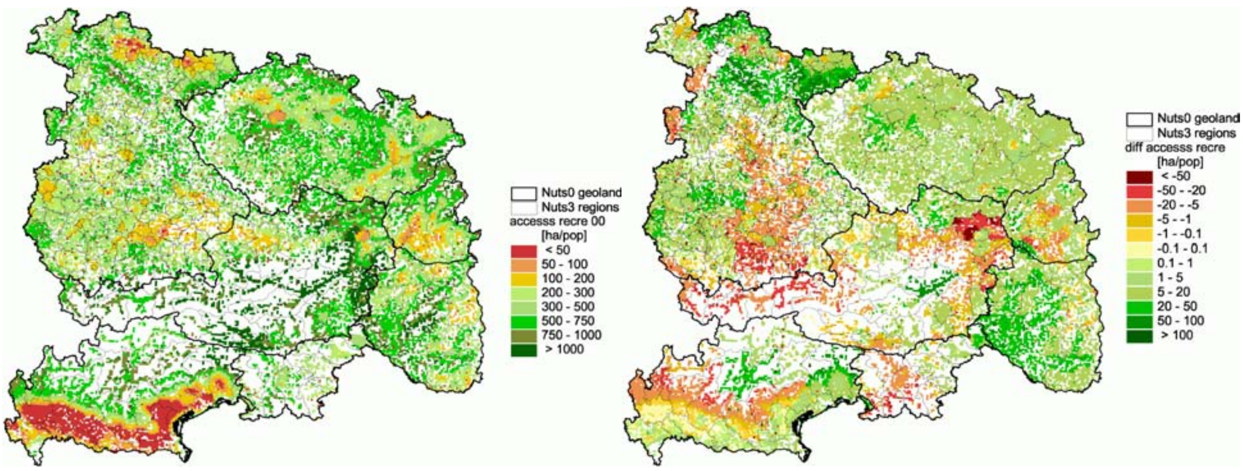


Fig.4: Left: access to recreational areas (2000), right: absolute change of access to recreational areas (1990/2000)

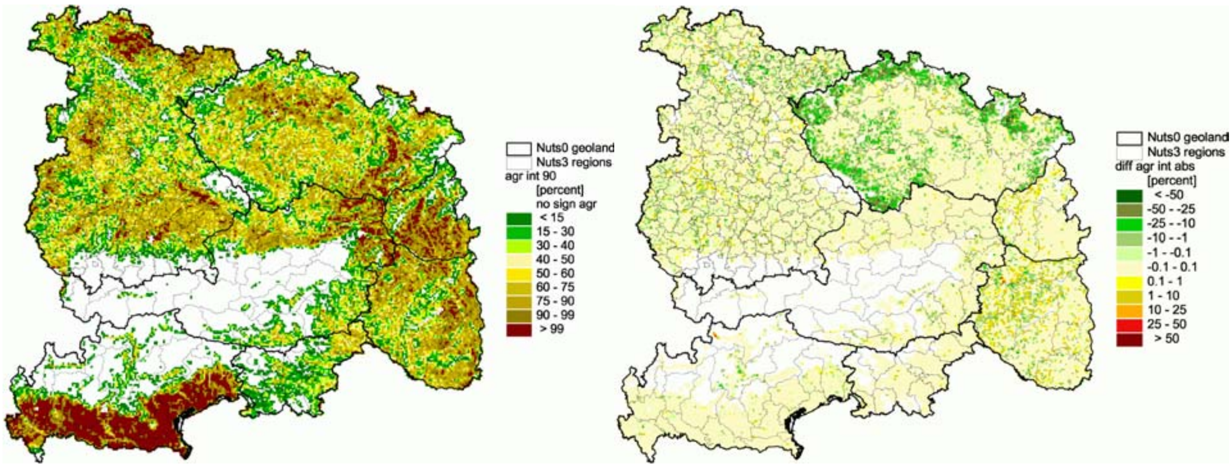


Fig.5: Left: agricultural intensity (2000), right: absolute change of agricultural intensity (1990/2000)

4.3 Agricultural intensity

This indicator refers to the percentage of arable land and permanent crops on the potential utilizable area. The potential utilizable area may be taken either as total agricultural area or as agricultural area plus forests and semi-natural areas. In the first case the indicator represents the ratio between intensive and extensive agriculture, as the total agricultural area without arable land and permanent crops leaves meadows and pastures. The latter approach represents the importance of intensive agriculture in terms of agricultural land consumption for the area under investigation. Fig. 5 shows the latter approach for 2000 and the absolute change between 1990 and 2000.

5 DISCUSSION

In the following the three European indicators and their development over time are discussed.

5.1 Population density in urbanized areas

This indicator shows how densely people live in cities, while also indicating the structure of the residential area. This can also be demonstrated by the reciprocal of the density that yields land consumption for housing per capita; high land consumption indicating single family housing, low land consumption indicating apartment buildings. Fig. 2 shows the basis for deriving this indicator: the increase in residential areas in grid representation and the change of population on a NUTS 3 level. The increase in residential areas is a clear example of the uncertainty that is linked to the standardised CORINE Land Cover methodology. The observed changes in residential areas may depend to a large extent on the quality of the revision of the CORINE 1990 data. Any underestimation of e.g. settlements in the original CLC 1990 data lead to an enormous overestimation of the increase in built-up areas in the CLC 2000 data, if not corrected adequately. Fig. 2 shows that most parts of southern Germany and the larger Po-Region in Italy have a large increase in built-up areas. As this increase is not bound to urban agglomerations but rather appears in rural areas, conclusions have to be drawn very carefully. Whereas Slovenia shows almost no changes at all, in the Czech Republic, Austria and partly also in Slovakia larger increases can be observed in the suburban areas of major cities.

With regard to the population changes in Fig. 2 one has to keep in mind that an absolute change in population depends largely on the size of the NUTS 3 region. Therefore the Po-region turns into dark read, reflecting on one hand a very high increase in population, but also the size of the NUTS3 regions which are larger than average. The German NUTS 3 regions have to be mentioned in particular, as they show a high increase of population despite of their small areas. The general trend of population decrease in peripheral regions is shown quite impressively. Not by occasion these areas are located mostly at the border line between countries or within a country in the most peripheral regions. Exceptions are the "new federal states" in Germany where a strong decrease in population has been observed during the last decade (most northern part of the German part of the test site – shown in blue in Fig. 2 right).

Looking at the **change of population density** between 1990 and 2000 (Fig. 3) one can see the different developments in central Europe (increase of population density is shown in red colours, decrease in blue colours, no change in green, white areas indicate no residential areas).

At this point it is to be mentioned that change of population density does not necessarily mean change of population but rather a change of the ratio between population and residential areas. Increase of population density is likely to be a result of high increase of population linked with low increase of residential areas. Decrease of population density is related to a low increase or even a decrease of population linked with a high increase of residential areas. No change in population density might result from no activities – neither migration nor urban sprawl – but might as well indicate a proportional increase of population and residential areas. On has to note that even with an increase in population the density may decrease. This occurs if the population increases in a slower rate than the built-up area (land consumption per capita is higher than it was before).

The areas with the **strongest decrease in population density** are larger cities (such as Munich, Prague and Chemnitz). This trend is largely due to a significant decrease in population while residential areas stay unchanged – leading to a lower density in 2000 compared to 1990. The largest changes appear in areas with change rates from –5 up to +5 population/km2.

Areas with **decreasing population density** can be grouped into two main process oriented categories:

- The first category comprises areas which show a decrease in population and almost no changes in residential areas, thus leading to a lower population density (most areas in HUN, CZ, and SK).
- The second category represents completely other processes. While on NUTS 3 level an increase of population is reported the residential areas are growing even stronger. Thus one can interpret that people moving to these – mostly rural – areas require more residential area per capita than the "old" population. Thus the population density decreases – as the increase in built up areas overcompensates the increase in population. Such developments usually are an impact of suburbanisation but also seem to appear in remote regions such as parts of southern Germany and Northern Italy. However, analysing this effect may be hampered by the quality of the built-up area change based on CLC 1990 data.

The interpretation of areas with an average **increase in population density** is doubtful because the criteria of the 25 ha minimum mapping unit may lead to wrong conclusions. As in these areas on NUTS 3 level quite a large increase in population is observed, the increase in built-up area may be underestimated, thus leading to apparently higher density figures compared to 1993.

Areas with the **highest increase in population density** (> +5 population/km2) are linked to those with a high absolute population density. Only in the neighbourhood of very densely populated areas very strong increase of population density can be observed. So to say no population hot spots are created in the open countryside, but population hot spots grow in the direct vicinity of previous population hot spots.

5.2 Recreational areas within citizen reach

The indicator on Recreational areas within citizen reach turned out to be an interesting representation of landscape features. As it takes local patterns into account we again face the problem of spatial detail in the land cover representation. The distance applied is to be seen as a proxy variable but does not represent the actual effort to reach recreational areas. Discussions with the users lead to the conclusion that this indicator should not be limited to residential areas but could be improved by introducing population numbers. Applying population density per residential area allows calculating the amount of recreational area available per capita, thus refining the significance of the indicator.

The results of the latter approach for the European test site are shown in Fig. 4 (red colours indicate low availability, green colours high availability of recreational areas). While the general availability of recreational areas indicates mainly landscape features, the availability per capita sets a focus on the highly populated urbanized areas. The reddish belt in northern Italy results from the combination of high population density and a dominance of agricultural land use, which is not defined as recreational area.

The change of the amount of recreational area per capita (Fig. 4 right) reflects the increase of population on one hand, but also takes into account the change of recreational areas. The latter do not change very strong but if they do have a significant influence on the resulting indicator.

The main conclusion that can be drawn is the "greening of cities" and the "browning of regions with urban sprawl". Considering the cities it is known that various programmes are installed at least to keep the remaining urban green areas. And this conservative approach is accompanied by mostly decreasing population numbers, thus leading to more recreational areas per capita. The opposite trend is taking place in sub-urban regions. While they are faced with large increases in population, the "recreational areas" do not grow, but rather shrink in favour of new built-up areas. This effect can lead to a substantial decrease of recreational areas per capita in wider suburban regions, which somewhat counteracts the recreational effect of living in the countryside.

5.3 Agricultural intensity

This indicator represents the ratio between intensive agriculture and vegetation cover in general.

Agricultural intensity as represented by this indicator is not a measure of how intensively the arable land is managed but is a measure of the potential to grow high value agricultural products. Out of the history of agricultural production most land with a high potential for agriculture is already used as high value farmland (arable land and vineyards) today. Thus major changes refer to a decrease of arable land or vineyards while conversion into arable land almost never occurs.

Two general trends can be observed nowadays. On the one side high value farmland is turned into new settlement areas, as the value of building land is 10 to 1000 times higher than the value of the same piece of land for agricultural use. On the other side farmland of lower value is given up and turns into grassland or – in the long run – into forest.

The most impressive change in the agricultural intensity occurs in the Czech Republic (see Fig. 5). Due to the change of arable land to pastures – a decrease of almost 280.000 ha equalling 8% of all arable land in 1990 and an increase of pastures of almost 130% – this land cover change is unique within central Europe. According to Czech experts this change is due to

- cancellation of agricultural subsidies for crop production in less productive areas in 1990
- implementation of new subsidy schemes to support extensive agriculture in less productive areas in 1995/96
- changes in land ownership due to restitution in 1990 (in particular complicated/unclear ownership structure in former "Sudetenland" areas)

The second effect can be observed in Hungary. It is taking place in a complex agricultural landscape comprising more or less intense agricultural areas within local neighbourhoods. Both intensification and extensification takes place, whereas the intensification slightly dominates in this area.

Larger areas of extensification can also be observed in the "new federal states" in Germany mainly due to abandonment of arable land.

6 QUALITY ASSESSMENT

For the indicator population density a quality assessment was performed based on the comparison with reference data in Austria. The indicator data set is derived from the spatial disaggregation of NUTS 3 population statistics onto CLC residential areas (as described in chapter 4.1) and is provided in a 3x3km grid representation (see Fig. 6 left). The reference data set is an Austrian wide raster with 250m grid cells representing population. It was derived from the 2001 census by Statistik Austria (Kamiger et al. 2004). For the comparison the 250m population raster was aggregated to the 3km indicator grid (see Fig. 6 right).

A visual comparison shows the main difference of the two data sets: while in the reference data set a huge majority of cells are "inhabited", the indicator data set shows large areas without population. The reason is that due to the CLC mapping rules settlements smaller than 25ha are not mapped and thus cannot be populated in the disaggregation process. On the other hand it is obvious that these small settlements will not comprise a large part of the population. Therefore it is likely that a majority of the population will be distributed correctly by the indicator. A numerical comparison proves this hypothesis: while the indicator populates only about 50% of the actually inhabited cells, it includes more than 90% of the actual population; i.e. only 10% of the population lives in the "white" areas of the indicator grid.

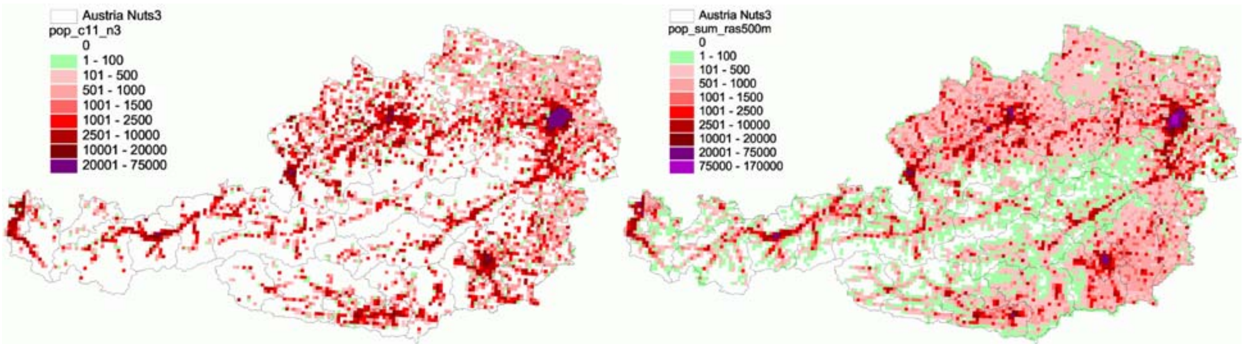


Fig.6: Population density in Austria Left: geoland indicator (2001), right: raster statistics (2001)

In order to cover most of the missing 10% a smaller minimum mapping unit (MMU) is required. Reducing the MMU to 1 ha should be sufficient to cover most settlements, only leaving out stand alone buildings such as single farm houses.

The remaining 90% of the population is distributed to the CLC residential areas. As we use a proportional distribution – assuming the same population density in all residential areas – the indicator will differ from the reference data set also in populated cells. Here the trend is an underestimation of highly populated areas such as city centres and consequently an overestimation of population in the surrounding areas. While the underestimation is restricted to a few hot spots, the overestimation has an areal dimension. This can be observed in Fig. 7 where the deviation of the indicator from the reference data set is shown for the city of Vienna and surroundings. The red colours represent cells where the reference data set states a higher population than the indicator, cells in blue indicate the opposite, green cells show equal numbers and white cells are uninhabited. It can be clearly seen that the population is strongly underestimated in the centre of Vienna (dark red) while in the outer districts is overestimated (dark blue). The wider surroundings are slightly underestimated (light blue) except for the densely populated axis south of the city and some regional centres shown in red.

In order to reduce this deviation housing density measures need to be included in the analysis. Steinnocher et al. (2005b) shows that the introduction of 3 density classes results in a significant improvement of the disaggregation results.

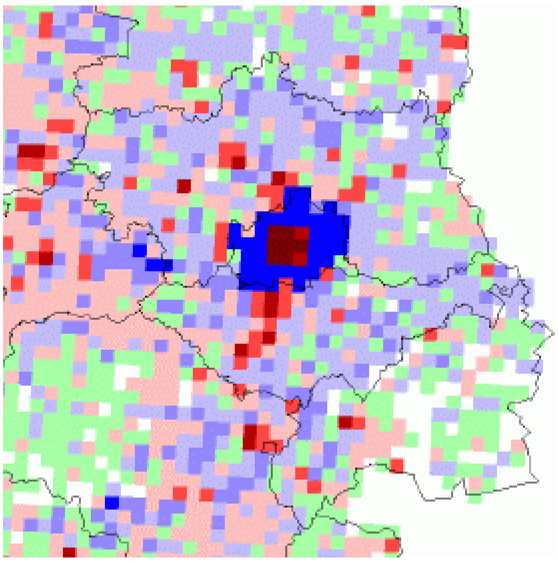


Fig.7: Vienna and surroundings: Differences between raster statistics and geoland indicator (2001)

7 CONCLUSIONS

The described indicators demonstrate the usefulness of EO based information in particular when linked to statistical information. However, improvements are required both in terms of land cover specification and indicator definition. In order to use land cover data efficiently more spatial detail is needed. While the thematic detail of CLC level 2 is generally sufficient – except for residential areas where different density classes would be helpful – the minimum mapping unit of 25ha is much too large for detailed analyses.

The temporal development of the three indicators discussed (population density in urbanized areas, recreational areas within citizen reach, agricultural intensity) has quite different interpretation qualities. For the interpretation of quality of trends, the indicators can be rowed in ascending order: agricultural intensity, population density and recreational areas.

As the agricultural intensity is a quite constant indicator those changes that are observed should be analysed carefully. However if they turn out to be reality, as is the case for the Czech Republic, it is a clear indicator for the effect of extensification of agriculture in peripheral and less favoured regions.

The population density is the indicator that needs a very sound interpretation. As it is based on two data sources (change of built-up areas and change of population) the interpretation has to take the matrix of potential intersections of the two variables into consideration. The main categories of change range from high decrease of population density over decrease, increase up to high increase of population density, but do not form homogeneous groups. Especially the category with decreasing population density has to be interpreted carefully as two different trends of the underlying variables can lead to the same effect. This is important when it comes to the point of defining adequate political scenarios and administrative measures that deal with this problem.

The change of recreational areas shows two major trends. The urban regions – characterised by a decrease in population – offer an increasing recreational potential, whereas the peripheral growing regions show a decrease in this indicator. Although the baseline values for these two types of regions are quite different (urban areas offer quite limited areas of recreation), the trend may in the long run lead to a shortage of this good in the peripheral sub-urban regions, which may lead to a significant loss of quality of life.

The quality of the population density indicator has been analysed by means of comparison with available reference data. The comparison has revealed two sources of systematic deviations. The first is related to the insufficient level of spatial detail of the land cover data. The second refers to a lack of thematic information in the land cover data. Both shortcomings can be overcome by applying improved mapping techniques. In terms of the statistical data it is to be mentioned that inconsistencies might occur between data from different sources. However the magnitude of these inconsistencies lies in the range of the expected accuracies of the indicators.

The introduction of land cover into socio-economic indicators clearly represents an improvement compared to pure statistical representations. However, the information content of such indicators can become quite complex and their acceptance will highly depend on a proper but simple description of what the indicator's message is. In that sense there is still effort required both in terms of indicator design and communication of results.

8 REFERENCES

EEA (1999): CORINE Land Cover – A key database for European integrated environmental assessment. Available: http//terrestrial.eionet.eu.int/CLC2000/docs/publications/corinescreen.pdf

Eurostat (2004): European Regional Statistics Reference Guide: 2004 Edition. Available at: http://epp.eurostat.cec.eu.int/portal/page?_pageid=1073,46587259&_dad=portal&_schema=PORTAL&p_product_code=KS-BD-04-001

Kamiger I. & Wonka E. (2004): Von einer Österreichgliederung nach Gemeinden zu Plan-quadraten: Statistik Austria erweitert sein regionalstatistisches Angebot. In (Manfred Schrenk Hrsg.): CORP 2004 Proceedings, pp. 549-554.

Steinnocher K., Gangkofner U., Hoffmann C., Köstl M., Petrini-Monteferri F., Tötzer T. (2005a): Spatial planning indicators – the geoland approach. In (Manfred Schrenk Edt.): CORP2005: 10th International Conference on Information & Communication Technologies (ICT) in urban Planning and Spatial Development and Impacts of ICT on Physical Space, Proceedings, pp. 185-191.

Steinnocher K., Petrini-Monteferri F., Tötzer T., Weichselbaum J. (2005b): Räumliche Disaggregation von sozio-ökonomischen Daten. In (J. Strobl, T. Blaschke, G. Griesebner Hrsg.): Angewandte Geographische Informationsverarbeitung XVII, Wichmann Verlag, Heidelberg, 2005, pp. 702-707.

9 ACKNOWLEDGEMENTS

The project geoland is funded by the European Commission in the frame of the GMES (Global Monitoring for Environment and Security) initiative of the 6th framework programme (Contract No SIP3-CT-2003-502871) and is co-ordinated by Infoterra GmbH, Friedrichshafen, and Medias France, Toulouse.

Geo-informatics in the electrical energy sustainable development

Mircea BĂDUTS

(OPI Vâlcea; PhD candidate at Cluj-Napoca Technical University; Romania)

1 ACKNOWLEDGING THE ENERGY PERSPECTIVE

Almost all the aspects we plan/develop for the modern future Europe – from infrastructures to culture, from urban to rural communities – require a lot of energy, and mainly electrical energy. Buildings we erect, residences we spread, streets and highways, water-ducts, telecommunication ways – anthropogenic facts covering almost all the planet; beyond their effects over the natural environment (which we have to mind, too), they all need a lot of electricity. Therefore we have to find reliable ways to support a sustainable development of electricity production, ways for ensuring our increasing energy demands without forgetting about the next generations.

This paper is firstly an attempt to reveal applicability directions and practical issues about using GIS in planning, developing and managing the electrical energy. It presents various aspects of the geo-spatially approach in planning durable electricity, disclosing and even assessing the potential resources (natural or cultural).

1.1 Why we need durable energy approaches

But, at the same time, this workpaper is also a call for a more balanced development of the electrical energy sources: remembering that the Earth is fragile and threatened by mankind's activities, thus understanding that we all have the obligation to develop and promote high quality, clean, renewable energy sources, in an acknowledged effort to preserve our shared environment. Why must we keep "lobbying"? Because it seems more education is needed, to make people aware of the sustainability and concern for the future. The world requires a development that complies with the needs of present generations without compromising the future. Why? Because many of the energy sources are limited and not renewable (or renewable in a too long time), so we need energy policies to ensure not only the energy cover for our next demands, but also for the necessities of the future people generations. And again, why? We have to be aware that most of the existing electrical energy producing facilities stimulate the climate changes. Power stations are actually a lead contributor in the whole anthropogenic emissions, and many of the electricity consumption forms stress vital elements of the life. We need to create an ethical dimension of energy production and consumption.

Like many of the human activities, energy production always has an impact on the environment: on the soil, land, water, air. On the other hand, we all use electrical energy for heating, cooking, lighting, manufacturing, transportation, travelling, cooling, communication, entertainment. And the efficiency and the care of energy exploitation have an impact on the world we live in.

Because there are strong (although sometimes not very obvious) links between the choices people make concerning electrical energy and both the natural environment and the society's life, the future decisions must be more and more carefully made, and the GIS technologies can help to reveal, to represent, and to control many of the durable development related issues.

1.2 The electrical energy situation

Electricity was introduced at the end of the 19th century in the United States and Europe, and until nowadays it has became essential to the operation of most modern technological systems –industrial, commercial, cultural or domestic/residential. For this reason electricity has attained the status of a 'meta-technology', and it is often viewed as an essential public good in contemporary society. [John Byrne, Yu-Mi Mun, 2003]

The electricity systems developed over the last century are mainly based on large-scale power plants and on extensive networks for delivering electricity at affordable prices. (In many countries most citizens are connected to the electricity grid.) On the other hand, such power plants are estimated to account for almost two-thirds of carbon and sulphur dioxides emissions in Europe and North America.

We can find that the accounts of the sources of nowaday's world primary energy are [WEC, 2001]:

Energy primary source	Percent	Observations
Oil	34,00%	
Natural gas	21,00%	
Coal	22,00%	
Nuclear power	6,50%	about 16% of the world's electricity
Hydroelectric power	2,20%	
Traditional fuel wood, crop wastes, animal dung	12,00%	
Modern renewable energy sources (biomass/biogas, wind, solar, geothermal, tidal/wave, small hydropower)	2,30%	The solar energy produces now 750 MWh per year

Some energy sources are more efficiently converted into electricity than others (and this is a prime issue, because the productivity plays a leading role on the energy market), and some have a smaller environmental impact. Others are cheaper to produce, but carry 'hidden' costs, such as acid rain, air pollution, adverse water quality impacts, long-lived radioactive wastes, enduring energy-based economic inequalities, and widening security threats.

Sometimes even the best renewable energy has unwanted side-effects, and sometimes the traditional energy sources can not be judged apriori as being the worst:

- large-scale biomass crops rise worries about the loss of bio-diversity, and adverse impacts on agriculture and hydrology [WEC, 2000];

- in spite of the fact that the use of fossil fuels is implicated in emissions of "greenhouse gases" (sulphur, nitrogen, carbon oxides, etc), the natural gas (whose composition is usually methane (~83%) and ethane (~16%)) do no emit carbon monoxide (due to the good aeration and to the lower carbon content). Therefore the natural gas is a relatively clean fossil fuel by comparison to coal and oil [WEC, 2001];
- tidal/wave power developments cause adverse affections of migratory bird populations.
- despite the fact that nuclear power rise severe questions concerning waste disposal and operational safety, it has zero greenhouse gas emissions; the nuclear option is not only little disruptive from this point of view, but it is also a very efficient alternative (the cost of the typical nuclear power plant investment is 2-3 billion Euro, but the cost per unit proves that it is a cheap energy);
- conversion of ocean energy disturbs the salt gradients.

Because all energy forms have some negative effects, we have to choose carefully. Thus we need to understand these impacts, and we have to encourage the future development of technologies involvable in the mitigation of the environmental impact. Consequently – also due to the fact that the environment health has to become a constant theme among public discussions, researches and designs related to electrical power – geo-information must be involved in such activities.

2 APPLICABILITY OF GIS IN DESIGNING AND MANAGING DURABLE ENERGY SOLUTIONS

The accomplishment of a long-term balanced relation between nature (and its regeneration capacity) and the demands place on it by man inherently calls for new methods and instruments. And because on the one hand the environmental issues have a geo-spatial spread, and on the other hand the mankind activities are usually deployed in communities covering large spaces too, the geographical attributes are obvious. Therefore, the potential of the informatics – and of the GIS technologies in particular – to help in sustainable development of electrical energy is clear.

The dedicated information systems must be able to deal (through its storage/capturing, re-aggregating and analysing functions, but also through its human coordinates) with information from a variety of domains, including engineering, geography, environmental science, and politics.

Such GIS solutions involved in durable development of the electrical energy must become related to the European, national or regional Spatial Data Infrastructures (SDI) – or even to become part of them – for a proper collaboration between governmental institutions and non-governmental organizations, as well as for leveraging public participation.

It is already *a common fact that IT&C technologies help manage the electric energy supplying services: Enterprise Resource Planning, Document Management, Electric Operations Switching, Electric Network Connectivity, Outage Management System; Electric System Design; Meter Reading; Enterprise GIS; Location Based Services (Mobile Applications); Intranet; Database Management; etc.*

Most *of the integrated IT&C solutions are (to be) engaged for gaining a plus in efficiency and comprehensiveness. As an example, a well-known fact: GIS supplies a framework for better decisions, because problems can be considered in a geo-spatial context rather than in isolation.*

Geo-*information for the management of electricity production/distribution:*

_ *AM/FM* – technical *and economical administration (managing facilities and equipment for a better exploitation)*

_ *SCADA – real*-time *parameters monitoring (assuring normal functioning; remote controlling; load adjusting)*

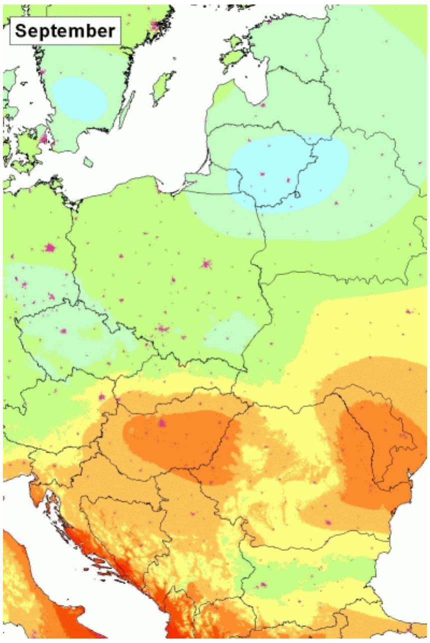
_ *OMS/MMS* – outage*/maintenance management (assisting revisions and restorations of the equipments)*

_ *DSS* – executive *management (supporting strategical and tactical decisions)*

_ *ERP, CRM* – interoperation *with other enterprise information applications/systems (we mind that a modern practical goal is the GIS–ERP integration for energy enterprises).*

For electrical power enterprises, the GIS solutions assist the assets management, the network/grid exploitation, the operational maintenance activities, the customer connectivity and consumption, but also the electrical network strategic development. It is about day-by-day tactics and enterprise activities, and also about the decision concerning the enterprise's future. In addition, geo-informatics can contribute to managing the enterprise's relation with the surrounding environments: markets, economical, people, social, cultural, natural. [Bădut, 1]

Beyond the electricity production, GIS can significantly contribute to electricity distribution: networks/grids development and administrations, and even in power station engineering and management.



From a somehow transcendental point-of-view, the previous experience has shown that a pathway to sustainable development must be directed through processes of learning and adaptation, and this requires new types of analysis and communications tools. [TERI & IISD, 2003]

GIS applicableness at low-impact and renewable electricity

We can use GIS for creating average solar radiation maps, showing the irradiance (solar energy falling on a unit area per unit time – W/m2), the irradiation (the amount of solar energy falling on a unit area over a stated time interval [Wh/m^2), the insolation values (the resource available to a flat plate collector facing south, at a vertical angle equal to the latitude of the collector location), and also for revealing the local/particular attenuation factors and the latitude lean condition.

Certain specialized/advanced GIS solutions can provide instantaneous values of such parameters, computed on the basis of geographic location on the globe, of the terrain 3D particularities, and of the date/time of determination, but the virtual analysis should be confronted and completed with on-the-field measurements.

<fig. – A grid map showing average solar radiation>

The interaction of solar radiation with the earth's surface is determined by three groups of factors:

1. the Earth's geometry, revolution and rotation (declination, latitude, solar hour angle);

2. terrain *(elevation, surface inclination and orientation, shadows);*

3. atmospheric *attenuation (scattering, absorption) by: gases (air molecules, ozone,* CO_2 *and* O_2*); solid and liquid particles (aerosols, including non-condensed water); clouds (condensed water).*

The global *radiation consists in:*

1) the radiation, selectively attenuated by the atmosphere, which is not reflected or scattered and reaches the surface directly is direct radiation (beam radiation).

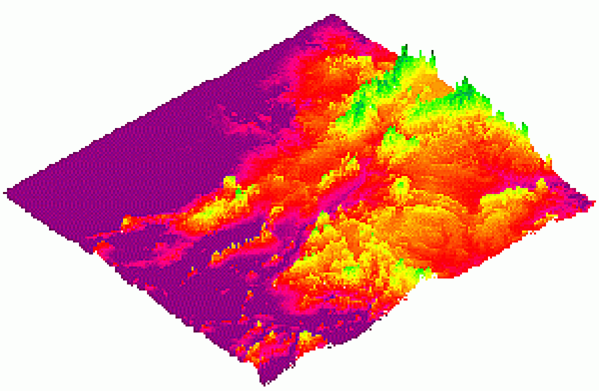
2) the scattered *radiation that reaches the ground is diffuse radiation.*

3) the small *part of radiation that is reflected from the ground onto the inclined receiver is reflected radiation (related to "albedo").*

A wind resource assessment program starts with a survey of the entire focus region's potential, and this step may involve several wind resource digital maps, and information about meteorological characteristics and wind speeds. The same GIS can assist to develop and disseminate detailed maps of the region, including land use restrictions, obstacles and other limitations. The GIS analysing features will help us to develop criteria for identifying promising sites by assessing and quantifying all factors influencing large and small scale wind development. For instance, a gridded map with classification of wind speeds – assuming a given, or rather a parametrized, mean wind-farm installable density (in MW/km2) – can disclose optimums.

In the offshore wind-farms construction and maintenance a key issue is sediment transport monitoring (bottom-sea sand) – thus a geo-information application showing the sedimentological and hydrographic distributions and dynamics could be welcomed. Maps of individual bedforms (megaripples, sandwaves etc) can be created from the interpreted side-scan sonar records, and when any gross changes of sediment transport regime are detected, then the GIS analysis features can make a comparison with natural seasonal and interannual bedforms variations.

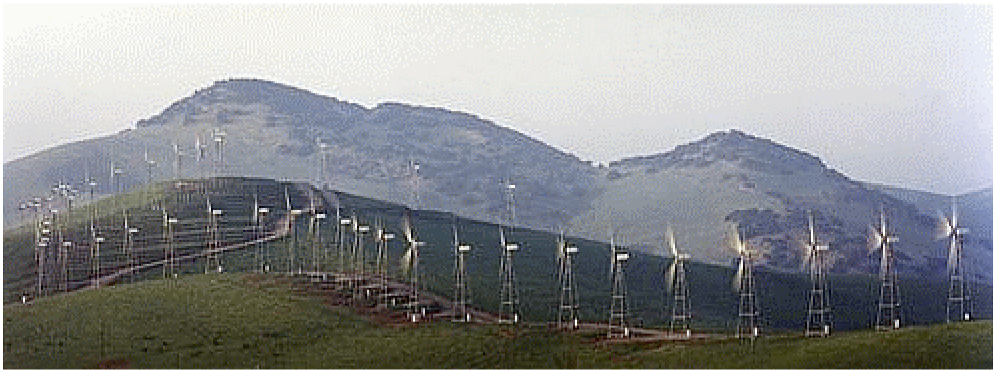
Like in the solar energy GIS support, we can benefit from numerical modelling techniques (3-D digital terrain modelling) coupled with meteorological expertise & field measurements (data capturing from anemometers– remote sensing data for wind resource monitoring).



<fig. – A wind map>

A three-dimensional terrain model of a large area – associated with a special-focused statistical analysis regarding several key parameters of wind blowing (supplied by a long time monitoring from some meteorological/specific measuring points), providing basic winding aspects (such as average wind directions and speeds) – can help to search locations suitable for wind farms (aeolian generators).

<fig. – Wind farm>



In the same approach of considering the weather as being a resource, meaningful studies can be done – with certain GIS technologies – on the sunlight (flux, brightness, mean daylight duration, typicalness of the clouds-shading, etc), very useful for planning, designing and exploiting/managing solar energy applications (solar thermal collectors; photo-voltaics; sunlight traps for building illumination; etc). Such geo-spatial studies not only help to find suitable locations for wind/solar capturing sites, but furthermore they can assist the specialists (engineers, responsible people, managers) to choose the most efficient solutions (what type of generation principle or equipment is more suitable – e.g. high or low speed turbines; if a PV is more applicable than a solar heat transfer; path changes), to make strategic and tactic decisions concerning electrical power facility (distributing, grid-connection, exploitation, maintenance, optimizing, expanding).

Also, the strategic comparison of electricity production from several spatially-related resources can reveal choices and approaches for finding lasting solutions.

In addition, weather monitoring through GIS can be involved in decisions for operating and monitoring such energy facilities (load balancing, QoS assuring).

Many of the critical problems that our world faces – about air quality/pollution, water stresses, land uses, climate changes, deforestation, soil erosion, urban sanitation, etc – are specific energy related challenges. Geomatics can be used for monitoring relevant indicators regarding the environment (not necessarily directly linked to the energy sources, e.g. the bird population are very sensitive to changes affecting the environment, such as pollution, waste contamination, biomass large crops, etc; therefore this is considered as an appropriate indicator for environmental monitoring).

By using GIS in planning and deploying energy development projects, many and valuable key issues and indicators can be revealed, especially if the responsible people involve some expert features and continuously keep in “mind” a general sustainable development framework (economic, social and environmental) without forgetting the energy specific keys (efficiency, security, accessibility/acceptableness and cleanness). Do not forget that many planners see today the “GIS” as being the central nervous system of 21st century urbanization.

Many research efforts and investments have been allocated for wave and tidal energy development, which – along with solar and biomass energy – will play an important role in the future energy. Almost all these sources (along with the associated facilities for production, storing, distribution, controlling/managing) can benefit from geo-information techniques.

Some special GIS applications can assist the surveillance of the nuclear wastes stores, because such residues must be kept in specific locations, packaged and sealed.

Geo-informatics can also be engaged in demographically and geo-spatially monitoring of many aspects related to electrical energy consumption/usage (human activities, travelling, environmental risks, weather, utilities distribution, HVAC / heating, census, population densities, economical power, etc).

In order to support a durable development of electricity – and consequently to help the integration of the geo-informatics – some governmental/parliamentary support for geography education will be needed (a broad/high use of geo-informatics require efforts/skills). Also many national and international organizations have to deploy significant standardization efforts, concerning systems interoperability, data/information exchanging (ISO/TC211), Internet mapping (GML, XLM), data translators), metadata publishing, etc.

We have to accept, by synthetization, that GIS can really help us seek to ensure that economic and social developments are fully integrated with the protection of the natural environment and consequently with our health.

The future decision must be more carefully made, and the GIS technologies can help us to disclose, to represent, and to control many of the durable development related issues. This technology can play a key role in worrying about the environment and respecting the society, in raising awareness, shifting attitudes and behaviours.

3 EFFICIENCY AND CAREFULNESS IN ENERGY EXPLOITATION

For electricity companies it is often difficult to bring into agreement the necessity of making a profit with the social and environmental responsibilities. But a prime and affordable solution to find that approach between pragmatism and idealism is to improve efficiency.

Promoting energy efficiency more actively is firstly an economical/financial issue (and the competition pressure will improve the efficiency in electrical energy production), but also a main lever to satisfy the Kyoto agreement concerning CO_2 emissions reduction. An improved energy efficiency will lead the European countries to a more sustainable energy policy [EC, 1998].

The administrative organizations can follow several key criteria concerning electricity saving by using a geo-spatial information approach, at European, regional, national and community levels: for representing and monitoring the economic potential for energy efficiency (including marketing and demographic analysis); to reveal the successes and failures of the policies followed so far; to evaluate of the results; to publicly promote the energy efficiency and stimulate open discussions on a demographic base; to coordinate policies and subscribed actions.

The European Union has previously adopted a strategy which aims to reduce by 30% the average CO_2 emissions of new cars to 120g/km in 2005-2010 against the 1990 baseline, and a main measure – related to the electrical power – consists in leveraging the rail transport, which may benefit of GIS help in planning, developing and exploitation. Naturally, most of the measures from that strategy need IT applications/systems for traffic modeling/simulation and optimisation.

The European Commission consider that one of the most difficult institutional barriers in the electricity market is the practice of selling energy in the form of kWh instead of energy services such as heating and cooling, lighting and power [EC, 1998].

One of the easiest ways to save the planet is to become really cheap; practising energy conservation with every opportunity. And this concerns anyone of us, whether considered as an employee at work or as residing at home. A main energy conservation way consists in a continuous process of monitoring and evaluating the building and utilities use and the building construction (including educating home-owners on the importance of assessing the entire building envelope). New building construction (and renovations where applicable) will be designed to provide at least a 20 percent energy improvement where technically feasible and where payback is reasonable.

Raising awareness about the electricity consumed in "stand-by" regime by many household systems, which – accounted for a large community – can rise to a significant amount, is advisable.

In the purpose of leveraging efficiency at energy producing stage several particular measures can be engaged:

_ designing the turbine to be flexible enough to handle varying steam loads with a wide range of controlled and uncontrolled extraction pressures while maximizing electrical output;

_ using residual heat from the turbo-generator to heat a nearby industrial development;

_ facility which converts garbage into steam, during the incineration process, in order to provide this steam to a nearby small enterprise, or for a turbo-generator to create electricity (addressing nearby community needs).

Micro-turbines and small-scaled power plants may have higher unit costs, but they have the significant advantage of being more easily sited near loads/consumers than large power plants – thereby saving transmission and distribution losses (thus reducing dependence on energy capital).

4 ELECTRICAL ENERGY CHOICES FOR THE FUTURE

The use of energy has been and will be a key contributor to our comfort, safety, eating, health, travelling and education. It is foreseen that the world energy needs are going to double by the year 2050 [WEC, 2001]

On a hand, the world population growth (foreseeing a number of 10 billion people until 2050) will impose increasing nourishment and accommodation costs. In the following 20-50 years, the world must triple the energy efficiency, so it will be necessary to pass (or to avoid) technological barriers.

The reliable future, from this energy perspective, counts significantly on renewable energy, in spite of its actual lower "energy density". Conventional machinery used in electricity production (from thermo-electrical and nuclear plants) operates at extremely high pressure, temperature and velocity: the “energy density”, taken into account as expenses per unit of output, is cheap in comparison with that of the renewable energy.

It is known that the exploitation of the renewable energies – solar, wind, wave/tidal, water's thermal power – require large and expensive machinery. But, in a strategic approach (long-term planned and very well environmentally tuned), this obstacle can be, if not directly overpassed (by technological breakthroughs/advances), then at least positively assumed. It is about projects which will be conceived in tens of years, with a chance to be deployed and exploited when many key conditions and constrains will be others than now.

The regular course of increasing electrical energy demands, conditioned by the finiteness of fossil energy sources (coal, oil, natural gas, wood), will force us to find and deploy world-wide, regional and national energy policies and strategies, for many years to come. And the geo-informatics will play a key-role in conceiving, defining, monitoring and disseminating such strategies. There will be a world-wide planning, so all the involved people must know and assume the same information standards (concerning geo-data representation, world-scale resource monitoring, rules and policies, etc). The GIS will assist our future challenge to expand existing energy infrastructure (representing, searching, re-aggregating, revealing, monitoring, leveraging), but also for finding new solutions, mainly in the direction of renewable energy sources (to get the best and environmental-friendly solutions in capturing the power of wind, water and sun).

For instance, one of the oldest quasi-renewable power sources is the hydroelectric power, and in the future its ponder will probably rise, the only concern is that the new projects have to be conceived and deployed in more harmony with the natural environment. It is about many good sites for hydro-electrical power plants on large rivers in the developing countries, but also about the stress people must lay on micro-power-plants on small rivers (creeks or even brooks). If for those large hydroelectric plants, the IT&C materialised in GIS have great importance mainly at national/regional level (because the local management activities rather use the maintenance and telecommunication support and the real-time monitoring/controlling of the energy supplying parameters; SCADA), for the networks of micro-plants a surprising use of geo-spatial data applications (modeling hydrological networks, planning the water flow, charge balancing, assets management, disaster management) it might be possible. [Bădut, 2003]

It can be noticed that there is an inherent contradiction between the large-scale and high-intensive electricity sources (such as nuclear power) and the soft options of low-impact or renewable energy, because the former sustain a centralized electricity supplying and are based on increasing demands from consumers, while the latter promote a decentralized and moderate-scale model, based on lowering the consumption. [John Byrne, Tze-Luen Lin, 2000]

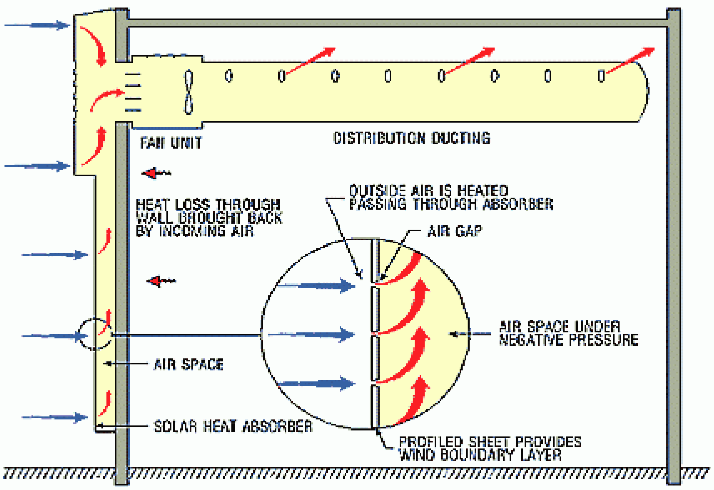
4.1 Enhancements in producing and consuming conventional electricity

Obviously, one of the key factors of sustainability consists in improving the efficiency of energy use and in saving it. It is known that nearly 35% of the energy we use is wasted by default in our cumulative uses (heating, cooking, cooling), and a similar percent is applicable to most of the electricity-based industrial processes. There is high potential for improving the ways in which we use the energy, and we have to acknowledge this and to find ways for it.

Also, the production of the electrical power must be subject to searching more efficient approaches: from the already-classical co-generation, the simultaneous production of electrical power and thermal energy, which lowers the cost of electricity and steam and reduce air pollutants, to non-traditional solutions such as small geo-thermal power plants producing power by conversing exhausted industrial heat, to micro-plants which recover the clinker cooler heat or the gas-turbines exhausted heat.

Several methods for measuring the energy efficiency can be conceived and applied, such as the “Best Practice Benchmarks” established by “World Energy Council” for electricity production and distribution [WEC, 2001]

For residential, commercial and industrial buildings we can apply a series of building improvements and upgrades that will reduce energy consumption (wall and roof envelopes; natural light traps). The governments/parliaments can release building regulations in order to largely adopt approaches of rational use of energy (for the building envelope as well as for heating, lighting, ventilation and



cooling) and for heat loss control (by designing solutions regarding house conception, walls, windows, etc).

<fig. – Two famous solar buildings: Bombardier and Windsor Housing>

<fig. – Light traps>

Subscribed under sustainable design strategies, a major issue is made by the reduction in energy costs/consumption, assumed at individual, local, municipal, regional, national levels (the latter proving geo-information modeling/analysing valences).

As it is the case for solar-thermal applications, the PhotoVoltaic systems are always associated with European Union's "Rational Use of Energy" measures in buildings and can be evaluated as part of the significant effort of reducing energy consumption.

We note that for an efficient electric lighting (private/public) the LED illumination is already a proved solution for low consumption. Also, photocell controls and occupancy sensors can be used in conjunction with electronic fluorescent dimming ballasts to save energy in the areas receiving daylight. Related to this, the RoHS directive recently legislated by the EU ("Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment") has mandated that, by July 1, 2006, the manufacturers must restrict the use of several classical electric materials (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominate diphenyl ethers) for environmental protection reasons. And such legislation will cause fundamental changes in electric industry. For instance, the high-brightness LED technologies (seen as a future alternative for public illumination) can benefit from this RoHS directive.

An advanced ventilation solution (especially HVAC for large building-sites/facilities), includes variable speed air-handling and pumping systems. This solution, which has been utilized extensively in Europe, features low-velocity air introduced at the floor level to efficiently condition the space and remove indoor air pollutants. Displacement ventilation uses the principles of buoyancy and thermal stratification to effectively condition and clean the air in a space.

But we will observe that there are situations when we can not reduce the electricity demands: for example, we all hopefully expect electrical vehicles, as an healthier alternative to fossil-fuel-based cars.

4.2 Renewable and low-impact energies

Mankind is already searching for environmentally-sustainable technologies, and we hope that in the future enough of the low-impact electricity solutions – harnessing solar power, wind power, biomass/biogas energy, hydropower, geothermal power, wave power, and converting them into electrical power (or also into other energy forms) – will be found viable for mass exploitation. Let us review these physical possibilities:

Solar energy - can be captured by several (almost-stated) technologies:

_ PhotoVoltaics (PV): directly convert the sun's energy into electricity using electronic devices. Having an annual global growth rate in sales over 25%, the PV technology provides operational cost savings in many on- and off-grid applications. Often, such local installations require backup power systems.

_ Solar thermal: converts solar energy into thermal energy for water/air heating. Applications include solar water heating systems as well as solar walls for large-scale space heating.

_ Passive solar: uses building design techniques to capture and store the sun's energy for temperature regulation and for illumination into residential and commercial buildings.

Wind energy - is captured by wind-turbines and converted into electricity. It is the fastest growing form of energy in the world and has achieved by now compelling cost reductions. The most versatile aeoliane generators are "wind-seeker turbines" (automatically catching the best orientation by the wind blowing). The wind turbines come in all sizes and many European manufacturers are now building individual wind turbines big enough to provide the electricity for more than 500 residencies.

Earth energy - stored below the earth surface (few meters, or into deep), this free energy can be retrieved using a ground-source heat pump, and then can be delivered as hot air/water for houses or stores. The process can also be reversed for air-conditioning.

No-dam hydro – the natural flowing of river/creek spins a generator which will convert the water movement into electricity, without building a dam to store water specifically for this purpose. Micro- and mini-hydro technologies are often suitable for smaller-scale generation in rural or remote locations (off-grid).

Tidal energy – it is about using special offshore developments or estuarine barrages to convert the wave/tide movement/power into electricity. A close-related application is trapping the energy of the ocean currents.

Biomass fuels - are produced from a variety of agricultural crops as well as from wood and agricultural wastes. Ethanol is one example of a biomass fuel that is already commonly used as a gasoline additive. Also the “bio-diesel” (oil-seed rape) is used as automotive fuel (and the miscanthus is becoming strategic crops in developed countries). Fuel cells, although they are not a renewable resource in themselves, have the potential to deliver versatile low-impact electricity in combination with renewable resources.

Ocean thermal – capturing the heat of the ocean water.

These resources can replace fossil fuels in a variety of areas, including electricity and building climatization and water heating.

In the last years several researches were deployed and even implementations based on alternative fuels (hydrogen, methanol, ethanol, bio-gas, vegetable-oil) were achieved, and this will be a hopeful direction for future. Until now, the energy supplied by some of these (such electrolysis hydrogen, ethanol) is less than the effort required to produce them. But even so there still remains the potential advantage of low pollution. Perhaps in future it will be easier to reduce the producing costs of such fuels than to reduce the pollution of the fossil fuels. Also, in a (closer or further) future the “energy density” criterion could fall from its top position in developing strategies.

Because the national/local governments and many international agencies have to formulate and implement economical, legislative and administrative frameworks concerning durable energy [WEC, 2001], these organizations have consequently to control various geo-spatial aspects, therefore they must learn to use GIS for supporting such tasks. The increasing accessibility (as graphical-user interface, and also as implementation architecture – which are obvious trends) already helps organizations to largely assimilate GIS technologies.

Decisions regarding *electrical energy:*

_ strategic *(developing energy production enterprises; researching new electricity production technologies; planning long-term consumption);*

_ tactical *(day-by-day behaviour – small ordinary decisions – concerning energy consumption and/or energy savings/economy.*

The GIS facilities involvable in the research over sustainable electrical energy can help us in creating low-energy architectures for appliances and especially for industrial/manufacturing enterprises, and in increasing efficiency and reducing waste too.

But the geo-informatics can also help us to manage negative side-effects of energy exploitation (as a first step into negative-effect mitigation):

_ representing and monitoring the main environmental impacts (related to each location and energy type);

_ assisting in moving the pollution from a populated to an unpopulated area;

_ revealing and monitoring other side-effects: chemical waste, electromagnetic perturbations, sonic disturbance, landscape and soil degradation;

_ observing the climate changes (mainly caused by population pressures and energy demands);

_ supporting calamity crisis management.

The greenhouse effect and atmospheric pollution are caused by carbon oxides, sulphur dioxide and nitrogen emissions released into the atmosphere.

Greenhouse gas (GHG) emissions cause the global climate warming and the sea levels rising.

The principal greenhouse gases (GHGs) are: carbon dioxide (CO_2 - 60%), methane (CH_4 - 22%), ozone (O_3), nitrous oxide (N_2O - 5%), sulphur dioxide (SO_2) and chlorofluorocarbons (CFCs). Among these, CO_2 (emitted by fossil fuels burning) is the most significant by volume.

The biggest solar power plant: Goettelborn, Germany; estimated costs: 50 million Euro; City Solar AG; 50000 solar panels; production: 7 MWh per year.

For people familiarized with geo-information it is easy to imagine how a GIS application – which naturally handles key information about the studied areas and their water, wind, solar and tidal resources, aggregating them in specific and focused analysis – can be useful in establishing the most suitable locations for electricity project development. Beside the initial identification of possible renewable energy project sites with significant development potential, such applications can consider, reveal, or monitor other issues too. Therefore, a strategic model/concept, assisted by GIS, can engage (and crossbreed) secondary or even adverse aspects: environmental constraints, economical or demographical requirements. Identifying the most promising project locations can consequently rely on factors such as resource intensity, land availability, environmental constraints, utility interconnection, zoning, public acceptance.

A broader approach is necessary for the success of an electricity development, because for most renewable energy technologies a sufficient resource theoretically exists in many locations, but there other issues will be the determining factor in identifying projects with development potential. Furthermore, these other issues (e.g., public acceptance, land availability/ownership, utility grid size) are subject to change over time, so the geo-spatial model should include a time coordinate, enabling a long-term deployment. For example, future developments in the studied area may either enhance or decrease the opportunities for renewable energy projects (power grid expansion/diminishing; network load re-balancing; changes in land uses due to urban expansion or to conversion for tourism or agriculture).

For large energy sites (such as wind-turbine farms), the GIS application can be used to capture, monitor, collect, and analyze long-term data about the power resource, even after the beginning of exploitation. The data-mining and analysis results can help the managers to operate changes in the electricity producing/providing way, and even to make strategical decisions regarding the expansion of the business model (DSS).

The potential development can also become affected by factors such as changes in the operating characteristics of the grid utilities, incorporation of energy storage, widespread use of electric vehicles, or districts interconnection.

The land-intensive energy projects are difficult to site in other areas than those used for agricultural purposes. Most of the biomass energy crop projects assume replacement of existing crops with an energy crop. A number of the wind and solar project sites also displace existing agricultural land uses.

The public acceptance of energy projects is difficult to quantify and it is subject to change. As these technologies become more common, public perception of their use, particularly in terms of visual impact, is likely to change. [RLA Consulting, 1995]

From a geographical point of view, we can observe that the renewable energy sources are indigenous (often having rural roots), and, as a result, they can contribute to reducing dependence on electricity transports (or even imports), and therefore increasing security of supply.

Preparing for the “Third Conference of the Parties to the United Nations Framework Convention on Climate Change”, Kyoto, December 1997 (five years after the Rio Conference), the European Union adopted a negotiating position of a 15% greenhouse gas emissions reduction target for industrialised countries by the year 2010 from the 1990 level. Then the European Parliament proposed a goal of a 15% share of renewables for the European Union by the year 2010, and it calls on the European Commission to submit specific measures to facilitate the large-scale use of renewable energy sources. A significant part of this common program consists in including a further 1,000,000 photo-voltaic roofs, 15,000 MW of wind and 1,000 MW of biomass energy. [EC, 1997]

A strategy for promoting the renewables requires many initiatives circumscribing a wide range of policies: energy, environment, employment, taxation, competition, research, technological development, agriculture, regional and external relations policies. The European Council resolution stated that such a comprehensive strategy should be based on certain key priorities: harmonisation of standards concerning renewables; appropriate regulatory measures to stimulate the market; investment aid in appropriate cases; dissemination of information to increase market confidence with specific actions to increase customer choice. [EC, 1997] The Committee on Agriculture and Rural Development of the European Parliament has also issued an opinion in which it considers that the contribution of biomass-derived energy to the primary energy mix could reach 10% by 2010. But this objective – which was a pre-Kyoto scenario – will be perhaps re-estimated, as a result of the 2004 massive enlargement of the Union.

In spite of the fact that some technologies – in particular biomass, small hydro and wind – are currently economically viable, and even competitive in comparison with other decentralised applications, a serious obstacle to greater use of certain renewables still exists: a higher initial investment cost as compared with conventional energy cycles.

The main contribution of RES (Renewable Energy Source) growth in the European Union (90 Mtoe) could come from biomass, tripling the current level of this source. Wind energy, with a contribution of 40 GW is likely to have the second most important increase. Significant increases in the solar thermal collectors (with a contribution of 100 million m2 installed by 2010) are also foreseen. Smaller contributions are expected from photo-voltaics (3 GWp), geothermal energy (1 GWe and 2.5 GWth) and heat pumps (2.5 GWth). Hydro-power will probably remain the second most important renewable source, but with a relatively small future increase (13 GW), keeping its overall contribution at today’s level. (The current share of renewables in the energy mix of approximately 6% including large-scale hydro, for which the potential for further exploitation, for environmental reasons, is very limited.) Finally, passive solar could have a major contribution in reducing the climatization energy demand in buildings. [EC, 1997]

The 96/92/EC Directive of the European Parliament and of the Council of 19 December 1996 (concerning common rules for the internal market in electricity), in Article 8(3), permits electricity from renewable sources to be given preference in dispatching. In that order, the transmission system operators should accept renewable electricity when offered to them, and the regulatory institution will issue guidances concerning the price to be paid to a generator from renewable sources, which should at least be equal to the avoided cost of electricity on a low voltage grid of a distributor plus a premium reflecting the renewables’ social and environmental benefits and the manner in which it is financed. [EC, 1997] This kind of strategy stresses that the environmental benefits of renewable energies justify favourable financing conditions. There is a variety of actions – whether of a fiscal, financial, legal or other nature – addressed to facilitate the penetration of the technologies into the market, and most of them have a geo-spatial nature, thus being able to benefit from GIS support in conceiving, deploying and monitoring.

TYPE OF ENERGY	EU SHARE IN 1995	EU SHARE BY 2010
1. Wind	2.5 GW	40 GW
2. Hydro	92 GW	105 GW
2.a. Large	(82.5 GW)	(91 GW)
2.b. Small	(9.5 GW)	(14 GW)
3. Photovoltaics	0.03 GWp	3 GWp
4. Biomass	44.8 Mtoe*	135 Mtoe
5. Geothermal		
5.a. Electric	0.5 GW	1 GW
5.b. Heat (incl. heat pumps)	1.3 GWth	5 GWth
6. Solar Thermal Collectors	6,5 Million m^2	100 Million m^2
7. Passive Solar		35 Mtoe
8. Others		1 GW

(* Mtoe - Million Tons of Oil Equivalent)

In Europe, where the electricity grid is omnipresent, a large part of the future PhotoVoltaics market will be associated with building applications. The “500,000 PV roof and façade” campaign of the European Union will represent, on the basis of 1kW generators, a total capacity of 500 MWp. The EU campaign should incorporate specific actions such as: promotion of photo-voltaics in schools and other public buildings; incentives for photo-voltaics applications in tourism, in sports and recreational facilities; etc. [EC, 1997] The above assumptions of contributing with 3 GWp installed capacity from photo-voltaics by 2010 would be mainly accounted for by grid-connected installations incorporated into the structure of buildings as well as a certain number of large-scale power plants (0.5-5.0 MWp).

The estimated contribution of 40 GW wind power in the RES (Renewable Energy Source) development by 2010 for the EU is realistic given the strength of the trends. An enormous potential is found in offshore wind farms, which have the advantage of higher wind speeds, although access is clearly more difficult.

<fig. – An offshore wind farm>

The electricity providers have to prepare themselves (by investing in research and development) for a market in which perhaps the renewable energy will provide 5%-10% of the world’s energy supply by 2020 and 50% by 2050.

Quasi-totality of the renewable and low-impact electricity sources are somehow related to terrain or to other geography, thus the geo-spatial feature of their implementation and exploitation is obvious.

Projected electricity production by RES (Renewable Energy Source) (in tWh) for 2010 [EC, 1997]:

	PROJECTED FOR 2010	
TYPE OF ENERGY	**TWh**	**% of total**
Total	2,870 (Pre-Kyoto)	
1. Wind	80	2.8 %
2. Total Hydro	355	12.4 %
2.a. Large	(300)	
2.b. Small	(55)	
3. Photo-voltaics	3	0.1 %
4. Biomass	230	8.0 %
5. Geothermal	7	0.2 %
2 TOTAL RENEWABLE ENERGIES	675	23.5 %

During the implementation of this strategy there is a need for a constant monitoring – emphasizing geo-spatial criteria at continental, zonal, national, regional, local levels – in order to follow closely the progress achieved in terms of penetration of RES (12-15% by 2010), and to ensure and improve co-ordination of programs and policies under the responsibilities of the Community and the Member States. [EC, 1997]

4.3 Energy future in the socio-political space

The main goals of sustainable design are mitigation of the natural areas destruction, of air and water pollution and solid waste, reducing the depletion of finite resources. Thus, a healthier and safer environment.

In several European developed countries the government legislation requires that in a relatively short time (i.e. 2010) a significant percent (5-15%) of the whole electrical energy supply come from renewable sources. (In Europe, where wind resources are not rich, wind energy already serves the domestic electricity needs of more than 5 million people.)

Also, for developing- or poor-countries a reliable and affordable access to modern energy services can play the role of an indicator of sustainable development. [WEC, 2001]

It is worth mentioning the “Energy Sustainability Gauge” project of the “International Institute for Sustainable Development” [TERI & IISD, 2003], which is an Internet-based analysis and communications tool designed to help governments and the public study the community’s progress towards economic, social and environmental sustainable development, and it was successfully used for Canada and India (1998-2002) along with other effective measures (see also http://www.iisd.org). The “Energy Sustainability Gauge” tool assists in answering the following questions:

1. Which are the pertinent indicators of sustainable energy development for a country?

2. How is society progressing towards sustainability in a specific area as defined by an indicator?

3. Is the national government implementing a mix of policy instruments to address the issue? (taxes, laws, incentives, etc).

<fig. - “Energy Sustainability Gauge” [http://www.iisd.org/energy/gauge.asp]>

The monitoring of progress toward sustainability is indispensable for making the concept of sustainable development operational. It helps decision makers and the public define development objectives and targets, and assess progress made in meeting those targets. [TERI & IISD, 2003]

Let us review now several environmental policies and regulatory measures to encourage the development of renewable and low-impact electrical energy:

- market-wide incentives for stimulating low-impact and renewable electricity generation (measures to provide consumers with information in order to understand the impact of electricity generation, and to empower them to make smarter choices about how much and what type of electricity to consume; commitment of the administration institutions to acquire a portion of their electricity from renewable energy sources);
- removal of those taxes which can obstruct the renewable energy generation;
- leveraging the financing for low-impact and renewable technologies (encouraging the market by consumer/producer beneficial rebate and/or credit for “green power”);
- government guarantee preferred mortgage rates for citizens who choose to build “green standards” homes;
- low interest loans (or tax incentives) for residential energy efficient retrofits;
- access to financing and tax breaks for home-owners who invest in energy-efficient retrofits;
- “bi-directional net metering”: creating the technical, economical and juridical possibilities for giving credit to electricity consumers whenever their on-site generation from solar, micro-hydro or wind exceeds their electricity use, so in such cases the excess power they generate can be fed back to the electricity grid/network; etc.

Such measures – which can be seen as investment in future, or as prices paid for the future – have begun or are in process of implementing in countries like the U.S., the U.K., Japan, Germany, France and Canada. This kind of policies will have several great effects: significantly reduce greenhouse gas emissions; create thousands of new jobs; reduce health-care costs. But there is significant market/behaviour inertia favouring traditional electricity sources (like investor comfort, utility expertise, market structures, energy delivery infrastructure, house habitudes, etc). Thus, a lot of education and information about energy and our choices must be broadly supplied to the people. Also, the decision makers, potentially responsible with such policies/measures, can benefit from geo-information in conceiving and deploying such electricity incentives, to study many aspects of the geo-spatial situation.

We have to understand that pollution is often a result of inefficiency in energy production, and also to see the low-impact electricity enhancement as economic opportunities.

Another priority of the new sustainable energy paradigm must be removing the global inequalities associated with current energy arrangements.

Competition on electricity market, started mainly in the late 1980s, have changed the character of the gas and electricity business, and influenced the relationships between companies and customers. A notable effect was favouring the smaller-scale generation.

If the first energy policies, starting from the 1970s, responded mainly to concerns about security of supply and about satisfying the community demands (also arising the affordableness issues), later governmental policies encouraged energy conservation and efficiency. Now, they have new responsibilities: climate changes, and fostering a sustainable development.

A quarter century ago, a set of institutional reforms – privatisation of ownership, separating charges for energy services, introduction of competition into the generation sector – was seen as a global solution to the existing and potential problems of the electricity industry. People believed that this reform will more efficiently leverage this sector than regulated monopoly arrangements, and what also appeared was the presumption that “power liberalisation” will enhance environmental quality by driving out old technologies. Also, governing the electricity industry by market dynamics, rather than by socio-political considerations, promises to result in its more efficient operation. [John Byrne, Yu-Mi Mun, 2003]

But the energy reform raise several contradictions, too:

- economical contradictions – one spread result of power liberalisation consists in the concentration in ownership of electricity systems on a regional and global scale (creation of electricity oligarchies by mergers and acquisitions across national borders);
- environmental contradictions – because power liberalisation promotes an electricity system that is geared by short-term profits, a long-term public interest in sustainable alternatives can be neglected;

- political contradictions – the neo-liberal ideology, which places the individual above the socio-political choice, reduces the space for collective, deliberative decision-making;
- social contradictions – the population could experience price or quality discrimination (e.g., because the large energy consumers may negotiate low prices with competitive providers, domestic consumers can pay higher unit prices). [John Byrne, Yu-Mi Mun, 2003]

Another important issue is due to the fact that older, highly polluting power plants can have competitive advantages compared to newer modes of power generation because prices do not include environmental costs. This issue must be addressed by stronger environmental regulations, otherwise the liberalised electricity markets appear likely to add to environmental harm in the search for a cheaply priced electricity commodity. Also we can observe that regulatory measures needed for adequate supervision of market activities are more complex than those required under regulated monopoly regimes [John Byrne, Yu-Mi Mun, 2003].

When participation of all stakeholders – from government, business sectors, and from civil society – is institutionally supported and encouraged, then diverse concerns are discussed in an open and transparent manner, the needs and aims of society regarding electricity service can be better clarified, and the possibility of reaching social consensus can be advanced.

One of the side-effects of new energy approaches is that the energy services tend to become – from commodity services, sold/measured by the unit – services where the quality (including security and environmental-friendliness) is essential.

Modern information&communication technologies can empower the public and administrative willingness into revealing and choosing the renewable energy options available (in particular, identifying and managing geo-spatial conditionings may benefit from GIS technologies).

5 A SORT OF CONCLUSION

Mankind has to consider beyond people's short-term interest, anticipating environment facts, foreseeing durable paths.

From my point of view, I believe we firstly need a great amount of information about the energy future and about the approaches we can choose. Also maybe we need more determined / firm policies from the European institutions regarding both energy utilisation and future energy developments. Surely we need international debates about energy, first for formulating sustainable policies, and second to reconcile the economic, social and environmental hopes of the modern society.

And we have to continuously keep in mind the same two ways for preserving some future:

_ carefully promoting electricity usage and increasing the consumption efficiency (by consumer education and awareness);

_ developing durable energy sources (by developing new/only viable solutions for power production, and even by shutting-down old/disrupting plants).

Governmental and non-governmental organizations have to focus on the global-to-local long-term electricity demands and to implement coherent strategies to fulfil them, without forgeting about the planet's future.

Because there are already partisans of governmental/political regulation, and opposite are people who believe that the energy future will be assured only by the technological solutions, perhaps we have to find a right balance, between legislative constraints and technological innovation, a vivid combination of them.

6 BIBLIOGRAPHY

Bădut, M., "GIS: fundamente practice", Albastra Publishing House, Cluj-Napoca, 2004
Bădut, M., "Informatica in management", Albastra Publishing House, Cluj-Napoca, 2003
European Commission, "Energy Efficiency in the European Community. Towards a Strategy for the Rational Use of Energy: COM" report, COM(1998)246
European Commission, "Energy for the future: renewable sources of energy" white-paper, COM(1997)599
John Byrne, Yu-Mi Mun, "Rethinking reform in the electricity sector: Power liberalisation or energy transformation?", Center for Energy and Environmental Policy, University of Delaware, 2003
John Byrne, Tze-Luen Lin, "Beyond Pollution and Risk: Energy and Environmental Policy in the Greenhouse", University of Delaware, Proceedings of the International Conference on Sustainable Energy and Environmental Strategies, Taipei, Taiwan, 2000
Information System for Renewable Energy, http://wire.ises.org/
RLA Consulting, "Renewable Energy Assessment Plan"; Global Energy Concepts, Inc.; 1995
TERI & IISD (International Institute for Sustainable Development), "A Framework for Energy Sustainability Assessment" project-report, Canada, 2003
World Energy Council, "Living in One World", WEC, 2001
World Energy Council, "Energy for Tomorrow's World – Acting now!", WEC, 2000

* * *

Building Common Infrastructure for Dissemination of Real Estate Data in Slovenia

Jože SENEGAČNIK

(permanent associate of S&T Hermes-Plus d.d.,Ljubljana, Slovenia, email: joze.senegacnik@snt.si)

1 ABSTRACT

S&T Hermes-*Plus d.d., Slovenia, together with other partners is currently working on several ongoing projects concerning data dissemination. All projects have similar objectives and are encountering similar problems. This paper describes a logical model of the web based system for data dissemination used to support the dissemination process in the Slovenian government. This logical model was prepared in a preceding theoretical project and is a good entry point in preparation of physical implementation of data dissemination process in the surveying and mapping authority of the republic of Slovenia.*

2 LOGICAL MODEL OF THE DISSEMINATION PROCESS

The dissemination model is based on web services accessed through a unified portal. The logical concept contains one three levels:

The first level contains the entry point to all services. The second layer consists of one or several dissemination databases that provide all necessary data. The third level contains background system services which support security and system administration and support (like data transformation, recording of all data orders, payment system, etc....)

The end users perceive the dissemination system as one entry point – as a Spatial Portal. This portal contains links to different services of the portal (ordering, data browsing, data acquiring, general and special information, etc...). The same portal is used also for the internal governmental users. Figure 1 displays the logical structure of the spatial portal.

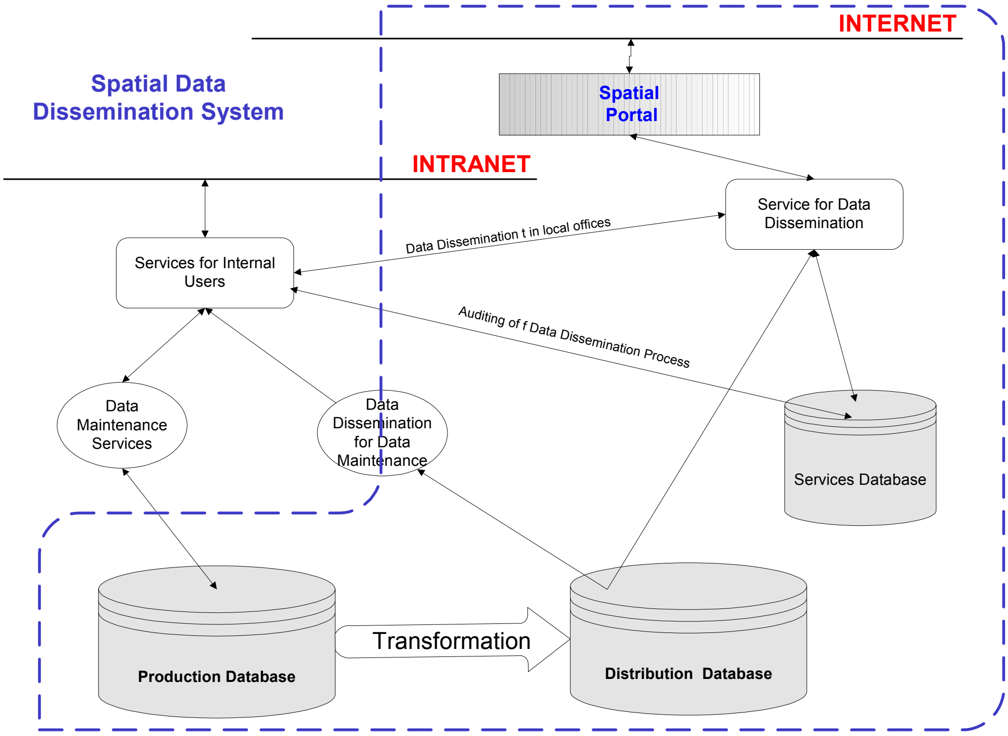


Figure 7: Logical Model for Dissemination of Spatial Data

3 THE KEY PROCESSES AND THEIR RELATIONS

From the above figure we can see the logical model of our system with the main data flows and processes. On the highest level the logical model is presented with the data flow diagram of the Spatial Portal that consists of:

- global system processes
- data warehouses
- data flows among data warehouses and processes

***Data sources* in the dissemination system are the following:**

1. *Dissemination database* – is the main data source of the dissemination system
2. *Production databases* – these databases are not a part of the dissemination system but are the main source of the data flow for new or updated data that are through transformation process entered in the dissemination system.
3. *The metadata database* - in this database we keep the metadata about our data records.

4. *The overview layers database* – in this database we keep additional metadata attributes at the level of data maintenance, all planned data maintenance or data acquisition activities and also the constraints about the minimum amount of data that can be acquired.
5. *The Statistics or Services database* – keeps all necessary data for overview and managing the dissemination process.
6. *The system database* – contains the system setup data and all other data used for controlling the dissemination process.
7. *The users database* – contains the data about the registered users, their attributes and rights that influence the data dissemination process and also the price of the service.
8. *The price list database* – keeps the records for different services and data types.

***Processes* in the Spatial Portal are the following:**

1. *Registration* - This process provides the authentication of portal users. All new users that want to access services with restricted access must first register and they are automatically redirected to the registration process.
2. *Data dissemination processes* - The main part of the system are the following processes for data dissemination:
    - data browsing services for browsing the spatial data, metadata, overview layers etc...
    - data ordering services,
    - special services
3. The non-registered users can access some of these services as well.
4. *Services for the internal users* - The Spatial Portal also provides the services for activities that are not directly related with the dissemination process but are part of the internal procedures of the data providers.
5. *Common e-governmental services* - The Spatial Portal is connected to the common e-governmental services in the process of:
    - User authentication
    - Electronic data interchange of ordered data with the digital signature
    - Billing and Payment system - This is a general service used for preparing the necessary documents for the billing process.
6. *Statistics* - The system keeps records about all necessary statistics about all accesses to the system and data requests.
7. *Auditing system* - The purpose of the auditing system is to keep the track off all accesses to the data especially to the data with defined attribute of privacy. According to the Slovenian legislation the personal data has a high degree of privacy and thus special procedures of providing privacy of this data are required.
8. *Data transformation* - Data transformation process is used for transformation of the production data into the dissemination data and properly updating all the overview layers and metadata database.
9. *Help system* - The purpose of the help system is in providing context and technical help to the end users.

Implementation of the data dissemination system

The whole dissemination system is implemented in web technology. The database system is ORACLE RDBMS that is a de-facto standard in the Slovenian governmental environment. There is a significant difference between the production and distribution data organization which can be expressed with the following:

The organization of *production database* supports:

- The normalized structure of all data types that is easy to maintain (update); each attribute appears only once; the de-normalized structure is an exception in the case of serious performance problems.
- All data changes are recorded in the history of changes. The audit record contains also the information by whom the change was performed.
- All business rules how to maintain data are implemented at the database level (triggers, database procedures) or are provided by the application code.
- In the application data browsing is supported for data maintenance function and not for the data dissemination process.

The organization of *dissemination database* supports:

- The data model is optimized for querying data regardless the point in time
- The number of business rules implemented in dissemination process is smaller then in production database.
- The data organization can be also optimized for supporting certain standard formats.
- For all personal data with certain degree of privacy special rules are in order. The user rights to access data are checked differently than in production systems.
- The process of de-normalization of production data is one the key success factors for successful dissemination model.

4 IMPLEMENTATION

The system was implemented in past two years in order to replicate the production data from Survey and Mapping Authority to the common distribution environment available for all governmental institutions and all other users. As already stated the distribution environment is optimized for data dissemination with the following goals:

- Good response time
- Data structure is optimized for data dissemination
- Two data sets: the current data (used mostly) and historical data

The data structures, which are used in the production environment, are de-normalized and optimized for the dissemination as we already stated. The history of changes on production database is de-normalized and kept differently in the distribution environment to enable simple and efficient querying of historical records.

Because the distribution system is de-normalized the regular procedures available for data replication are not suitable any more. Therefore a complete set of replication procedures was developed which in the first step replicate original data structures from production environment and then in the second step build de-normalized data for the current and historical state of the data. Currently there is only one refresh of the data performed per day during the nightly batch processing window. Although this is enough to fulfill almost all requirements a refresh on demand is also available and can be performed when required. Most of such urgent refreshing cases evolve in the time before the elections when the population register is intensively updated and the most recent data from Spatial Units Register are required to prepare the required material for local elections committees.

The security issues require that only the owner of the data has the right to update the distribution database. All procedures, which were implemented to support web services for data retrieval, are implemented in a separate schema, which has only read rights on the dissemination database.

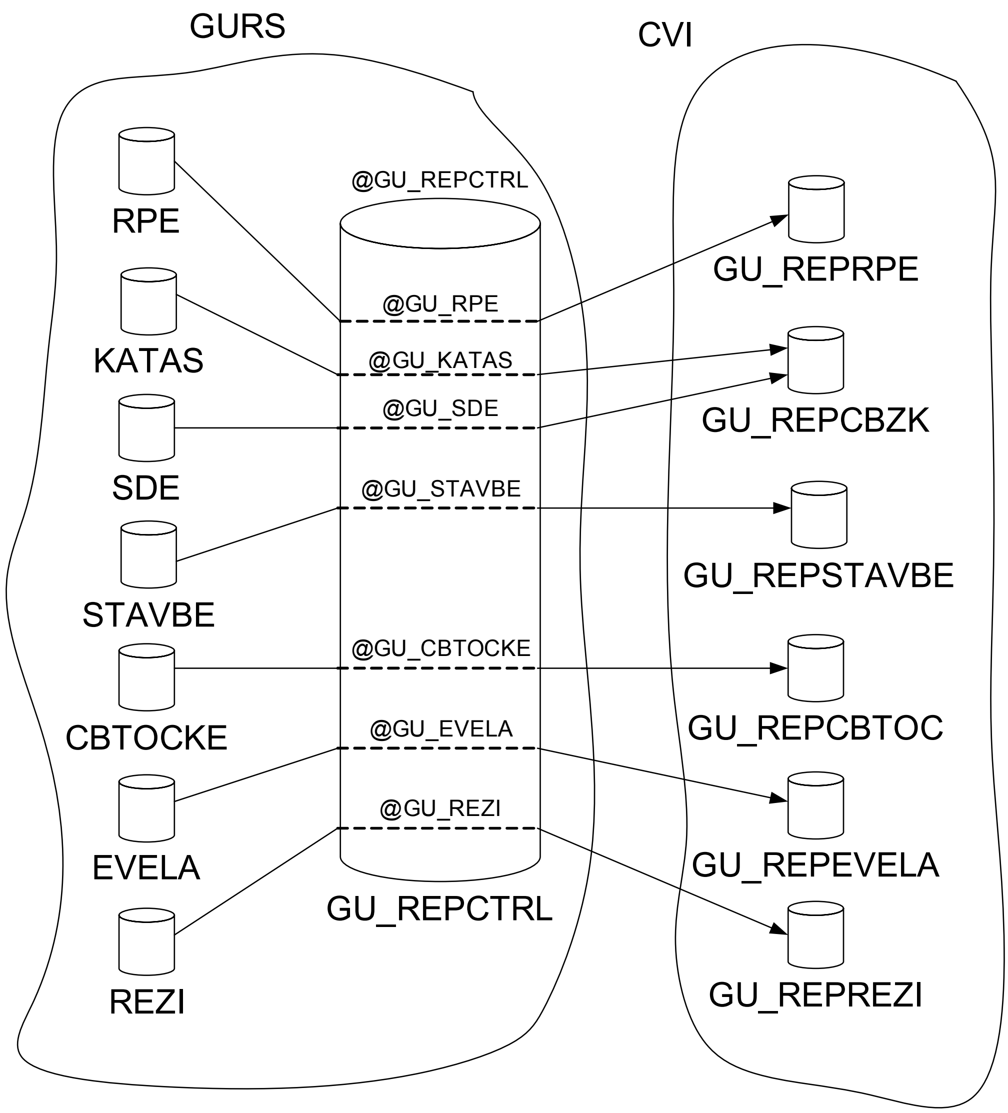


Figure 8: The logical model of replicated data - schemas

A special effort was made to fulfill the requirements to maintain and protect personal data according to the Slovenian legislation.

4.1 Replication of attribute data

All tables with the attribute data are replicated via Oracle replication mechanism using snapshots which enable incremental replication.

The graphical data in the production environment are stored in different formats due to historical reasons. Some of the systems were developed more than 10 years ago when there were no standards available yet and the developers used their proprietary data format.

During the planning phase for the common distribution environment a very important decision was made – to use Oracle spatial as a standard format for all graphical data. Therefore it was necessary to prepare the conversion routines to convert a variety of graphical data to Oracle spatial format.

Application System	**Data Format**
Registry of Spatial Units	Aster proprietary format
Registry of Geographical Names	Aster proprietary format
Central database of Geodetic Points	Aster proprietary format
Central database of Graphical Cadastre	ArcSDE
Central database of Buildings	ArcSDE

4.2 Existing graphical data formats

Aster d.o.o. in years 1993 and 1994 developed the Registry of Spatial Units which for the first time stored all graphical data in a relational database (Oracle). At that time there was no Oracle Spatial available and therefore a proprietary data format was developed that was capable to store point, line and polygon objects in classical relational tables. The graphical data model was highly optimized to minimize the required space for keeping the track of changes on different graphical objects. The same data structure was used later in several projects in Survey and Mapping Authority of the Republic of Slovenia.

The other data format used in some other application systems was ESRI's Arc SDE format.

The implementation of new distribution environment required a full implementation of conversion modules for the above data.

5 CONCLUSION

Suring last years Slovenia made a lot of efforts to provide more and more e-governmental services to the citizens and other subjects like companies. One of the fields where Slovenia was quite successful was also the distribution of spatial data.

The dissemination database is operational for last two years and is used for the distribution of the graphical and attribute data in the governmental environment. During the last months the whole hardware infrastructure both in production and distribution environment were upgraded. At the same time the database software was upgraded to Oracle10g as well.

As new GIS data will be collected and maintained at the state level more and more data will be available to all kind of users.

6 BIBLIOGRAPHY:

10. The Model and Implementation Plan of the Dissemination of the Geodetic Data - University of Maribor - Faculty for the electronics, Igea d.o.o. and Aster d.o.o, Ljubljana, 1991
11. Senegacnik, Joze: LOGICAL DATA MODEL FOR DISSEMINATION OF SPATIAL DATA, UN-ECE-WPLA-Workshop Vienna 2002

Implementation of the KOMPSAT European Regional Archive Supporting the OGC WebMap-, WebFeature-, and WebCoverageService as well as International Catalog Interoperability

S. MEISSL, C. SCHILLER, G. TRIEBNIG

(Austrian Research Centers - Seibersdorf research Ges.m.b.H. (ARC-sr), Intelligent Infrastructures and Space Applications Department, 2444 Seibersdorf, Austria; stephan.meissl@arcs.ac.at, christian.schiller@arcs.ac.at, gerhard.triebnig@arcs.ac.at)

1 ABSTRACT

The development of the KOMPSAT European Regional Archive (KERA) aims to demonstrate and prove an implementation concept for easy access to Earth Observation (EO) data. The basic results are (i) the offer of enhanced products based on the principles of a high degree of automation, (ii) an easy access to data and services, (iii) and the availability to both expert and non-expert users. This implementation was facilitated by the well established scientific and technological collaboration between the Korea Aerospace Research Institute (KARI) and the Austrian Research Centers - Seibersdorf research Ges.m.b.H. (ARC-sr), Intelligent Infrastructures and Space Applications Department.

The archive is intended to provide full and easy access to the EO data in an adequate time. Therefore, a database considering existing standards and specifications is designed for use in an Object-Relational Database Management System (ORDBMS). Access to the data is granted through Open Geospatial Consortium, Inc. (OGC) Web Services (OWS), namely WebMapService (WMS), WebFeatureService (WFS), and WebCoverageService (WCS).

There are several different access points to the data stored in KERA. One is implemented and located at ARC-sr. It acts as a client to the WMS, but has additional functionalities concerning the archive. Other access points are via the Service Support Environment (SSE)-Portal and the eoPortal, both hosted by the European Space Agency (ESA).

2 INTRODUCTION

With computers and Internet being more and more part of our everyday lives, the possibility to provide Earth Observation (EO) data to a greater audience has significantly grown. The development of the KOMPSAT European Regional Archive (KERA) aims to demonstrate and prove an implementation concept for easy access to data. Basic results are the offer of enhanced products based on principles of a high degree of automation, an easy access to data and services, and the availability to expert and non-expert users.

The data processed at the Austrian Research Centers - Seibersdorf research Ges.m.b.H.1 (ARC-sr), Intelligent Infrastructures and Space Applications Department are images derived from earth observation satellites. Currently nearly all data arrives from the first Korean Multi Purpose Satellite (KOMPSAT-1). The archive will be expanded by data from the future KOMPSAT-2 satellite. Both missions are developed and operated by the Korea Aerospace Research Institute2 (KARI). The development of KERA is possible due to a well established scientific and technological collaboration between KARI and ARC-sr [1].

The KOMPSAT-1 satellite collects high-resolution imagery at 6.6 m spatial resolution. The sensor, called Earth Observing Camera (EOC), delivers panchromatic images. The future KOMPSAT-2 platform with its very-high-resolution Multi-Spectral-Camera (MSC) will provide imagery with one panchromatic channel with a spatial resolution of 1 m and four multi-spectral channels with 4 m spatial resolution.

Considering the archive it is necessary to store all required data and metadata in an appropriate way. Hereby, an Object-Relational Database Management System (ORDBMS) is used. The design considering existing standards and specifications and some implementation details of this database are presented.

Additional developments for KERA are achieved by applying the Open Geospatial Consortium, Inc. (OGC) Web Services (OWS) WebMapService (WMS), WebFeatureService (WFS), and WebCoverageService (WCS). These standardized web services are used to access the data in various ways over the Internet.

Furthermore, different access points to the EO data stored in KERA are explained. The method implemented and located at ARC-sr is introduced as well as the access points via the Service Support Environment (SSE)-Portal and the eoPortal, both hosted by the European Space Agency (ESA).

3 METADATA CATALOG SERVICE

It is very important for every data warehouse to store metadata, mostly defined as "data about data". The biggest data collection is good-for-nothing if nobody knows which and how data is stored. The Internet and it's high availability offers the possibility to search the archive from all over the world at any time. It additionally offers the possibility to search more than one storage place at the same time. Many difficulties arise if two or more servers are queried at the same time. They need to "talk the same language" and therefore there is a big need for standardization on metadata storage and access.

The international standard on metadata [2] from the International Organization for Standardization's (ISO) Technical Committee ISO/TC 211 Geographic information/Geomatics3 is one of the attempts to solve this problem. At ARC-sr it is also important to take ESA's SSE ICD [3] into account to make the archive searchable and accessible via the SSE-Portal and the eoPortal.

All this geographic metadata needs to be stored somehow on the computer. The best way to do to this is to use a database and a Database Management System (DBMS). Nowadays, such systems are commonly used and have many advantages e.g. control of concurrent access by multiple users, prevention of data inconsistency, easier local and remote access, etc. At ARC-sr it was decided to use PostgreSQL4 as database management system because of various reasons. First, PostgreSQL can be extended with software

1URL: http://www.space-applications.at
2URL: http://www.kari.re.kr
3URL: http://www.isotc211.org
4URL: http://www.postgresql.org

like PostGIS5, which adds support for geographic objects to PostgreSQL. In effect, PostGIS "spatially enables" the PostgreSQL server. Second, PostGIS follows the "OpenGIS® Simple Features Specification for SQL" [4]. Third, PostgreSQL is an OpenSource Object-Relational Database Management System (ORDBMS).

4 GEOSPATIAL SEARCH

The most common search, dealing with satellite derived images, is the simple spatial search (e.g. Which images cover Vienna?, Which images are within Europe?). What has to be done to get the correct answers to these questions? First the outline of every image has to be stored as object in the database. The PostGIS object POLYGON is the appropriate data-type. The four corner coordinates of the image are stored in simple longitude/latitude coordinates using the World Geodetic System (WGS84).

All needed spatial functionality, like re-projection of objects, spatial search, etc., within the database is provided by PostGIS. The PostGIS function Intersects() determines if objects share common points or not. The function GeometryFromText() constructs geographic objects from a Well-Known Text (WKT) format [4] for use in PostGIS. Thus the following SQL-command retrieves whether the image given with the polygon is showing Vienna (given in the POINT object) or not:

```
SELECT Intersects(GeometryFromText('POLYGON((16.02063625 48.86594772,16.2
6286888 48.89667965,16.81641535 47.30641733,16.58351857 47.27637656,16.02 063625
48.86594772))',4326),GeometryFromText('POINT(16.37 48.2)',4326));
```

There are also some problems arising with the use of PostGIS. The first problem occurs from the fact that Earth is not flat. PostGIS assumes all objects to lie in a plain surface using the coordinates in a two dimensional Cartesian coordinate system. On the horizontal axis the longitude is measured and on the vertical axis the latitude. Longitude is defined to be in the interval lon: $-180° \leq lon \leq 180°$. What happens if a search crosses the line of ±180° longitude, which lies opposite the prime meridian? This line is mostly identical with the international date line, which reveals a new problem if the search is also considering date. The worst case is caused by the poles. If one of the poles is covered by the image everything gets much more complicated.

Fortunately, there is another extension to PostgreSQL to cope with these problems called pgSphere6, which provides spherical data types, functions, and operators. The only problem, or maybe another advantage, with pgSphere is that it takes the Earth curvature into account and thus there are some differences in the search outputs compared to PostGIS. A combination of PostGIS and pgSphere can perform all tasks required.

It depends on the application which extensions are best to be used. Currently at ARC-sr, just PostGIS is being used since there are only images of Europe and nearby countries to manage and therefore, no problems with the ±180° meridian and/or the poles arise.

5 DATABASE DESIGN

The logical schema of the database is best explained in a graph. Thus, the schema is shown using the class diagram of the Unified Modeling Language (UML) (Figure 1) as described by Kemper and Eickler [5]. UML is a non-proprietary, third generation modeling and specification language, used especially for object-oriented modeling.

The "main"-entity is shown in light orange and called "image_metadata". For every image at ARC-sr an entry in this table with primary key "ImageName", which is a string with a fixed count of 24 characters, e.g. "eoc06182_20010216T091614", is created. The name of this image tells, that it was captured at orbit number 06182 on February 16, 2001 starting at 9:16:14 Universal Time Coordinate (UTC) with KOMPSAT-1's EOC.

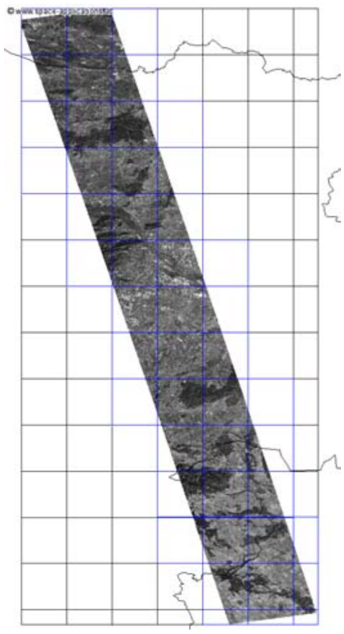


Figure 1: Tiling: Blue lines are outlines of tiles, black lines represent the full image.

The second basic entity is "process" which is a generalization of "raw", "geo", "ort", "wms", and possible future processes e.g. "urb". Generalization means, that the generalized entities inherit the superclass's, here "process" attributes. Every processing step done with an image gets logged here. "raw" implies the process of getting a new raw-image and storing it in the file system together with a browse image (quick-look) which needs to be generated and managed as well. "geo" describes the process of looking up geographic coordinates and assigning them to image-pixels. "ort" is the process of taking the points-files from the "geo" process, orthorectifying the image, and storing it in the file-system. "wms" (light-blue) finally is the process to prepare the image resulting of the "ort" process for usage within the OpenGIS® services. For easier, controlled, and advice providing content management an administration tool was developed at ARC-sr. This tool can be accessed with every standard web browser.

5URL: http://postgis.refractions.net
6URL: http://www.pgastro.org/cgi-bin/wiki.pl?pgSphere

6 THE WMS PROCESS

"wms" is the name of the process to prepare the image for the usage within the WebMap-, and WebCoverageService which will be introduced in the next section. A short response time is very important for these services. To increase speed and performance the large raster images are tiled into smaller pieces and shapes are created for their outline (Figure 2). These shapes are saved in the database. After the database has been searched for the required area (based on the outline vector shapes) just the actually required raster images have to be loaded and processed. The tiling has the additional advantage that only tiles that contain information need to be saved.

If the size of the tiles is given with 2048 *pixels* the image shown in Figure 2, which has a size of 13380 *x* 27240 *pixels*, is tiled into 7 *x* 14 = 98 *tiles*. Only 47, out of the 98 *tiles* created, need to be saved since the other contain no data.
The tiling process also generates so-called "overviews" which are images at half resolution in both dimensions, and therefore only a quarter in size of the original image. These overviews are also tiled and the process continues until the smaller image extent can be shown by one tile. For the image in Figure 2 the first overview has 4 *x* 7 *tiles*, the next one has 2 *x* 4 *tiles*, and the last one has 1 *x* 2 *tiles*. Because the tiles with no data are deleted only 71 *tiles* out of the 136 created are saved.
This tiling and building of overviews has turned out to be the fastest solution (for display on the web) among some alternatives (e.g. GeoTIFF with the built in tiling and overview options, compressions like JPEG) which were all tested at ARC-sr. It is also recommended to store the images in the most often used projection because reprojecting images on the fly is very time consuming.

7 WMS, WFS, AND WCS

This section explains which and how services can make use of the database. Especially the remote access via a network to these services is of interest. The Open Geospatial Consortium, Inc.7 (OGC) has specified several OpenGIS® web services like the WebMapService (WMS) [6], the WebFeatureService (WFS) [7], and the WebCoverageService (WCS) [8]. OGC is an international consortium of companies, agencies and universities. They define themselves as "a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services in different working groups". Through their member-driven consensus programs, they work together with government, private industry, and academia. Virtually all well-known providers of software for Geographic Information Systems (GIS) take part in the OGC.

A web service is defined as any software that makes itself available over the Internet and that supports interoperable machine-to-machine interaction over a network. Software applications written in various programming languages and running on various platforms use web services to exchange data over computer networks, e.g. the Internet, in a similar manner as inter-process communication on a single computer. This interoperability is possible due to the use of open standards, like those of OGC.

The WMS is one of OGC's most popular standards. This service produces maps, which are visual representations of georeferenced data. These maps are not the data itself. The specification defines the syntax of requests as well as the format and features of the result. The platform supported by the service is the World Wide Web (WWW) or more specifically Internet hosts implementing the Hypertext Transfer Protocol (HTTP), like every standard web browser.

A WFS publishes feature-level geospatial data to the web. This means that instead of returning an image, like a WMS does, the client directly obtains information about specific geospatial features of the underlying data, at both the geometric and the attributive levels. Finally, the WCS returns representation of space-varying phenomena like satellite images - i.e. it returns data with its original semantics (instead of pictures like the WMS) as coverages together with a detailed description. Coverages can be interpreted, extrapolated, etc. and not just portrayed like maps.

To implement the OGC Web Services (OWS) described so far the software MapServer8 is used at ARC-sr. MapServer was originally developed at the University of Minnesota (UMN), which is an associate member of the OGC. The choice to use MapServer was made because it is an OpenSource development, supports all required OWSs, and data input through PostGIS, which is used for the archive, is allowed.

The WCS can be used for data delivery. Following request will provide the image shown in Figure 2 in its original resolution, which will result in a GeoTIFF-format file with about: 350 MB.

```
http://spacey.arcs.ac.at/cgi-bin/wms?SERVICE=WCS&VERSION=1.0.0&REQUEST=Ge
tCoverage&COVERAGE=eoc06182_20010216t091614_scale1&CRS=EPSG:4326&RESX=0.00005925
26158445443&RESY=0.0000594823788546256&FORMAT=GeoTIFF
```

8 SERVICE INTEGRATION

This section covers the client side of KERA. The first access point to KERA is a WMS client implemented at ARC-sr. This client is implemented to show and extend the possibilities of the WMS. It is important that everybody is able to use the client with a standard web browser without having to install any software (i.e. plug-ins, applets, etc.). Therefore a mixture of JavaScript and PHP with MapServer's PHP/MapScript scripts was developed and implemented. The client implements standard GIS functionality as well as functions to search the archive and obtain metadata.

Other access points are via the Service Support Environment9 (SSE)-Portal and the eoPortal10, both hosted by the European Space Agency (ESA). For both, ESA provides a neutral infrastructure, capable to foster the seamless integration of Earth Observation (EO) archives, products and services.

7URL: http://www.opengeospatial.org
8URL: http://mapserver.gis.umn.edu
9URL: http://services.eoportal.org
10URL: http://catalogues.eoportal.org

The SSE acts as service broker, which registers published service providers under particular service categories. It also acts as search service provider, that allows users to search catalogs of connected data providers. Currently a service for searching the KERA catalog is implemented.

The eoPortal, also provided by ESA, is a non-brand portal providing an interface for space data providers to connect their catalogs. The KERA catalog at ARC-sr is now available as data collection and therefore searchable via the eoPortal catalog client.

Figure 3 shows the interaction between the individual parts of the implementation at ARC-sr including these access points. The system can be divided into four functional units. The first three units with light-blue background represent ARC-sr whereas the dark-orange one Korea Aerospace Research Institute (KARI). The first of the ARC-sr units (light-orange background) represents the access point via the SSE-Portal. The second one (blue background) includes all the WMS related components as well as the local client. The third one (green background) shows all parts required for the access via the eoPortal. Finally, the last unit on the right, actually a copy of the third one, represents the implementation at KARI which allows access to their international KOMPSAT archive also via the eoPortal.

9 CONCLUSION AND SCOPE

With the Internet being more and more part of our everyday lives, many barriers have already been removed and, assuming easy access, satellite images could be enjoyed by a greater audience. For example, in Europe the demand for easily accessible, online, very high resolution, geocoded information products is continuously increasing, driven by mass market applications which have cartographic data needs, e.g. car multimedia navigation systems and other navigation devices. To integrate satellite derived data in these devices, standards, like those of OGC, are required and will be used.

Additional many different web services exist focusing on EO data. Chaining these existing services will create various new services and products. The SSE-Portal provides the ability to chain existing services. Due to the integration of many different web services focused on EO into the same portal with respect to existing standards, the data dissemination will, hopefully, grow and a greater number of users will use EO data. Sometimes they will not even realize to which services their devices connect but sometimes they will develop services by themselves that possibly integrate other services.

The aim of the development of the KOMPSAT European Regional Archive (KERA) and its different access points is to offer enhanced products based on the principles of a high degree of automation, easy access to data and services, and availability to both expert and non-expert users. The proven concepts of the successful integration of the KERA into various systems namely WMS, SSE-Portal, and eoPortal provide the basis for further developments.

Making satellite data more accessible and reducing the necessity of investment in software and time to learn the handling, will improve the acceptance and increase the number of users. These improvements might additionally enlarge the various possibilities to use satellite data in miscellaneous applications.

10 REFERENCES

[1] Schiller C., Kressler F., Triebnig G., Kim Y., Meissl S., Moll B., and Maas H.: European Node of the Urban Application Center for KOMPSAT-1/2 derived products; In Manfred SCHRENK (Ed.), Proceedings of the CORP 2005 & Geomultimedia05 - 10th Int. Conf. on Information & Commun. Techn. (ICT) in Urban Planning and Spatial Development and Impacts of ICT on Physical Space (pp. 207-212); February 22-25, Vienna, Austria, 2005. Available at: http://mmp-tk1.kosnet.com/corp/archiv/papers/2005/CORP2005_SCHILLER_KRESSLER.pdf

[2] ISO/TC 211 Geographic information/Geomatics: Geographic information - Metadata (ISO/FDIS 19115:2003 E)); January 23, 2003. Available at: http://www.ncits.org/ref-docs/FDIS 19115.pdf

[3] Service Support Environment (SSE), Spacebel: MULTIAPPLICATION SUPPORT SERVICE SYSTEM ENVIRONMENT - INTERFACE CONTROL DOCUMENT (ME-ICD-0001-SPB, Issue: 1, Revision: 4); February 2, 2005. Available at: http://services.eoportal.org/massRef/documentation/icd.pdf

[4] Open Geospatial Consortium, Inc (OGC): OpenGIS® Simple Features Specification for SQL, Revision: 1.1. OpenGIS Project Document: 99-049; May 5, 1999. Available at: http://www.opengeospatial.org/docs/99-049.pdf

[5] Kemper A. and Eickler A.: Datenbanksysteme - Eine Einführung; München, Wien; R. Oldenbourg Verlag, Edition: 4, 2001

[6] Open Geospatial Consortium, Inc (OGC): Web Map Service Implementation Specification, Version: 1.1.1. OpenGIS® project document: OGC 01-068r3; January 16, 2002. Available at: http://www.opengeospatial.org/docs/01-068r3.pdf

[7] Open Geospatial Consortium, Inc (OGC): Web Feature Service Implementation Specification, Version: 1.0.0. OpenGIS® project document: OGC 02-058; September 19, 2002. Available at: http://www.opengeospatial.org/docs/02-058.pdf

[8] Open Geospatial Consortium, Inc (OGC): Web Coverage Service (WCS), Version 1.0.0. OpenGIS© project document: OGC 03-065r6; August 27, 2003. Available at: http://www.opengeospatial.org/docs/03-065r6.pdf

Spatial Information Systems for Supporting Strategies of TransEuropean Management of Cross-Border Protected Regions in Central Europe

Elmar CSAPLOVICS, Stefan WAGENKNECHT

(Prof.Dr. Elmar Csaplovics/Dipl.-Ing. Stefan Wagenknecht, Technische Universität Dresden, Institut für Photogrammetrie und Fernerkundung, Professur Fernerkundung, Helmholtzstr. 10, 01062 Dresden, csaplovi@rcs.urz.tu-dresden.de/Stefan.Wagenknecht@tu-dresden.de)

1 INTRODUCTION

Protected cross-border regions are more and more affected by economically driven planning and management strategies. There is thus an urgent need to develop, integrate and maintain spatial information systems especially for protected regions which are both highly vulnerable as well as extremely important in terms of preservation of natural heritage. Similar problems raise from the fact that regions of cultural and natural heritage are divided by frontiers into two ore more national parks, biosphere reserves, nature reserves or protected landscape areas in two or more countries with two or more administrative and management structures and - if existing - spatial information systems (SIS).

The project SISTEMaPARC (Spatial Information Systems for Transnational and Environmental Management of Protected Areas and Regions in CADSES [Central, Adriatic, Danubian and South-Eastern European Space]) within the EU INTERREG IIIB Programme aims to foster sustainable regional management and development of cross-border national park regions by improving or establishing geo-spatial information pools and TransEuropean exchange of communication concerning homogenised documentation, management and development of cross-border national park regions.

The project allows for initial activities bringing together research institutes, regional planning authorities and authorities of administration. Case studies are focussing on the cross-border nature protection regions Sächsisch-Böhmische Schweiz (DE/CZ), Neusiedler See-Seewinkel/Fertö-Hanság (AT/HU), Krkonose/Karkonosze (CZ/PL) and Triglav/Prealpi Giulie (SI/IT). The approach is open-ended in order to assure the successive integration of additional regions.

The homogenisation of geo-spatial and thematic references is a precondition for setting up and maintaining transnational networks of spatial information systems for management and long-term development of protected areas and regions. The project promotes the planning and establishment of ecologically sound spatial development strategies in the CADSES in general and – in close correspondence to the directives of international and European programmes such as IUCN-GreenBelt and EC-ESDP - of TransEuropean networks of ecological corridors particularly.

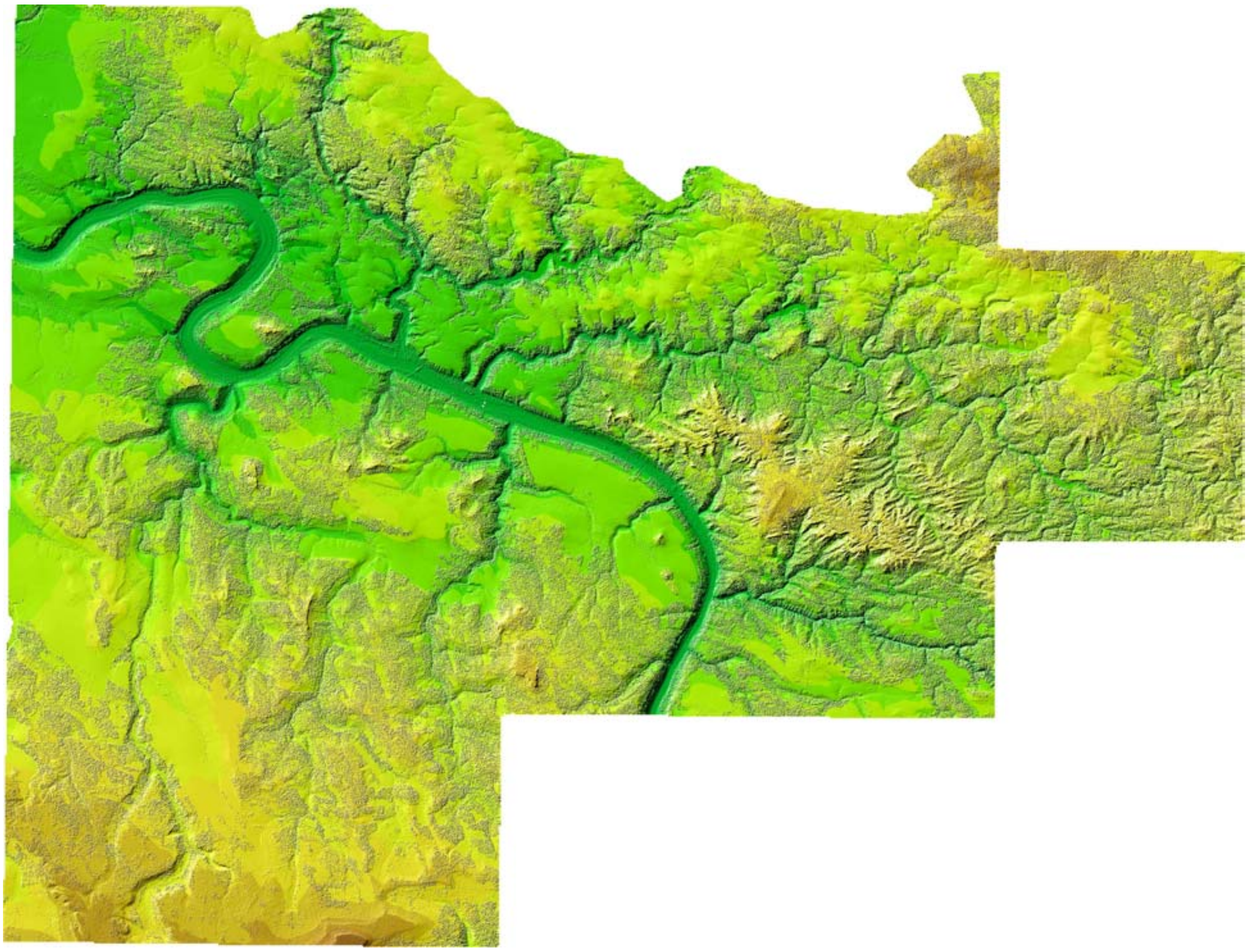
This paper exemplarily presents activities of continuous support of national park authorities and other regional actors with special regard to landscape management, tourism marketing and visitor guidance. A web-based platform for communication and exchange of geo-spatial information has been developed and implemented. It will support the establishment of structures for cooperation in and among specific regions in CADSES. Furthermore transnational exchange of experiences and know-how among cross-border national park regions in Central Europe is initiated. Monitoring and analysing the changes of land use patterns in time and space since the late 18th century supports the development of indicators which allow for comparative assessment of dynamics of impacts due to political and socio-economical changes during the last two centuries. Selected case studies interconnecting regional actors from Slovenia and Italy to Austria, Hungary, the Czech Republic, Germany and Poland in issues of spatial analysis and management by means of sophisticated geo-information networks are highlighted. A concluding remark refers to an outlook on the strategies for extension of geo-information networks and networking based on the project outcomes both in terms of integrating further regions in CADSES and Eastern Europe as well as in terms of enlarging the thematic scope of transnational spatial planning and management communication.

2 SPATIAL INFORMATION SYSTEMS IN NATIONAL PARK REGIONS

Spatial information systems are of striking importance for analysing and managing the dynamics of regional land cover and land use change (Walz et al., 2003). Protected regions have an important ecological value for preservation of biodiversity in environments dominated by different forms of human impact. Various national parks have been promoted during the last decades in the Central European Space (CES). On the one hand the official status of these national parks is very different and only few of them meet the IUCN criteria. On the other hand the specific national park regions differ in terms of geographical space and have to face different forms of impact caused by different parameters of pressure on the land. A lot of varieties of criteria, e.g. specific impact patterns, organisational constraints and methods of monitoring, managing and planning, have to be documented, analysed and harmonised.

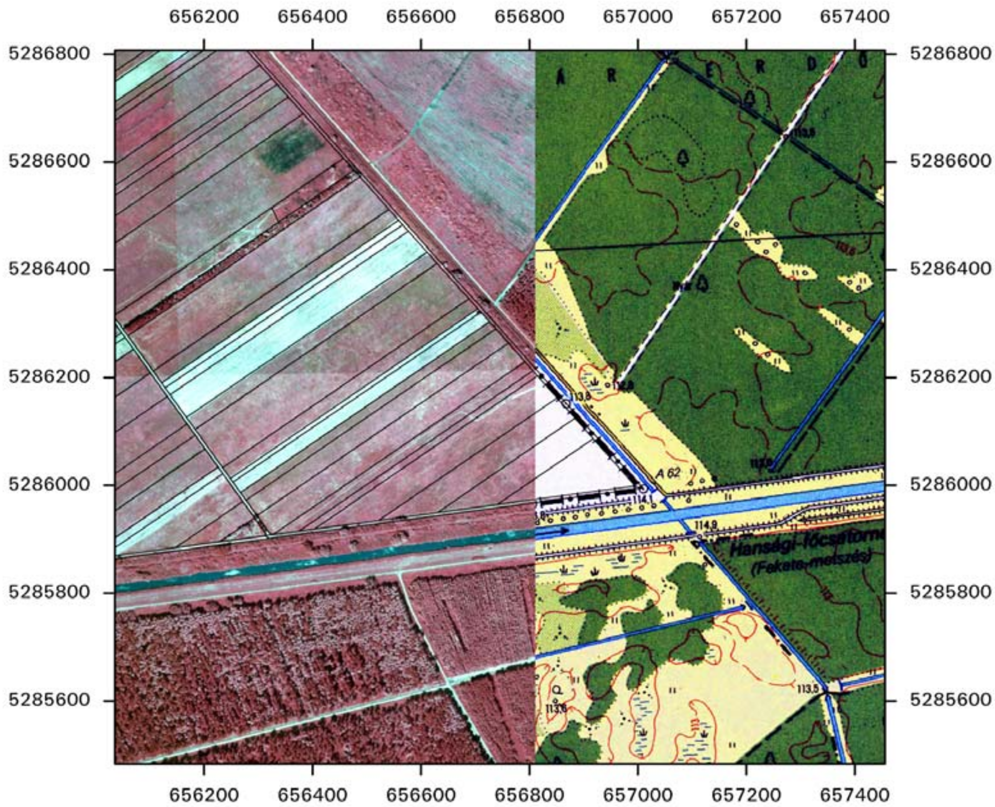
The project focuses on the development and implementation of spatial information systems for selected national park regions in order to analyse the socio-ecological and socio-economic status of the regions, to investigate on specific mosaics of impact patterns on a local and regional level, to improve national park management issues and finally to build networks of both cross-border and transnational cooperation.

The establishment of a representative data base both in terms of spatial as well as thematic qualities is supported by the interdisciplinary application of technologies such as remote sensing supporting land use and land cover change detection (LUCC) as well as landscape structural analysis, airborne laser altimetry for generating very high-resolution digital terrain and vegetation cover models and topographic information systems (see Graph 1), which allow for the calculation, maintenance, interpretation and presentation of digital terrain models (DTM), e.g. slope gradient models, slope aspect models and perspective views as well morphometric parameters (Csaplovics & Wagenknecht, 2000).



Graph 1: Color-Coded Digital Terrain Model of National Park Region Sächsisch-Böhmische Schweiz based on airborne laser scanner data (© IPF, TU Dresden)

The topo-chronological analysis of maps and plans for highlighting aspects of landscape transition in a retrospective time scale beginning with the late 18th century (regional maps) provides knowledge about the historical dimensions of landcover change (Walz et al., 2004). (Digital) cadastral maps support the large-scale level of investigations by allowing the synthesis of parameters of land use and protection status with information on ownership (see Graph 2). Advanced methods of terrain analysis like vegetation mapping, socio-economic and socio-ecological inventories have to establish a network of reference information.



Graph 2: Harmonisation of ortho-imagery and digital topographic cadastral map at the National Park Region Neusiedler See-Seewinkel/Fertö-Hanság (© I.P.F. TU Wien)

GISs are used for the integration of the whole bunch of heterogeneous hybrid data (remote sensing, maps, statistics, DTMs, sampling), for the homogenisation and maintenance, the analysis (multi-thematic analysis, e.g. for determining landscape structural parameters) and the presentation of data, as well as for multi-media data handling (virtual walks, integration of maps, videos and text).

Applying informatics helps to establish internet links between the national park information systems, to provide data transfer and exchange as well as networking, and to build facilities for storage of data and data products (e.g. CD-ROM).

In the frame of the presented EC-INTERREG IIIB project four specific regions have been selected for establishing a set of case studies. These regions are characterised by landscape units representative for the Central European Space. The cross-border National Park Region Sächsisch-Böhmische Schweiz (Czech Republic, Germany) is dominated by forests (93%) over hilltops and hillsides of basalt and granite and by the steep sandstone cliffs and gorges of the Cretaceous period. The National Park Neusiedler See - Seewinkel extends over a cultural landscape around the shallow steppe-lake Neusiedler See, its reed belt and around the areas east of the lake characterised by relic grasslands (puszta) and small shallow lakes with typical halophytic flora and fauna over quaternary sediments. In the Hungarian part of the lake the relics of the vaste lowland moor of the Hanság enlarge the variety of landscapes of natural heritage. The National Park Karkonosze/Krkonosze extends over a large forest region along the Polish-Czech border containing highly valuable cultural landscapes in valleys and Alpine grasslands above tree limit. The National Park Triglav together with the Nature Park Prealpi Giulie along the Slovenian-Italian border represents one of the oldest protected national park regions in Europe. Together with its surroundings the region represents a variety of patterns of high mountain rocky landscapes, of Alpine forests and pastures, thus of cultural landscapes from valleys up to the mountain pastures.

By selecting these four regions we intended to collect a maximum of heterogeneous spatial data representative for national park regions within the Central European Space (CES), a subspace of CADSES. This gives us the opportunity to utilise the heterogeneity of spatial data to develop a highly efficient method of building a network of communication and interaction by means of national park spatial information systems.

3 SPATIAL INFORMATION SYSTEMS FOR TRANSEUROPEAN MANAGEMENT OF NATIONAL PARK REGIONS

Spatial planning in and around protected regions needs spatial information systems capable to handle large data bases both geometrically and thematically. Issues for managing interaction between primary and secondary zones as well as surrounding areas of protected or non-protected landscapes have to be supported by GISs.

Multi-scale approaches to regionalisation in landscape ecology have to take into account micro-scale, meso-scale and macro-scale investigations. Like biotope networks in agricultural landscapes and networks of more or less protected areas at a regional scale the importance of transnational networks of national parks is increasingly recognised by national authorities.

Though EU agriculture policies partly are orientated towards a new perspective of intensive/extensive land use strategies, the diversity of landscapes is still diminuished by measures of land transformation which are driven by efforts to maximise productivity.

Especially the non-member and new-member countries in the EU have to face these impacts and have thus to be supported in protecting already protected and categorised regions or selecting regions which should be protected as soon as possible. Short-term acting and re-acting needs a high value of information support.

Actually national park authorities are building concepts for GIS-based spatial management in very different ways, with different motivations and with different progress. Monolithic approaches are common and thus only related to specific national parks. Bilateral concepts in the sense of connecting attempts to harmonise and standardise GISs on a cross-border level are rare. The cross-border links are thus of great importance and can serve as key initiatives for transnational cooperation in the CES. The chance to compare and harmonise two GIS concepts in a second degree level of transnational cooperation is set up by the North-South-transversal Polish-German-Czech-Austrian-Hungarian-Slovenian-Italian link.

We thus focus on the completion of inventories of national parks based on the different status of the four selected National Park GISs. By choosing the specific national park regions we meet several requirements of implementing GIS into spatial development strategies in and around protected regions by transnational cooperation in the Central European Space. On the one hand cross-border parks connect similar protected regions in old and new member countries, on the other hand the four cross-border regions cover an enormous variety of landscape units. Fortunately we can therefore handle a large heterogeneous spatial data base when building and harmonising GIS-based spatial development strategies for regional planning in and around national parks in Central Europe (Csaplovics et al., 2001).

National and transnational cross-border research on national park information systems is highly correlated to the tasks of the INTERREG programme. Interaction between activities at local and regional levels and the two fold transnational concept will highly increase the efficiency of building and linking spatial information systems.

Socio-economic and socio-ecological conditions are still different in member, new-member and non-member countries of CES. Protection of the environment in general and of national parks in particular is a common task with strong transnational components. The transnational cooperation opens a new dimension for operationalisation of cross-border spatial information systems of national parks. Existing transnational networks can thus be strengthened and established in terms of sustainable profit for both member and non-member partners. Category-1-classified border regions of member countries are additionally supported to protect and manage their regions of natural beauty and to increase the ecological but also economic (touristic) value of the regions when connecting cross-border national parks by homogenising management and planning strategies.

4 SPATIAL INFORMATION SYSTEM AS DRIVING FORCES FOR INNOVATION IN SPATIAL MANAGEMENT OF PROTECTED REGIONS

Innovation is achieved by linking cross-border national park management and planning issues by means of standardised spatial information systems. Recent communication technologies allow high-level data exchange of vector- and/or raster-based map and image data. Especially actual developments in facilitating GIS-data exchange, explicitly known under the terms OpenGIS and Interoperability, are integrated under web-based tools as the already invented GeoPortal. This gives way to a new quality of transnational on-line information support, which meets the requirements both driven by ecological aspects as well as by guidelines of regional and transnational planning (Csaplovics, 2005). On the one hand scientific and management demands can be supported efficiently, on the other hand data can be treated for presentation and thus for raising of people´s awareness by supporting multi-media tools for thematic and topographic 4D-visualisation of national park landscapes. People, who are more or less concerned, can thus be motivated to familiarise with problems, constraints and ecological and economic advantages of living in and around national parks and national park regions respectively. People on both sides of the borderlines can be motivated to meet, discuss and get used to re-define the regional identity, which has been spilled by the political transitions in the CES during the 20th century.

As a key result spatial information systems, which are - in the presented case - particularly developed for national park issues, can also serve as key systems for building transnational environmental information systems in the CES, later in the CADSES and the European Space. The two fold approach additionally serves as a guideline for not only managing connected transnational regions but also for linking the mosaic of CES-National Parks. The status quo of and the needs for the development of protection strategies can for the first time be evaluated in an objective sense both in terms of multi-thematic as well as spatial topographic (geometric) accuracies. Policies of west-east transnational spatial development strategies can thus be supported in a long-term sense.

5 OUTLOOK

It is evident, that spatial planning in local, regional and continental scales has to integrate environmental protection of spatially and thematically well-defined regions. In addition the quality (IUCN-criteria) and quantity (number) of protected areas is not satisfying the minimum multi-scale standard of ecological demands. Thus homogenised networks of spatial information systems covering national park regions as well as regions of other protected areas will be of highest value for codifying protection of additional areas on an European level of decision finding. The networks of spatial information systems of national park regions are based on a trans-sectoral approach both in terms of the collection, integration, maintenance and analysis of multi-thematic data as well as in terms of supporting multipurpose planning for a well-balanced and sustainable ecological and economic spatial development of transnational cross-border regions of outstanding natural and cultural value.

Following the criteria of the IUCN, national park administrations are obliged to provide local and regional multilevel management plans. The project SISTEMaPARC fosters the establishment of standardised levels of management plans for the specific national parks and national park regions, for their cross-border relatives and will thus develop a new perspective of adjusting and homogenising management of national park regions in CADSES in perfect correspondence with the transnational guidelines of the INTERREG programme and in file with actions on interconnecting green spaces in Europe by preserving and linking the threatened nature conservation regions under networks of green corridors or – more specifically – under the Green Belt initiative.

6 REFERENCES

CSAPLOVICS, E.: Grenzüberschreitende transnationale Kommunikationsplattformen und Managementsysteme zum Schutz des Naturerbes – das EU-Projekt SISTEMaPARC; Proc. Sommerakademie St. Marienthal, 2005 (to be published)

CSAPLOVICS, E., WAGENKNECHT, S.: High-resolution environmental monitoring of wooded mountainous regions supported by airborne laser scanning; Int Archives of Photogrammetry and Remote Sensing, vol XXXIII, part B7/1, Amsterdam, pp 1668 – 1673 (CD-ROM), 2000

CSAPLOVICS, E., KAUTZ, A., TROMMLER, M. & WAGENKNECHT, S.: Spatial Information Systems for National Park Regions in the Central European Space (CES) – Remote Sensing and GIS for Monitoring and Management; Symposium Space and Time, Sopron 2001

WALZ, U., LEIBENATH, M., CSAPLOVICS, E.: Der Aufwand lohnt sich – Erfahrungen mit grenzüberschreitenden Geoinformationssystemen in der Nationalparkregion Sächsisch-Böhmische Schweiz; GeoBit 7(8), S. 25-27, 2003

WALZ, U., WAGENKNECHT, S., CSAPLOVICS, E., LISKOWSKY, G., PRANGE, L.: Eignung von CORONA-Fernerkundungsdaten zur Analyse der Landschaftsentwicklung; PFG (8) 5/2004

🏆 reviewed paper

Applications of Fuzzy Logic in Geographic Information Systems for Multiple Criteria Decision Making

Almir KARABEGOVIC & Zikrija AVDAGIC & Mirza PONJAVIC

(MSc EE Almir Karabegovic, Gauss, Geo Information Systems, Stupine B9/6, Tuzla – Bosnia and Herzegovina, almir@gauss.ba)
(PhD Zikrija Avdagic, Faculty of Electrical Engineering, Department for Informatics and Computer Science, Zmaja od Bosne (Kampus), Sarajevo – Bosnia and Herzegovina, zikrija.avdagic@etf.unsa.ba)
(MSc EE Mirza Ponjavic, Gauss, Geo Information Systems, Stupine B9/6, Tuzla – Bosnia and Herzegovina, mirza@gauss.ba)

1 ABSTRACT

This work will present some of problems in making spatial analyses, study done as part of making Spatial Plan of Tuzla Canton. This procedure in classic GIS is very demanding in time and it is unsuitable for decision making in real time. Limitations of multi criteria analyses in standard GIS are necessity to define all steps in advance and inability to simple change criteria or thresholds later.

Here will be shown how incorporation of fuzzy set into GIS is improving system's level of intelligence and have useful implications for spatial data handling.

Contrary to classic method, where was everything done graphically, this methodology moves whole process to database side. This approach put time demand part in preparation of process and delaying defining criteria to time of creating queries. This makes possible doing such multiple criteria decision making in real-time. Also, very important issue is that results could be ordered according to its importance for decision makers.

2 INTRODUCTION

Geographic Information Systems (GIS) are computer based systems designed to support the capture, management, manipulation, analysis, modeling and display of spatially referenced data at different points in time. Today, GIS are widely used in many government business and private activities, which fall into three major categories:

socio-economic applications (urban and regional planning, cadastral registration, archaeology, natural resources)

environmental applications (forestry, fire and epidemic control) and

management applications (organization of pipeline networks and other services such as electricity and telephones, real-time navigation for vessels, planes and cars).

In these applications GIS provide decision makers with effective tools for solving the complex and usually not-at-all or semi-structured spatial problems.

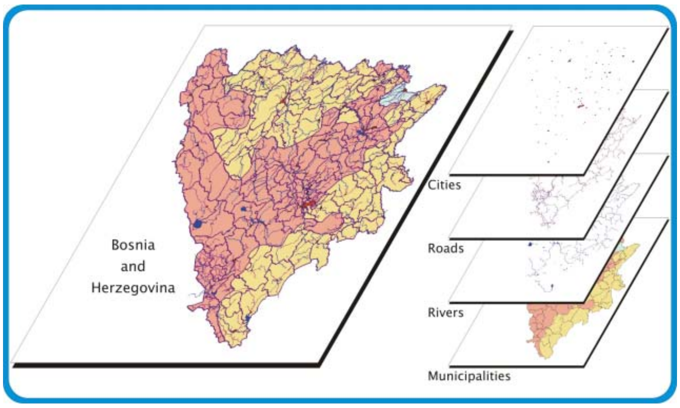


Figure 1: Map of Bosnia and Herzegovina made from layers

GIS contains various interrelated information for urban planners: cadastre maps, altitudes, urban plans, land use, economic development information, demographic information and various statistical analyses. GIS maps are layered, with each layer consisting of information related to the area contained in the map, such as spatial objects (roads, rivers, lakes, etc.), population distribution, land division, etc. Regarding spatial objects, the GIS contain a special feature that allows their illustration in either vector form or with abrupt fields (grid and raster).

GIS also has capability to show different kinds of objects (houses, lakes, plots of land) by using simple geometric forms to represent them: dots, lines and polygons. For example, polygons can be used to represent objects big enough to be shown with borders (lakes, parks, municipalities), lines can be used to draw linear objects such as rivers and roads, and dots are useful for illustrating small objects such as trees and other abutments.

The primary function of GIS includes: geoprocessing, 3D visualization, interoperability, cartography and infrastructure. GIS provides a mechanism for data integration, management and analysis, and generates concise reports on spatial environment. This tool assists planners and decision-makers with their urban analysis and planning.

One of the main benefits of GIS is improvements to the management of the organization and its resources by allowing for the sharing of data between various departments. A shared database allows one department to benefit from the work of another; data can be collected once and used many times.

GIS, at present, has several limitations which make them inefficient tools for decision-making. Biggest limitation is that current commercial systems are based on an inappropriate logical foundation. Current GIS are predominantly based on Boolean logic.

Fuzzy logic is an alternative logical foundation coming from artificial intelligence (AI) technology with several useful implications for spatial data handling. Contrary to traditional logic, fuzzy logic accommodates the imprecision in information, human cognition, perception and thought. This is more suitable for dealing with real world problems, because most human reasoning is imprecise.

Major advantage of this fuzzy logic theory is that it allows the natural description, in linguistic terms, of problems that should be solved rather than in terms of relationships between precise numerical values. This advantage, dealing with the complex systems in simple way, is the main reason why fuzzy logic theory is widely applied in technique.

Fuzzy logic appears to be instrumental in the design of efficient tools for spatial decision making. Fuzzy set theory is an extension of the classical set theory. A fuzzy set A is defined mathematically as follows:

IF X = {x} denotes a space of objects, THEN the fuzzy set A in X is the set of ordered pairs: $A = \{x, \mu A(x)\}$, $x \in X$,

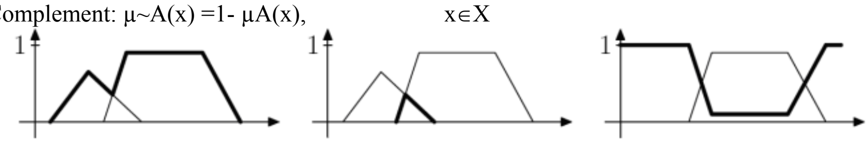
where the membership function $\mu A(x)$ is known as the "degree of membership (d.o.m.) of x in A". Usually, $\mu A(x)$ is a real number in the range [0, 1], where 0 indicates no-membership and 1 indicates full membership. Here $\mu A(x)$ of x in A specifies the extent to which x can be regarded as belonging to set A.

Operations of fuzzy set theory provide the counterpart operations to those of classical set theory. Logical operations with fuzzy sets are more generalized forms of usual Boolean algebra applied to observations that have partial membership of more than one set. The standard operations of union, intersection, and complement of fuzzy sets A and B, defined in domain X, create a new fuzzy set whose membership function is defined as:

Union: $\mu A\ B(x) = \max\{\mu A(x), \mu B(x)\},\ x \in X$ (1)

Intersection: $\mu A\ B(x) = \min\{\mu A(x), \mu B(x)\},\ x \in X$ (2)

Complement: $\mu{\sim}A(x) = 1 - \mu A(x),\quad x \in X$ (3)



union intersection complement

Figure 2: Standard fuzzy operations

Considering the classification of individual locations on a layer based on the slope values with linguistic values [level, gentle, moderate, steep] and a second classification based on the land moisture with linguistic values: [dry, moderate, wet, water].

For each individual location l (e.g., d.o.m. for level = 0.8 and d.o.m. for dry = 0.4) the d.o.m. value which provides an overall measure regarding:

level ground and dry land is derived by: min{μlevel(l),μdry(l)}, (e.g., min{0.8,0.4}=0.4);

level ground or dry land is derived by: max{μlevel(l),μdry(l)},(e.g., max{0.8,0.4}=0.8); and

non-level ground is derived by: 1-μlevel(l), (e.g., 1-0.8=0.2).

3 LIMITATIONS OF GIS

Uncertainty in GIS means the imperfect and inexact information. The uncertainty is an inherent feature of geographic data. Currently used methods for the representation and analysis of geographic information are inadequate, because they do not tolerate uncertainty. This is mostly due to the applied membership concept of the classical set theory, where a set has precisely defined boundaries and an element has either full or no membership in the set (Boolean logic).

The representation of geographic data based on the classical set theory affects on reasoning and analysis procedures, adding in all problems of an "early and precisely classification". Final decision is made after steps which drastically reduce the intermediate results. Any constraint is accompanied with an absolute threshold value and no exception is allowed. For instance, if the threshold for a flat land is slope = 10%, a location with slope equal to 9.9% is characterized as level, while a second location with slope equal to 10.1% is characterized as non-level (steep). Moreover, for decisions based on multiple criteria, it is usually the case that an entity (i.e., an individual location), which satisfies quite well the majority of constraints and is marginally rejected in one of them, to be selected as valid by decision-makers.

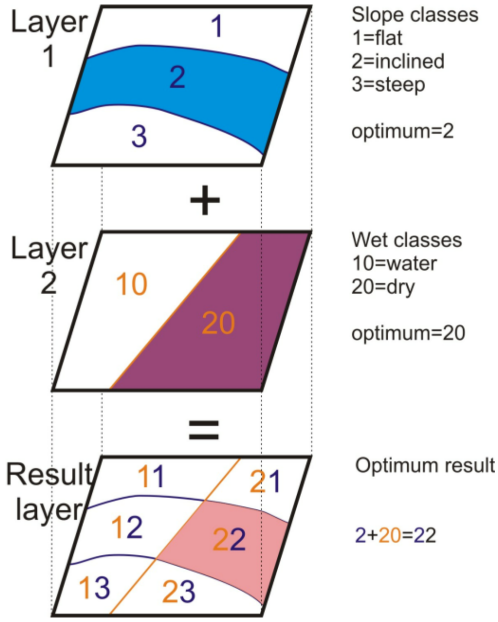
However, based on Boolean logic, a location with slope 10.1% will be rejected (as non-level), even if it satisfies quite well all other constraints posed by decision-makers. In addition, decision-makers are obliged to express their constraints through arithmetical terms and mathematical symbols in crisp relationships (e.g., slope < 10%), since they are not allowed to use natural language linguistic terms (e.g., flat land). Finally, another effect of classical set theory is that the selection result is flat, in the sense that there is no overall ordering of the valid entities as regard to the degree they fulfill the set of constraints. For instance, dry-level layer highlights all locations which satisfy the constraints: dry land (threshold 20%) and flat land (threshold 10%). However, there is no clear distinction between a location with moisture = 10% and slope = 3% and another with moisture = 15% and slope = 7%. These impediments call for a more general and sound logical foundation for GIS.

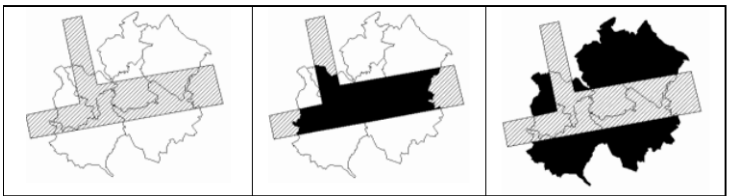
3.1 Overlay operation

The polygon overlay is used to calculate the common (or different) area between two overlapping objects.

The overlay operation is analogous to join operation in conventional database systems, and is defined as the assignment of new attribute values to individual locations resulting from the combination of two or more layers.

It could be additive or subtractive overlay operation. The additive overlay creates one or more polygons from the intersection between the polygons on layers A and B. The subtractive overlay subtracts the polygons on layer 2 from the polygons on layer 1. Fig. 3. a) shows two layers: layer A (no hatch pattern) and layer B (diagonal hatch). The result of additive overlay on layer C is displayed in solid black on b). The result of a subtractive overlay on layer C is displayed in solid black on c). Overlay operation is most used of all vector analysis in GIS.





a) layers A and B	b) result of additive overlay	c) result of subtractive overlay

Figure3: Schema of polygon overlay operation

3.2 Site selection in classic GIS

Here will be presented example of searching for relevant location, study done as part of making Spatial Plan of Tuzla Canton. In this situation, the set of constraints and opportunities consists of: level and smooth site (slope < 20%), not-north-facing slope, not agriculture land (usability) class 1, not close to garbage depot, vacant area (no development), not close to exploiting area, not close to sliding-land area, not reserved for special purpose, not close to mine contaminated area (MCA), nearness to the existing road network, nearness to the existing electrical network, dry land.

Figure4: a) Constraint: development area b) Opportunity: agricultural area not class 1 c) Result: selected area

In addition all candidate sites should have an adequate size to satisfy the needs of the planning activity (more then 2 sq km). The whole task requires as input five themes (layers) of the region under examination: hypsography theme (3D surface of the region or altitude values), development theme (existing infrastructure of the region like roads or buildings), vegetation theme (area covered with vegetation like forest or usability areas), moisture theme (soil moisture of the region like lakes, wet-lands, dry-lands) and MCA theme.

The procedure of site selection, based on the sets of constraints and opportunities determined above, may consist of the sequence of operations. First, from this 5 themes it is necessary to extrude 12 layers one by one. Some of the layers should be buffered (roads are usually presented as lines, buffer operation will make areas of them; MCA or sliding area are very dangerous, so it should be buffered to wider protective band). After that, using overlay operation (additive and subtractive) of all layers will produce a result layer with only areas that satisfy all criteria. Then, it should be checked if candidate sites satisfy condition of minimal area and exclude which not. Here was created a set of constraints (e.g. development area on Fig. 4.a), which restrict the planned activity, and a set of opportunities (e.g. agricultural area on Fig. 4.b), which are suitable for the activity. The combination of this two is considered in order to find the best locations (result on Fig. 4.c).

This procedure was very demanding in time and it was unsuitable for decision making in real time. It produced useful results but it also emphasis some of limitations. The biggest problem was that all criteria have to be given in advance and every change requires repeating many steps of the procedure (time demanding). Second problem was mathematical precision of data, which is in such real case unnecessary high and require additional user's effort to define precise constraints.

4 FUZZY LOGIC IN SPATIAL MULTIPLE CRITERIA DECISION MAKING

In classic model each theme is described through a set of attribute values and each individual location on it is assigned by only one of these values. The assignment of an attribute value to an individual location indicates its full membership regarding this feature in the corresponding layer.

In fuzzy set theory the concept of full membership is replaced by concept of partial membership and consequently the representation of individual locations should change. The incorporation of fuzziness into the spatial data model forces the redefinition of the components forming the hierarchical data model.

Specifically, while in conventional set theory the individual locations in a layer are assigned the attribute values (soil, grass, fruit-trees, forest) characterizing a theme (vegetation), in fuzzy set theory they are assigned d.o.m. values regarding each attribute value (0.1 for soil, 0.6 for grass, 0.3 for fruit-trees and 0 for forest). These values are derived by applying both the appropriate membership functions chosen by decision-makers and the knowledge provided by the experts.

Field measurements and results derived from sampling techniques are processed and transformed into d.o.m. values for the predefined attribute (linguistic) values characterizing a theme. Apparently, the number of layers increases, since each theme is represented by as many layers as the number of attribute values associated to it.

The Fuzzy Logic Toolbox in MATLAB provides tools for building Fuzzy Inference System (FIS), as show on Fig. 5. Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The process of fuzzy inference involves: membership functions, fuzzy logic operators and if-then rules. There are two types of fuzzy inference systems that can be implemented in the Fuzzy Logic Toolbox: Mamdani-type and Sugeno-type.

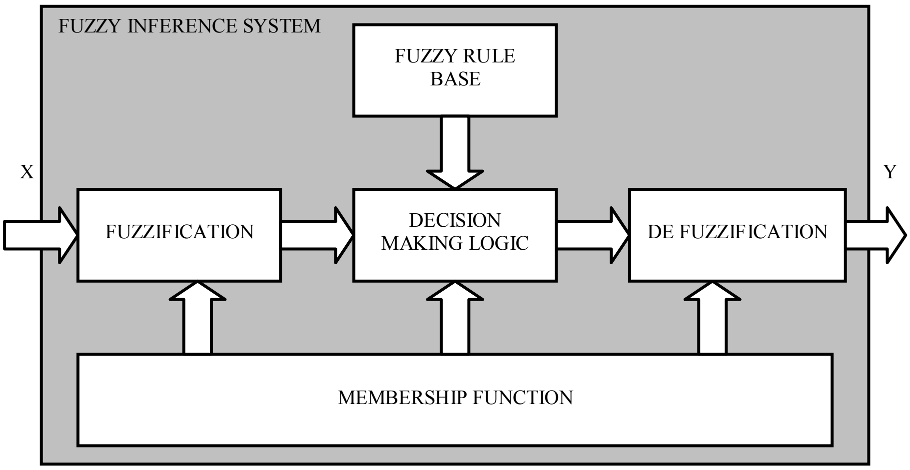


Figure5: Block structure of Fuzzy system

Mamdani's fuzzy inference method is the most commonly seen fuzzy methodology and it expects the output membership functions to be fuzzy sets. After the aggregation process, there is a fuzzy set for each output variable that needs defuzzification.

There are five parts of the fuzzy inference process: fuzzification of the input variables, choosing membership functions, constructing rules, making decision and defuzzification.

4.1 Fuzzification

It is chosen 6 main criteria for analyze: spatial accessibility (from centers of settlements, with consider of natural barriers), slope (level or slope), relative altitudes, aspect (orientation to the sun), usability (for forestry and agriculture) and ecological value (land Use got from satellite images).

Classes of slopes	Klase nagiba	from	to
flat (level)	ravno	0	2
small inclination (gentle)	mali nagib	2	4
inclined (moderate)	nagib	4	10
steep	strmo	10	20
very steep	vrlo strmo	20	30

Table 1: Fuzzifucation of slopes

Also there are some constraints like areas under water (lakes and bigger rivers), sliding-land areas, forest, mining areas, construction areas, MCA etc.

An important issue for decision making is reasoning based on linguistic values assigned to physical entities (e.g. inclined is slope between 4% and 10%). A set of linguistic values should be assumed to classify entities and measurements in categories. Each linguistic value corresponds to a range of physical values. Every input criterion should be fuzzified. For example, slopes are classified in five categories, what is shown in Table 1.

Based on this classification, it is made a thematic map of slopes in GIS shown on Figure 6.

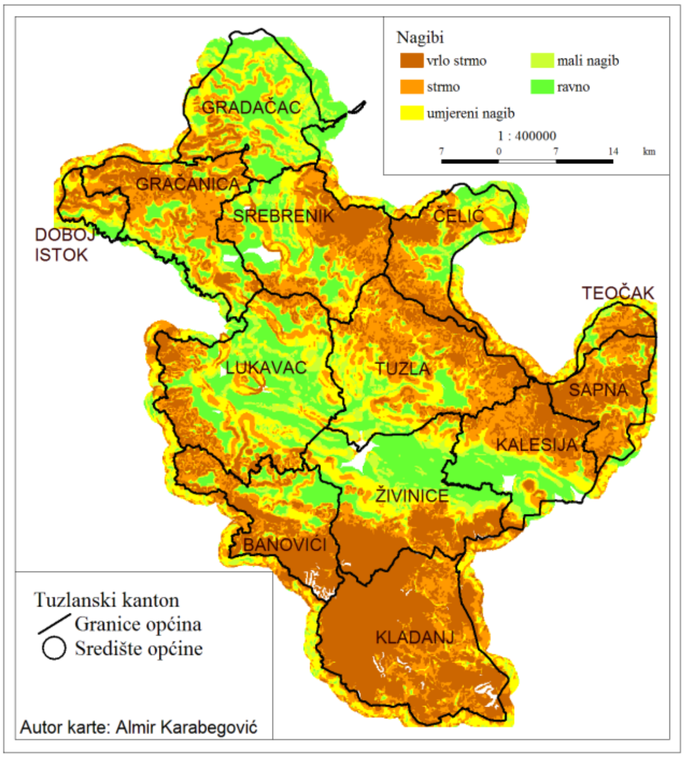


Figure6: Thematic map of slopes

4.2 Choosing membership functions

A fuzzy membership function is a curve that defines how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1. The input space is sometimes referred to as the universe of discourse. The choice of the membership function, its shape and form, is crucial and strongly affects the results derived by the decision-making process.

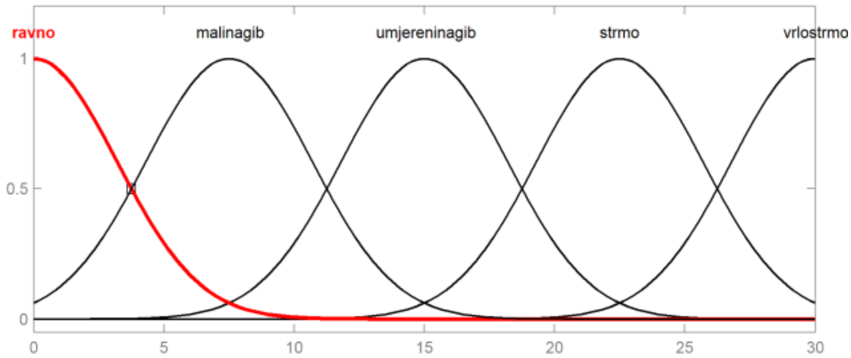


Figure7: Membership function for slopes

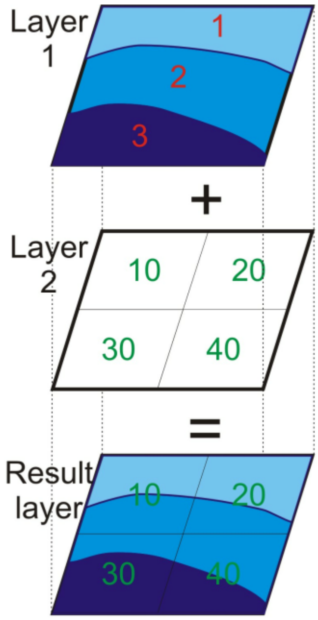
There are several membership function mostly used for geographically phenomena, but especially triangular and Gaussian. A Gaussian membership function is built on the Gaussian distribution curve and is defined as following formula.

$$f(x_1) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-1}{2\sigma^2}(x-\mu)^2} \qquad (4)$$

where μ is the mean and σ is the standard deviation, the two parameters for the Gaussian membership function.

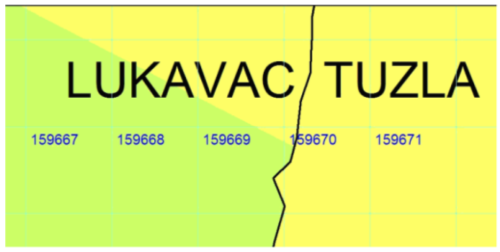
Because of its smoothness and concise notation, Gaussian membership function is popular method for specifying fuzzy sets. This curve has the advantage of being smooth and nonzero at all points.

In this work, Gaussian membership function is used form in most of criteria, like is shown for slopes on Fig. 7. There is one transformation function associated to each linguistic value, what means that number of functions is equal to the number of linguistic values assumed.



Result of ovarlay

%	1	2	3
10	58	42	
20	67	33	
30		24	76
40		67	33



ID	Municipality	Accessibility	Area [ha]
159667	Lukavac	Near	1
159668	Lukavac	Near	1
159669	Tuzla	Moderate	0,000326
159669	Tuzla	Moderate	0,02652
159669	Lukavac	Near	0,943643
159669	Lukavac	Moderate	0,029511
159670	Tuzla	Moderate	0,945568
159670	Lukavac	Moderate	0,031038
159670	Lukavac	Near	0,023182
159670	Lukavac	Near	0,000206
159671	Tuzla	Moderate	1

Figure 8: Overlaying, a) schematically and b) example

4.3 Spatial representation

General spatial data model is here presented in space as two-dimensional grid of cells, or land units. This grid is created in GIS, every cell is one entity connected with one record in the database. Schematically, it is shown on Fig. 8. a).

Most important feature of grid is its resolution, because accuracy of results is dependent on it. In isometric analysis for every municipality is used grid resolution of 30x30 m2. But, for whole Tuzla Canton area (around 2700 km2), as optimal resolution, is chosen grid 100x100 m, or 1 ha, which satisfy level of regional planning. This produced layer of basic land units (grid layer) with 281 526 entities and same number of records in database.

This layer is overlaid with every theme (layer). This operation add linguistic values (classes) of overlaid layer as new attributes to table of basic land units, and fill in values as size of area which cover that class in that cell. An example is overlaying layer of accessibility with layer of basic land units. Results are shown on Fig. 8. b). As a result it is produced a big table connected to layer of basic land units with all classes of all input criteria as attributes and with their parts in area as values. This table of fuzzified values for one record is presented on Fig. 9.

Basic information

ID	Number	Municipality
1000554913	188342	Tuzla

Slope classes

Flat	Small inclination	Inclined	Steep	Very steep
0,036906179	0,251406435	0,479215376	0,211899903	0,020572108

Aspect classes

Horizontal	North	East	South	West
		0,71126	0,28874	

Accessability classes

Close	Near	Moderate far	Far	Very far
			1	

Altitudes classes

Lawland	Hill	Mountain
	1	

Agriculture classes

Agrozone1	Agrozone2	Agrozone3
	0,0333171	

Biological values classes

NoBioVal	SmallBioVal	MedBioVal	HighBioVal	VeryHighBioVal
0,30296106		0,69703894		

Development classes and wet

Development	Economic	Water
0,9415659		

Figure 9: Table of fuzzified values

4.4 Constructing rules

Fuzzy sets and fuzzy operators are the subjects and verbs of fuzzy logic. These if-then rule statements are used to formulate the conditional statements that comprise fuzzy logic. A single fuzzy if-then rule assumes the form:

$$\text{IF } x \text{ IS } A \text{ THEN } y \text{ IS } B \tag{5}$$

where A and B are linguistic values defined by fuzzy sets on the ranges (universes of discourse) X and Y, respectively. The if-part of the rule "x is A" is called the antecedent or premise, while the then-part of the rule "y is B" is called the consequent or conclusion. An example of such a rule might be

IF slope IS inclined THEN area IS suitable (6)

The input to an if-then rule is the current value for the input variable (slope) and the output is an entire fuzzy set (suitable). This set will later be defuzzified, assigning one value to the output.

Interpreting an if-then rule involves distinct parts: first evaluating the antecedent (which involves fuzzifying the input and applying any necessary fuzzy operators) and second applying that result to the consequent (known as implication). In the case of two-valued or binary logic, if-then rules don't present much difficulty. If the premise is true, then the conclusion is true. If the antecedent is true to some degree of membership, then the consequent is also true to that same degree. The antecedent of a rule can have multiple parts.

IF (slope IS flat) AND (aspect IS south) AND (accessibility IS close) AND (altitudes IS low) AND (usability IS agrozona3) THEN area IS suitable (1)

in which case all parts of the antecedent are calculated simultaneously and resolved to a single number using the logical operators. Number in brackets is weight of that rule. Every rule has a weight (a number between 0 and 1), which is applied to the number given by the antecedent. Generally this weight is 1 and so it has no effect at all on the implication process.

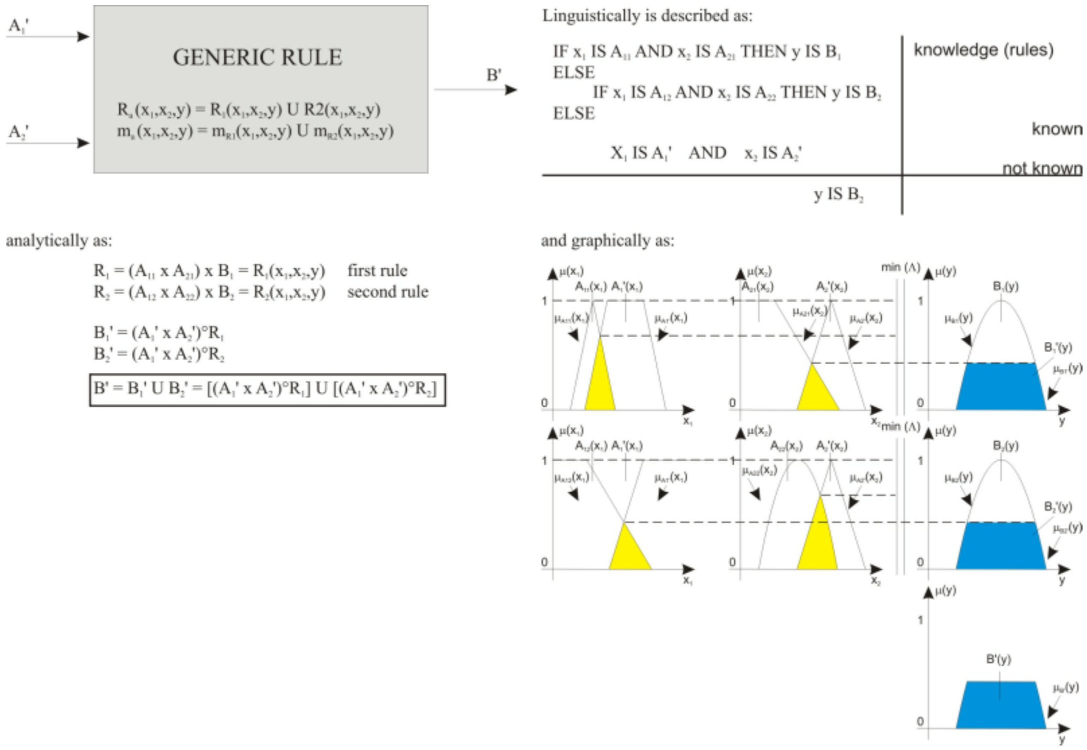


Figure10: GMP with many inputs and many rules

Apparently, number of rules is equal to number of combination for all membership functions (classes, linguistic values). Using knowledge base, some of combination are excluded, so final number of rules for solving this problem is 432.

The consequent specifies a fuzzy set that will be assigned to the output. After that, the implication function modifies that fuzzy set to the degree specified by the antecedent. The most common ways to modify the output fuzzy set are truncation using the min function.

Consider the rule (5). If it is observed that x is A', it uses fuzzy implication to reason that y is B'. Mathematically written, the implication form is

$$R = \int_{(x,y)} \mu(x,y)/(x,y) \quad \text{or} \quad R = \sum_{(x_i,y_i)} \mu(x_i,y_i)/(x_i,y_i) \tag{7}$$

There are 40 implication operators, but most important are Zadeh Max-Min, Mamdani Min and Larsen. In this work is used Mamdani Min implication operator, defined as:

$$\Phi m\ [\mu A(x), \mu B(y)] \equiv \mu A(x) \wedge \mu B(y) \rightarrow \mu(x, y) \tag{8}$$

where Φ is implication operator which take as input membership function of antecedent μA(x) and consequent μB(y).

4.5 Making decision

Fuzzy algorithms are evaluated using generalized modus ponens (GMP). GMP is a data-driven inferencing procedure that analytically involves the composition of fuzzy relations, usually max-min composition. Max-min composition under a given implication operator affects right side of rule in a specific manner (by clipping with Mamdani or scaling with Larsen implication operator). In general, GMP is a transformation of the right side of the rule by a degree commensurate with the degree of fulfillment

(DOF) of the rule and in a manner dictated by the chosen implication operator. As far as the entire algorithm is concerned, the connective ELSE is analytically modeled as either OR ($\wedge$) or AND ($\vee$), depending on the used implication operator for the individual if-then rules (when the Mamdani min implication is used, the connective ELSE is interpreted as OR). In this work is used GMP with many inputs and many rules. It is described as on Fig. 10.

From table of fuzzified values, using given rules is now possible to make multiple criteria analysis or multiple criteria decision making. The easiest way of manipulation data in tables is with SQL statements. So, in this work it is suggested to transfer if-then rules to SQL statement. Last if-then rule could be present in database as:

```
SELECT
ID, Municipality
FROM
TK
WHERE
Slope Is Not Null AND South Is Not Null AND Close Is Not Null AND Low Is Not Null AND [Agrozona 3] Is Not Null;
```

Based on such query in GIS are selected all basic land units which satisfy this condition and calculated total area. The result is same as it was got in classical method of overlaying and there no any ranging of data.

A problem that arises in this case is that only one of the participating d.o.m. values dominates by assigning its value to the whole decision criterion. In this way the contribution of the other d.o.m. values is eliminated.

For decision criteria which combine more than one layer and linguistic value e.g. level ground and dry land an overall measure should be computed and assigned to individual locations. This measure is derived from the consideration of d.o.m. on two or more layers. For a fuzzy set $A \in X$ with d.o.m. $\mu A(x) \in [X]$ the overall measure can be provided by an exponential function, which is given by the following commonly used formula:

$$\mu E(x) = \sum_{i=1}^{k} \left[\mu_{A_i}(x) \right]^q \tag{9}$$

By applying this equation (e.g. for q = 2, quadratic measure) the big weight values (d.o.m.) are amplified, while the small values are nearly eliminated. Assuming the previous example, the overall measure characterizing each individual location (l) of a region, regarding level ground and dry land using the energy function, is given by:

$$\mu_{level\text{-}dry}(l) = [\mu_{level}(l)]^2 + [\mu_{dry}(l)]^2 \tag{10}$$

Results derived by the previous formula should be normalized in the fuzzy domain [0, 1]. Using formula (10) it is produced new SQL statement which add new result field to express degree of membership of every basic land unit.

```
SELECT
ID, Municipality, ([Flat]^2 + [South]^2 + [Close]^2 + [Low]^2 + [Agrozone 3]^2) AS Result
FROM
TK
WHERE
Flat Is Not Null AND South Is Not Null AND Close Is Not Null AND Low Is Not Null AND [Agrozone 3] Is Not Null;
```

Here is chosen exponent 2 which provides order of qualified locations. This feature of exponent is very beneficial for decision criteria which combine multiple sets and linguistic values and make order of results for decision maker.

In GIS, process of visualization such data is process of making thematic maps, which gives decision maker a clear picture of his decision.

$$y^* = \frac{\sum_{i=1}^{N} y_i * \mu_{B'}(y_i)}{\sum_{i=1}^{N} \mu_{B'}(y_i)} \quad \text{or} \quad y^* = \frac{\int_y \mu_{B'}(y_i) * y * d(y)}{\int_y \mu_{B'}(y_i) * d(y)} \tag{11}$$

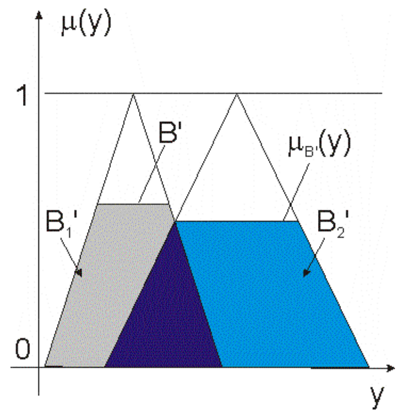


Figure11: Defuzification scheme: COA

4.6 Defuzzification

The output of fuzzy system is a fuzzy value. There is an option of using this value without any modification (leaving the final crisp action to the human operator) or to use a defuzzification scheme and generate a crisp output.

Commonly used defuzzification schemes include Tsukamoto's, Center of Area (COA) and Mean of Maximum (MOM) methods. In case of COA the defuzzified output y is given by an equation (11) or graphically as on Fig. 11.

Fuzzy output was defined in four classes as in Table 2. These linguistic values are from real world, and there are terms that the decision makers normally use in their work. So, even without any modification (leaving fuzzy values) results are appropriate.

Category classes	Klase kategorizacije	from	to
extraordinarily suitable	izvanredno podobna	75	100
very suitable	vrlo podobna	50	75
suitable	podobna	25	50
unsuitable	nepodobna	0	25

Table 2: Fuzzification output

4.7 Results

Final query for multiple criteria decision making did land valorization for every of 13 municipalities in Tuzla Canton, which final result for municipality Tuzla is on Fig. 12. It is also produced a table of areas balances for all municipalities, where decision makers can see, for every class of quality, how big area it covers. Combined with thematic maps, it makes the base for any analyses.

```
SELECT
ID,
Municipality,
[flat]+[small_inclination]+[inclined] AS Slope,
[east]+[south]+[west] AS Aspect,
[close]+[near]+[moderate_far] AS Accessibility,
[lawland]+[hill] AS Altitude,
[agrozone2]+[agrozone3] AS Usability,
[nobioval]+[smallbioval]+[medbioval] AS BioValue,
([slope]^2+[aspect]^2+[accessibility]^2+[altitude]^2+
[usability]^2+[biological_value]^2)/6 AS Result
FROM
TK
WHERE
[flat]+[small_inclination]+[inclined])>0) AND
(([east]+[south]+[west])>0) AND
(([close]+[near]+[moderate_far])>0) AND
(([lawland]+[hill])>0) AND
 (([agrozone2]+[agrozone3])>0) AND
(([nobioval]+[smallbioval]+[medbioval])>0) AND
((ALL CONSTRAINTS)=0));
```

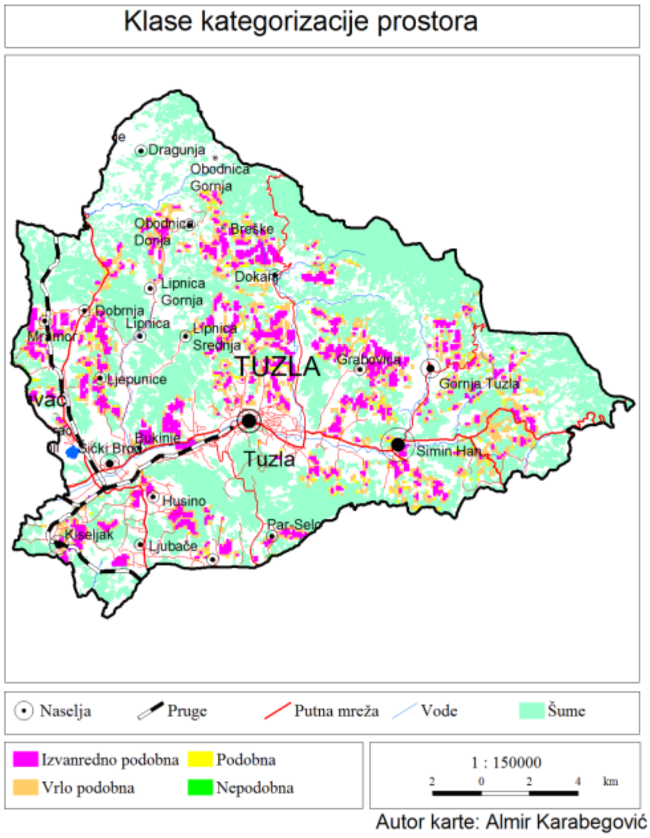


Figure 12: Land valorization for municipality Tuzla, SQL query and graphic result

Getting results with such procedures is only matter of database and GIS is now just a tool for making spatial presentation of results. Contrary to classic method, where was everything done graphically (in database data were only copied), this methodology employs database, which enables to put time demand part in preparation and defining criteria delaying to time of creating queries.

Every change of input data, now, requires only checking its influents to information (classic UPDATE statement in database). Also, data are ordered according to its impoertance for decision makers.

5 CONCLUSION

In spatial multi criteria analyses geographic information systems are used to identify alternatives, present them and give information to decision makers for evaluating, comparing and ordering of alternatives. Limitations of multi criteria analyses in standard GIS are necessity to define all steps in advance and inability to simple change criteria or thresholds later.

Fuzzy set methodologies could be excellent for designing efficient tools to support the spatial decision making process. Here is examined the incorporation of these methodologies into a DBMS repository for the application domain of GIS. It is shown how the useful concepts of fuzzy set theory may be adopted for the representation and analysis of geographic data, whose uncertainty is an inherent characteristic.

It is presented example of a real world situation involving spatial decision making and shown that using fuzzy logic makes the process simpler and faster enabling the possibility of ordering results.

Future research includes choice of the appropriate membership functions to simulate physical phenomena and fuzzy operations for the set of constraints posed by decision-makers (experts).

Also, this work is a solid logic base for solving spatial optimization problems in multiple criteria analysis using genetic algorithm.

6 REFERENCES

AVDAGIC, Z.: Vjestačka inteligencija & fuzzy-neuro-genetika, Artificial Intelligence & fuzzy-neuro-genetic, 2003.
AVDAGIC, Z.: Metode i primjena vjestacke inteligencije, Methods and Applications of Artificial Intelligence, 2004.
BUBLIN, M.: Prostorno planiranje, Univerzitetska knjiga, Sarajevo, Studentska stamparija, 2000.
LONGLEY, P., GOODCHILD, M., MAGUIRE, D., and RHIND, D.: Geographic Information Systems and Science, John Wiley&Sons, Ltd. England, 2002.
MatLAB 7, Fuzzy toolbox help
TANAKA, K.: "An Introduction to Fuzzy Logic for Practical Applications", Springer-Verlag New York, LLC, 1996.
KLIR, G.J, and YUAN, B.: Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall PTR, 1995.
STEFANAKIS, E., and SELLIS, T.: "A DBMS repository for the application domain of GIS", 7th International Symposium on Spatial Data Handling, Delft, The Netherlands, 3B19-3B29, 1996.
ZHU, A.X., HUDSON, B., BURT, J., LUBICH, K., and SIMONSON, D.: "Soil Mapping Using GIS, Expert Knowledge, and Fuzzy Logic", Soil Sci. Soc. Am. J. 65:1463-1472, 2001.
STEFANAKIS, E., and SELLIS, T.: "Enhancing operations with spatial access methods in a database management system for GIS", Cartography and Geographic Information Systems, 25(1), 16-32, 1997.
RATSIATOU, I., and STEFANAKIS, E.: "Spatio-temporal multicriteria decision making under uncertainty", First International Symposium on Robust Statistics and Fuzzy Techniques in Geodesy and GIS, Zurich, 2001.
SASIKALA, K. R., PETROU M., and KITTLER, J.: "Fuzzy classification with a GIS as an aid to decision making", University of Surrey, Guildford, Surrey, UK, 1996.
ALESHEIKH, A.A., MOHAMMADI, H., and KALANTARY SOLTANIEH, S.M.: "Spatial fuzzy classification in GIS", KNT University of Technology, Tehran, 2002.
KARABEGOVIC, A.: "GIS, Planning and Development of Communal Infrastructure", IV Conference of Urbanism of BiH, Tuzla, 2002
PONJAVIC, M.: "GIS Application in Implementation of Spatial Plan", IV Conference of Urbanism in BiH, Tuzla, 2002
KARABEGOVIC, A.: "WinGIS implementation in various markets like electricity, forestry, community, rural & city planning", Progis International Conference, Villach, Austria, 2003
KARABEGOVIC, A., KONJIC, T. and ATIC, V.: "Implementation of Geographic Information System in Electro distribution Tuzla", BH K CIGRÉ - International Council on Large Electric Systems - VI Conference, Neum, BiH, 2003
KARABEGOVIC, A., PONJAVIC, M., and KONJIC, T.: "Geographic Information Systems - a platform for designing and development of Cable Television", IKT 2003 - XIX International Symposium on Information and Communication Technologies, Sarajevo, 2003
PONJAVIC, M., and KARABEGOVIC, A.: "Land Inventory System and Validation of Agricultural Areas", Progis International Conference 2004, Villach, Austria, 2004
KARABEGOVIC, A. and PONJAVIC, M.: "Informatics support in designing local loops", BIHTEL 2004 - V International Conference On Telecommunications, Sarajevo, 2004
PONJAVIC, M., AVDAGIC, Z., and KARABEGOVIC, A.: "Applying Genetic Algorithm to Land Use Planning Problem of Multicriterial Optimization", ICAT 2005 - XX International Symposium on Information Communication and Automation Technologies, Sarajevo, 2005

The role of scientific support in mediation processes: experiences from the VIE mediation

Tanja TÖTZER and Wolfgang HESINA

(DI Tanja Tötzer, ARC systems research GmbH, Regional Studies, Donau-City-Straße 1, A-1220 Vienna, tanja.toetzer@arcs.ac.at;
(DI Wolfgang Hesina, ARC systems research GmbH, Regional Studies, Donau-City-Straße 1, A-1220 Vienna, wolfgang.hesina@arcs.ac.at)

1 INTRODUCTION

Due to decreasing flight prices and increasing living standard and mobility, air traffic grows continuously. The forecasts show an average annual growth rate of 5.6% for international passenger traffic between 2005 and 2009 (IATA 2005) and it is expected that the long-term growth trends will continue and that worldwide air traffic will double in the next 10 to 20 years (Short 2002, http://www.boeing.com). This trend can also be noticed in Austria: in 2005, flight movements exceeded the mark of 1 million movements for the first time and an annual growth of +11.6% is expected for 2005 which lies far above the European wide assumptions of 5-6% (der Standard, 7th/8th Dec. 2005). Airports have to react on these increasing demands and have to adapt their airport capacities. In many cases this requires enlargement of the airport and construction of additional runways. Airports are changing into new regional development poles, into "airport cities", which do not stand alone and detached from the airport surroundings (Güller and Güller 2003). Many studies prove that airports can be seen as economic growth engines for the entire airport region (e.g. York Aviation 2004, SIAA 2003, Blöchliger et al. 2004), but they also show negative impacts on the region. In particular, air traffic growth and enlargement of airports directly affect the abutters in the airport regions and often lead to conflicts. In order to guarantee the social acceptability of airports operation and the territorial insertion of airports, the need for other or alternative proposals and environmental actions is sought in all worldwide airports. […] It is about shaping actions types and modes allowing compromises between the two trends: air traffic growth and environmental concern/communities threats near major airports (Faburel and Mikiki 2004, 2). Thus, the big challenge for airports is to achieve a sustainable development in the entire airport region which means a balanced regional economic, ecological and social development.

This also requires participation as to achieve generally accepted and lasting solutions. Thus, participatory processes like mediation become increasingly important. However, participation lies not only in the interests of sustainable development but also in the interests of project operators who more and more frequently conduct mediation in the forefront of EIAs (environmental impact assessment) in order to accelerate the EIA procedure based on social acceptance. Mediation processes are led by mediators who help disputing parties to communicate with one another. Mediators are mainly responsible for process management and process control which is essential for facilitating and for accelerating the process of coming to a consensus-based conflict resolution. Sole process control may be sufficient for mediating family or workplace conflicts. Glasl (2004) distinguishes between three arenas of conflicts: micro-, meso- and macro-social conflicts. Whereas micro-social conflicts can be solved "face to face", meso-social conflicts between groups, departments or organisational units already need additional organisational and management competence. Macro-social conflicts affect a wider environment and often need additional expertises from various other fields. Macro-social conflicts can occur when large infrastructural projects are planned. In this case, many questions among the parties refer to potential impacts of the infrastructural project and to spatial, social, economic and environmental issues. Thus, for environmental mediations scientific support is essentially needed. Learning, knowledge transfer and knowledge building become key elements of mediation. Large mediation processes like environmental or land use mediations are fundamentally science-intensive and need to be assisted scientifically.

Many discussions and extensive literature on the role of mediators already exist. However, the role of scientific assistance in large environmental mediations is still rather unlighted. This paper describes the mediation process initiated by Vienna International Airport (www.viemediation.at) and focuses on the significance of scientific and technical information transfer. The VIE mediation demonstrates that a new role complementary to the role of the mediators emerged: an additional impartial party which is responsible for management and evaluation of the scientific and technical information and which integrates the information of separate expertises, translates the main findings to the participants and builds trust on the scientific results.

2 WHAT IS MEDIATION?

Mediation is an Alternative Dispute Resolution (ADR) process of exploring solutions and negotiating mutually acceptable resolutions. Mediation can be seen complementary to litigations. In the forefront of a legal process or in some cases even instead of it, mediation can lead to fair and reasonable solutions negotiated between the parties. In comparison to legal processes, conflicts are not delegated to be settled by judges but have to be carried out by the parties themselves (Heintel 2005). The parties have to deal with their conflicts, which can be a very challenging process. But finally achieved resolutions are perceived to be balanced and reasonable, which is not always the case with judgements. Today, medation is applied in many fields e.g. to solve family and working place disputes, but also public disputes. This paper concentrates on large and science-intensive mediations like in the case of the VIE mediation.

The reason for mediation is the existence of a conflict between two or more parties. Such conflicts are always closely connected with interests, emotions and relation-ships (cf. Zilleßen 1999). To achieve a robust and mutually acceptable solution, all levels of conflicts and all stakeholders have to be considered sufficiently. A basic requirement for mediation is that the parties participate voluntarily and are willing to find a common solution.

Generally speaking, the term "mediation" covers any activity in which an impartial third party facilitates an agreement on any matter in the common interest of the parties involved (http://en.wikipedia.org). Thus, the mediation process and negotiations are led by a third, neutral party: a mediator or a team of mediators. *The mediator has no authority to impose a settlement. His or her strength lies in the ability to assist the parties in resolving their own differences. The mediated dispute is settled when the parties themselves reach what they consider to be a workable solution* (Comick 1980, 27). Mediators do not advise those in dispute, but create a process through which the disputants find a resolution themselves. The first step for achieving this goal is that the parties talk to each other.

The negative feelings commonly associated with conflicts (Heintel 2005) often cause communication to stop or to become confrontational. Mediators shall help people to communicate with one another and shall avoid that negotiations reach a deadlock.

Mediation aims to establish a win-win-situation among the parties, so that sustainable solutions become more likely. The primary goal of mediation is to find a solution that all parties have consented to. If mediation takes place in the forefront of an EIA, it can not replace official environmental impact assessment procedure, but enables the ground to reach a generally accepted conflict resolution. Although the procedure of mediation is basically informal, the goal of a successful mediation is, that the parties decide to sign a legally binding contract. This helps to speed up the subsequent EIA procedure, because it is backed by a consensus among the signed parties.

3 THE VIE-MEDIATION

Lately, mediation procedures are also in Austria, Germany and Switzerland more and more often set up to resolve the dispute over airport enlargements (Vienna, Innsbruck, Frankfurt, Zurich). When Vienna International Airport (VIE) started to think about enlargement of the airport, citizen´s groups formed up and ran against it. Thus, VIE airport decided for a democratic experiment (VIEaktuell 2005, 12) and initiated a mediation process in 2000 aiming to achieve a robust solution with all participants. The VIE mediation was finished in 2005 and a mediation contract was signed which contains binding agreements between VIE airport and the mediation participants.

At the beginning of the VIE mediation 51 parties, at the end 54 parties engaged in the process (VIE airport, Austro Control, Austrian Airlines Group, Neighbourhood Advisory Committee, environmental advocacies of Vienna and Lower Austria, associations, chambers, representatives of the local companies and employees, Donau Auen National Park, regional and supra-regional citizen's groups, political parties and the states of Vienna and Lower Austria). The VIE-mediation process became the largest of Europe. The process was supported by a team of 3, at the end of 2 mediators and an advocate. Several surveys were carried out, e.g. on the topics of fauna and flora, emissions and immissions, traffic, economic effects, external risk and level of safety, soil consumption and change of landscape. Due to the huge amount of separate surveys and the complexity of issues and participants, systematisation and integration of the information became necessary. As mediation is always a learning process it requires to implement interdisciplinary studies far from sectoral approaches and sequential logics. Thus, a system-oriented approach was chosen and it was decided to apply the concept of sustainability. This required scientific support from an interdisciplinary team comprising experts from the fields of spatial and landscape planning, economics, biology, meteorology and geography. Thus, a research team from ARC systems research was assigned to assist the VIE mediation as an additional neutral party and to facilitate the solution finding process through their scientific support.

The ARC research team assisted the VIE mediation from 2001 to 2005 and provided scientific support throughout the entire process. Our team took an additional neutral position beside the mediation team. The task of the scientific team was not to advise the participants, but to systemise, prepare, evaluate, complete, summarize and integrate the existent scientific and technical information in order to help the participants to understand and assess the information and data. Decision making remained with the parties and was not made by the mediators or the scientific team. The ARC team was involved in the process in order to allow a systematic procedure and to transform information into knowledge.

3.1 Methodological approach: Sustainability model and scenarios

At the beginning of 2002, a separate working group was installed that engaged in the development of scenarios for the airport region. Together with the working group, the ARC team developed a sustainability model which integrated all essential ecologic, economic and social indicators. The aim of the model was to illustrate how different runway systems cause different amounts and routes of airport traffic and how this affects the regional development. The indicator-based model encompassed 21 topics and 71 indicators including ecological, economical and social aspects. Some indicators could be covered by scientific information and data available, others had to be completed by conducting own analyses. The ARC team evaluated, presented and discussed all indicators with the working group which was a crucial step towards generating knowledge and building trust among the participant.

The indicator-based sustainability model provided an essential basis for the development of scenarios. The scenario-technique was chosen, because scenarios are able to give a comprehensive picture of a potential future development. Complex issues can be presented in an easily understandable way and differences between scenarios become clearer. Eight Scenarios were developed for 2010 (date of completion of a third runway) and for 2020 (third runway in use for 10 years). Following the model, 71 indicators would have been to be prepared for each date – 2010 and 2020 – and for each scenario. This would have meant a flood of information and data and it would have been asked too much from the participants to cope with all this information. Thus, a two-stage procedure was applied to assess the indicators and to decide about the scenarios. First, a rough evaluation was carried out in order to identify those indictors that were critical for decision making. The parties agreed that it was not crucial to examine each indicator in detail and addressed the most fundamental "core" issues, in which the scenarios differed. The selected indicators were ranked as to their importance. A further aim of the rough evaluation was to classify these scenarios which were analysed in detail, which were postponed and which were not continued, because they had turned out to be infeasible.

The working group decided to choose two scenarios for further detailed analyses. This procedure allowed focussing on the most important issues and scenarios without neglecting the others. With the help of the two-stage procedure certain scenarios could be eliminated in the first stage and did not need to be investigated further. But they had been treated and discussed and this was most important for the participants. Trust in the selected scenarios had been built among the participants which was essential for finding a joint solution.

3.2 Scientific support of the learning process

Separate working groups were installed to increase the efficiency of the process. It has to be taken into account that the parties engaged in the process voluntarily and spent their leisure time for numerous meetings and sessions. Thus, it was necessary to design the process as efficiently as possible. Meetings of the forum board, which included all participating parties and encompassed over 50 members, took place regularly, but mainly for decision making. These decisions were based on the outcomes from the working groups. The working groups consisted of representatives of the different parties and thus represented the various interests of the participants, but did not encompass the entire forum. Work could be divided among the participants and discussing in smaller groups of approx. 15 people was easier, more open and more efficient. On the other hand, reference to the other members of the party became necessary and accordance of the larger group was important. Thus, the representatives reported to their colleagues about the results of their working group and got feedback from the others. The sustainability model and the development of the scenarios facilitated this transfer of information, because the process became more transparent and provided confidence in the representatives. Additionally, a process control group was established to coordinate communication between parties and forum board in agreement with the mediators.

Whereas mediators are expected to be process experts and conflict managers (Zilleßen 1998), the scientific team is intended to facilitate the technical learning process. Like mediators the scientific team is to remain neutral and assist the parties in finding resolution to their problems. Scientific and technical information often needs translation for lay users to be useful in dispute resolution and conflict management proceedings (Adler et al. 2000, 20). For decision making it is crucial that participants trust in the work of scientists. But often it is hard for laypersons to understand and assess surveys and expertises can be contradicting. Bringing in an acceptable third-party scientific team can restore confidence in scientific and technical surveys. In the case of the VIE mediation the participants were overwhelmed by numerous surveys. To systemise and integrate the flood of information, the ARC team developed a theory-based sustainability model and scenarios for the future development of the airport region. The most important contribution to facilitate the process was to transform the vast amount of separate studies into integrated understandable and tangible information and finally knowledge for the participating parties. Complex interdependencies within the airport region were transformed into comprehensible maps, figures and tables, which essentially helped to achieve a common understanding, trust and increasing willingness for finding solutions. GIS (Geographic Information System) was one methodology applied which was especially suited to visualise regional patterns and interaction. GIS-based maps allowed illustrating, comparing and discussing versions of different runway systems in an easily understandable way. It even enabled the participants to decide that some versions did not need to be examined in detail. Figure 1 illustrates the agreement between the mediation members that no new building land will be planned within the zone of 54dB and that the noise zones will not increase. Thus, GIS was a very helpful tool that facilitated the learning and decision making process significantly.

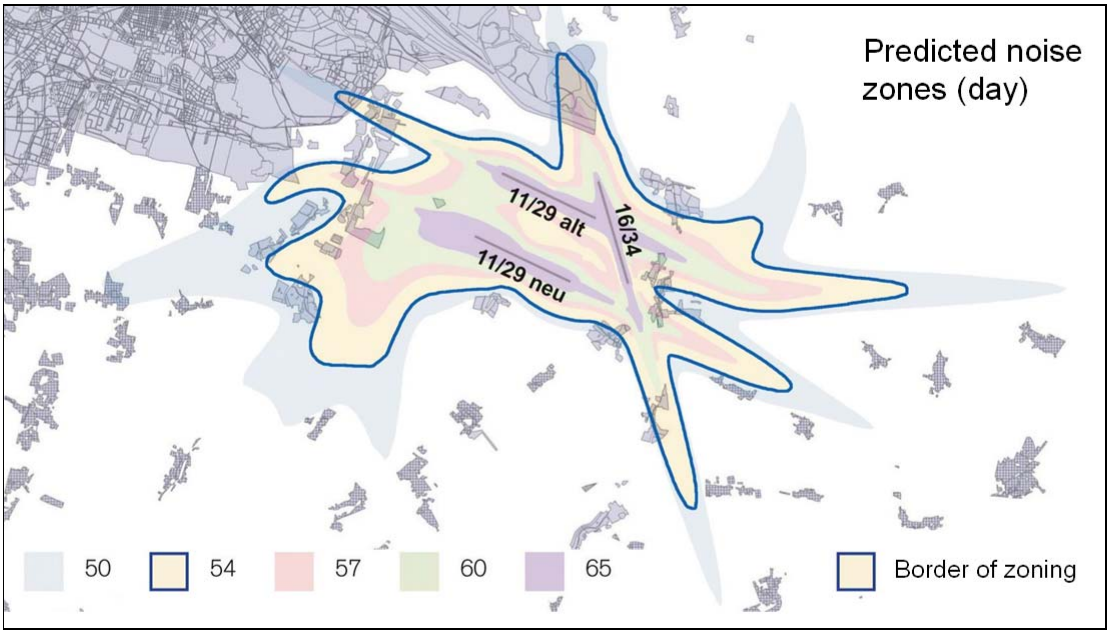


Figure 1: GIS-based map illustrating the future runway system
Source: Generalised zoning: Government of Lower Austria and City of Vienna; Noise zones: VIE airport

Through a joint learning process a comprehensible and trustful information basis could be created for all participants. Clearance about terms and definitions improved mutual understanding and efficiency of the discussions (Hesina and Tötzer 2003). It helped to avoid talking at crossed purposes and strengthened the confidence to address also more critical issues. Building knowledge and providing confidence in scientific information enabled the parties to supplement emotional and subjective estimations with objective facts and figures. This facilitated understanding and acceptance of the other's point of view and set the groundwork for finding a common solution.

4 CONCLUSIONS

Complex negotiation and learning processes like mediation of large infrastructure projects require methodological process support and control. This task lies with the mediators. But beside the methodological process support, scientific process assistance is needed to transform the flood of information and data into knowledge among the participants. Although decisions are left to the parties, foundations for making mutually acceptable decisions must be laid. In family or working place disputes the parties possess all the knowledge required to decide about potential ways out of crisis. But in large environmental mediation processes a further dimension has to be considered: the scientific dimension. Numerous separate surveys on different issues do not suffice to facilitate the solution finding process. It requires an additional step to transform this information into reliable knowledge on which decisions can be reached. It can not be demanded from the participants to become experts in every field. Besides, individual learning processes would consume enormous time and energy, but would not be able to build a joint knowledge basis. Thus, to accelerate and improve the process an additional facilitator is needed which holds the technical expertise to evaluate the surveys and to conduct own analyses, but which also possesses the interdisciplinary competency to integrate separate facts in models and scenarios. The scientific facilitator improves transparency and credibility in scientific issues. The VIE mediation example demonstrates that in large environmental mediation processes where economic, ecologic and social issues are addressed scientific support plays a crucial role. In the VIE mediation the interdisciplinary team of ARC systems research was in charge for the scientific support. Our experiences prove that an interdisciplinary scientific expert team complementary to the team of mediators significantly improves and accelerates the mediation procedure and can decisively contribute to the success of the mediation.

5 REFERENCES

ADLER, P. S., BARRETT, R. C., BEAN, M. C., BIRKHOFF, J. E., OZAWA, C. P., and RUDIN, E. B.: Managing Scientific and Technical Information in Environmental Cases: Principles and Practices for Mediators. Published jointly by Resolve, Inc; US, Institute for Environmental Conflict Resolution, and Western Justice Center Foundation, March, 2000. (Also at www.ecr.gov, www.resolv.org, and www.westernjustice.org)

BLÖCHLIGER, H., KOELLREUTER, CH., KÄMPF, R. and ROTH, U.: Die internationale Verkehrsanbindung der Schweiz in Gefahr? Volkswirtschaftliche Beurteilung der Erreichbarkeit des Wirtschaftsstandortes Schweiz und seiner Regionen. BAK Basel Economics, Mai 2004. [online] URL: http://www.bakbasel.ch/downloads/bak/publications_papers/2004m05_erreichbarkeit.pdf

CORMICK, G.W.: The "Theory" and Practice of Environmental Mediation. The Environmental Professional. 2: 24-3, 1980

FABUREL, G. and MIKIKI, F.: Valuation of Aircraft Noise Social Costs: Policy and Science Implications. In: Proceedings of 10th WCTR, Istanbul, Turkey, 2004

GLASL, F.: Konflikt-Diagnose in drei Schritten. In: perspektive mediation. 1/2004: 11-17, 2004

GÜLLER, M. and GÜLLER, M.: From airport to airport city. Gustavo Gili, Barcelona, 2003

HEINTEL, P.: Über "Wert und Nutzen" der Wirtschaftsmediation. 4. Internationaler Kongress Wirtschaftsmediation. Universität Wien, 8. April 2005

HESINA, W. and TÖTZER, T.: Mediation als vorbereitendes Konfliktlösungsverfahren für Infrastrukturprojekte – ein Erfahrungsbericht aus dem Mediationsverfahren Flughafen Wien. In ÖROK (ed., 2003): Raumordnung im Umbruch – Herausforderungen, Konflikte, Veränderungen. Sonderserie Raum&Region. Heft 1. Eigenverlag, Wien, 2003

IATA – International Air Transport Association: Passenger and Freight Forecast 2005 – 2009. [online] URL: http://www.iata.org/NR/rdonlyres/CC8F53FF-D587-4C7A-8CDA-1E9F5835531E/0/PressPackPassengerandFreightForecasts20052009.pdf

SHORT, J.: Introduction in: Güller M. and Güller M. (2003): From airport to airport city. Gustavo Gili, Barcelona, 2002

SIAA - Swiss International Airport Association: Volkswirtschaftliche Bedeutung der schweizerischen Landesflughäfen. Synthesebericht, Zürich/Bern, 2003

VIEaktuell – Informationen rund um Ihren Flughafen. Edited by the VIE airport, Dec. 2005

YORK AVIATION: The social and economic impact of airports in Europe. Studie im Auftrag von Airports Council International – ACI, 2004 [online] URL: http://www.yorkaviation.co.uk/docs/the%20social%20and%20economic%20impact%20of%20airports%20in%20europe%20secure.pdf

ZILLEßEN, H.: Die Stellung der Mediation im politischen System der Demokratie. In: KONSENS, Zeitschrift für Mediation, Vol. 2, Bd. 5, S.278-282, Berlin, 1999

ZILLEßEN, H.: Mediation als kooperatives Konfliktmanagement. In: H. Zilleßen (ed.) (1998): Mediation. Kooperatives Konfliktmanagement in der Umweltpolitik, Opladen, Wiesbaden, 17-28, 1998

INTERNET-SOURCES:

http://en.wikipedia.org/wiki/Mediation

www.viemediation.at

http://www.boeing.com/atm/resources/speeches_1202.html

Technologies and community mechanism for civil protection assistance and cultural heritage conservation

A. GIUFFRIDA, A. Lo TAURO

(Antonio Giuffrida, Nicolosi Civil Protection Centre, Via Calvario n. 27, 95030 Nicolosi, CT, protcivnic@infinito.it)
(Agata Lo Tauro, Centre of Excellence Telegeomatics, GEONETLAB, University of Trieste, omar3@mail.gte.it)

1 ABSTRACT

The project was intended to help ensure better protection, primarily of people but also of the environment and property, including cultural heritage in the event of major emergencies, i.e natural, technological or environmental accidents occurring inside or outside the community. This project also explores the potentiality of a prototype for a dynamic GIS and real-time local tactical communications system specifically oriented to the activities of the forecast and the prevention of the volcanic risk. Actions foreseen for the Department of the Civil protection are: Set up a training programme including joint courses, an exchange program and exercises; stimulate and encourage the introduction of new technologies; take measures to facilitate strategies for assistance intervention and other intervention support for the conservation of cultural heritage. In particular the EuroSot Event 2005 had the objective to reinforce co-operation between the community and the member states in civil protection assistance intervention in the event of major emergencies, or the imminent threat thereof, which may require urgent response action.

2 INTRODUCTION

The Plans of Civil Protection are important instruments for the management of all possible risks and events of emergency related to a territory. This project takes into account the important guidelines of the AUGUSTUS method produced by the Department of Civil Protection. The project also concerns the realization of a database and the implementation of the appropriate technological support for the conservation of cultural heritage specifically oriented to the activities of the forecast and prevention of the volcanic risk. This study analyses the territory of Nicolosi1 and represents the test-field for all possible events related to volcanic danger and risk in Mount Etna volcano for which the geodatabase has been already implemented. The first phase of the job concernes the accurate knowledge of the territory and research related to the definition and the simulation of the most common risk models such as the seismic risk, volcanic risk (lava flow, volcanic cinders) forest fires, meteorological risk, etc.

In this phase we take into account the more important guidelines (already available or in itinere2), in order to analyse the modality of the geographic database related to the implementation of the Civil Protection (L.225/92), the AUGUSTUS method, the Regional Programme HORUS

and the documentation produced by the INSPIRE Programme3. This project takes into account the important guidelines for the Conservation of the Cultural Heritage (L. 137/2002 and L.R. nr. 14/1998)4. Furthermore, in this phase we analyses the more important guidelines in order to define the modality of the geographic database related to the implementation of the Cadastre of Roads (DM 1.6.2001) and the documentation produced by the "Intesa Stato-Regioni- Enti Locali" for the realization of the Geographic Information System. General use of risk assessment can provide a basis for preventing and limiting the consequences of accidents, thus enabling the risks to be dealt with in a coherent way (DCDEP, 2000). This is also supported by the United Nations Environment Program APELL (Awareness and Preparedness for Emergencies at the Local Level), which lists the identification of risks that can pose a potential threat as one of its main goals. Similarly, FEMA (FEMA, 2001) has its PROJECT IMPACT, aimed at building disaster-resistant communities. In order to gain better preparedness for disasters, possible risks must be identified. Visualization may here provide a valuable tool for both identifying, exploring and communicating risks.

In this paper we describe methodologies for the implementation of a specialised GIS, for the production of thematic cartography and for the management of the risk assessment (such as post-event analysis). The project also concerns the realization of a GIS (geographic information systems) and the implementation of the appropriate technological support. The project makes it possible for those who deal with the management of emergency situations to take more efficient decisions thanks to the interconnection of national contact points and the sharing and exchange of information. For this purpose the radio-transmission technologies has been implemented for the Plan of Civil Protection in Nicolosi. In particular the EuroSot Event 2005 involves authorities responsible for protecting citizens from natural and man-made risks, for testing new tecnologies and for training programme including joint courses.

3 GIS TECHNOLOGIES FOR THE HAZARD ASSESSMENT

The planning and the realization of a prototype for a dynamic GIS is specifically oriented to the activities of the forecast and the prevention of the risk related to danger events. This prototype can also support the management of possible events of emergency not only in Nicolosi but in the Mount Etna volcano.

The GIS Technologies implements models of simulation for the risk phenomena both with natural or man-made features and with specific required conditions. They also apply to the Nicolosi Plan and define both the immediate definition of pre and post-event analysis (such as the seismic events, earthquakes), and the slow evolution of the time-scale event (such as lava flow, woodland fires, etc). On the use of GIS to assess natural hazards we note visualization as important not only in the development of GIS generally, but also as a tool to improve reliability of hazard assessment, thus decision support, and also to improve the ability of non-experts to take

---

[1] www.protezionecivilenicolosi.it., link of the Civil Protection Centre in Nicolosi.

[6] DL 31/3/1998 n° 112, art. 108 related to the Sanitary Risk, "Circolare Sirchia" 1/7/2004, and the guidelines of the DPC 6/7/2001.

[3] The INSPIRE – Infrastructure for Spatial Information in Europe is a large current initiative of the European Commission to promote the multipurpose availability of feasible geographic information. Smith et al (2002)

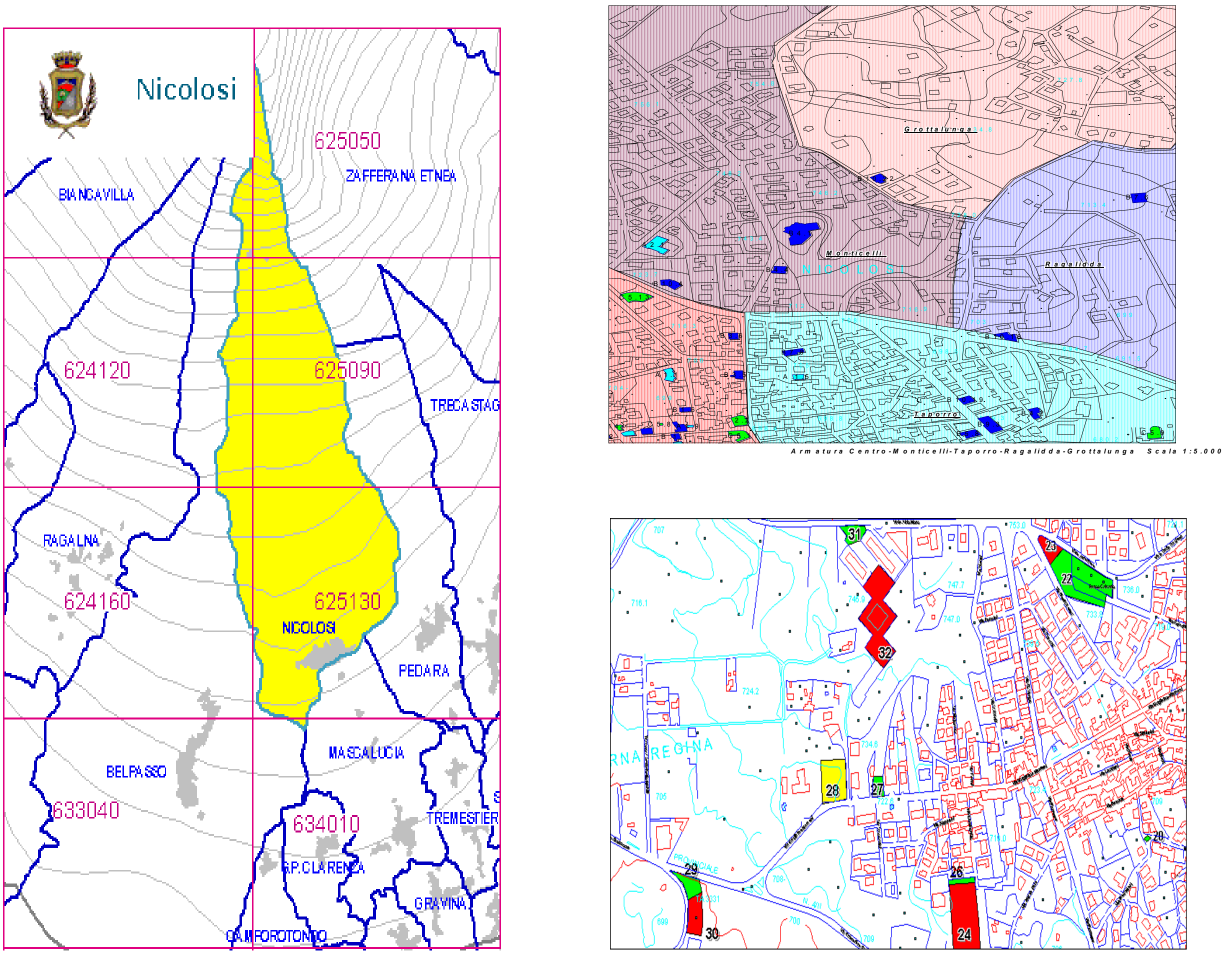
[4] Other guidelines are: The NOPPCEC (D.Lgs.490/99) for the implementation of Operative Stations in Provinces and the SORIS emergency strategies (deliberation 304/2000).

advantage of the information presented5. A statement on the need to improve the representation of risk and vulnerability is also found in Radke et al. (2000), noting that the average GIS is not able to represent the depth and richness of the dynamic nature of risk and vulnerability.

The primary issues of this study are also related to the definition and implementation of methodologies and models. Within the study of those models and their implementation on the GIS platform, the project included the detailed definition of the features of the cartographic data (available or in phase of acquisition) and all the necessary elements (both topological and informative) for the specialised GIS. The prototype GIS tool was created using different softwares such as MapInfo 7.0 SCP and AutoCAd Map technology. In order to facilitate the ever-expansion of new data, thematic layers were developed for all data input into the database.

Cartographic research6 explores the use of thematic maps for civil protection with the emphasis on extracting specific pieces of information such as:

1. volcanic risk: historical series for volcanic events; maps of hazard assessment related to lava flow; census of the population; survey of the vulnerability related to building and public service; data related to volcanic cinders.
2. seismic risk. map of the hazard assessment related to the seismic risk; vulnerability maps building (public and private buildings) and in particular vulnerability maps for cultural heritage; inventories of areas sensitive to volcanic risk and volcanic risk inventory; inventory of densely populated areas and road network. Life lines (electrical network, water-works, gas-pipes, etc.), areas of emergency;
3. woodland fires: land use maps (extension of the woodland heritage), climatic map of the territory; map of the historic woodland fires and strategic places; hidrography and remotely sensed data (vegetation, soil moisture);
4. estimation of population density related to districts and ISTAT (Italian Statistic Institute) data;
5. and use and existence of such risk to be taken into account in land-use planning
6. meteorological risk**:** climatic variability and the temporal variability of disaster risks, climatic data network spread across the territory;
7. sanitary risk;



Graph 1: Models of the seismic risk and emergency areas in the territory

5 Coppock (1995) for further study.

6 Readers are referred Kraak, M J and Ormeling F.J (1996) for further study.

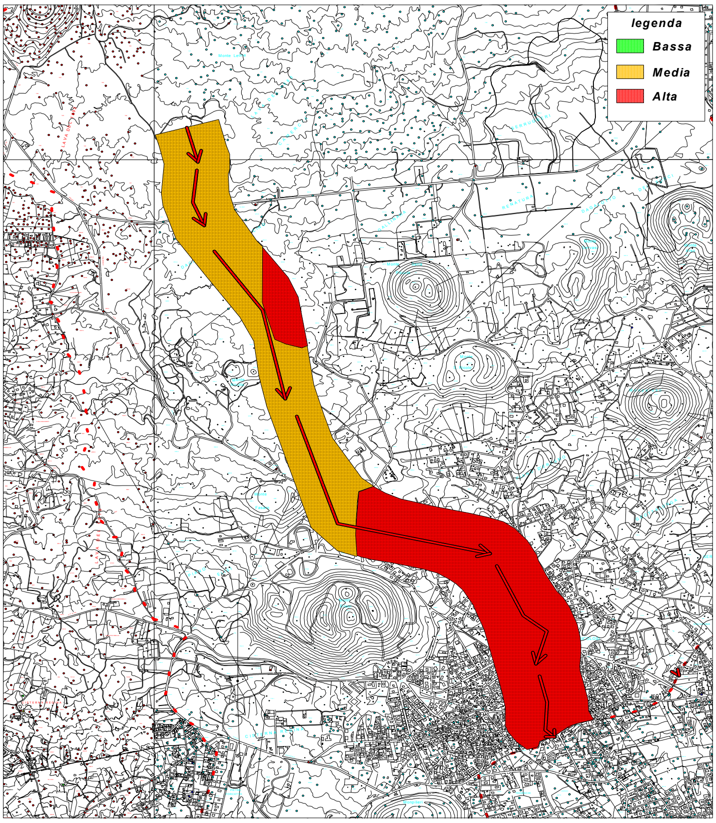
4 VULNERABILITY IN CULTURAL HERITAGE ANALYSIS

The central idea upon the "Risk Map" is based on the development of systems and metodologies enabling maintenance and conservation strategies for cultural heritage with regard to their conditions and the environment where they are situated related to the risk phernomena. The objective is to predict, and thus to decide in advance, wich measures has to be taken most urgently, with regard to the time necessary for execution in order to avoid losses and damage. In the particular case of the volcanic emergency "Etna 2001", the Superintendence BB.CC.AA. of Catania produced a specific plan for the conservation of the "movable" cultural heritage (paintings, sculptures, etc). This plan also involves a detailed listing of the cultural heritage in the urban centre related to ICR standards.

In general the first line of defence against volcanic risk and earthquakes has historically been the construction of buildings that can withstand severe shaking. Nicolosi relies on the seismic design provisions in building codes related to cultural heritage to ensure that structures can resist earthquakes. The variations in the seismic threat across the country are depicted on maps in building codes as zones of different risk levels. These building-code maps are based on more detailed shaking-hazard maps. The geological survey shaking-hazard maps for the Catania province are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources. Shaking-hazard maps can be combined with data about the strength of existing historic buildings (churches, monasteries, etc.) and traditional architecture, to estimate expected earthquake damage in an area over a given period of time. Although strong earthquakes are frequent in Nicolosi and in the Mount Etna in general, damage in those areas could be catastrophic in a powerful temblor. This is because most buildings and other structures there have not been constructed to withstand severe earthquake shaking.

For this reasons it will be possible to update the SIT throught the transmission of useful information for post event analysis. In particular will be possible the delimitation of the lava flow areas and the location of the damaged buildings and cultural heritage in general to the Central Operative station (COS). In the same way, it will be possible to fill a short inventory of the survey of the damaged buildings or of the road network with the radio-transmission technologies related to the DB and to send the data to the GIS in real time. In fact natural factors and small-scale man-made can deeply modify the morphology of the land use and the characteristics of urban areas and natural environments. It is well known that the updating of a reliable cartography, both for its metric quality and its contents, represents an indispensable tool for the realization of a specialised GIS.

The primary objective of this phase of analysis was the updating of the cartographic data, and of the informative contents (presented in the database) which are strictly connected to each other. The main purpose was to avoid useless duplications and redundancies (on one side and informative errors and incompleteness, on the other) and to stimulate the implementation of multi-scale and multi purposes systems.



Graph 1: Risk Map

In the mid-term phase of the Plan for Civil Protection in Nicolosi, vulnerabilità data partially derived from ISTAT 1991 census, coming from a study published in 2001 by the Italian National Sesmic Survey and by Regional data. Still statistical derived data are not enough reliable and complete, such they have been analised for other purpouses. To update these data a deeper analysis of vulnerability distribution on the territory a specific investigation campain will be performed in many seismically exposed towns in the Etna volcano, by means of a method named “Guided Interviwe Protocol”7. Vulberability of built environment and population’e exposure data have been implemented in the GIS of Risk-Exposed Building of Nicolosi, together with damage probability analysis.

The purpose of this study is to test how well a particular GIS algorithm would be able to delineate areas around Nicolosi that would be safe from lava flows from any event that could open around the Etna volcano. The accuracy of the algorithm calculations will be tested against physical models and correlated well. In populated areas around volcanoes that produce effusive lava flows, it is important to know the areas that are and are not in danger of being damaged by these lava flows. Assumptions made in the study were that eruptions were most likely to occur within or adjacent to known vent source areas, and that basaltic lavas flow downhill following the path of maximum gradient. Hazard maps were produced using these assumptions that highlighted areas with highest probabilities of being reached by flows. Calculation buffers were then designed for the neighborhood analysis operations. The buffers ware applied only to areas where eruption probability was highest, mostly the areas with the highest vent concentrations. The buffer was then able to identify “safe areas” on the terrotory that statistically should not be in the path of future lava flows. The outcomes of this study can be used to prepare emergency response and evacuation plans before the next eruption on Etna occurs. Historically, eruptions in this area have been shown to produce pyroclastic flows and surge eruptions. GIS was used to delineate the areas most likely to suffer the largest loss of human lives in the event of eruptions of varying magnitudes. Volcanic risk assessment in the study area is also complex because there are various regions of vent complexes, rather than one central vent. Maps were generated of the zones of highest probability of being hit by pyroclastic flows relative to the total number of simulations. The maps produced showed that topography will tend to control the emplacement of pyroclastic flows, with areas of low elevation having the highest hazard probabilities. A map of relative volcanic risk was then generated by combining the hazard probability maps with population density data.

5 RADIOCOMMUNICATION TECHNOLOGIES AND POSITIONING SYSTEM

The danger events stimulate the implementation of reliable technological support in the field of innovative positioning systems via satellite and telecommunication technologies related to the management of emergency and the evacuations or danger events. For this purpose the Radiocommunication technologies have been implemented for the Plan of Civil Protection in Nicolosi and in general in the Etna Mount. In the field of the plan for emergencies, the Italian Amateur Radio (A.R.I.) implemented the installation of the radio-communication network as a multi-user data network for the Central Operative Stations (COS). In particular, the Civil Protection Department displays system for emergencies with a relay installed in a protected area. Furthermore technological equipment also concerns an other relay for the ARI. This is installed in a private house in Vetore Mount. Those places will be properly tested in order to verify the communication technologies with the Civil protection equipments in the emergencies areas, shunting station and massing areas. This technology will connect the Central Operative Station and the Vittorio Emanuele Hospital. The Center is equipped with communication systems and it is directly connected with the competent services all over the territory. The Disaster Management Agencies and the Operative Central Station are organised with client server system, radio station and radio localization (27 MHz and 43 MHz) related to different equipment such as a digital network and APRS, a real-time tactical digital communicatons protocol for exchanging information between the stations covering the Mount Etna and the eastern slope of Sicily. The technologies also concern the APRS (Automatic Position Reporting System) for the integration of maps and other data and display data by using a one-to-many protocol to update everyone in real time. With this technological equipment the Central Operative Station (COS) will be able to easily identify the location of the emergency team in real time and to deploy them to that destination through the more direct channels. The modem GPS technologies and the packet radio guide emergency and operative team into a real-time tactical communications and display system for emergencies and public service applications. The installation of Voip systems and WI-FI guarantee the optimal communication and management of the emergency strategies between the Operative Central Station and the team involved in the site of emergency. The use of the Standard 802.11ib (WI-FI) technology is also implemented for the transmission of files and images via e.mail and for the suitable internet network. This always maintains efficiency, reliability and security of the telecommunication system. Viewing the complex radio-communication technologies at the highest level of implementation, it will have an important advantage in the field of the strategic operations in emergency: the bi-directional informative flow between the COS and the team involved in the site of emergency will always guarantee the updating of the data in real time. For this reason the GIS could be implemented with the realization of a client/server system related to the management of an emergency post event equipment (connected to the Central Operative Station). This will interface with the computer and remote controllers (or remote palm systems). Also it will be possible to share and to update the useful information in real time. This also guarantees the optimal management of the emergency strategies between the Operative Central Station and the team involved in the site of emergency.

6 EUROSOT EVENT 2005

The Event uses the opportunities offered by information and communication technologies to encourage and support the delivery of cross-border public sector services to citizens in Europe, to improve efficiency and collaboration between Italian and European public administrations and to contribute to making Europe an attractive place to test civil protection strategies. In particular the EuroSot Event 2005 had the objective to reinforce co-operation between the community and the member states in civil protection assistance intervention in the event of major emergencies, or the imminent threat thereof, which may require urgent response action.

The objectives of the event were:

- to support and supplement disaster prevention efforts at the national, regional and local levels, including the preparedness of those responsible for civil protection and intervention in the event of a disaster;

[7] Dolce, M. (1996)

- to contribute to informing the public about a disaster;
- to establish a framework for effective and rapid cooperation between european civil protection services when mutual assistance is needed;
- to enhance the coherence of actions undertaken at international level in the field of civil protection.
- to Coordinate the response and recovery actions in emergencies.
- to organize and promote the volunteer organizations work in the field of Civil Protection.

The EuroSot Event 2005 adopted all the available technologies on reinforcing the civil protection capacity of the EU, which focused on how to pool intervention teams and resources during a major disaster related to the sismic risk in the most effective way. The telecommunication identified a number of information gaps. It also highlighted the need for more training and interoperability and the need to improve communication and coordination.

7 CONCLUSIONS

This information will be in real time loaded by the GIS system and database software and immediately made available for all the final users involved in the emergency.

The need for the development of methodologies in the implementation of the network of permanent GPS station and specialised GIS has pushed the research groups to achieve experimentations and applications in this field of studies. As Molak (1997) points out, earlier forms of risk analysis and risk communication tended to overemphasize the role of the expert in "proving that something is not dangerous". However, as he states further, the most important issue is to always make risk assessment transparent to the public with all the assumptions and parameters clearly stated. The thought process that goes into evaluating a particular hazard is more important than the application of some sophisticated mathematical technique or formula, which often may be based on erroneous assumptions or models of the world. Visualization is an excellent tool to overcome these limitations, because it stimulates thought and because it can be used to display uncertainties and the variability of the parameters that influence risk. What lacks most is the interoperability of systems for scientific visualization, image processing, GIS, database engineering, statistical analysis and other methodology. In the search for relevant applications of new techniques for risk analysis, it was discovered that most literature, with a few notable exceptions, only employs static 2D techniques, maybe covering a few variations of risk factors with 3D techniques and DTM. Risk analysis seems preoccupied with numbers rather than figures, more concerned with modelling risk accurately than allowing room for uncertainty and exploration. Unfortunately, this seems to be the nature of risk analysis; in the end, the public wants certainty whether there exists a risk or not, vagueness does not seem to be an option here. Risk analysis is a crucial element in emergency preparedness. Visualization is one methodology that should be part of risk analysis. Visualization is closely linked to GIS. The number of limitations, challenges and possible improvements in GIS with respect to using it in emergency preparedness, as highlighted by Radke et al. (2000), can serve not only as a guideline for future GIS research for emergency preparedness, but also point to rewarding research avenues for visualization of risk and vulnerability.

8 REFERENCES

ALEXANDER, D., A survey of the field of natural hazards and disaster studies, In: Carrara, A. and Guzzetti, F. (Editors), Geographical Information Systems in Assessing Natural Hazards, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1-19. 1995

APELL, United Nations Program on Awareness and Preparedness for Emergencies at Local Level, http://www.unepie.org/apell/ 1999

KOPPOCK, J. T., GIS and natural hazards: An overview from a GIS perspective, In: Carrara, A. and Guzzetti, F. (Editors), Geographical Information Systems in Assessing Natural Hazards, Kluwer Academic Publishers, Dordrecht, The Netherlands, 21-34. 1995

CUTTER, S. L., Living with risk, Routledge, Chapman and Hall Inc., New York, 215p 1993

DAVIS, T. J. and Keller, P., Modelling and visualizing spatial uncertainties, Computers and geosciences (special issue), 23, 4, 397-408, 1997

DCDEP, Risk Assessment in Europe, A summary of the EU workshop on Risk Assessment, Oslo, Norway, 25-26 November 1999, published by the Directorate for Civil Defense and Emergency Planning (DCDEP), Norway, http://www.beredskapsnett.no, 2000

DOLCE, M. Seismic vulnerability evaluation and damage scenarious, US-Italian Workshop on Seismic Evaluation and Retrofit, Columbia University, New York City, 1996

FEMA, Project Impact, http://www.fema.gov/impact/impact00.htm, 2001

FUHRMANN, S., KUHN, W. and STREIT, U., Geoscientific Visualization, Computers and Geosciences, 26, 1, 2000

GAHEGAN, M., Visualization as a tool for geocomputation, in: Openshaw, S., and Abrahart, R.J. (Editors) Geocomputation, Taylor and Francis, London, 253-274, 2000

International Cartographic Association (ICA), Commission on Visualization and Virtual Environments, http://www.geovista.psu.edu/icavis/index.html, 2001

LUNDGREN, R., Risk communication: A handbook for communicating environmental, safety and health risks, Battelle Press, Columbus, Ohio, 176p., 1994

MACEACHREN, A. M., Visualization in Modern Cartography, Pergamon Press, London, 345p., 1994

MOLAK, V., Introduction and overview. In: Molak, V. (Editor), Fundamentals of risk analysis and risk management, CRC Press Inc., Boca Rotan, Florida, 1-10. 1997

LO TAURO, A., COSTA N. "Metodologie di Analisi e DTM per i Piani di Protezione Civile", Sessione 2.1. "Processi di elaborazione di carte tematiche per l'analisi e la gestione del territorio", in Atti della 99 Conferenza ASITA, ", pp. 1387-1392, 2005

OHRTMAN F., ROEDER K, WiFi Handbook McGraw-Hill Professional, 1993

SLOVIC, P., Risk perception and trust. In: Molak, V. (Editor), Fundamentals of risk analysis and risk management, CRC Press Inc., Boca Rotan, Florida, 233-246., 1997

SMITS. P.C. et al. INSPIRE Architecture and Standards Position Paper, JRC-Institute for Environmental and Sustainability, Ispra, INSPIRE AST, Eiropean Commission, Joint Research Centre, 2001, EUR 20518 EN, 2002

A Multifunctional Agriculture for China
Sustainability Aspects Considering the Spatial Dimension

Veronika PRÄNDL-ZIKA

(DI Veronika Prändl-Zika, Oikodrom – The Vienna Institute for Urban Sustainability, Brunhildengasse 1/3, 1150 Vienna, veronika.praendl-zika@oikodrom.org)

1 INTRODUCTION

China is currently undergoing rapid changes in many respects, mostly noticeable in big towns and cities in terms of economic growth and consequentially with effects on social, environmental, infrastructural and political systems there. The rural areas, where still 70 % of the Chinese population is living have not been affected by these tendencies until now. 50 % of the population are still farmers and live on or somewhat above subsistence level. Hence, China's agriculture is extremely small structured with an estimated average size of farmland/farm of about 0.5 hectare and the per capita arable land comprises about 0.11 ha, which equals only one-third of the world's average (see LIAO 2005). *China…is now feeding 22 % of the world's population on about 1.3 billion hectare, which only accounts for 7 % of the world's cultivated land.* (GUO 2002).

The Green Revolution, which has reached China in the late 1970s, supported endeavours of intensification of agriculture and insures a high land-productivity level until today. *China has significantly improved its agricultural technology since 1978. The country has introduced high-yield crops, increased its use of agro-chemicals (fertilizers, pesticides) and agricultural machinery, and expanded irrigation.* (HEILIG 1999) However, in many cases the lack of education and adequate instructions about the use of these new technologies led also to misuse and consequentially to damage of the natural environment.

All these innovations left their marks also in the appearance of the agricultural landscape. Today the very small structured agriculture is not visually perceivable. In many cases the single fields cannot be distinguished from the neighbouring fields, because a whole village/region plants the same crops year after year. In regions with intensive agriculture there is whether any field margin vegetation nor any islands of "wild vegetation" or other landscape shaping elements. Soil is just considered to be economically productive and leaves cleared swathes of land. The aesthetic dimension of a diverse "nature" is not yet considered as a value within the Chinese society. This dimension is "kept" in more or less artificial gardens and in some nature reserves.

Within the China-EU-Project "SUCCESS - Sustainable Users Concepts for China Engaging Scientific Scenarios" (ICA4-CT-2002-10007) a qualitative sustainability approach was chosen for the agricultural analysis in four Chinese villages.

Following this approach the rural areas shall be recognized as important parts of the whole system within the Chinese society and fair rural-urban partnerships with mutual benefits should be the long-term perspective and will contribute to economic stability in rural regions. Rural life as important balancing complement to urban life should get a higher significance and value within the Chinese society apart from just being production base.

2 FOUR PRINCIPLES OF SUSTAINABLE AGRICULTURE – THE THEORETICAL APPROACH

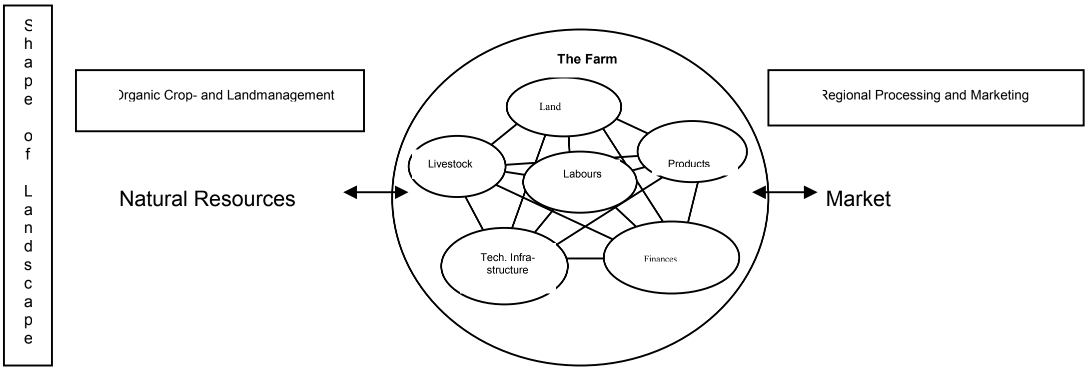
The theoretical basis of the agricultural research within the SUCCESS-Project was influenced by a strong sustainability approach (cp. Levine 2004) which primarily claims balanced ecological concepts and leads to socially acceptable adaptations of economic structures. …strong sustainability recognizes the unaccounted ecological services and life-support functions performed by many forms of natural capital and the considerable risk associated with their irreversible loss. Strong sustainability therefore requires that natural capital stocks be held constant independently of human-made capital. (Wackernagel, Rees 1996) Such unaccounted ecological services include e.g. the appearance of landscapes which cannot be measured in economic concerns at first sight but contributes to economic prosperity if it can be used as tourism potential. Monotonous agricultural steppes will not attract any visitors.

The Four Principles of Sustainable Agriculture (Prändl-Zika 2005) were developed following this approach and served as an ideal and framework respectively for the analysis of Chinese agricultural production and marketing systems. Hitherto sustainability concepts within agronomy concern predominantly the production side of agriculture and differ widely from efficiency oriented approaches as e.g. integrated agriculture to systemic approaches as e.g. organic farming. (cp. Mason 2003) Sustainable marketing and processing strategies as well as structural and organisational dimensions are often not considered in these concepts.

The fact that agriculture is one of the worst polluters indicates that there is an urgent call for action in developing new locally adapted concepts for sustainable agriculture. They should be accompanied by a paradigm shift from a short-term quantitative towards a long-term qualitative approach wherever possible. Following a strong sustainability approach organic agriculture is the core of the concept.

However, organic agriculture should not be regarded isolated but always in relation to local and regional, social and economic circumstances. Within the system of sustainable agriculture the farmer transforms into an entrepreneur organising his farm by crop and land management, by product processing and marketing.

Figure 1: The farmer as sustainable manager between natural resources and the market



The farm is the smallest productive and economic entity in agriculture. Influenced by the agricultural policy and market conditions the decisions what to produce and how to produce are made on the farm.

Sustainable agriculture describes one possible relationship between the use of natural resources and the needs of the market and tries to balance ecological capacities and economic interests.

The *Four Principles of Sustainable Agriculture* form an ideal concept – in the first instance following the intention of protecting natural resources as soil and water – with emphasis on:

1. organic plant production and animal husbandry,
2. regional processing
3. regional marketing and
4. additional income through para-agricultural activities.

(cp. Prändl-Zika 2005)

3 THE PRESENT AGRICULTURAL SITUATION IN CHINA AND SUSTAINABLE FUTURE POTENTIALS

3.1 Current major tasks of China's agriculture

China's agriculture is currently facing big challenges. To feed the biggest nation of the world means an extraordinary tightrope walk between the production of enough food by exploitation of natural resources by technical and chemical means, the production of safe food not burdened with chemicals and other pollutants and the maintenance and protection of a healthy environment and diverse landscapes.

3.1.1 Food security

One important aim of China's agricultural policy is to reach/maintain a high self-sufficiency ratio of primary food commodities as wheat and rice, which presently is considered to be secure (cp. Heilig 1999). However, according to different tendencies and impacts of economic growth in China future strategies for food production and consumption should be developed.

These tendencies are:

- The still growing population of China estimated until the year 2030 will demand for increasing amounts of staple food. (cp. http://www.library.uu.nl/wesp/populstat/Asia/chinac.htm)
- The ever increasing need for land for construction and technical infrastructure will reduce the arable land more and more.
- Erosion and desertification are major dangers in China and therefore another reason of arable land reduction
- The change of nutrition habits in urban areas will demand for new agricultural products which are more land and energy consuming in production.

As a consequence, priority decisions on land use will be necessary and also the question should be posed, which crops and products could deliver the necessary food energy for the nation.

3.1.2 Food safety

Healthy food and clean drinking water are declared aims of the Chinese government. But it is an official fact that food safety cannot be guaranteed in many cases. Lacking of regulations, of controlling measures, of authorised disposal and of adequate education and knowledge in agricultural production and processing of food are the main reasons for misuse of chemicals in these branches.

In addition, both the individual interest of achieving high yields in order to gain more money and to raise the living standard, and the public concern of achieving food security lead to the request of ever increasing land productivity by chemical means. There exists the fallacy mostly among farmers that the more chemicals are applied the proportionally higher yields can be expected. Side effects like chemically burdened crops and drinking water as well as degraded soil are the consequence and compromise food safety.

Hence, in countries like China where food security is at its limits both tasks will enter into competition with each other. The Chinese answer to these conflicting areas was the introduction of "Green Food Production" which seems to be the pendant to the western concept of integrated farming and tries to combine different sometimes contrarious purposes. *It considers aspects of food production, economic viability, producer and consumer safety, social responsibility and conservation of the environment in a well-balanced manner.* (EISA 2001)

This concept intends to hold a high level of productivity but with a more efficient use of agrochemicals. *Using crop protection products as much as necessary, but as little as possible, always applying legally and in a targeted manner.* (EISA 2001)
From a strong sustainability approach the weakness of this concept lies in the fact that universally valid definite directives for are very difficult to compile as different natural conditions demand for different answers. This is also the reason why the controlling of this production system and therewith an adequate quality assurance is almost impossible.

3.1.3 Rural poverty alleviation

The third big task of Chinese agricultural policy is to achieve a better-off life for farmers and the rural population and to narrow the income-gap between urban and rural population.

In this context urbanisation is the magic word in China, which follows the reverse that urban structures and lifestyles wherever transferred lead to good living conditions. In many Chinese cases this becomes obvious in an improved infrastructure. But, as it is not always fitting to rural conditions and often neglecting local demands and styles this strategy is not necessarily leading to long-term improvements. Another measure in this context, which is already adopted in the "Small Town Strategy", is to resettle peasants in urban structures in the periphery of cities or even to found new small cities for this purpose and then hope that peasants will integrate into their new lives. (ACCA 21, 2005)

It seems that rural live in China is mostly just implicated with poverty until now and therefore this situation should be strongly altered or even eliminated. It seems also that its big potentials as e.g. the special socio-cultural life in villages, the cultivation of old local customs and traditions which shape the identity and diversity of a country and influence in its peculiarity the appearance of local landscapes are not yet recognized as complement to urban structures. From a sustainability point of view typical rural structures must be maintained and strengthened. Rural development needs special adapted concepts considering local potentials and abilities with the aim of creating new jobs there.

3.2 Characteristics of Chinese agriculture in brief

During the SUCCESS research 4 Chinese villages – Xiao Qi, Jiang Jiazhai, Bei Suzha and Du Jia – have been visited for agricultural investigation. They represent – besides literature and internet research – the basis for this agricultural analysis. The following listing is based on findings in these villages and gives a short overview over the current state of Chinese agriculture.

The Chinese agriculture is characterized by:

- very small structures in concerns of field sizes and heads of animals, most farmers cannot make use of economies of scale
- mostly conventional production systems which achieve high land productivity; besides the tendency to "green food production"
- low degree of mechanisation which is the reason for low labour productivity
- water shortage as the main limitation in agriculture in many regions
- soil degradation, desertification and erosion problems in some parts of China - mostly in the western regions
- poor structured cultural landscapes; the non-economic value of the preservation of a beautiful landscape is not yet recognised as a public benefit and considered in different measures
- a low income level and consequently low living standards for farmers
- high dependency of farmers on outside forces as e.g. political programmes, big traders, big companies and cooperatives and therefore a weak position on the market
- no direct subsidies for farmers but there is a system of micro credits
- inflexible land-transfer rights, which make it difficult to leave the first sector for the second or third
- the existence of agricultural high-tech zones all over China as a network of further education and for the introduction of new agricultural techniques and for marketing

4 A MULTIFUNCTIONAL AGRICULTURE FOR CHINA

4.1 Preconditions

In future Chinese agriculture should not be seen just as the production basis of food and raw materials in sufficient quantities, but as a sector providing several services for the whole society, like safe food, a healthy environment through a sustainable management of natural resources, an attractive agricultural landscape and a vital rural life cultivating traditions and customs and in sum leading to good living conditions for farmers.

4.1.1 Adaptive education systems

Basic and further education of farmers is the first postulation to secure a safe exposure to agro-chemicals and therewith to guarantee no harms for humans and the natural environment. The network of agricultural high-tech zones in many rural regions in China can support the requirement of farmers' education and training. These agricultural high-tech zones, which are supported by the government and have close links to agricultural universities, should develop efficient instruments and methods for a better knowledge transfer to the village level.

Moreover departments for organic cultivation and processing could be installed there to promote research and implementation in this field and to develop maybe a Chinese type of environmentally sound agriculture lying in its approach between green food production and organic cultivation. For implementation an adaptive education system could be recommended, which is based on conducted trial-and-error processes operated by farmers in their fields. Continuous knowledge transfer and exchange of experiences between farmers, agricultural trainers and scientists should accompany these processes to come to locally adapted solutions which may lead to sustainable concepts.

4.1.2 Subsidies and state aided credits

The major aim of an agricultural subsidy system should be to provide farmers with a reasonable standard of living and consumers with quality food at fair prices. (EU 1992)

In China an agricultural subsidy system would contribute to poverty alleviation of farmers and their allocation should be bound to laws and regulations of environmental standards. Subsidies influence farmers decisions in production to a large extend and can induce farmers to operate an environmental sound agriculture. In addition such a policy will establish the value of healthy, balanced ecosystems as a need for the whole present and future society and therefore justify the financial support for farmers who operate agriculture in this sense.

State aided credits in agriculture should be awarded for investments in small scale holdings with innovative long-term concepts which are embedded in superior concepts on village or regional level.

4.1.3 Laws and regulations

Agricultural laws and regulations have to include the compilation of environmental standards and strategies to fulfil them and set up thresholds for dangerous chemical toxins. (cp. EU Council Directive 91/676/EEC 1991) A legal framework for organic or similar agricultural production systems has to be elaborated and controlling authorities have to be established to guarantee their abidance.

4.1.4 Knowledge about markets

To introduce new crops and value added products, it is elementary to have a good knowledge about markets and possible tendencies in demand. Farmers should identify different markets and existing marketing channels and open new sale possibilities, e.g. contracts with hotels, restaurants, social institutions as schools, hospitals, staff canteens etc. and reduce too strong dependencies from outside forces. If tourism is an option for certain villages agricultural production and marketing should consider this fact in their orientation.

For China where the rural mobility and therefore the access to knowledge about markets are very limited a system of key-persons, who provide the village with those informations, could be set up. These key-persons should be authorised by the village and the local government and would represent a link between the local agriculture, governmental strategies and market conditions with the target to set up new economic networks of fair urban rural partnerships.

4.2 Perspectives

4.2.1 A good living standard for farmers

Major efforts for a better-off life for farmers and the rural population have to be undertaken. Through larger farm sizes (see 1 and 4.2) and within a basic subsidy system, (see 5.1.2) which guarantees farmers to fulfil their subsistent needs, more flexibility in land- and crop management would become possible and farmers would have more options to generate income. Additional services could be offered by them as tourism services and also social services, which are accordable with the agricultural work.

Within the concept of a multifunctional agriculture the farmer transforms from being just simple producer to a manager, who steers all processes on the holding, who cultivates marketing contacts and who is a member of local cooperatives and networks. The farmer with his family comprehends his holding as a small scale enterprise adapting the activities to the personal, infrastructural and financial abilities and natural resources. The self-conception of farmers would change for the better and working in agriculture would get a better image and become more attractive again.

4.2.2 Food safety and environmental safety

Food safety and environmental safety should become the major ambitions in Chinese agriculture delivering healthy food and leaving an intact environment. Quality of agricultural crops and products should take priority over quantity.

A Chinese type of an environmentally sound agriculture could help to reach these targets. It could emanate from the Chinese green food production concept and include more methods of organic farming as conserving soil cultivation, green manuring, wider crop rotation and intercropping systems. The careful exposure to water with sparing water consumption techniques and preferably low eluviation of nutrients and pollutants into the ground- and surface-water should be also major research issues.

4.2.3 Rich structured agricultural landscape

The aesthetic dimension of landscape should be conceptualised as the rural equivalent of urban public space and therefore be understood as an important public resource and future capital. Chinese farmers operating sustainable agriculture that preserves natural structures will become the keepers and “designers” of an attractive landscape. This activity should be recognised as a service by farmers and reflected in financial acceptation by the society

4.2.4 Agriculture and gentle tourism

Agriculture and gentle tourism can be a fruitful combination in rural regions being attractive as to their beautiful landscape and traditions. Such a concept similar to “holidays on a farm” in Europe could be based on the idea of “urban family meets rural family”.

Small scale tourism would allow direct contact and exchange between rural and urban people and fit to a small structured agriculture. By temporarily watching, experiencing and participating in rural lives, farmers' image and esteem of their work would increase.

In China rural regions with their beautiful landscapes, clean air and tranquillity will become more important destinations of recreation for urban people burdened with stress, polluted air, noise etc. in their daily lives. Chinese domestic tourism with its specifications as culture tourism, weekend excursions and holiday tourism will get higher significance and different concepts for tourism in different places will be developed.

A multifunctional agriculture in China should recognize the manifold interfaces with economy and social realms and thereof identify new potentials of farming activities and find synergies with agriculture. New concepts for agriculture should prepare the path to innovative strategies creating new networks of resource management, production, processing and additional services. Such conception of agriculture could contribute to the stabilization of social and ecological structures in rural areas. It needs approval and reward in the public and reflexion in political measures. These should become manifest in fair prices for agricultural high quality products and in financial support for farmers in terms of subsidies, subventions and state aided credits for services provided by them for the whole Chinese society.

5 REFERENCES

Administrative Center for China's Agenda 21 (ACCA 21), China's Agenda 21, White Paper on China's Population , Environment and Development in 21st Century. Chapter 4 – Economic Policies fir Sustainable Develoment, http://english.acca21.org.cn/acca21/news/whitepaper4.htm

Bio Ernte Austria: Produktionsrichtlinien für den organisch-biologischen Landbau in Österreich, Linz 2003, www.ernte.at

Bio Ernte Austria: Rinderzucht im Bio-Landbau, Ernte spezial, Linz 2002, www.ernte.at

Dalkmann H., Vogelpohl, K., 2004. SUCCESS Deliverable 9 - Analysis Report for the SUCCESS Case Study Villages, Potentials for a pathway to a sustainable mobility in Du Jia, Jiang Jiazhai and Bei Suzha, EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Dalkmann, H., Hutfilter, S., 2005. Deliverable 15 – Future Perspective Report for the SUCCESS Case Study Villages. EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

EISA - European Initiative for Sustainable Development in Agriculture, 2001. A Common Codex for Integrated Farming, http://www.sustainable-agriculture.org/codex.pdf

EU Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

FAO 2002. World agriculture: towards 2015/2030, Summary report, http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/004/y3557e/y3557e09.htm

Guo Y., 2002. Impact on China's agriculture and fertilizer market after joining WTO, IFA Regional Conference for Asia and the Pacific, Singapore.

Heilig, G., Can China Feed itself? IIASA 1999

IFOAM - International Federation of Organic Agriculture Movements: Norms for Organic Production and Processing, IFOAM Basic Standards, IFOAM Accreditation Criteria, IFOAM 2002

Levine R., 2004. An assessment of the potential of the villages for developing strong sustainabililty, SUCCESS Deliverable 9 – Analysis Reports Part 1: Theoretical and general approaches, EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Levine R., 2005. SUCCESS Deliverable 19 – Thesaurus of Sustainability, Part 1: General Description, EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Liao R., 2005. Land use planning in the rapid change of China, SUCCESS Deliverable 13 – Schemes to upgrade the agriculture to modern sustainable criteria, 9-12., EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Liu L., 1999. Development of sustainable food production: review and outlook, in: Agro-chemicals News in Brief, Special Issue, November 1999, http://www.unescap.org/rural/doc/GreenFood/NIB-Sept2000_2.PDF

Liu Y.: 2003 SUCCESS Deliverable 6 and 8 – Data Report of the SUCCESS Case Study Villages, EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/,

Mason, John: Sustainable Agriculture, Australia 2003

Prändl-Zika, V., 2004. WP J – Optimisation of the Eco-Economic system of Case Study Communities, Task 2: Ways towards Sustainable Agriculture, in: SUCCESS Deliverable 9, Part 3: Analysis Report of the Village Jiang Jiazhai, Case Study 2 of the EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Prändl-Zika, V., 2004. Schemes to Upgrade Chinese Agriculture to Modern Sustainable Criteria, SUCCESS Deliverable 13 of the EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Wackernagel, M.; Rees, W., 1996. Our ecological footprint: Reducing human impact on earth

Wagner, D., 2004. SUCCESS Deliverable 9 – Analysis Report of the SUCCESS Case Study Village, EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Wagner, D., 2005. SUCCESS Deliverable 15 – Future Perspective Report for the SUCCESS Case Study Villages. EU-Project SUCCESS, ICA4-CT-2002-10007, http://new.china-eu-success.org/ce/forum/deli/

Participation processes in seven Chinese villages towards sustainable future images by implementing small project concepts

Ilse MARSCHALEK

(Oikodrom - The Vienna Institute for Urban Sustainability. ilse.marschalek@oikodrom.org)

1 ABSTRACT

Within the three year research project SUCCESS in the 5th framework programme of the European Commission, Oikodrom was co-ordinating, we have initiated and conducted a participation process in each of the seven case study villages. The processes aimed at the involvement of village dwellers to actively take part in a participatory sustainability research.

For combing the local knowledge of the villagers and the expert knowledge of the scientists we have introduced a negotiation process between the expert-pool of SUCCESS and the village dwellers. One main task within this process was the conception and realisation of exemplary small projects by implementing the sustainability concept in each case study village. The work on the project concepts and the implementation of them were important elements of the participation process, because village dwellers directly could checkout their possibilities and the limits of their engagement. Being aware and interested in their (built) environment is the main aspect of an "emotional co-ownership" with a community.

With the help of participatory methods dwellers articulated their needs and interests and exchanged them with the scientists according to the sustainability concept. The implementation of the ideas which have come up had to be negotiated. First within the villages, who have carried out the ideas and concepts and second within the scientific expert pool. Feed back loops guaranteed the exchange between these two levels of decision making. The final decision was made by the villages themselves. Dwellers enhanced their resources and capabilities and became representatives of their own ideas. Villagers groups that worked on local project concepts, future labs and discussion rounds supported this continuous process.

We have constituted gender and age balanced village groups as continous staff in the villages, consisting of at least two settlement managers and the critical reference groups, both composed by village dwellers. They had regualar meetings in the villages to discuss and decide about the sustainability process in the village and the small project ideas. The constant linkage between the staff in the villages and the expert pool were the responsible team leaders with their bilingual language skills and their scientific expertise as an SUCCESS participant, combined with their local anchor.

Following the concept of sustainability we have worked out selection criteria that should help for the self evaluation process in the villages. The village groups developed proposals and ideas for local sustainability projects following these selection criteria to shortlist the range of collected ideas.

Besides the empowerment effects of participatory processes the SUCCESS study had impact on three levels:

the villages, the policy making level and the scientific level. There were a lot of observed upcoming awareness processes and activities in each of the case study villages, especially concerning their specific local situation. This includes tangible actions like building activities as well as participatory discussions and processes. The SUCCESS project gained much attention by the local governments. The bottom up approach of the SUCCESS project, involving villagers, based on their needs and potentials gave a well observed example both for villagers and the local authorities. The discussion about the local project ideas gave the research team the opportunity to deal actively with the real conditions in the respective village and to see the partners in the village as the owner of their own questions, needs and wishes. In this way, it forced to consider the wider consequences by exercising in a small scale.

2 INTRODUCTION

As the SUCCESS project followed a case study approach with seven villages in six Chinese provinces the research team had to facilitate the involvement of peasants in Chinese rural areas. Following the sustainability definition, which was agreed by the SUCCESS consortium (Levine et. al., 1999), sustainability among others has its local expressions. So one major aspect was the work on the spot in collaboration with the village dwellers in the respective case study villages.

Scientist working together with non scientists and tending to transfer scientific results into praxis follows in principal the approach of transdisciplinary research, although there is still no common understanding of the terminology (Loibl, 2005). Furthermore there do not exist consistent evaluation criteria for public participation methods (Rowe, Frewer, 2000). Adequate tools and methods have to be developed with regard to the specific research questions.

For combing the local knowledge of the villag dwellers of the case study villages and the expert knowledge of the scientists of the SUCCESS consortium Oikodrom has introduced a negotiation process between thiss expert-pool and the village dwellers. The idea of conception and realisation of exemplary small projects by implementing the sustainability concept in each case study village as one part of the initiated participation process was carried out by Oikodrom after long term experience in theory and praxis and is based on the general assumption that inviting the public to be part of decision making processes improves the likelihood that the resulting decision will be considered appropritate (Renn, Webler, Wiedemann, 1995) and find more acceptance.

In the context of a research study participatory generating tangible projects is an innovative approach. It combines two streams that have been seen contradictory. The sustainability negotiation process aims at the involvement and awarenessraising of the dwellers and at the same time compasses information that complement the scientific results.

3 METHODOLOGY

3.1 The Concept of Local Sustainability Projects

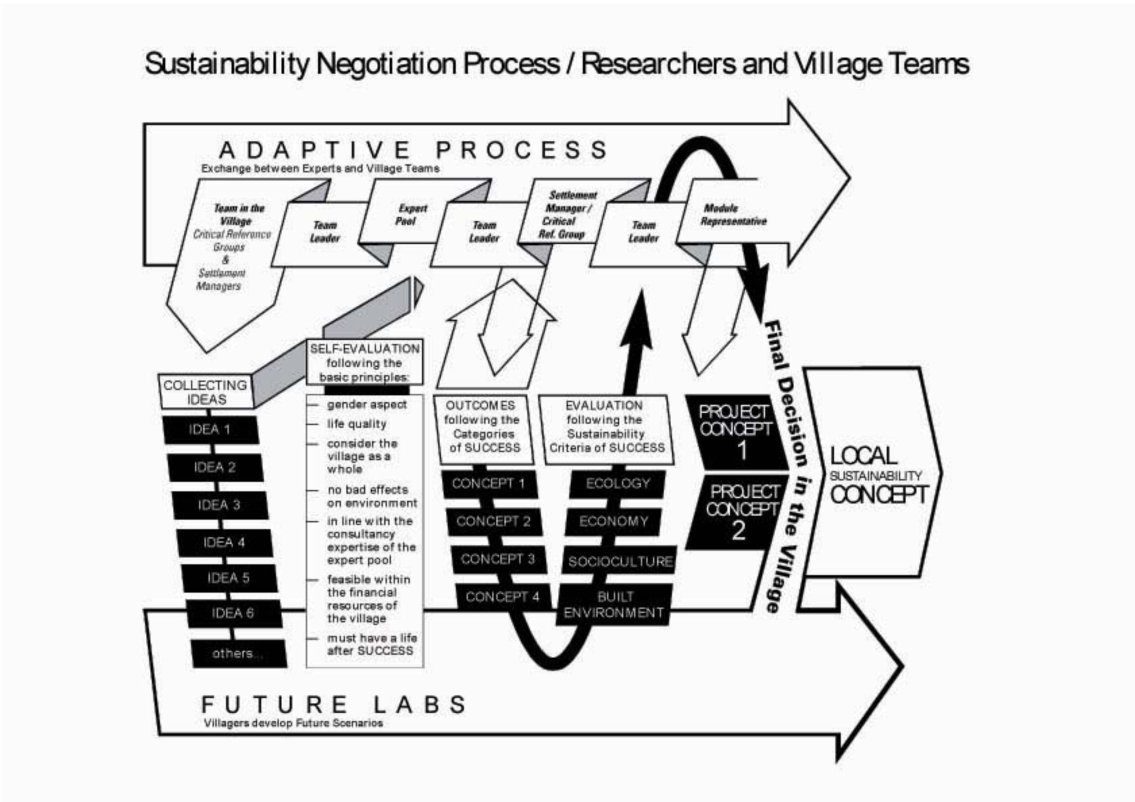
Participation in the sense of empowerment means activating concerned people in detecting their own interests and potentials to achieve both, awareness raising of local conditions and strengthening the capacity for sharing their own topics in "organised efforts and actions that use the instruments of democracy". This so called advocacy (Ondrusek et.al, 2003) is a pre-condition for the self reliance in future development. The intended local sustainability projects which were elaborated and managed by the villagers themselves, had empowered them trough the experience of a successfully process from the first ideas to the final realisation.

The work on the project concepts and the implementation of them were important elements of the participation process, because village dwellers directly could checkout their possibilities and the limits of their engagement. Being aware and interested in their (built) environment is the main aspect of an "emotional co-ownership" (Dumreicher, Kolb, 2003a) with a community. It is the specific social actions that produces this kind of vicinity which creates the relation to a village or district. The debate about the small projects always contained aspects of infrastsructure which concerned finally the village as a whole. In many cases one aspect had led to another, and brought up by this latent needs that had to be discussed. For example building a community house in a village, raised the question of where to locate the new building. Defining a place which was finally accepted by all villagers had led to an unuttered conflict about illegally but accepted occupation of this (public) place by one family, and so on.

The discussion about the local project ideas gave the research team the opportunity to deal actively with the real conditions in the respective village and to see the partners in the village as the owner of their own questions, needs and wishes. In this way, it forced to consider the wider consequences by exercising in a small scale.

The Sustainability Negotioation Process

With the help of intercultural communication methods (Marschalek 2005b), dwellers articulated their needs and interests and exchanged them with the scientists according to the sustainability concept. The implementation of the ideas which have come up were to be negotiated. First within the villages, who have carried out the ideas and concepts and second within the scientific expert pool. Feed back loops guaranteed the exchange between these two levels of decision making. The final decision was made by the villages themselves. Dwellers enhanced their resources and capabilities and became representatives of their own ideas. Villagers groups that worked on local project concepts, future labs and discussion rounds supported this continuous process. For the researchers, the concepts gave examples of feasible concrete measures that the participants could discuss along the line of sustainability. Developing the idea of a small project was important for both processes in the SUCCESS project, the local participatory process as well as the scientific process. When developing the projects, both sides could show their view and could exercise reciprocal auditing (what is the expert view on the proposal that comes from the villagers? what is the villagers view on the comments from the expert-group?). The adaptive negotiation process increased the effectiveness of the research and improved the meaningfulness of the information which had been generated. In this way, the findings in the scientific process were involved in the settlement process.



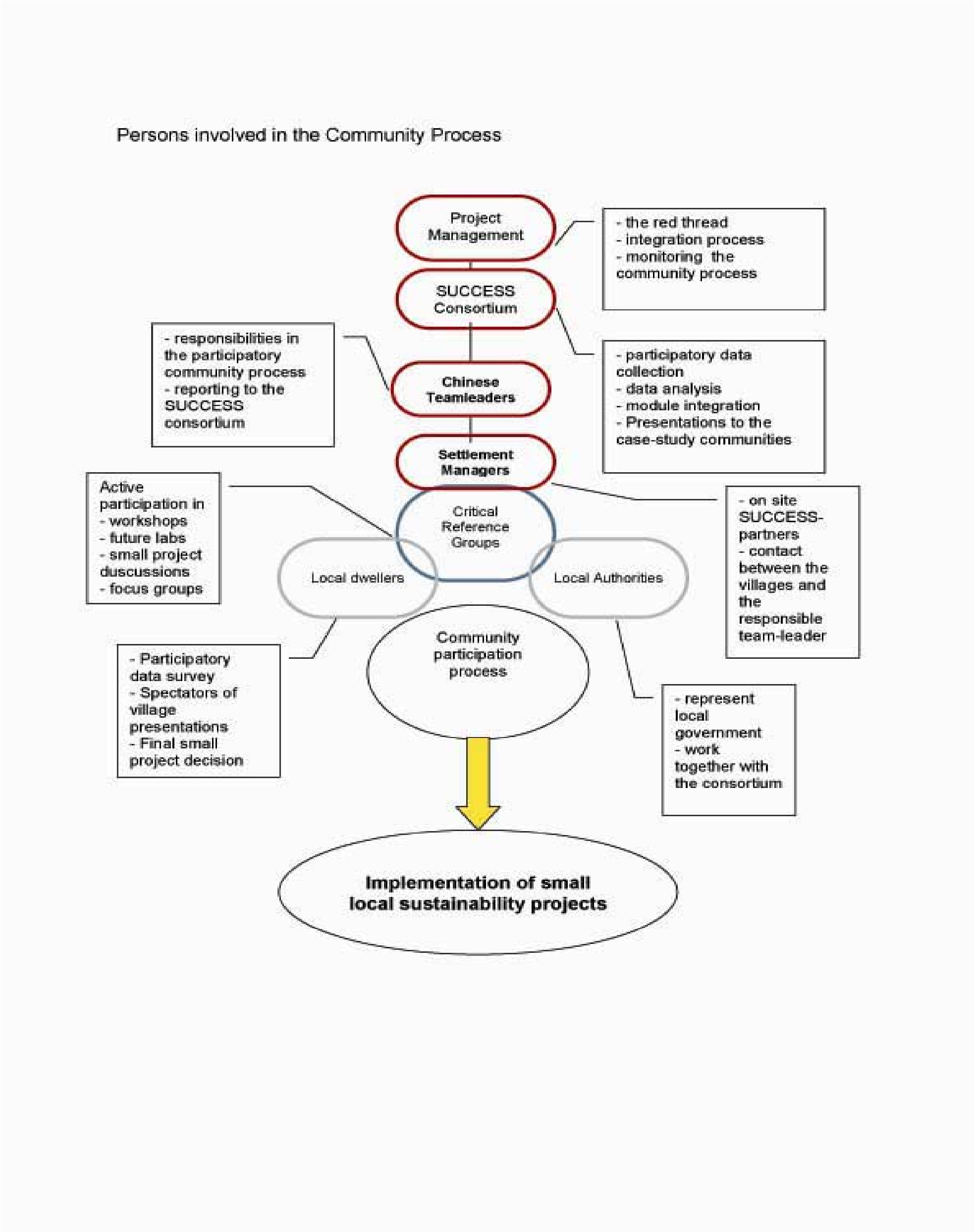
Graphic 1, Oikodrom © 2003

3.2 Persons Involved in the Process

3.2.1 SUCCESS Team leaders

The leaders of the teams in each case study village played a significant role within the SUCCESS study. Besides their specific expertise in the pool of experts they had many other tasks such as selecting the case study villages. Much preparation work had to be done to inform village representatives about the project and to get the necessary local commitment. The team leaders conducted the participatory process in the village. They nominated the settlement managers and helped in building up critical reference groups. They initiated regular meetings of the groups which were organised by the settlement managers. The team leaders were in constant contact with the village teams and gave regular reports to the scientific co-ordinator about the work progress in the village. At the integration conferences, where all experts took part, the team leaders conducted village related working groups and communicated key information gathered from the village dwellers. The team leaders were also responsible for communicating back the results of the research to the villagers.

In addition, the field study visits of the researchers were organised by the team leader with support of the village teams. With their language skills of Chinese mother tongue and excellent English and their scientific expertise combined with their local anchor, they acted as communication bridges between the local dwellers and the SUCCESS pool of experts during the negotiation process.



Graphic 2, Oikodrom © 2004

3.2.2 Settlement Managers

In order to carry out the participatory process, every SUCCESS village had at least two people (a woman and a man) who were on site SUCCESS-partners. The settlement managers were responsible for facilitating the working relationship between the villagers and the responsible team-leader, ensuring good communication. They were in constant and direct contact with the team leaders and were well accepted by the village dwellers. The settlement managers were responsible for the transparency of the participatory process in the villages and the documentation of the villagers meetings.

Critical Reference Groups

Every village had established a so-called critical reference group, consisting of 8 to 25 village dwellers. The installation of these village groups led to the identification and involvement of the people concerned. It enhanced the relevance and creativity of the new agreed actions and the commitment to further research them and implement them. In this way, the disciplinary findings of the various work packages could be integrated to the settlement process.

The critical reference group assisted the research process by attending the consultation meetings and providing helpful feedback. They had regular meetings in the village to discuss and decide about the sustainability process in the village and the implementation of the small project ideas. There are ninety records of such meetings. At the end of the project, members of the critical reference group were given a certificate confirming their participation.

3.3 The Workflow of the Process

The phases of the settlement process followed the general timetable of SUCCESS and used

the face-to-face-conferences of the SUCCESS consortium for developing the inter- and trans-disciplinary negotiation process. The project was organised according to the following stages:

The villagers expressed their interest in the process. This phase had been accomplished before the start of SUCCESS. Every village had prepared a written document showing its interest.

Basic information: the settlement dwellers were informed about the SUCCESS study, about the role and expertise of the scientific expert pool as well as of their own role. The information also contained the limitation of SUCCESS ("this is not a development project") and expectations from the village. This information was either given to a group of representatives of the village or during a public assembly.

The process of ideal-making. This process was the core activity during the SUCCESS project. It involved the dwellers according to the rules of the critical reference group. It aimed to define the potential of the settlement in relation to sustainability and defined the local topics of such a process starting from the question “What to maintain and what to change?

The phase of group meetings. These groups developed proposals and ideas for local sustainability projects according to the following selection criteria:

Raise the life quality in the settlement

Be able to put into practice at the village level

Fit into the sustainability concept of SUCCESS

Concern public (common) space

Fit into the official regional policy

Be an example of good practice for other villages

Have a life after the end of SUCCESS

The negotiation process (see graphic 1) between the expert-pool of SUCCESS and the village looked for ways in which both knowledge bases, the local knowledge and the scientific expert knowledge, could be combined. This process used proposals for activities and projects that the village had worked out, including defined responsibilities and the time frame.

As the agreement of all dwellers was important, the last step of the negotiation process involved in many cases the whole village.

Implementation phase: After finishing the negotiation process all villages began the implementation of the decided projects within the duration of the study. At this stage all local projects are effectively implemented with options for further activities.

From participation to self organisation

In this phase dwellers themselves continued the process which was initiated and conducted

by the project team. The dwellers have experienced fields of activities and entered thereby new "spaces of opportunity and possibility" (Levine et. al, 1999). The motivation to engage themselves in such a process comes out of the successful participation and the gained awareness of the dwellers about their potentials and possibilities. This process in one community can be a starting point and acupuncture point in a certain region for the development of a civil society.

4 RESULTS

4.1 Local Projects relating to Village Typologies

Through the participatory elaboration, the agreed small projects illustrate the village patterns and the identified needs of the village dwellers and also correlate with the village typology as clearly stated in the final paper (Liu, 2005).

The following table shows the three types of Chinese villages we have encountered within the SUCCESS study and the effectively implemented small projects in each of the case study village.

Village type	Village name	Implemented project
Agriculture-based communities	Du Jia	- Solar panel - Biogas pit - Basketball court
	San Yuan	- Dongba evening school - Entrance door to the village
	Jiang Jiazhai	- Concrete roads within the village - Garbage boxes - European Trees
Rural-urban partnership communities (peri-urban communities)	Bei Suzha	- Internet/computers for the village school
	Chi Qiao	- “(Big)Hands-in-(Small)Hands” meaning frequent friendship parties of collage students (Big-Hands) and the children of Chi Qiao primary school (Small-Hands)
Eco-tourism based communities	Xia Futou	- Public bath house
	Xiaoqi	- Drink water system completed (pumping station, water storage tower, pipes to the households

Table 1, Village Typologies

The table above clearly illustrates the significant outputs concerning the replicability of the results.

In the peri-urban villages like Bei Suzha (Hebei province, south of Beijing province), that are likely to be integrated into the city , the villagers have a strong wish for a better education. Bei Suzha is located at the edge of Hengshui, the prefecture city that is nowadays 50 times bigger in its area and 20 times in its population than it was in the 1960es. In Bei Suzha, the villagers decided through the process of secret election to invest in new computers and internet access for the school. This correlates to the outputs of other participatory methods, such as the photo-interview: Education was crucial within the surveys. "For the young generation, the school carries one more important significance: it is the place for good education, it is also a basis for the future: learning Putonghua, is learning the right Chinese language at school for the professional biography". (Dumreicher, Kolb, 2003b). Having good teachers that are able to speak Putonghua and a good school infrastructure was the wish of the villagers so that their children could find well paid jobs in the city.

Comparable results were also obtained in Chi Qiao (Shanxi province, middle China), another peri-urban village, close to the big city of Taiyuan. The local project carried out by the village group was a co-operative education project with the University of Taiyuan and the school of Chi Qiao to provide better education and job opportunities.

In fact the majority of the Chinese rural population tends to have job options in the cities[1], (Stockholm Environment Institute, 2002) but for most of them this is not possible – or at least at the time of the project. In an agricultural based remote village like Du Jia (Yunnan province, Western China), which is connected with a 7,5 kilometres sand road to the next township (with 5.000 inhabitants) and 50 kilometres away from the county, which is the next bigger city and another 25 to the province capital, the situation is completely different. The arable land of Du Jia is very limited as well as the possibilities for further income sources because of the lack of access to a market. The village dwellers have to deal with the existing resources. One possible solution for them is to intensify the agricultural production, another one is to reduce labour force and costs to set these resources free for other applications. The generated ideas for small projects by the villagers were very different to those of Bei Suzha and Chi Qiao. Suggestions were: The covering of the village drink water tank, better waste management, buying processing machines, raising of livestock etc.

One further outcome of the relatively small amount of money provided by the SUCCESS project was the effect of what we call “seeding money”. That means for the villages a negotiation basis with government representatives at different levels for further support. This was also the case in Du Jia. With the SUCCESS local project money together with financial support of the government Du Jia was able to build solar energy panels and biogas pits for each household. The thereby saved energy and working labour (for example because of no more necessity of collecting fire wood for cooking and heating) opened new capacities for further development ideas.

In San Yuan, another agricultural based village, also located in Yunnan province , but in the northern part, the situation is similar to that of Du Jia in many aspects, and only differs because of the cultural origin of this village.

The majority of the village dwellers is represented by the cultural minority of Naxi people, affiliated to Dongba religion, which is strongly connected to nature and environment. Until the cultural revolution, the village also had a high local value for its wood products. With the upcoming tourism in that region and the present danger of extinction of Naxi language and culture, the possibility for a local project led to different results than in Du Jia, although San Yuan still lives at about 70 % from agricultural production. All project suggestions, like training classes for Naxi language or (re-)building the tree tower, which is a symbolic relict, contained the strong wish for keeping or re-activating the cultural and religious live. Suggestions comparable to Du Jia like building biogas pits – which is nowadays strongly pushed by the national government in China (People's Daily Online 2005[2]) – had different implications

[1] "Most migration in China is to urban areas. During 1980–1998 urbanisation levels grew from 19 to 30 percent —a net movement of well over 100 million people. The level of urbanisation is forecasted to grow to 45 percent by 2010 (United Nations Team in China, 2000). Thus, within the next 10 years, over 200 million people will move to the already stretched urban areas." (China Human Development Report 2002)

[2] China will expand the scope of six categories of small rural projects: water-efficient irrigation, potable water supplies, road building, **methane production facilities**, hydroelectric plants and pasture enclosures. (Report on China's economic and social development plan)

in San Yuan: The environment protection and the saved spare time which could be spent for Naxi education, especially for women, who are usually obliged to collect fire wood, were the two main motivations.

The village of Jiang Jiazhai is in its situation between a peri-urban village - 4 km away from Yangling, where a famous agricultural university is situated - and an agricultural based village with incomes for the most part from agricultural production. We call this subtype: community based on intensive agriculture. The numbers of agricultural production have to be understood in a different way from other agricultural based villages. In Du Jia for example the approximate 100 % of agricultural production means a subsistence economy. This is not the case in Jiang Jiazhai. It has intensified milk and greenhouse production, which cover the main income sources. The dairy products and vegetables find a booming market in the city nearby. As there is no industry, only few villagers, offering services remote to Yangling.

Proposals for small projects in Jiang Jiazhai were: To built a training centre for high tech agricultural knowledge, to improve the roads inside the village, to prepare rubbish boxes, and to buy some European trees for planting at the side of the main road.

Here we see the combination of the wish first for improving education, precisely the know-how about agricultural production and second for raising life quality in the village. To get rid of the rubbish, get no more dusty boots on muddy roads and improve the appearance of the village with exotic trees reflect attitudes of an urban life style, which the villagers are aiming at, despite keeping an agricultural production which is very profitable for them.

Two of the case study villages represent the third type of Chinese villages we have faced within the SUCCESS study. Xiao Futou (Henan province, middle China) and Xiao Qi (Jiangxi province, Southern China) are eco-tourism based communities.

According to the SUCCESS Strategic Paper (Liu, 2005) the main characteristics of villages of this type are: Improve daily life quality, improve hygiene and sanitary condition, maintain the village pattern within the surrounding landscape, and the local traditional style. In the two respective villages, the small project ideas were the wishes of the dwellers .

In Xia Futou, that is situated at a river which has a recreation area which attracted many tourists, most of the undertaken activities were aimed at modernisation. In an exemplary participation process, that united the former split between the up hill and downhill parts of the village, they have together built a public bathhouse.

Xiao Qi which is a village located within an appealing landscape, is a booming tourist area with a very traditional architectural style. Keeping this nature and tradition by coinstantaneous upgrading of the living conditions led to an extension of the village water supply system within the small project budget.

4.2 Impact of the participatory work on small projects at three levels

4.2.1 Village level - tangible and intangible changes in the case study villages

In general the scientific and participatory work in the seven case study villages had a good take-up by the villagers. With the help of the local team leaders the research teams could find a basis of confidence and readiness for an efficient co-operation in each case study village.

There were a lot of observed upcoming awareness processes and activities in each of the case study villages, especially concerning their specific local situation.

A lot of new space was created in the villages. Public space and community buildings which could be used for manifold common activities. Building activities also initiated new spaces for holding open conflicts concerning labour, money, communal shares

or ownership structures. Other tangible actions accompanied the generation of the small projects (like picture boards, cleaning activities etc.). Many common activities were set this way which further led to fruitful debates among the villagers.

Awareness raising processes concerned many societal and economic issues, but also local potentials of the villages. The self-confidence and the protection of their own culture and idiosyncrasies became more evident in the villages.

Villagers also became aware of their own present and future. They highlighted their self-value and the importance of a sustainable future.

With the help of the participatory data survey methods (Jones, 1996) of the research team, the common presentations and workshops and the ongoing discussions in the villages, the villagers got new ideas for decision making and involvement of the dwellers. Equity and transparency were recurrent issues. This observed increasing of social capital was a precondition for the selforganisation in the villages. The small projects would have never been implemented without the contribution of time and labour of the village dwellers themselves. So their organisational skills, teamwork and effort became manifest in their specific projects.

4.2.2 Policy making level and regional development

During the field work of the research teams and in the ongoing work of the local team leaders there was continuous contact between officials and SUCCESS consortium members. Village leaders and other village representatives often accompanied the meetings and presentations and built the bridge between policy and research.

The SUCCESS projects gained much attention by the local governments on township level and also on county level.

Despite of the concrete information about the project activities, the villages became all in all better known by officials and other communities which allowed for better basis for negotiation in the specific region. The case study villages got more assistance, either in becoming model village (Three of the seven case study villages became ecological model villages.) for implementing regional based concepts (like tourism), or in financial support for certain projects.

The SUCCESS project showed examples of many kinds of activities on the spot, which attracted much interest, also from the policy making level. The researchers, accompanied by village leaders had many meetings with local government representatives and gave presentations of their findings. The such a kind exchanged information gave much insight and new ideas on both sides and led to a lively discussion considering the sustainability concept.

The bottom up approach of the SUCCESS project that involved villagers and was based on their needs and potentials gave a well observed example both for villagers and the local authorities. Innovative democratic and empowerment strategies (like election secrecy in Bei Suzha or open villager's discussions, focus groups, especially with marginalized groups etc) implicated much awareness for the importance of participatory and transparent decision making. The benefits of villager's involvement and equalized strategies that considered the complexity of sustainable development became obvious to policy makers.

The implemented small projects were in line with regional development strategies. So village representatives and teamleaders found a better negotiation basis, combined with the above mentioned effect of "seeding money", the villages could implement governmental intentions adapted to their local situations.

By this the selected case study villages underwent an upgrading in many concerns. They got more attention and in further consequence more support from outside the villages, especially from the policy level. They provided a basis for the replicability for other villages and regions and became this way a field for innovations and attempts. This meant new development possibilities especially for remote villages (like Xia Futou or Du Jia).

4.2.3 Scientific level

During the field study visits the researchers stayed and worked together with their colleagues and the villagers and created this way a living learning process for both sides. Disciplinary information was available at first hand and could directly be exchanged. The researchers identified many interfaces to other disciplines and carried out innovative methods for the integration of the different results. In the field the scientist worked together in multidisciplinary teams and prepared common presentations of preliminary results in each case study village at the end of their visits.

The presentations and discussions with the research team and the villagers gave the opportunity to check if both sides had been well understood. Results gained this way, guaranteed a more precise perception of the current situation.

Different data survey and integration methods were used and brought new experiences for other disciplines. The varying questions brought a wider understanding in linking these questions together. So far neglected data could become more relevant in exchange and in combination with other disciplines.

The researchers of the SUCCESS study became aware of the participatory impact activated by their research and noted the higher quality of their results (Marschalek, 2005). Participatory data survey methods (like PRA method and photo-interview) and negotiations concerning the small projects not only activated the villagers, but also allowed a deeper insight for the researchers.

The implemented small projects were the final results of a long lasting negotiation process within the villages, as well as with the scientists. Villagers had to vote for the projects and lay their priorities on them. That means that the researchers could identify what was the villagers‘ main focus. The carried out data and analyses were the source for comparative studies between the villages and finally defining a typology of Chinese villages.

4.3 The Example of Du Jia

As introduced above, Du Jia is a small village in a very remote area in the Southwest of China. In 2004 there were 97 inhabitants living in 22 households in that village. Only a few steps away there is the neighbour village Na Ha with 68 inhabitants, living in 17 households at that time. These two villages had been united until the Cultural Revolution. At the beginning of the SUCCESS project, villagers and leaders of both villages had asked for involving both villages in the research process. So the first visible impact of SUCCESS was the common work with both villages. At meetings, presentations and discussion groups (for example women's group) dwellers of both villages took part. Also for the negotiation process concerning small project ideas, both villages were involved.

During the first visit of a small multidisciplinary research team in 2003, containing participatory data survey, group discussions and presentations, the villagers collected preliminary ideas for small projects. The outcome was a list of ten suggestions, which fit into the selection criteria catalogue, but were not ranked or evaluated in detail so far.

At the final presentation of the research team all villagers were informed about these ideas and had the first opportunity to negotiate about them. One example was to buy a common truck, that could be owned by the two villages and support the dwellers to carry their goods to the local market. Not all villagers appreciated this suggestion. Out of this discussion a spontaneous working group of villagers who were interested in that project was arranged. The research team member with the expertise of transport and traffic participated in this group to discuss the possibilities for a group investment of interested people. So this proposal was deleted from the common agenda of small project ideas but was implemented by a smaller group of villagers.

Another suggestion for a small project was the creation of a common public space; A meeting place with additional facilities like a public shower. Most villagers supported this idea, found it "reasonable, but not practicable" (Huang, 2004). They could not imagine the realisation of it and found other topics more urgent, like biogas pits for each household and solar panels. Implementing these ideas would have made the idea of a public shower obsolete, because each household could have had its own shower place then, that was the argument of the villagers.

Another idea was renovating and enlarging the little school building, not only for the lessons but also for holding villager's meetings there. So far, only one representative of each household could join such meetings, due to the lack of space. In consultation with local authorities, villagers got the information, that the school which only had just six pupils at that time, should have been closed and another bigger school for all concerned villages should be built at the township.

The narrow roads within the villages and the ford across the small river between the two neighbour villages were also a topic; To ease the communication between the villages, to widen the roads and to bridge the river. Such building activities were not feasible within the small project money and at least could not meet the intrinsic needs of the dwellers: They wanted a truck to be able to cross the village, but the narrow roads between the houses did not leave enough space.

After the field visit, some ideas were deleted this way from the list; others were discussed in many more villager's meetings after the departure of the research team. (There exist 30 records of villagers' meetings in Du Jia/Na Ha within the SUCCESS period.)

Among the researchers those ideas and inherent findings were presented and discussed at the following SUCCESS integration conferences. The team leader was responsible to feed back the results to the village and in turn to deliver actual information from the village to the researchers. In two further conferences of the consortium and another three visits of research teams in Du Jia, the negotiation process was continued.

As mentioned above, the visits of the researchers and the activities in the village attracted much interest from local authorities. They visited the research team during their field visits, had several meetings with village leaders and the team leader. Finally Du Jia was nominated as an ecological model village. For every installed biogas pit the villagers got a subsidy from the government that they could afterwards invest in solar panels. After two SUCCESS project years every household was equipped with solar panels and biogas pits. “This significantly reduced the cutting of firewood (now each household may need only 200—500 kg of firewood each year, which is ten times less than they used to). What is more, the use of methane-generating pits made the environment cleaner. The warm water from solar panel greatly improved the hygiene of people, particularly that of women. Here in Du Jia the renewable resources successfully replaced the unrenewable resources and they have brought a new face to social life. Du Jia has set up a good example to the villages around in this aspect” (Huang, 2004).

“People never can be convinced by words”, Huang Jiansheng, the team leader of the Du Jia case study has stated at the beginning of the SUCCESS project. They need visible results before they are confident to participate with engagement.

After much attention was gained from outside and their small project idea was successfully implemented, the villagers decided to invest in building up a common space and community center. This idea had been already discussed before.

According to the reawakened relation between Du Jia and Na Ha, it was obvious that this space should be located right in the middle between the two neighbouring villages.

A year before, already during the first field study visit, youngsters had expressed their wish for a common playground. They had shown the research team the deserted basket ball yard at the very edge of Du Jia, a long distance away from Na Ha. They had taken photos of possible places between the two villages and had mentioned the necessity of land conversion because of the paddy fields between the villages. This precondition led to far reaching discussions, which the team leader had to facilitate very carefully. Latent conflicts about the usage of the designated place came up trough the negotiation process. After questions about property and usage rights had been solved, the dwellers of the two villages finally built up a huge flat place in front of a new community house. This place could be used as playground for playing basketball or other activities and for celebrating feasts and holding villager’s meetings, which had been expressed by the villagers several times before.

Also the wish for the possibility for celebrating together had became obvious at the first arrival of the research team. That day happened to be the birthday of one researcher and the team brought a cake and little wine. After a short time curious people of both villages had assembled in the small house of the host family to join the spontaneous party. More and more visitors came to sing and dance together with the researchers. It was the first oportunity other than a wedding or a funeral that they celebrated all together. Every other evening of the field study visit the villagers wanted to continue the feast, once in the kitchen of another host’s house, once in the living room right after the mid-term presentation of the research team, once in front of one house, lightening a big fire. For the first time they had additionally invited dwellers of other villages from up the valley.

Until now, due to the newly created common public space people of Du Jia and Na Ha are celebrating feasts together. On the last China’s “Respecting the Old” – holiday they organised a rich party. “They also invited school teachers from the township to join the dinner party, have a basketball match between the villagers and the teachers. These teachers also bring some gifts to the old persons in Du Jia. Such event is the first in the history of Du Jia. It is also unique among all the nearby villages. What is more, they organise the event independently, without our suggestion or help.” Huang Jiansheng said in his recent e-mail, still recording the progresses in the village although the SUCCESS project has already ended.

5 SUMMARY

Designing and implementing a participatory research process needs a lot of effort and time both from researchers and from the involved people, but brings much impact on both sides, too. For the multidisciplinary research team (not only for social scientists) the results were gained on first hand and could be continuously evaluated in the frame of a negotiation process. Concerned people underwent the experience of successfully participation in decision making processes and became more aware of their potentials and intrinsic needs. Within this empowerment process they improved their skills and capabilities towards the self organisation in their specific situations.

To establish a successful participation process a set of pre conditions was needed:

The agreement and the will of local authorities to support the process. Village leaders of all seven case study villages had signed letters of interest before the start of SUCCESS.

On the other hand the trust of the village dwellers in their village leaders was important. Villagers that articulated good governance of their villages leaders were more motivated to engage themselves in such a process.

Responsible persons with specified functions within the process had to be defined.

The constitution of critical reference groups guaranteed the procedure of the ongoing negotiation process which led to further participation of more people concerned. Finally the small project could only be realised with the acceptance and the support of all villagers.

The settlement managers were the constant bridge to the team leader and through them to the research consortium. They were important for organising the meetings and holding the red thread, especially during those periods of time, when the process could not carry out visible results.

The team leaders of the respective village were the key persons of the process. Depending on their communication basis in the village and their personal engagement the process was equivalently fruitful. The better and more regular the contact the more intensive was the involvement of the dwellers.

A set of framework conditions and criteria for self-evaluation had to be communicated to sensitise both villagers and policy makers for the concept of sustainability.

A predefined sum of money was allocated for the small projects to ensure their realisation and a story of success for the villagers.

The transparency of the decision making process and the assignment of the project money was crucial for the whole process.

The villagers generated future images. These defined perceptions of their future lives will enable the villagers to trace their ideas step by step (backcasting).

Many different small projects were carried out in the seven case study villages according to the characteristics of the specific village type. Despite of these ideas the importance of public space became evident in all case study villages. Some villages (like Du Jia) have implemented community places within the small project money. Some villages, as an effect of the participatory process became aware of the importance of community life and found innovative arrangements to create new spaces of possibilities (like Jiang Jiazhai, where an empty shop was placed by the owner at the villager's disposal as a meeting place). Other villages are still working on concepts of community centers, including education and free time facilities.

It became obvious that places need a social meaning and people who feel responsible for them. Creating such new spaces with involved people could open up new options.

In the meaning of sustainability the projects not only addressed ecological and economic aspects. The highlighting of social and cultural aspects was of great importance in each case study village and should be considered even deeper. “Social sustainability determines how people conceptualise their environment, their relations with nature and their attitude as well as the way of behaviour towards nature. And it is important that people recognise their present value. So training, education and self-awareness of the local people are important for the future.” (Huang, 2005) The SUCCESS project has taken first steps in this direction.

6 REFERENCES

DUMREICHER, H., KOLB, B. Seven Theses on Town and City Quality, (pp 241 - 262), in: BENZING, B., HERRMANN, B. (Eds.), Exploitation and Overploitation in Societies Past and Present, Münster. 2003a

JONES, C.. A compilation of PRA methods, Institute of Development Studies, University of Sussex, 1996

LEVINE, R. S., et.al. The Sustainable City of the 21st Century: Westbahnhof, Vienna – Theory and Practice, XXth UIA Congress, Beijing, 1999

LOIBL, M.C., Spannungen in Forschungsteams. Hintergründe und Methoden zum konstruktiven Abbau von Konflikten in inter- und transdiziplinären Projekten, Wien, 2005

ONDRUSEK, D. et al.. A Reader for Non-profit Organisations, Bratislava, 2003

RENN, O., WEBLER, T., WIEDEMANN, P.(Eds): Fairness and Competence in Citizen Participation. Evaluating Models for Envrionmental Discouse; Kluwer Academic Publishers, 1995

ROWE, G., FREWER, L.. Public Participation Methods: A Framework for Evaluation, in: Science, Technology and Human Values 20/4, London, 2000

Stockholm Environment Institute.. (In collaboration with United Nations Development Programme - UNDP). China Human Development Report. Making Green Development a Choice. China Oxford University Press, 2002

WEB REFERENCES:

Dumreicher, H., Kolb, B. 2003b. Socio Cultural Aspects of Beisuzha. Deliverable 6. 2005-10-20
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-18.2056175115/

Huang J. 2005.WP L, Sustainable Regional Economy, in Analysis Report, Part 7, Dujia, 2005-12-15
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-13.2325187196/

Huang J., 2004. WP L, Sustainable Regional Economy, in Perspective Report, Part 7, Dujia, 2005-12-15
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-13.1565794028/

Liu, Yonggong. et al. 2005. Recommendations for achieving Sustainable Development of China's Rural Communities. SUCCESS Strategic Paper 2005-10-20
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-18.0073898941/

Marschalek, i. .2005. SUCCESS Impact Summary, in Perspective Report. Part Theory, 2005-12-15
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-13.1565794028/

Marschalek, i. .2005b. Tool for Intercultural Methodology in Research. Deliverable 17, 2005-10-20
http://new.china-eu-success.org/ce/forum/deli/folder.2005-10-13.7198762504/

Report on China's economic and social development plan. People's Daily Online. 2005-04-01
http://english.people.com.cn/200503/15/print200050315_176927.html

Participation On The Wire
Internet based Participation in urban and regional planning in Germany

Tilmann SCHULZE-WOLF

(Dipl.-Ing. agr. Tilmann Schulze-Wolf, Ingenieurgesellschaft *entera*,
Alte Herrenhäuser Str. 32, D-30419 Hannover, schuwo@entera.de)

1 INTRODUCTION

The future role of participation processes by planning organizations will become significantly more important within the near future. European Union directives and according national legislation indicate a dramatic increase in public paticipation, e.g . the directive on public participation or the the water framework directive.

Two distinctive methods are used for the participation procedures in general: On the one hand there is the discussion orientated type of informal participation. This serves to capture public interests and wishes as well as their creativity in the run-up to the planning process. This occurs most generally with small-area planning projects which have a direct influence on the living environment of the citizens. Usually this type of participation is moderated and allow a full exchange of opinions between all involved parties.

On the other hand there are so called formal planning participations in use which occur with large-scale planning projects (such as road network, airport construction, regional planning schemes etc). In contrary to the discussion platform mentioned above the role here is to communicate the objections, concerns and suggestions regarding a project between individuals (or stakeholders) and the planning authority. As a rule, a general, open discussion does not take place here and it is a more or less one-to-one communication. Very often the results of this participations are verified by jurisdiction. In comparison to the discursive proceedings, extensive planning documents must be presented in a more or less standardized form giving an opportunity to the involved parties to view and comment upon them.

This type of formal participation procedures is the subject-matter of this paper.

2 INTERNETBASED PARTICIPATION

Planners and politicians agree that due to huge personnel and material cut-backs in the public sector, future participation projects can only be efficiently carried out through massive utilisation of the internet. As a result of the increased availability of PCs and the internet in the public and private sector, the communication possibilities and habits of the population have changed. These transformations in communication technology must be recognised and acted upon by authorities in order to prevent a situation of communicative isolation.

For the conveyance of views and considerations regarding planning processes over the internet, there are only a few comprehensive and tested methods available.

2.1 Participation-phases

There are basically three identifiable phases to a participation process.

- Presentation of the planning documents,
- Communication between the authorities and the parties involved,
- (authority) internal assessment process

The objective of an internet based participation procedure is therefore, to reproduce all three phases of the participation process on the internet in such a way as to create advantages for the authorities as well as the participants.

From the existing internet participation schemes, only partial stages of the whole process have been covered. This creates difficulties due to the exchange of information in various media types. This served to restrain the overall acceptance and understanding of the innovative potential of this method. Also the use of emails as a central communication channel has been increasingly impaired through internet viruses, worms and spam-mail, so that desired mails are sorted out through restrictive filtering of mail servers. Finally unencrypted email communication presents a security risk which has to be secured. This can only be achieved by an extensive replacement of email through an internet protocol independent form of communication.

2.2 Technical Implementation

The implementation of a formal participation scheme over the internet is particularly suitable to make politics and administration transparent. On the other hand there are increased requirements placed on the technical implementation of internet based participation procedures because of the diverse technical requirements of three different phases described earlier.

In order to achieve a uniform communication medium, the following aspects must be integrated into the participation process:

- Online presentation of large-format and well readable (high resolution) cartographic material
- Online presentation of comprehensive written material
- Creation of objections regarding individual text passages whilst maintaining the context in which it was written
- Creation of graphical objections from cartographic material whilst maintaining the original context
- User friendliness
- Low hard- and software requirements
- Accurate assingment of objections and participants as the basis of communication
- Secure transfer of objections

- Databased administration and editing of the objections
- Flexibility to adapt to the different types of planning processes
- Lowest possible costs

3 'PARTICIPATION-ONLINE'

The first internet based participation project which was capable to meet the above mentioned requirements was developed and tested as part of a research and development project in Hannover, Germany. This was carried out in 2003 as a cooperation between the consultant and service company entera (Ingenieurgesellschaft entera) and the University of Hannover. Within this project the three phases of a participation procedure were established in a uniform, continuous system exclusively available on the internet.

The base modules of the original system were meanwhile developed further and improved to enable implementation in other arbitrary participation procedures. The system is now in operation in many projects under the name of 'Participation–Online' ('Beteiligung-Online' in German).

3.1 The Concept

The concept of 'Participation-Online' combines several innovative approaches. It is totally operational over the internet; it offers database support; it allows textual as well as graphical objections in the original planning documents and maps; and is constructed mainly upon open source software components. Moreover, since the internet-server meets the performance requirements of the system, the requirements of the user consist merely of an internet browser and no other hard- or software.

3.1.1 Internet

All three phases of the process run exclusively over the internet. Therefore there are no alterations between online and offline working periods, no redundant data storage and no necessity for one or more changes of medium.

3.1.2 Graphical objections

Unlike other participation projects, not only textual communication is enabled but also graphical objections within the original cartographic image are posible. This occurs through a java-applet which the user can use over the internet. The advantages of this are obvious: that the drawings will always have an exact spatial reference, they will be exceptionally precise and readable, and make detailed descriptions of spatial reference unnecessary such as 'right over the motorway' or 'behind the forest'. Due to the fact that the graphical statements are geo-referenced, they can be used later on as a digital basis within a geo-information system in order to edit the specific geo-data.

3.1.3 The Database

To be able to overcome the above mentioned disadvantages of email communication, a database application was developed which is situated on an internet server. All objections are directly written into the database without using the internet protocol (e.g. email). Additionally the transmission of sensitive data (e.g. passwords) is encrypted (SSL).

The core application is the so called participation database. It consists of two strictly separated password protected areas: The working area of the authority (or the project carrier) and the different personal areas of the individual paticipants. This password protected areas will be created for every person or institution that is involved in the process and is only accessible by that person. It is here that all the comments and objections are created, collected, edited, and finally 'sent' to the project carrier. In the process of sending material to the project carrier, the data from the personal area is simply transferred to the processing area of the project carrier in the same database. For every single objection, a specimen copy remains in the personal area of the sender, which of course either can be saved locally onto a hard drive or printed out. Through the utilization of the original reference material (text and maps) to create the objections, the context of the dispatched statements is always present and applicable.

3.1.4 Asessment Tool

The authority assessment procedure is performed in the same internet database which is used by the participants. Thus the objections have to be typed in only once and this is done by the objectors themselves.

Through the authentication procedure prior to the creation of objections, all records on the database are automatically assigned to the corresponding individual or institution. Objections which were sent by mail also can be easily integrated into the participation system by an analog input interface. Thus, all statements form the participants, sent by whichever method in whatever form, can be entered and processed within the same system.

With the help of different database tools, all objections on the database are directly accessible. An easy to use but yet powerful query editor allows to retrieve a single objection out of thousands as well as a group of objections with common decisive factors. Objections can of course be sorted and ordered by different criteria. Finally the objections (single, group, all) can be printed out in a standardized tabular form (synopsis) or any other predefined layout scheme.

An integrated workflow management tool allows to manage and control the process of the assessment. Thus its very simple to keep trace of the status of a single objection as well as of the whole procedure.

All these different tools facilitate the time consuming assessment process which has to be carried out by the authority or the project carrier. As these tools decrease the necessary amount of time considerably the overall duration of a participation procedure will be reduced significantly. Especially important or large projects will gain economic advantages from this shortening of processing times.

3.2 Building blocks of 'Participation-Online'

'Participation-Online' is not a 'out-of –the-box' product, but rather a complex integration of many different building blocks, mainly adapted OpenSource software products. The most important system components are mentioned below.

The mapping interface is constructed through MapBender. The participation database and all other database functions are controlled by the high performance database management system MySQL. In place of MySQL other databases could be used if requested including PostgreSQL. PHP is the Scripting language and as a servlet engine Tomcat is in use.

The so-called participation modules are a new developments by entera which provide the complex functions for the online participation. All system components are connected through system links which can be individually tailored according to the needs of the project carrier. Due to the accessibility of each components program code, Online-Participation offers therefore an extreme degree of flexibility. 'Participation-Online' is designed for a Linux environment as well as for Windows based OS. Therefore it is capable of cooperating with commercial software components like ArcIMS (by ESRI) or Oracle as a DBMS instead of the above mentioned OpenSource products. Of course 'Participation-Online' is fully compatible with the OGC standards.

3.3 Deployment

Due to the number of different components which need to be installed, set-up and maintained, 'Participation-Online' is primarily used as application service providing (ASP). That means that the administration, security, backup, monitoring and employment of a powerful and specificly layed out internet server with the complete and, on request, individually adapted software components lies completely within the reposibility of entera. It will be on lease only for the period of time in which 'Participation-Online' is being used for a participation procedure. This method of operation results in savings of cost and time because there is no requirement for hard- and software purchase, installation, maintenance, support, backup procedures etc.

4 EXPERIENCES

The result of the above mentioned R&D project was a software which was tailored for a landscape planning project but not ready to be used for arbitrary participation projects. The source code therefore had to be revised, features needed altered or added and the setup of the whole system was changed to give it the flexibility which is necessary to be adaptable to requirements of other participation projects. Finally 'Participation-Online' was released for the first time in Summer 2004. It was then utilized in numerous participation projects in association with diverse types of planning schemes. Based on the experiences gathered with these projects 'Participation-Online' was improved and more features added. The actual version 2.0 of 'Participation-Online' was released in fall 2005 and an English version followed in February 2006. A complete demo version is available for testing purposes under http://entera-online.com/009_demoprojekt/ .

A few example projects which are or will be realized with 'Participation-Online' are given consecutively.

4.1 Landscape Framework Plan

The first project to be realized with 'Participation-Online' was a landscape framework plan for the administrative district of Diepholz (Landschaftsrahmenplan Landkreis Diepholz, www.diepholz.de) in summer 2004. This framework needed 30 maps (scale 1:50.000 and 1: 200.000) covering about 2.000 km2 and roughly 450 pages of describing texts to be displayed for the participants. In addition 40 thematic layers were provided for downloading.

4.2 Open Landscape Development Concept

An open landscape development concept for the conurbation (5.400 km2) of Braunschweig was released in summer 2004. This concept was a predecessor of the regional regional planning programme which is following in spring 2006. The concept comprised 18 thematic layers, 3 additional maps and about 60 describing texts which were directly linked to open landscape areas. The Zweckverband received more than 1.000 objections the open landscape development concept and made the assessment completely with 'Participation-Online' (Freiraumkonzept des Zweckverbands Großraum Braunschweig, www.zgb.de).

4.3 Motorway Development

In December 2004 an internetportal for the planned A22 Coastal Motorway (Küstenautobahn A22) was developed by entera and released by the State Office of Lower Saxony for Road Construction and Traffic. The purpose of this portal is to provide comprehensive information about the planned motorway at any stage of development and construction. At this early stage of planning 'Participation-Online' is used to communicate results of advisory reports and results between the involved authorities and to facilitate the exchange of opinions and questions . Later (probably in 2007) the offical formal participation procedure will be carried out with 'Participation-Online'. The total volume of the material to be released is not known yet precisly but it will be about 300 maps and 2.000 pages. As this motorway is very controversial 5.000 - 10.000 objections are expected (Internetportal und Beteiligungsverfahren zur Küstenautobahn A22, www.kuestenautobahn.org).

4.4 Urban and Regional Planning Scheme

In spring 2006 a re-compilation of the urban and regional planning scheme will be released by the State Ministry of Agricultur and Rural Development of Lower Saxony. This planning scheme will be given into public participation with the aid of 'Participation-Online' . At least 10.000 objections are expected. (eGovernment Pilotprojekt LROP-online: Niedersächsisches Landesraumordnungsprogramm 2005, www.niedersachsen.de);

VEPS – Virtual Environmental Planning System
First steps towards a web-based 3D-planning and participation tool

Yun CHEN & Sonja KNAPP

(Meng Sonja Knapp, HFT Stuttgart - University of Applied Sciences, Faculty of Geomatics, Computer Science and Mathematics, Schellingstr. 24, Stuttgart Germany, Sonja.knapp@hft-stuttgarrt.de; Yun Chen, University of Salford, Salford UK, Y.Chen@pgr.salford.ac.uk)

1. INTRODUCTION

A city is not only a space, but also involves culture, social aspects and environment. As a result, urban planning is a multi-disciplinary process. The general objective of urban planning is "to provide for a spatial structure of activities which in some way is better than the pattern existing without planning" (Hall 1992, p4). Achieving the objective is not only the matter of planners and governments, but also concerned with the cooperation among investors, architects, engineers, computer professionals and the public.

1.1 Urban Planning and Public Participation

Efficient public participation can help government officials and other professionals to create better planning alternatives. Here public participation is defined as the means by which members of the community are able to take part in the shaping of policies and plans that will affect the environment in which they live" (Whittick, 1974). The sense of public participation not only gives public meaning to their lives but also brings with it a sense of responsibility which is often lacking in modern society. Furthermore, it is believed that more sustainable city development will be achieved based on such approach (Rydin, 2000).

Although most authorities have made intensive efforts to publicise their planning proposals and try to attract more attention of public, narrow and low-level participation still occurs in most planning activities (Rydin, 2000). Involving the public is once again high on the agenda of central and local government and is an increasingly mandatory component of programmes aimed at improving service provision, regeneration, revitalizing democracy and achieving sustainability.

However, making sense of what is going on is not straightforward. Not only is the concept of 'public involvement' or public participation' itself notoriously ambiguous and contested, but the methods used were not suitable for meaningful involvement. That is because in most cases, the public lack sufficient knowledge about the qualities of place, problems, potential solutions and they need help to question their assumptions and take-for-granted preconceptions (Campbell & Marshall, 2000; Healey, 1998). New methods of participation need to be proposed to supplement traditional ones like public meeting and consultation documents.

1.2 Technologies and ePlanning Systems

It is envisaged that some existing Information Communication Technologies (ICTs), for example Internet, Geographic Information System (GIS), Virtual Reality (VR) and Computer-Aided Design (CAD), could be used to produce such kinds of new methods for improving and facilitating more effective public participation in planning. The rapid development of these technologies provides new opportunities to improve the planning processes (Chen, 1999; Huang, 2003) and make better use of resources.In recent years, the number of web-based systems for urban planning using virtual reality (VR) and/or GIS is increasing rapidly. In addition, many countries around the world have intended to modernise the planning process or already initiated such movement (Curwell et al., 2005, Pendleton, 2004).

ePlanning, which 'offers considerable opportunity for early and rapid change to the future delivery of planning services, with an emphasis on electronic delivery' (ePlanning, 2004), emerged during last decade. The main aims of ePlanning are to enable more people to get involved in planning; to increase openness, efficiency and effectiveness; to arrange the delivery of planning service to meet citizens' needs. To design a good ePlanning system, two aspects need to be carefully considered, namely access and comprehension (Hamilton et al., 2001), which will be illustrated one by one below.

First of all, in order to effectively participate in the planning process, it is essential for the participants to get access to relevant information at any time anywhere. The over-riding benefit is that the public participation in the planning process will be more successful if all parties have a time and location independent way of communication.

Secondly, new technologies like Virtual Reality could decrease the complexity of spatial information if it is used in a proper way. Former researches claimed that normal 2D maps are not as good as three-dimensional (3D) virtual models in regard to presenting detailed geo-information about an area for lay people (Hamilton et al., 2001; Zhang, 2004). Thus, 3D City Models can make the regional planning process more comprehensive and more transparent for all involved parties as less interpretation of 2D maps is necessary. Especially public without any training in interpreting planning maps could benefit from an intuitive understanding of 3D-Models instead of 2D-Maps.

1.3 Current problems and the way forward

Some of the critical judgments for environment planning are best made using 3D data, for example water run-off, site area and wind shadow can only be approximated using flat plans. Many of these analyses can be undertaken using GIS given accurate height data and appropriate spatial queries, but 2D representations of the results are not intuitively understandable without extensive training. Up to now, the possibilities with current existing technology are limited: real interactivity, interoperability and fast and secure data transmission are mostly not possible. The state of the art in ePlanning is limited to text or 2D maps but 3D visualization is rare, especially interactive visualization.

To sum up, there is still a lack of real and high level of applications in the ePlanning area although some local government in Europe has employed new ICT technology, for example, world wide web (WWW) has been used to provide on-line services (Pendleton, 2004). Moreover the diffusion of this kind of new approaches towards the public is still an open challenge (Huang, 2003). This paper describes a collaborative project taking place in North West European (NWE) region which is aiming to address the issues by explore the potential of ICT and develop an Internet-based the EU-funded INTERREG IIIB Project – "Virtual Environment Planning Systems" (VEPS).

In this paper, we also describe a methodology for designing these systems. The vast literature that covers computer use for this kind of application – spanning modeling, monitoring, management and so on – seems to pay little or no attention to the needs and requirements and different user groups and audiences. (Haklay, M. E., 2003). A proper methodology is needed to make sure the successful ePlanning system is designed and implemented, which could satisfy different requirements of various user groups

The paper is structured as follows: firstly explains the main aim of the VEPS project; then describes the issues of the pilot project, the case study of Rosensteinviertel in Stuttgart, Germany; then illustrates the structuring process of transforming initial scenario to final system solution (e.g. defining the scenario and stakeholder profiles as well as technical requirements based on Stuttgart VEPS case study) and finally shows examples of the first implementation steps towards successful ePlanning and participation via Internet using 3D-VEPS.

2. VEPS-PROJECT

2.1 AIM of VEPS – Virtual Environmental Planning System

The VEPS project aims to improve the knowledge base on the potential of Information and Communications Technologies (ICT) for territorial development in the North West European (NWE) region specifically on the use of ICT for ePlanning, consultation and communication of citizens' views on planning issues.

Some cities are already using 3D visualisation in the planning process, e.g. Edinburgh (UK), Nantes (France), and Stuttgart (Germany). These systems generally have low levels of user interaction. The state of the art in ePlanning is presently limited on sending and receiving (citizen's) comments on-line. VEPS aims to improve interactivity by trying to integrate interactive 3D visualisation to improve the understanding of planning decisions and consequences. Therefore, existing and already used tools, technologies and data shall be used (e.g. 3D city models, digital terrain models, etc.). In case of being successful VEPS will allow a two-way consultation process. The stage at which citizens may view and respond to planned changes can either be at the Master Plan stage for an area or at a development proposal stage. Aim of VEPS is to enable citizens to upload their own alternative planning scenarios and view the results in terms of visual and environmental impact (or at least set comments directly on the maps) as well as download and view the details of the planned development. If 3D-visualisation may (interactively) be used via internet mutual understanding of planning contents may be improved by exploring what-if scenarios (cf. http://veps3d.org/site/54.asp).

VEPS therefore is a step towards an alternative approach to planning consultation. An interactive 3D-visualisation of planning contents allows the viewer to experience highly complex information without the need for training because they can see the impacts of a planning development and the visual and environmental consequences in an easily understood format.

The current issues for the planning consultation process may be summarised as:

- Complex information in planning consultation is "dumbed down" to a level that can be understood by the average member of the public who does not hold a qualification or diploma in planning
- Full information is presented and the citizen would have to receive training in order to understand the highly accurate and highly complex information
- Plans/maps require training to read and interpret correctly and often contain ambiguities

A key part of the outcome of funding the VEPS project work should be to assess if this is the right technology and approach to addressing these planning consultation issues.

Considering these aspects, the aim of VEPS is mainly subdivided into 3 objectives:

- Share technical competencies between NWE partners in the field of 3-dimensional visualisation, ICT applications to promote public participation, environmental modelling, data collection and use for ePlanning in territorial development in NEW
- Develop a common architecture and methodology drawing on transnational experience and the knowledge of planning regulations and sustainability metrics in NWE, to enable citizens to view (3D if possible and sensible) and respond to planned changes via home PCs
- Refine and implement a test-bed system in a number of demonstrations in the NEW region, thereby increasing transnational experience. Evaluate and iteratively refine the methodology and the system architecture and applicable open standards

2.2 Partners and EU-Project-Programme of VEPS

The VEPS-project is supported through the INTERREG IIIB North West Europe Programme, which provides support to transnational cooperation projects that seek to improve territorial development and cohesion in the North West Europe area

(cp.: http://europa.eu.int/comm/regional_policy/interreg3/index_en.htm).

The VEPS project directly addresses the INTERREG IIIB NWE Measure 2.2: "Improved access to the information society" and also objective 3: "improving the knowledge base on the potential for territorial development of North West Europe".

Transnational cooperation in North West Europe is about approaching common themes (e.g. ICT for planning consultation) through joint projects which will benefit from working across regions to achieve sustainable territorial development together.

The VEPS project is a collaborative project which has eight academic and industry partners located in the United Kingdom, in France and inGermany, working alongside with associated planning authorities.

2.3 Project structure

VEPS is divided into single development steps:

there are two main sections of the project. First part is to define the examples of each partner by finding and defining the scenarios and use cases. This includes the definition of the concerned stakholders and the dealing with different requirements and wishes according to the different user groups. Therefore, workshops in all countries/cities of the VEPS-Partners have been hold. Planners, administratives, citizens and other important persons collected their requirements and wishes considering VEPS. Summarizing these results gave an overview of different requirements and different use levels of such a system. Out of the results the basic requirements of such a participation and planning system have been defined as well as different user groups have been described (cp. chart):

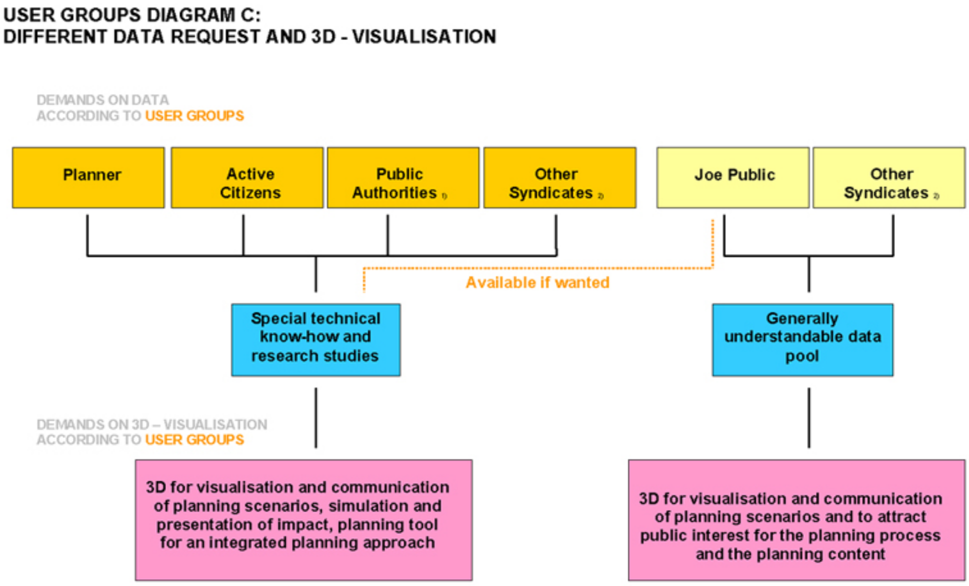


Figure 2.3 user groups data requests

Second part of the project includes the system implementation, evaluation and testing process of VEPS. As first step we develop documents for the implementation working with the pilot project Rosenstein (q.v. 2.4 Pilot roject: Rosensteinviertel Stuttgart). This implementation documents help to develop the other case study sytems much faster and help to develop a development structure wich can be used later on from everybody using VEPS. Out of this implementation documents the first prototype of a participation tool will be developed and tested with stakeholders of Rosensteinviertel.

At the end we will have a participation and communication tool allowing different levels of use with different requirement standards for different planning requests.

2.4 Pilot project: Rosensteinviertel Stuttgart

2.4.1 Introduction of task of pilot project

To give the scenarios a common structure and to develop guidelines how to define user and system requirements one of the demonstration projects has been chosen as pilot project. Rosensteinviertel of Stuttgart is an urban district located in the city centre and shows a lot of existing different land use. In the event of a big urban development project (Stuttgart 21) new areas will be developed, new structures in the existing area will come into being and the transport system will be changed.

VEPS shall enable the residents to compare different planning scenarios and the related consequences and enable them to comment those scenarios – in text and map form. To explain difficult planning contents and the realtion between different planning issues as well as to demonstrate the consequences of the different planning alternatives the illustration using 3D-models will ease the comprehension of the planning contents for all non-planners.

There are several partners related to the district like an organization of dedicated residents, the Stuttgart Planning Department and other Planners helping to find out which requirements are wished to have in such a system. These partners will also help us evaluate the concrete example by testing and evaluating the prototypes and the further modells of VEPS.

2.4.2 Description of the case study project Rosensteinviertel

Description of Rosensteinviertel

The Rosensteinviertel is an urban quarter and part of the city centre of Stuttgart. It is part of Stuttgart 21, a huge transport and urban development project which will change the whole face of Stuttgart’s inner city and transfer a lot of ground into other land use. Today, the Rosensteinviertel consists of wasteland, railway areas and built-up areas and presently is divided into several areas with different urbanistic patterns and diverse land use. Pesently 7000 habitants are living in the Rosensteinviertel as well as just under 10 000 are working in this district. The demographic trend is dominated by seniors and most of the residents are foreigners.

In the course of Stuttgart 21 several railway areas will be set free for developing new urban areas. Residential and office areas are planned. In future 14 000 habitants will live in the quarter and more than 20 000 employees will move into the district (cp. Das Rosensteinviertel, Stadtplanungsamt Stuttgart, 2004).

These plans mean big changes for the area and of course for the residents living there now. To show consequences of planning proposals and to find the best possible solution VEPS shall be implemented as participation and commenting tool, showing the residents the effects of different planning proposals and allow them to participate actively in the planning process (cp. Das Rosensteinviertel, location and site decription, content of planning scenario, 2005).

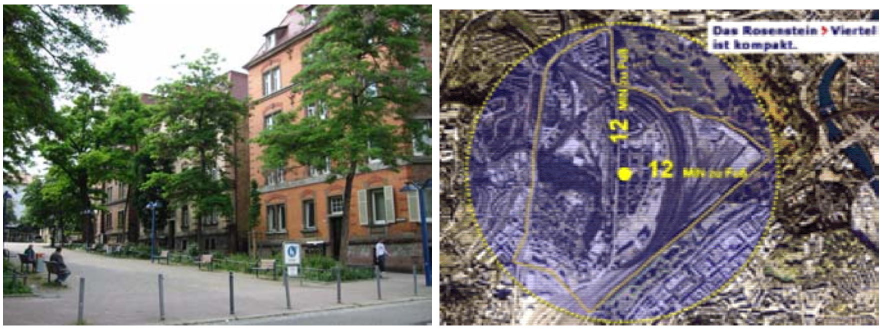


Figure 2.4 Rosensteinviertel: characteristic street and location of the district

Use of VEPS for Rosensteinviertel development

The participation model for VEPS to be used in this use case will be based on a website. The website on one hand gives all necessairy information concerning the district, the development plans, the existing data, etc. Also the functionality of VEPS will be explained. On the other hand there will be the linkage to the VEPS participation tool which will offer a commenting tool consisting of 2D and 3D maps and a comment and discussion platform. In a later phase of the implementation it shall be possible to change planning proposals interactively in the 3D-mode, but to get there many small steps are essential.

First prototype will show different planning proposals out of the architectural contest which has been held for the further development of the area. The plans will be shown as 3D city models. In the first prototype the users can add comments to specific topics of the planning proposals, they may discuss them or just mark what they think is not good. They can add the comments with or without linking it to the map. In the first prototype the 3D visualisation will “only” show the plans in real view and illustrate the different planning proposals for the Rosenstein development.

2.4.3 Partners – Evaluation – Public Administration

Beneath the varity of testing possipilites for VEPS one of the reasons to choose Rosensteinviertel as a case study and later on as pilot project is that we have a lot of dedicated partners willing to cooperate and test VEPS (as already mentioned in 2.4.1).

For evaluation, workshops and meetings with all or parts of the involved parties have been held or will be held in future. The residents’ initiative as well as planners from the city department and other planning related persons are willing to test our prototypes and will help us evaluate and implement the VEPS as a planning and participation tool.

3. DESIGN PROCESS OF STRUCTURING DOCUMENTS

There is a huge amount of researches to combine Internet, GIS and VR technologies for use in urban and environment systmes. However, there seems little concern for the theoretical way of designing such combined systems and evaluating their utility. A well-understood and salable development process needs to be developed to bridge this gap. This section illustrates a design process, namely modelling and matching process, which offers a roadmap for partners which is a well-understood methodology of transforming the initial planning scenario to the final system solution.

The process of selection and implementation is usually associated with a methodology or approach in order to ensure that models, methods, and data are adequately selected and fruitfully exploited. The modelling and matching process is produced based on the Human-Centred Approach. On one hand, users need to be the focus during the whole development process and the interactive design should be possible to take place within an integrated framework. However, on the other hand, designers cannot just follow what users say completely, since users tend to make decisions that are consistent with their preferences, which may not help to improve system performance (Khosla, et al., 2000). Designers need to match their requirements to the technologies in terms of the balance between them. The spirit of the process is illustrated in Figure 3.1 below:

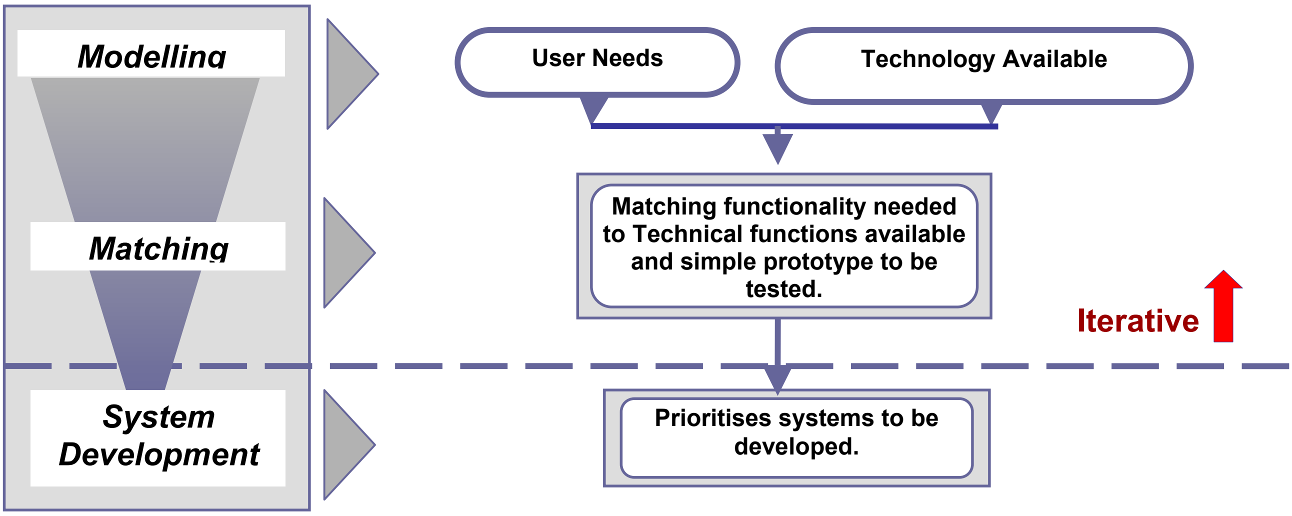


Figure 3.1 System Development Plan

3.1 Overview of the Process

There are five stages in the modelling and matching process design, shown in Figure 3.2, which are:

From 'Background Information' to 'Context Model';

From 'Context Model' to 'Descriptive Model';

From 'Descriptive Model' to 'Technical Model';

From 'Technical Model' to 'Interactivity Model';

From 'Interactivity Model' to 'High-level Design Specification'

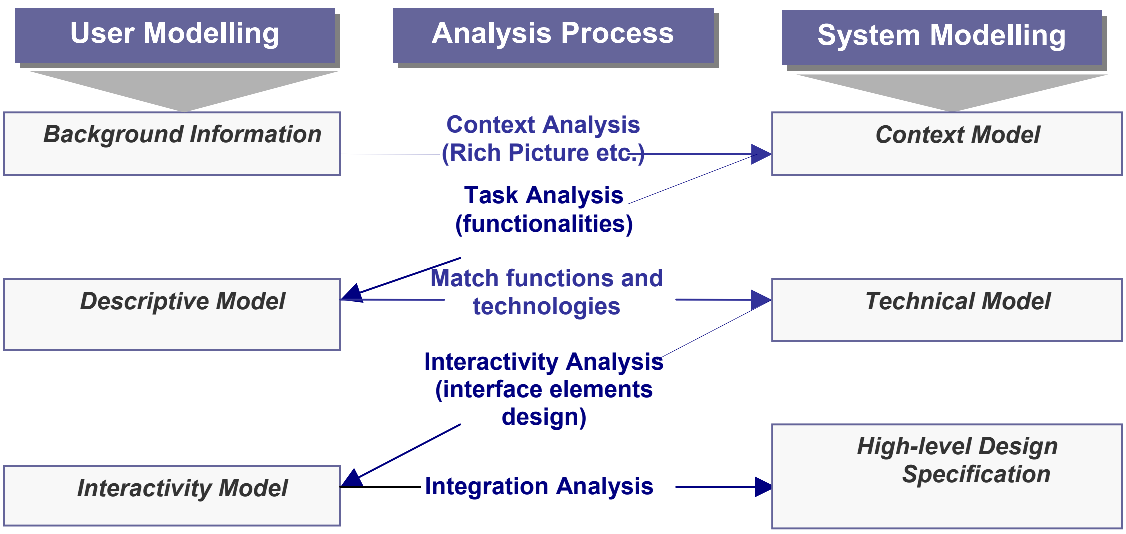


Figure 3.2 Modelling and Matching Process

In the design of any complex artefact a range of representations, or models, is essential during the design process. A model is a representation of something, constructed and used for a particular purpose. A good model is accurate enough to reflect the features of the system being modelled, but simple enough to avoid confusion. In the proposed design process four models should be produced before final system specification, namely 'Context Model'; 'Descriptive Model'; 'Technical Model' and 'Interactivity Model'. The roles of these models in the design process are illustrated below:

Context Model: The context model is the summary of the scenario checklist and stakeholders' checklists, based on the analysis of the rich picture. Scenario checklist, stakholders's checklists and rich picture could be served as the starting point of exploratory discussion documents with stakeholders in a problem situation. This is particularly important as poor consideration of stakeholders' viewpoints will result in a system that will be poorly or not maintained. The purpose of the context model is to give a top-view of the system's context and its related stakeholders, so that the 'user needs' addressed in Figure 3.1 could be captured correctly from the very beginning of the system development. In the context model, the proposed system is treated as a 'black box'. Related stakeholders' profiles and their relationship with the proposed system are the concern of this model.

Descriptive Model: The descriptive model describes the behaviour of the system as seen by its stakeholders. Use case diagram is applied to present this model. It could be served as the basis for discussions about technical development of systems within VEPS.

Technical Model: The technical model is a product of the matching process shown in Figure 3.1, to ensure that user needs could be balanced by available technologies and data. This model transfers the descriptive model to designers' language. The process of generating the technical model could be used to guide the architecture development and help with maintaining related development tasks. In addition, the technical model could be served as a good tool to facilitate the communication among partners.

Interactivity Model: Human understanding of geographical space will be affected by the interface of geo-based system. As a result, interface design is a key issue to make an ePlanning system user-friendly (Chen, et al., 2005). The interactivity model considers the interface elements design based on the human factors analysis.

Unified Modelling Language (UML), which provides a large number of well-known techniques and concepts for modeling various kinds of software artifacts from different perspectives or viewpoints, will be used in the design process to present some of the models.

3.2 Design Process in the Rosensteinviertel project

One of the demonstration projects, namely Rosensteinviertel in Stuttgart, which was described in the previous section has been chosen as the pilot project to give the scenarios a common structure and to develop guidelines how to define user and system requirements. The first three stages of this process will be addressed next in the paper.

3.2.1 First Stage: From 'Background Information' to 'Context Model'

In terms of modelling and matching process, the scenario checklist is an important data collection method for the first stage, which concerns collecting and analysing background information to create the context model. At this stage, the scenario checklist summarises and illustrates the scenario in the 'one-page' document, which could be used to capture and define various stakeholders involved in the proposed system and to state their motivations and expectations for the proposed system. As the result of the scenario checklist of Rosensteinviertel project, we got the following case study description:

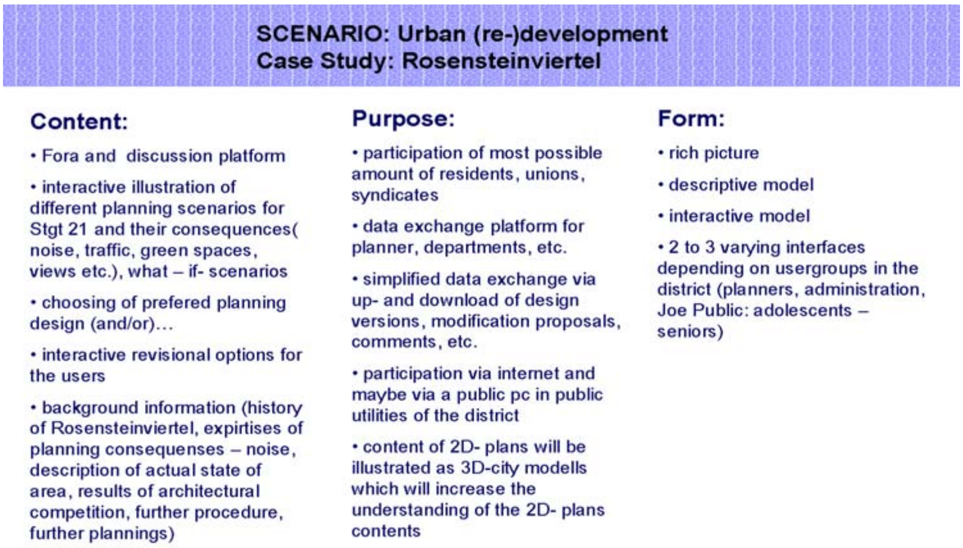


Figure 3.3: case study description of Rosensteinviertel

Although the scenario checklist is a good basis for creating a context model, it is useful to further explore the motivations of all stakeholders. Thus, for the context model, it is useful to produce stakeholders' checklists, which specifically focus on the viewpoints of key stakeholders. A stakeholder checklist describes a number of characteristics of the users whose needs and requirements must be met in the new computer system. The purpose of the stakeholder checklist is to ensure that the right level of terminology is employed, the system suits their level of computer and task expertise, and so forth. There are no hard and fast rules for selecting the information that should go into a stakeholder checklist, but any information that helps to specify the capability of users to handle systems is beneficial. For Rosensteinviertel project, we defined the following stakeholders: urban planners/architects, investors/project managers, citizens, and local authorities. The checklist for them mainly includes five parts, namely Basic Characteristics, Knowledge and Experience, Motivation and Expectation, System Requirements, Required resp. Desired data.Several stakeholder workshops were held in Stuttgart during this stage in order to capture stakeholders' information and preferences. Brainstorming method was used in these workshops and its result was organized into different stakeholder's checklist.

The scenario checklist and stakeholders' checklists consist of the background information, which is the startpoint of the process. Based on the background information, rich picture can be produced to describe the context of the system and finally leads to a context model.Rich picture is mainly about making drawings to indicate the elements in the human situation. It should illustrate how we see the situation at present, its main stakeholders and issues. Using rich picture, we could describe the context of the proposed system, explore existing problems for different stakeholders and reveal the real issues affecting system development. For Rosensteinviertel project, four stakeholders are the focus in the rich picture (i.e. main stakeholders identified in the scenario checklist), which are circled in the diagram. The other four items, namely planning issues, planning alternatives, planning budget and environmental impacts, are issues concerned by defined stakeholders (see Figure 3.4 below).

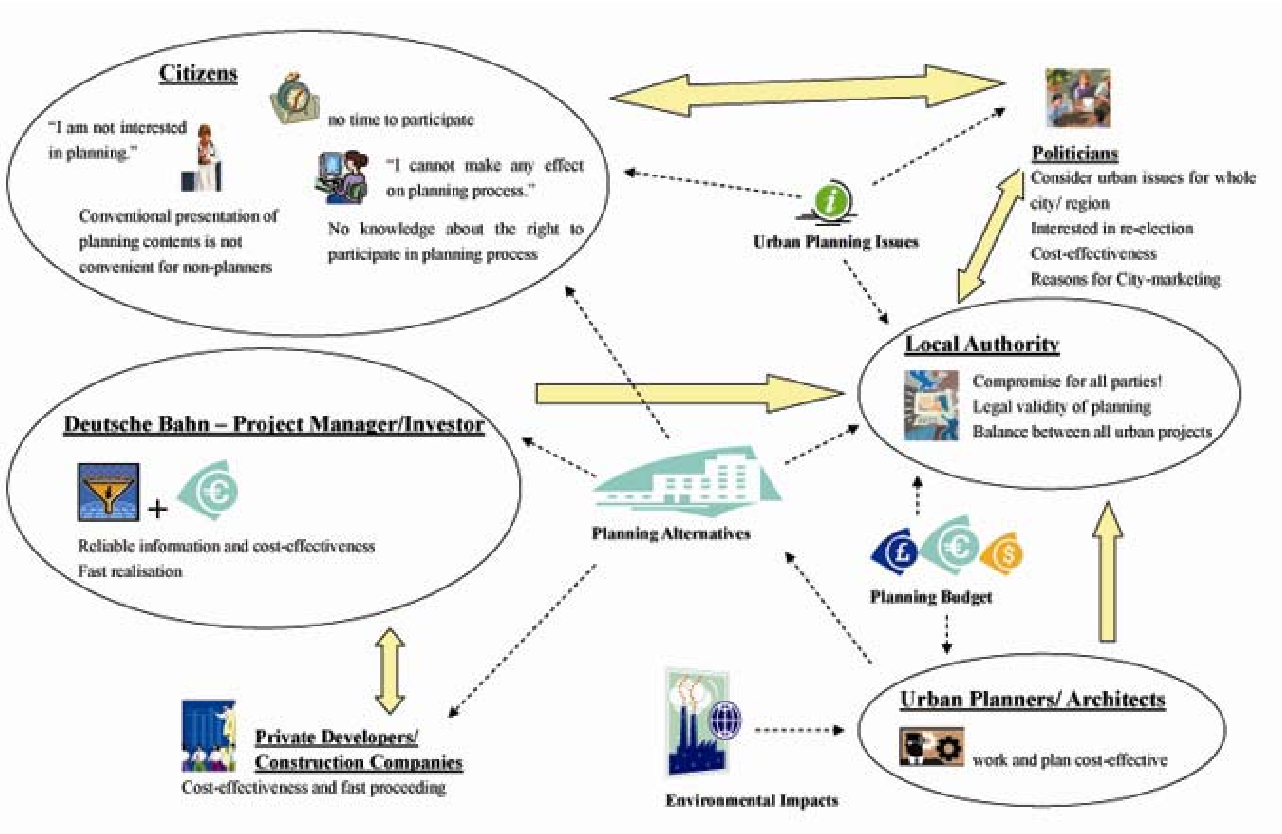


Figure 3.4 Rich Picture of Rosenstein Project

The context model is the summary of the scenario checklist and stakeholders' checklists, based on the analysis of the rich picture. Figure 3.5 below shows the context model of Rosensteinviertel project.

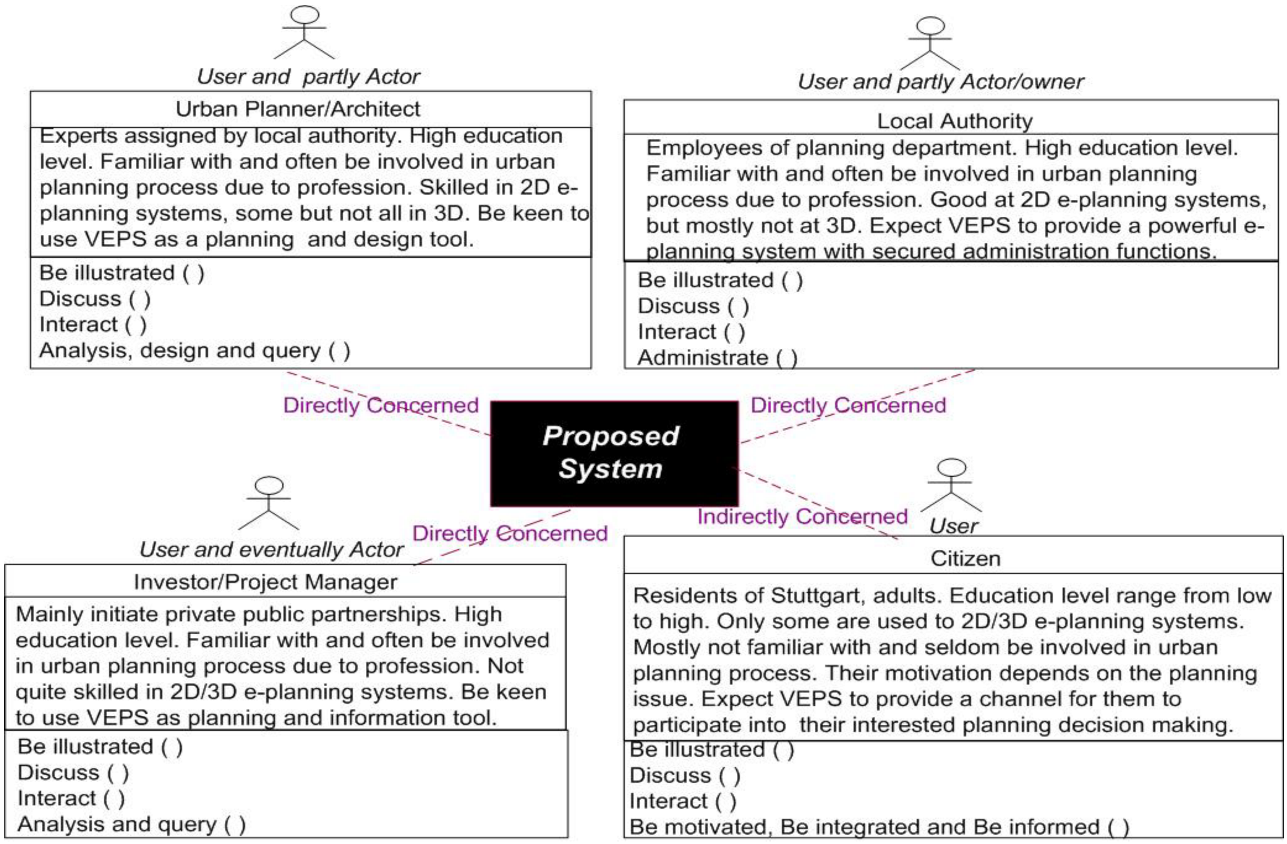


Figure 3.5: Context Model of Rosensteinviertel Project

3.2.2. Second Stage: From 'Context Model' to 'Descriptive Model'

The descriptive model is important in VEPS, as it is the way of communication what is involved in the design of a system to the technical team responsible for technical design and implementation.

At this stage, task analysis is adopted to get concrete tasks that users could do with the system, in terms of the top-level requirements in the context model. Task analysis is a methodology which is supported by a large number of techniques to help the analyst collect and arrange data systematically, to make explicit the requirements to be fulfilled by people and systems, and to optimise the capabilities of both components. The purpose of a task analysis is to contribute to design by transferring some knowledge from one group of people to another. It is used to gain an understanding of what people do in existing circumstances. The task analysis for Rosensteinviertel project specified three common functions for all four stakeholders and one specific function for each of them.

The result of task analysis could be used to define the functionality of the proposed system and for producing the descriptive model. The descriptive model describes the behaviour of the system as seen by its stakeholders. For Rosensteinviertel project, 23 use cases were defined in total (see Figure 3.6 below).

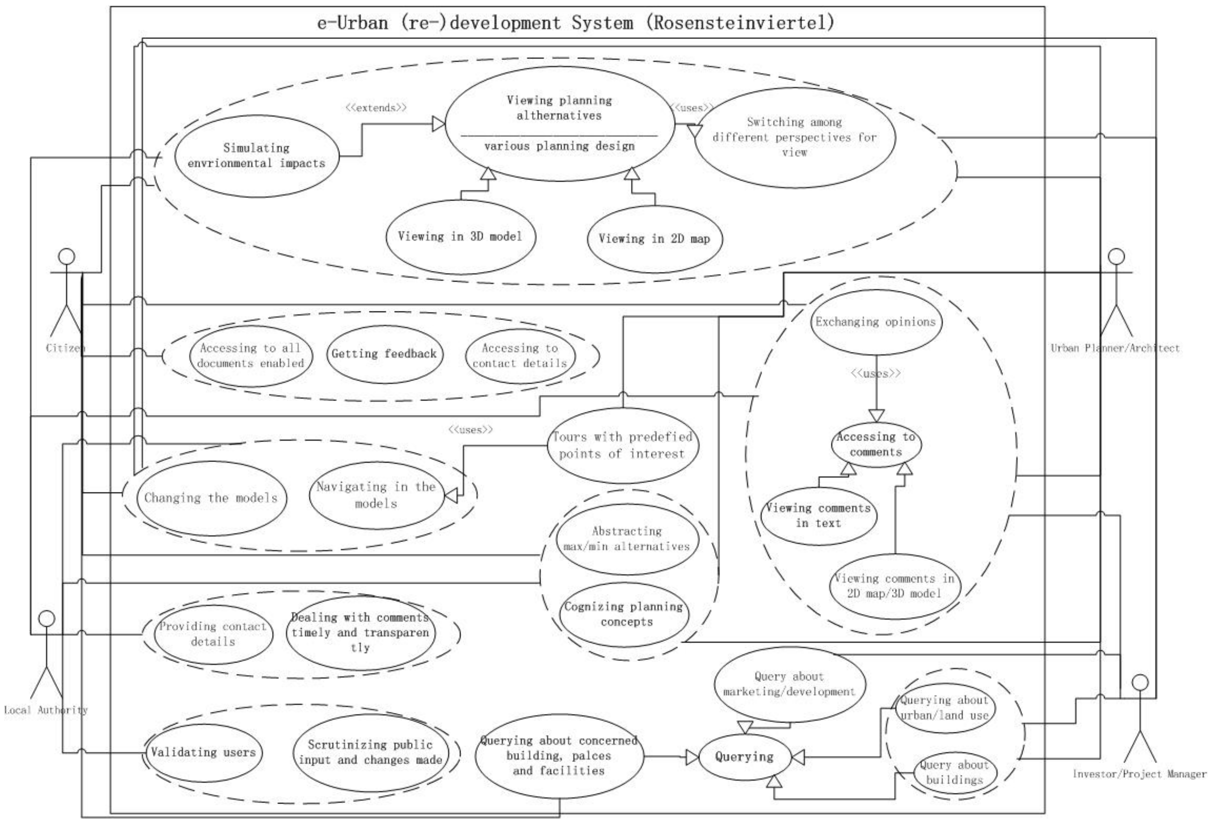


Figure 3.6: Descriptive Model of Rosenstein Project

3.2.3. Third Stage: From 'Descriptive Model' to 'Technical Model'

This stage focuses on the development of system architecture after matching the user requirements with available technologies. For Rosensteinviertel project, use cases of the system were grouped in terms of their relevance shown in the descriptive model and the system was divided into four sub-systems to be implemented separately at the beginning of this stage (see Figure 3.7 below). The Participation Tool is one of the four sub-systems. For each sub-system, one technical model will be produced before coding.

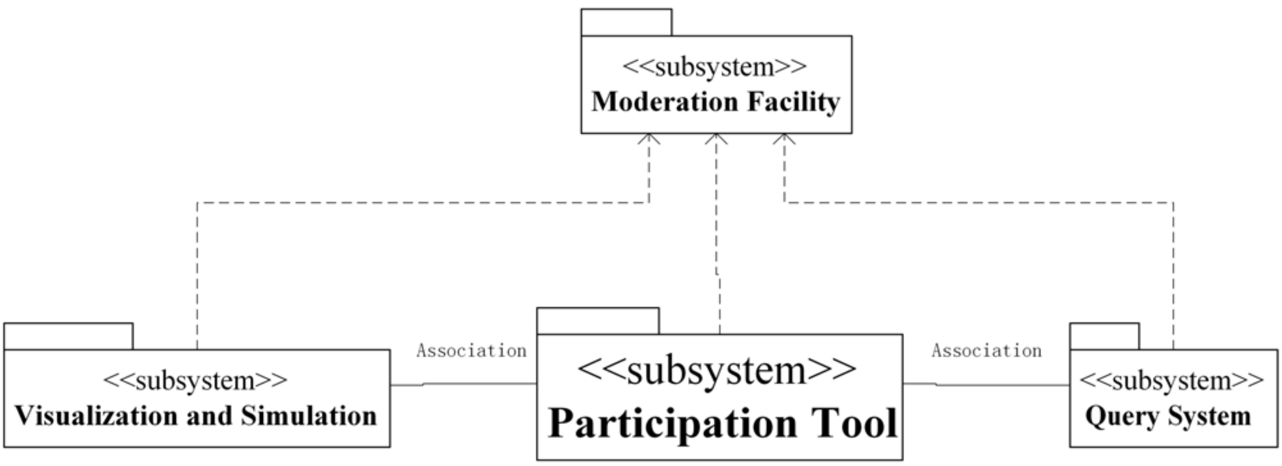


Figure 3.7 Four Sub-Systems

In the next section, the first step of implementation of Participation Tool will be illustrated. The implementation process started with transferring Participation Tool concered use cases to the technical model.

4. FIRST STEPS OF IMPLEMENTATION: PARTICIPATION TOOL

According to the descriptive model produced at the second stage, we defined two main functions for the Participation Tool sub-system:

Provide discussion forum for all stakeholders ('one-to-many' communication)

On one hand, this system could be a truly transparent system that all comments should be made available to create an open forum for discussion. Stakeholders could access the system 24 hours per day, 7 days per week, via Internet. That is to say, they could leave their comments, view comments of others and reply to their interested comments at any convenient time. During this process, all stakeholders could see and participate in the debate honestly, transparently and open. This could ensure more informed contributions.

Provide 'question and answer' function for the public to the local authority ('one-to-one' communication)

On the other hand, the system could also allow the 'one-to-one' communication. E.g. Local residents could leave comments only to local authorities, instead of putting the comments in an open forum. In this case, the related local authority could view the comments and give the feedback to the resident only. As a result, the need for the public to contact the local planning office by other means will be reduced. This could ultimately result in a more informed public, whilst releasing staff resources to concentrate on other works.

The Participation Tool concerned use case diagram is shown in Figure 4.1 below:

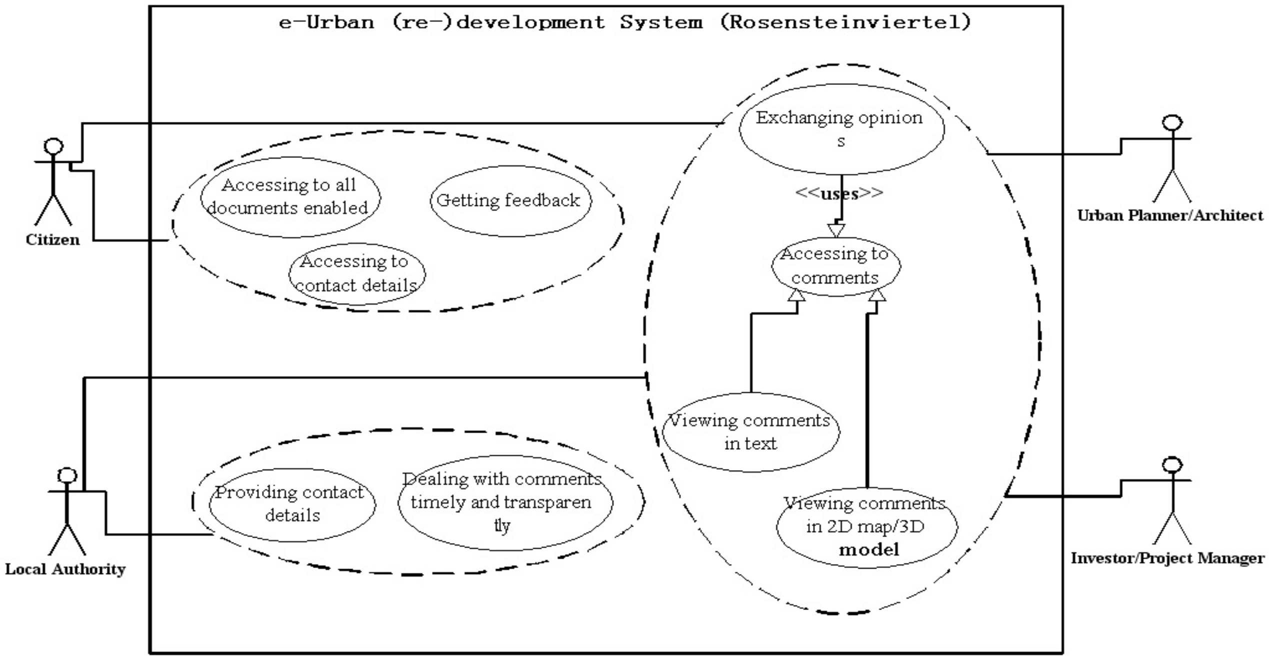


Figure 4.1 Participation Tool Concerned Use Case Diagram

We believe that Participation Tool could be more useful if it is facilitated with visualization and simulation functions, so that the spatial information could be more comprehensive to stakeholders, especially to non-prefessional citizens. Recently, lots of open source softwares emerged to help normal users understand the spatial information and the most representative one is Google Earth. Google Earth could quickly zoom from space down to street level and combine imagery, 3D geography, maps, and business data to get the total picture in seconds. It has been widely accepted that Google Earth is useful to plan a trip, find a house or local business, and even explore the world. The idea from Google Earth will be adopted in the Participation Tool development for VEPS project as well. Texts, 2D maps and 3D models will be combined together to make the tool more easily to use. Two example systems based on which Participation Tool are currently developed are shown in Figure 4.2 below:

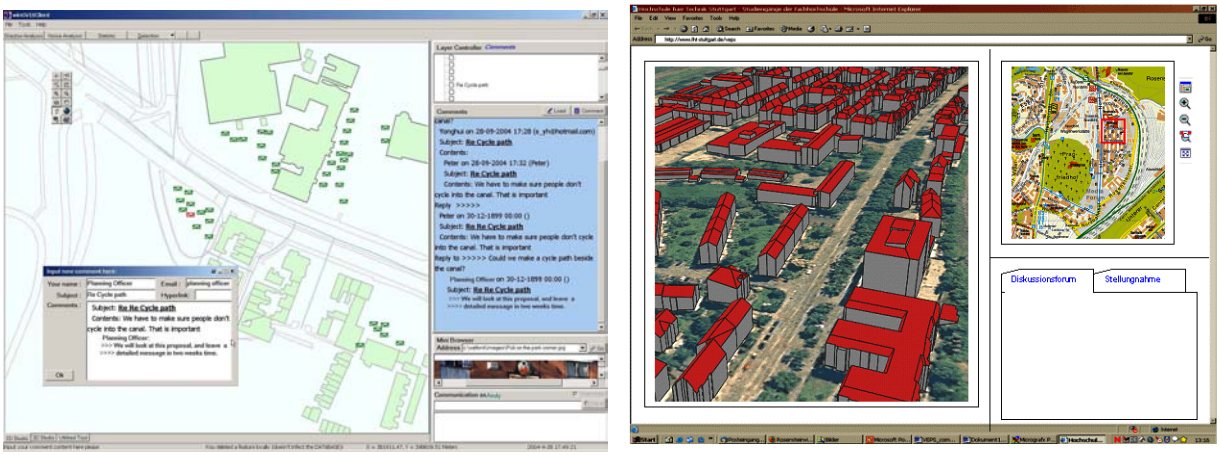


Figure 4.2 Two Example Systems of Participation Tool (3D-modell © Stadtmessungsamt Stuttgart)

5. FINAL COMMENT

Stuttgart and Salford partners in VEPS are currently working on the technical model for Participation Tool. The first prototype will be tested by the public before Feburary 2006. The efforts we will put on before the implementation of participation tool will be mainly from two aspects:

To carry on the design process

The interactivity model, which considers the interface elements design according to the human factors analysis, will be produced after the technical model for final system specification.

To consider evaluation issues for design and prototype development

We will consider evaluation issues especially for two stages: design stage and implementation stage:

At design stage:

To see if the functionality desired by end users is considered and designed correctly before actual implementation of the prototype. The questionnaire will be designed for and filled by the VEPS prototype developers.

At the implementation stage:

to see if the functional usability is really delivered to end users via physical prototype. Questionnaires will be designed for and filled by prototype end users.

We would like to thank INTERREG IIIB for co-operation and funding,

This project has received European Regional Development Funding through the INTERREG III B Community Initiative

nwe eno INTERREG IIIB NORTH WEST EUROPE

City of Stuttgart for making available the 3D city model

and Fraunhofer IGD for making available their software.

6. ANNEX: REFERENCES

Campbell, H., and Marshall, R., 2000. Public Involvement and Planning: Looking Beyond the One to Many, In: International Planning Studies, Volume 5(3), pp. 321-344.
Chen, C., 1999. Information Visualization and Virtual Environments. Berlin: Springer.
Chen, Y., Hamilton, A., 2005. Designing the user interface for effective interaction with ePlanning systems: the human centred approach. In: Proceedings of 5th International Postgraduate Research Conference, Salford, UK, Blackwell Publishing pp204-217
Coors, V., Huning, K., 2005. Compressed 3D urban models for internet-based e-planning, Paper on NextGeneration3DCityModels, Bonn.
Coors, V. et al. Appraisal of standards for 3D City Models. In: Proceedings of Information Visualization (iV05), IEEE Computer Society (P2397), July 2005, ISBN 0-7695-2397-8, pp. 157-162.
Curwell, S., Deakin, M., Cooper, I., Shapira, I., Ravetz, J., Babicki, D., 2005. Citizens' expectations of information cities: implications for urban planning and design, In: Building Research & Information. Volume 33, pp. 55-66
Electronic Planning (ePlanning), 2004. Available at <http://www.planningni.gov.uk/Corporate_Services/PlanningToDeliver/ePlanning/ePlanning.htm>
Haklay, M. E., 2003. Public access to environmental information: past, present and future, In: Computers, Environment and Urban Systems, Volume 27, pp.163-180
Hall, P., 1992. Urban and Regional Planning (3rd edition). London: Routledge.
Hamilton, A., Trodd, N., Zhang, X., Fernando, T., Watson, K., 2001. Learning Through Visual Systems To Enhance The Urban Planning Process, In: Environment and Planning B: Planning & Design, Volume 28 (6) November, pp. 833-845.
Healey, P., 1998. Building institutional capacity through collaborative approaches to urban planning, In: Environment and Planning A, 30, pp.1531-1546.
Huning, K., Knapp S., 2005. Upcoming standards for 3D city models, Case study Rosensteinviertel and used technologies, Paper on EnVis 2005, London.
Huang, Bo, 2003. Web-based Dynamic and Interactive Environmental Visualization, In: Computers, Environment and Urban Systems, Volume 27, pp. 623-636.
Khosla, R., Sethi, I. K. and Damiani, E., 2000. Intelligent Multimedia Multi-Agent Systems. Kluwer Academic Publishers.
Pendelton Survey, 2004. Available at <http://www.scotland.gov.uk/library5/planning/spws.pdf>
Knapp, S. and Chen, Y., 2005. VEPS: Design Process Discussion--- Scenario – urban (re-)development & Use-Case – Rosensteinviertel (pilot project) _Development of Profile and Process Guidelines based on the Pilot Project of Urban (Re)Development in the Urban District Rosenstein Available at: <http://www.veps3d.org/development10453/files/25-oct-2005/10-38-05/VEPS%20paris%20meeting_final%20from%20stuttgart.pdf>
Rydin, Y. and Thornley, A., 2000. Planning in the UK: Agendas for the new Millennium. Ashgate Publishing Ltd.
Sinning, H., Selle, K., Pflüger, K., 2003. Neue Medien und Bürgerorientierung. Anforderungen, Strategien und Praxisbeispiele. Gütersloh: Bertlesmann Stiftung. (in German)
Song, Y., Hamilton, A., Trodd, N. and Zhang X., 2002. Technical Design Issues of Linking Geospatial Technology for 3D Visualisation, Interaction and Analysis. In: Proceedings of the GIS Research in the UK 2002 Conference. pp256-262
Whittick, A., 1974. Encyclopaedia of urban planning. New York: McGraw-Hill.
Zhang, X., 2004. Designing A Geographic Visual Information System (GVIS) to Support Participation in Urban Planning. PhD thesis.

Shared Knowledge Construction in Heterogeneous Groups

Christine ROTTENBACHER

(Institute for Geoinformation and Cartography, TU Vienna, rottenbacher@geoinfo.tuwien.ac.at

1 INTRODUCTION

The goal of participative planning processes is to find sustainable solutions in organizing physical space. To develop a base for decisions it is necessary to get knowledge about social and physical usage of space.

Knowledge construction, decision making, acting, and the bearing of responsibility are immediately connected within the several planning steps. The planning group at the initial of the process usually is a heterogeneous group and consists of person in charge, planners, and of people affected by a planning intention. The outcome of participative planning processes should be a special form of collaboration organizing social and physical usage of space. Therefore a shared knowledge construction is the first step of a successful public participation.

Within heterogeneous groups we need communication structures for receiving and sending information, we need structures for building trust in the information, and we need structures to enable the participants to transform information into knowledge. Information has to be emotionally and cognitively perceived and accepted to reach a shared knowledge construction, and to arrive at decisions on future plans. The participants have to experience immediately the outcome of first decisions to strengthen the base of common action.

This paper analyzes the design of an open planning structure that is not based on an initially strived for consensus. An open planning process tries to enlarge usually used communication, interaction, and decision making structures of a village. The hypothesis focuses on the possibilities of development of the interaction base within the heterogeneous group, based on the assumption that an initially intended consensus restricts possibilities of development. Related to the question if a shared knowledge construction needs a consensus, I point out different theories of my latest research. Aspects of participative planning processes, the role of a planner, and cooperation ideas are pointed out in the next section. The third section considers different group structures and dynamics. The fourth section deals with phases of knowledge construction during a planning process with heterogeneous groups.

2 PLANNING PARTICIPATION AND COOPERATION

Planning as an instrument for preparing decisions depends on various factors. It happens in a social system of different pressure groups. There are advices, rules, administrative and technical restrictions, right in ownership and neighborhood. There are political influences or also competing projects.

Decision making, acting, and bearing responsibility are connected processes within the planning group. A planning group consists of responsible person, planners, and of people affected by a planning intention.

2.1.1 Open Planning Process

A moved planning process (Rottenbacher 2004) is one possibility to organize an open planning process. Within this procedure, joint activities of the group help to concentrate the mutual communication in a concrete situation, in Here and Now. In the moved planning process the joint activity is a common walk before sitting together and deciding the next steps of planning. Movement strengthens verbal and nonverbal communication. This communication orientates on mutual experience and an emotional correspondence (Rottenbacher 2005).

Theories of Merleau-Ponty (1966), Johnson (1987), and Goldstein (1934, 2000) describe the communication process as an embodied process (Johnson 1987). If a heterogeneous group meets the bodies of participants gives information about state and attitude. Persons meeting in concrete situations simultaneously perceive, decode, and make decisions on acting in the daily environment. Concrete experience increases an “inter corporal” existence of the group (Merleau-Ponty 1966). A heterogeneous group also experiences this inter-corporal existence during joint activities. The immediate behavior evokes primarily patterns of existence and less patterns of thinking. Different constructions remain as different concepts but new experiences, understanding, and knowledge are shared (Johnson 1987). A growing group identity enables a shared knowledge construction.

2.2. Role of Planners in Participative Planning Processes

Planners have to work in a field of different interests and have to develop a common space for acting. In participative planning processes planners have to care for an understanding of several steps of informing and decision making. Further, planners have to strive for sincerity, without creating new dependencies, shall not manipulate, nor use traditions to legitimate actions. They have to show cost, benefits and risks of each decision as correct as possible (Lanz 1996).

Building up a planning process on human resources (skills, knowledge, ideas) of the various participants contributes to the development of self responsibility and self initiative. The idealistic assumption is that the possibilities of influence and decision making are growing and enable a planning process between an orienting concept and a patchwork of decisions and actions. The orienting concept corresponds with the various spatial developments that can be solved here and now within a concrete task:

> *“This orienting concept is characterized through an orientation in values, and simultaneous decision making and acting.”*

(Young 2000, p.104)

The planning group consists of heterogeneous participants. There is no shared language, no shared way of looking at issues, no common assumptions. Every participant brings her histories and perspectives unfamiliar to each other within the group. From the beginning we have to look at differences and commonalities, to prevent a turning from many to one:

> *"The definitive quality of the public space is particularity: that the plurality of perspectives that constitute it is irreducible to a single common denominator. A claim to decisive authority reduces those perspectives to a single one, effectively discrediting the claims of other political actors and closing off public discussion. Meaning is not inherent in action but public, which is to say, constituted by the interpretative contest among the plurality perspectives in the public realm that confer plurality on action and thereby make it real".*

(Disch p.111, in: Young 2000)

To transform single needs and interests to a more comprehensive understanding that takes other needs into account it is necessary to look at the process of shared knowledge construction in groups. Participants cannot transcend their particularity (Young 2000). If participants make decisions appropriate to their personal context, they need to get mental space to express their particularity to others and learn about the particularities of the other.

This leads to a shared knowledge based on concrete situations (Haraway 1991). Participants have particular knowledge that arises from experiences about objects and about meanings and functions, and social roles. For example, they make experiences with their social positions and those social positionings influence the assumptions and interests they bring to the meeting.

2.3 Consensus

The goal to reach a consensus based on an initially assumed common good in various, heterogeneous groups from the beginning restricts the shared knowledge construction to a least common denominator. Here social difference and variety are considered as a resource (Young 2000).

Within a heterogeneous group we need structures to get and give, and to understand information. We need a design of a planning process within which the participants are able to recognize relationships and connections. This design has to have a clear structure for orientation and building trust.

With the postulated common good decisions are developed upon supposed commonalities of the group. Variety is leveled and disregarded if we try to find only commonalities for reaching a consensus. This leads to discussions, to argumentations. Emotions are avoided, and the objective is to collect rational statements. With the insights from cognitive science and other disciplines we know that knowledge construction and decisions are not made rationally. Decision making in groups follows a process of valuating topics with emotions, and reflecting and rationalizing intellectually (Dreitzel 1992).

The Human Theory of Action (Goldstein 2000, 1934) describes a human as an organism-environment entity. A human is embedded as a body-mind person in a social ecological environment. Experiences and knowledge are stored up in the body, and used in each concrete situation. Related to these concrete situations are the possibilities of experience, of reflection, and of imagination. According to this theory knowledge construction and action are connected immediately. A human is active, orientated to the future. She puts her own theories and goals, and makes hypothesis about the outcome of her acting in everyday acting. These hypotheses are verified through acting, and a correction of the action. Integrating these concepts in a planning theory, we have to consider how to organize the steps of decision making, and an experiencing of the outcome of these decisions in the design of a planning process. Decisions in heterogeneous groups and the experiencing of the outcome lead to a growing shared knowledge construction of the group (Johnson 1987), and should be made continuously during the planning steps (Schilling 1973).

2.4 Cooperation

In complex environments, planning processes are complex; participants are not fully able to analyze the situation "rationally" and decide for "optimal" solutions.

One theory used by Axelrod (1997) describes an adaptation of a common strategy like an evolutionary development. Based on the assumption that each individual looks for a repeated fulfillment of her needs (Maslow1954, 2002) and orientates her actions in surviving (Maturana 1998), Axelrod arguments biologically that interactions within groups that have been relative effective become more widespread than strategies that have been less effective.

One known example for cooperation from Axelrod (1997) is the simulated experiment of "The Prisoner´s Dilemma". Within this experiment two individuals can each either cooperate or defect.

> *"The payoff to a player affects its reproductive success. No matter what the other does, the selfish choice of defection yields a higher payoff than cooperation. But if both defect, both do worse than if both had cooperated."*

(Axelrod 1997, p. 15)

In a planning situation the individuals meet more than once. They can recognize previous interactions, remember outcomes of first decisions and actions, and develop interactions more and more focused on cooperation. This concept contributes to a design of planning participation with concrete meetings, with concrete experiences, decisions and actions, and a shared experiencing of the outcome of the decisions.

Cooperation is oriented between self interests of the participants and the common interest of a group that mostly does not exist at the beginning of a planning process. To get orientation, to build trust in the process, and to participate they need personal emotional relations towards some topics and towards each other (Rottenbacher 2004). The back and forth between self interests and group interest determine the dynamic of the meetings. Lewin (1951) describes in his field theory that this dynamic is based on[G1] and changes because of new common experienced facts.

3 GROUP STRUCTURE AND DYNAMICS

A heterogeneous group is determined by group characteristics and participant characteristics. Groups consist of individuals. Each individual is looking for security, communication, acceptance, acknowledgement, and cooperation. The dynamic of a group is more than the sum of the actions of participants (Lewin 1951). There emerges a dynamic, independent of the possibilities of the participants.

3.1 Group Structure

Structures of the heterogeneous group are built by the "I" of the individuals, by subgroups, and by the whole group. These structures influence the process of decision making. In the moved planning process several individuals can experience the changes of their environment, the outcome of their interactions, as immediate effects of acting. The bodily experience in the concrete situation enables, that "I" express the knowledge about this situation. It is possible that the expressions are seen and understood by others.

The integration of new emotional and cognitive experiences in the heterogeneous group are contributed, and:

1. Participants experience a personal development. Social interactions have an effect on personal development. The effects increase a self-organization of the group.
2. Participants experience repeated processes of socialization. They experience improvement, enlargement, and confirmation of their behavior, attitude, and acting (Schmid 1996).
3. The behavior of the participants depends more often on the actual situation than on previously developed thinking and feeling patterns. They speak more about current experiences and less about abstract opinions acquired from outside sources.

3.2 Group Dynamic

In an open planning process everyone should get the possibility of personal experiencing, communicating, and acting. Everybody should find space for personal needs, wishes, objectives, and tasks. Everyone is an expert of his or her personal life and must be respected for this and his contribution encouraged.

The first decisions at the first encounter in a participative planning process lead mostly to first realizations. The experience of the outcome of acting together develops a spiral of decisions, each related to realizations, which changes the base of interaction patterns of the group, the trust, and the tolerance for frustrations for further actions (Rottenbacher 2004).

The main resources of group influence to increase dynamics are the personal attendance, the public obligation, the social contribution, and norms of the group. Independent of participant characteristics the participants take roles depending on group structures, emotions, affections, likes and dislike. During usual participative meetings participants sit around a table and expect motivation and ideas form the planner. They sit beside friends, building subgroups repeating the social structure of the village. These subgroups remain mostly constant during the meeting. There are few possibilities for dissolving the groups and that the participants experience themselves mutually in a new context. To create concrete situations for new experiences one possibility is the moved planning process (Rottenbacher 2004).

During an open planning process participants should get the possibility to experience each other mutually in a common acting. Their shared emotional state can increase and leads to a shared knowledge construction.

4 KNOWLEDGE CONSTRUCTION IN HETEROGENEOUS GROUPS

Concrete experience increases an inter-corporal existence of the group. This inter-corporal existence is the basic human experience of relationship. This existence contains all information of experiences and knowledge, and influences our feeling, thinking, and acting patterns. In this inter-corporal existence you can feel, see, and interpret the actions and intentions of other participants, you integrate experiences, and construct knowledge.

4.1 Symbolic Meaning

Our civilization is based on the construction of meaning, which influences the ideas of people and their daily acts. These constructions document the personal and social process of perception, appropriation, identification, and integration. In the mutual experience of concrete situations communication is based on the expectation that all participants share this knowledge about capacities, practices, and stances towards objects. The symbolic meaning of roles, things, and situations motivate movement and actions, and give a shared orientation.

The capacity of people to understand the acting of the other is an evolutionary adaptation. Individual development differentiates from common actions. Older experiences are brought in as common sense and symbols, used like gestures or words, get their meaning from the context implied and understood.

During concrete experiences the meaning of symbols is related to the ever changing shared experiences. The previously constructed reality of individual participants often differs from the encountered reality during the walk. Differences can be pointed out and erroneous conceptions corrected. For example, I see plants that indicate the usage of nutrients and can inquire about fertilizer usage. The feedback from the visible evidence forces the participants to learn about the consequences of their actions. In our shared experience and speaking about it we explain our realities.

We progress from collecting data and abstract concepts to a common experienced reality. This ultimately touches upon the feeling of identity of the people affected. I am able to show them in which relationship their ideas stand to attitudes of society at large and norms, which are manifest in the use of space, and in the use of land.

4.2 Base for Knowledge Construction

Imagination and understanding emerges from our embodied experiences. Human bodily movement, manipulation of objects and interaction, integrate recurring patterns and develop new ones. We are able to integrate information and transform it into knowledge in a mutual understanding. Joint activities bring up joint experiences. We manipulate objects and interact in the group.

We are never separate from our bodies. Our bodies have been ignored in discussions about communication and decision making because they seemed to have no role in reasoning and understanding.

> *"The body has been ignored because reason has been thought to be abstract and transcendent, that is, not tied to any of the bodily aspects of human understanding"*
>
> (Johnson 1987 p.132)

This concept is the backdrop for the assumptions about understanding, decision making, and knowledge construction processes among participating persons. We are able to integrate information and transform it into knowledge in a mutual understanding. This transformation is also a bodily transformation. The experiences are stored in our bodies (Merlau-Ponty 1966). Joint activities bring up joint experiences; we manipulate objects and interact in the group. Experiencing actions together leads to a common knowledge construction.

4.3 Shared Knowledge Construction

The change from a collection of common goods, leveling variety for a consensus in least common denominator, to a shared knowledge construction of a heterogeneous group becomes apparent in behavioral patterns, through acting, and a growing group identity.

Structures of social interaction are opened and renew the base of contact. The participants experience themselves mutually within every new meeting; they experience the concrete situation, make a common decision about this situation, and experience the first outcome of the decision.

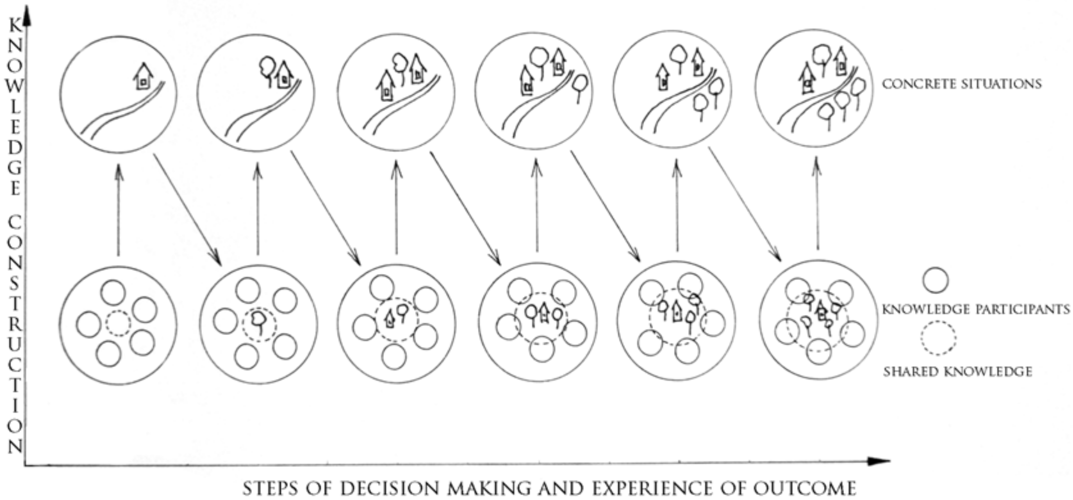


Fig.1: Shared knowledge construction

The knowledge the participants just brought with them, their constructions, their feeling and thinking patterns, remain. The concrete experience enlarges the shared knowledge (Johnson 1987).

Further the participants develop slightly changed roles and test them in new behaving patterns. This is the pre-condition: they are able to perceive new contents and information, and integrate it into their personal experience, knowledge, and acting. This flexible interaction enables to anticipate and imagine the future, to make decisions, to act, and to experience the outcome step by step. In the course of multiple meetings subjective and objective meanings are developed, corrected, and confirmed. Shared experiences, behavior, decisions, and acting grow during this planning process, and can lead to a shared knowledge construction of a heterogeneous group.

5 CONCLUSION

The objective of participative planning processes is to develop a common goal in physical space. To develop a common goal it is necessary to get knowledge about social and physical usage of space. Knowledge construction, decision making, acting, and the bearing of responsibility are immediately connected within the several planning steps. The planning group at the initial of the process usually is a heterogeneous group and consists of responsible persons, planners, and of people affected by a planning intention. They bring with them different knowledge about the circumstances and do not have a base for interactions in that special heterogeneous group. The outcome of participative planning processes should be a special form of collaboration organizing social and physical usage of space. Therefore a shared knowledge construction is the first step of a successful public participation.

Within heterogeneous groups we need communication structures for receiving and sending information, we need structures for building trust in the information, and we need structures to enable the participants to transform information into knowledge. Information has to be emotionally and cognitively perceived and accepted to reach a shared knowledge construction, and to arrive at decisions about future plans. The participants have to experience the concrete outcome of first decisions to strengthen the base of common action.

6 REFERENCES

Argyle, M. (1975). Bodyly Communication. Methuen & Co.

Burkart, R. (1998). Allgemeine Theorieperspektiven von Kommunikation - Kommunikationswissenschaft. Wien, Böhlau.
Burckhardt, L. Hrsg. Bazon Brock. (1985). Die Kinder fressen die Revolution. DuMont Buchverkag. Köln.
Damasio, A. (1999). The Feeling of What Happens. First Harvest edition.
Dreitzel, H. P. (1992). Emotionales Gewahrsein. München, DTV.
Fuchs, T. (2003). Non-verbale Kommunikation: Phänomenologische, entwicklungspsychologische und therapeutische Aspekte. Internet Source.
Geser, H. (1996). Elementare soziale Wahrnehmungen und Interaktionen. Internet Source.
Goldstein, K. (2000, 1934). The Organism. Aholistic Approachto Biology Derived from Pathological Data in Man. Zone Books. New York.

Hakansson, J. (2003). Exploring the phenomen of empathy. PhD-Department of Psychology. Stockholm.
Haraway. D. (1991). Situated Knowledges: The Science Question in Feminism and the Priviledge of Partial Perspective, in: Simians, Cyborgs, and Women. Routledge. New York.
Hochschild, J. (2000). "Where you stand depends on what you see: Connections among Values, Perceptions of Fact, and Prescriptions", in: James Kuklinski (Ed.). Citizens and Politics: Perspectives from Political Psychology. Cambridge University Press.
Jacobs, J. (1961). The Death And Life Of Great American Cities. Vintage Books. New York.
Joas, H. (1980). Praktische Intersubjektivität - Die Entwicklung des Werks von George Herbert Mead. Frankfurt.
Johnson, M. (1987).The Body In The Mind. Chicago Press.
Langer, S. K. (1984). An Essay on Human Feeling, John Hopkins University Press.
Lanz, St.(1996). Planungstheorie und Sozialtheorie. http://docserver.bis.unioldenburg.de/publikationen/bisverlag/landem96/inhalt.html
Lendi, M. (2004). Planung und Recht- Reflexionen. http://e-collection.ethbib.ethz.ch/ecol-pool/bericht/bericht_393.pdf
Lewin, K. (1951). Field theory in social science; selected theoretical papers. D.Cartwright. Harper&Row.
Mansbridge, J. (1980). Beyond Adversary Democracy. New York. Basic Books
Maslow, A. (1954, 2002). Motivation und Persönlichkeit. ROROROSachbuch.
Maturana, H. R. (1998). Biologie der Realität. Frankfurt am Main.
Merleau-Ponty, M. (1966). Phänomenologie der Wahrnehmung. Berlin, Walter De Gruyter & Co.
Mehrabian, A. (1972). Nonverbal Communication. Aldine- Atherton. Chicago.
Rottenbacher, C. (2004). Presence in the Planning Process. GEOS 2004. Brasilien.
Rottenbacher, C. (2005). Emotional Correspondence Links. CORP 2005.
Schilling R. (1973). Demokratie der Teilnahme. Ein politisches Kochbuch. Schulthess Polygraphischer Verlag. Zürich.
Schmid, P. (1996). Personenzentrierte Gruppenpsychotherapie in der Praxis. Ein Handbuch. Junfermann. Paderborn.
Smith, M.K. (2001). Kurt Lewin, groups, experiental learning and action research. The encyclopedia of informal education. www.infed.org/thinkers/et-lewin.html
Varela, F.J., Thompson, E., Rosch, E. (1997). The Embodied Mind. MIT Press Cambridge Massachusetts.
Young, M. I. (2000). Inclusion and Democracy. Oxford Political Theory. Oxford Univesity Press.

🏆 reviewed paper

Community Initiated Public Participation: Altering the Urban Design Decision Making Process with Real-Time Immersive Visualization

Mark LINDQUIST, John DANAHY

(Mark Lindquist, Victoria University of Wellington, School of Design, 139 Vivian St, Wellington, mark.lindquist@vuw.ac.nz, John Danahy, Univeristy of Toronto, Centre for Landscape Research, 230 College Street, Toronto, land@clr.utoronto.ca)

1. ABSTRACT

This paper examines opportunities that real-time immersive visualization offers the urban design decision making process. In a conventional public participation model the designer, developer and government bodies are all placed in privileged roles, controlling and editing information that is presented for public feedback. Through discussion of a case study from the University of Toronto's Centre for Landscape Research (CLR) this paper examines how a community group initiated the dialogue in an otherwise opaque process by approaching the CLR to represent a development proposal using real-time immersive visualization. The community's actions resulted in the local government and developers being forced to engage with the community group and to hear their concerns. The actions dramatically altered the process of planning and urban design development in the City of Toronto.

This paper argues that the conventional process of public participation can be altered by the public organizing and using the visualization tools prior to and independent of presentations made by designers/developers and government bodies. This allows the public to initiate a dialogue autonomously rather than relying on the other parties to do so. Once the public calls these parties to review identified issues with a given project the public gains a level of control over the information, forcing all parties to engage in a far more democratic decision making process.

2. INTRODUCTION

Public participation allows for democratic input on decisions made by a few people that affect many people. In the spatial planning disciplines, the public participation process frequently involves professionals communicating complex spatial arrangements to laypeople. However, traditional methods of spatial representation, orthographic plans and sections, are difficult for the layperson to decipher. Many of the problems contributing to unsuccessful public participation processes are caused by a communication breakdown between the public and professionals, which visualization can aid in overcoming (Lange 2005). Furthermore, in many instances of visualization for pubic participation, if computer based visualization is at all utilized it is primarily used as a sales tool, employing static glossy images or, at best video based cinematic animations, that are aimed at selling a proposal to the public rather than encouraging them to make a critical decision (Danahy, 2005a). The failure of traditional planning tools for communicating to the public has been presented, and the advantages of additional visualization techniques in a conventional public participation model have been discussed (Al-Kodmany, 2002). In addition, the advantages of real-time immersive visualization over more commonly used media for experiencing landscape has been argued (Danahy, 2001). Specific discussion of the advantages and potential of engaging the public using real-time visualization for engaging in participation have also been discussed (Bishop, 2005; Kwartler 2005.) The above mentioned examples of visualization for public participation are rooted in a traditional methodology, where the developer or government body control and edit the information that is available to the public for input.

This paper will expand on this discussion by examining how the process of public participation can be altered using real-time immersive visualization by forcing unknowing or unwilling professionals to engage with the public. The paper provides evidence on one mechanism the public may utilize when the powers that be are not interested in public input. This paper will use the case study of the development of lands adjacent to Fort York in Toronto, where the agreements of a previous public consultation process spanning several years of negotiation were ignored by a group of newly appointed civic officials. As a result the community group involved was forced to confront the developer and City of Toronto by modeling the proposal on their own to initiate a renewed process of public participation in an attempt to regain some of what was accomplished previously. What follows is an outline of the process and what stands to be gained from this inverted methodology of public participation.

3. CONVENTIONAL PUBLIC PARTICIPATION PROCESS

Public participation is broadly defined as 'forums for exchange that are organized for the purposes of facilitating communication between government, citizens, stakeholders and interest groups, and businesses regarding a specific decision or problem' (Renn et al 1995). The degree of inclusiveness of various models for public participation was identified early on by Arnstein. These range from manipulative non-participatory models to scenarios where citizens are empowered and control the participation (Arnstein, S. R. 1969). In a conventional spatial planning public participation mode, the designer, developer and government bodies control and edit information that is presented for public feedback. Public consultation seldom surpasses Arnstein's 4th rung of 'token placation'. Krek raises the issue that even when the public's opinions are solicited, there is very little hard evidence to support that such a process is a success or a failure (Krek 2005). Regardless of the degree of success, an overriding issue is that the process ultimately relies on those 'in charge', the designer, developer or urban design department, to initiate and form the process of public consultation. Much of the above discussion surrounding the difficulties of public participation revolves around how to engage the public. But an equally pertinent issue is what the public is to do when they aspire to participate but are denied the opportunity. The true value of a public participation process is when the public can initiate it whether or not the professionals see a need for public participation. If the public could successfully intervene in the process, it would radically shift the model of public participation from a non-existent status to the uppermost level of the Arnstein ladder for public participation, thus allowing for the most significant degree of influence by the public on the process and leading to the highest level of empowerment.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

4. THE FORT YORK NEIGHBORHOOD

Community involvement in the development process for lands in the vicinity of Toronto's Fort York commenced in 1994 when the community group Friends of Fort York was founded to confront the planning process being carried out by the City of Toronto (http://www.fortyork.ca/History%20Files/FOFY%20News%20V.7%20N.1.htm). At that time City officials were attempting to approve extremely high density development in the City's official Part II Plan for the sites adjacent to the Fort, justifying the extreme density by basing it on the areas prior industrial zoning. A group of citizens concerned with the status of the Fort rallied together to object to the density and development process. By objecting to the City of Toronto's proposal the community group was able to persuade planners to develop a medium height built form strategy that protected much of the visual integrity of the Fort. Ultimately the group was not able to change the density as was their desire but agreed with the City in 1995 to a pattern of blocks and towers similar to Toronto's existing St. Lawrence Neighborhood, which has been identified as a highly successful mix of density and livable urban design (Rose, 1980). However, in contrast to the 1995 decision, in 2001 the City of Toronto approved taller towers. The community group felt that the tall towers would negatively impact on one's experience of the Fort while achieving no higher overall density. The tower typology was approved mainly to appease the market conditions of the time, allowing developers to build what they viewed as being desirable accommodation by the market forces (Danahy, 2005b). The Friends of Fort York felt that their views as agreed in 1995 had been ignored and were again forced to initiate a more open process for development approvals.

5. PUBLICLY INITIATED DIALOGUE

Following the rejection in 2001 by the City of Toronto of the 1995 plan for development, the Friends of Fort York solicited the Centre for Landscape Research (CLR) to prepare a digital model of the official plan proposal that could be visually scrutinized in the CLR's Immersive Visualization Lab (Figs 1, 2).

Figure 1: Early Visualization of the City of Toronto Official Part II Plan massing

Figure 2: Screen capture of projected immersive visualization from within Fort York of the Official Part II Plan massing

Figure 3: Community members and volunteer urban designers discuss alternatives at the CLR Immersive Lab

In addition, with the assistance of volunteer local urban design professionals, alternatives were developed that maintained the high density mandated by the City of Toronto and the land owners while contributing positively to both the experience from within the Fort as well as the proposed neighborhood (Fig 4). City officials and developers were invited to view the visualization and to discuss alternative proposals at a series of workshops facilitated by the CLR. The Friends of Fort York argued that due to the historic significance of the battlefield landscape of the Fort, the experience from within the Fort was valuable enough to justify altering the built form preferred by developers. The City of Toronto and the developer did not agree. The case went to the Ontario Municipal Board (OMB), a Provincially appointed adjudicative tribunal that hears appeals on planning applications and resolves land use disputes (http://www.omb.gov.on.ca/). At the hearings, the community group was permitted to present their visual evidence. However, the OMB was reluctant to break with the tradition of meeting in a quasi judicial court room setting and declined an invitation to experience the proposal and the alternatives developed by the community group in the CLR's immersive lab. As a result, the Board was presented with comparative images in the format of 11x17 colour prints of the original and alternative proposals (Fig 5).

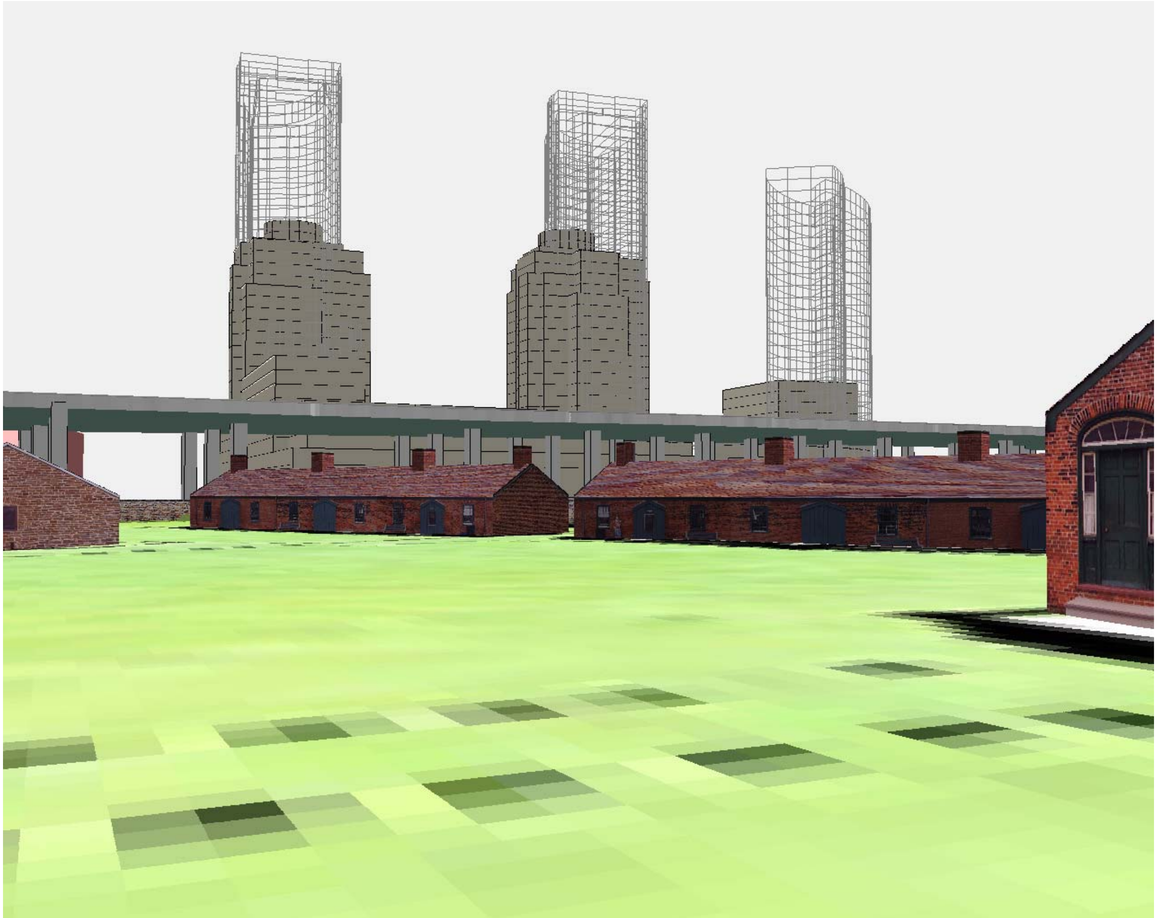


Figure 4: Comparative overlay of the developers favored tower typology (wire frame) and the equal density medium height typology developed by local volunteer urban design professionals (solid)

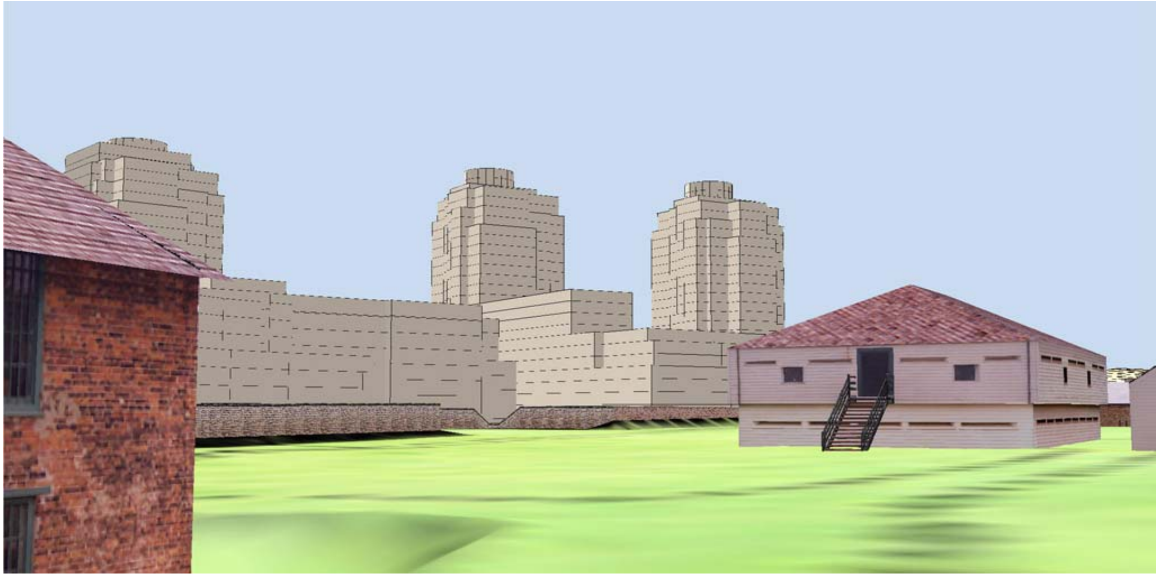


Figure 5: Example of comparative images presented at the OMB hearing with proposed development (top, solid outline) and projected development (top, wire frame) and the alternative equal density medium height strategy (bottom)

This static two-dimensional presentation style was a very poor substitute for the real-time immersive visualization available at the CLR for conveying the shape and form, as well as, the experience a person gets walking about in the Fort. Many in the Citizens group believe that this unwillingness to see their interpretation of the impact of the developers proposal may have contributed the OMB's decision to protect the private interests of the developer over the public historic and interpretive interest of the Fort. The Board ultimately ruled that the Fort was not of sufficient historic value to affect the developer's flexibility to exploit maximum market potential in its built form. The developers argued that tall buildings better met their financial reading of market demand for condominiums. The preferred bottom line of the developer was ruled as paramount, and no concessions to improve the ground-level experience of people within the Fort or the proposed neighborhood were made.

6. DISCUSSION

The example from the Fort York case was not a typical public participation process. By abandoning outcomes agreed upon with the Friends of Fort York in the 1995 public consultation, the City of Toronto effectively forced the community group to take action to represent the interest of the Fort and its heritage landscape. In this case, the traditional challenge in public consultation of engaging the public was not an issue because the Friends of Fort York had a long standing commitment to stewardship of the interests of the Fort in both its planning and on-going programming of interpretive events and improvement. While the community group was unsuccessful convincing a majority of City Councillors and the hearing officers of the OMB to minimize the impact of the development on the experience of people using the Fort, there were significant positive outcomes from the process, both locally and of wider application, in the immediate and longer term. In the immediate term, the action undertaken by the Friends of Fort York and the CLR has had a significant impact on the development process in the City of Toronto. The City of Toronto and the developers of properties surrounding the Fort have voluntarily agreed to public participation utilizing the CLR's facilities in the early stages of design (Danahy, 2005b). Arguably, this involvement may be motivated more by a desire to avoid the time and costs associated with future appeals by the Friends of Fort York to the OMB than to protect the public interest in the Fort. Regardless of the motive, the result is a more transparent process of development allowing the expression of opinion and ideas from a public that understands the impact of development proposals. In addition, the public are confident of their ability to effectively communicate with professionals by utilizing the immersive visualization capabilities afforded to them by the CLR as a common ground for discussion and negotiation. In the end, this should result in more accountable development.

The significance of the Fort York process is far wider reaching than in simply affecting the local planning policy of the City of Toronto. The fact that the pubic was able to completely alter the process of design, planning and development when blatantly not included in the process is an important discussion point. The shift in power from the private interest of the developer and Corporation of the City of Toronto was a direct result of explicit visualization that eschewed problems of professional communication to the layperson. It was the public that engaged and challenged the exclusivity of the representations provided to them (or not as the case may be) by the professional acting on behalf of the developer and the City in the process. This inverted the historic issue of communication in the public participation process; rather than the professionals struggling to communicate with the public and facilitating their understanding of a proposal, it was necessary for the public to convey to the professionals that they understood the ramifications of the development and were prepared to challenge it. It was no small task to shift the balance of power in the development process. It was this shift in power, enabled by the technology at hand, that had the most profound effect on the process and outcome. A public armed only with traditional means of visualization, such as orthographic plans and sections, could not have made the strong case they did, as they would have likely been outflanked by the professional experience of the developers. It was the explicitly comprehensible nature of the immersive visualization that formed the core of the public's understanding and commitment to their argument. The public's argument and resulting visualization was sound enough that the developer's lawyer, as a last resort, was forced to challenge the accuracy of the digital model, with no success.

The effectiveness of the tools clearly articulated the ramifications of the development to layperson and professional alike, necessitating the engagement of the professionals with the public on their terms. The application of this inversion of the traditional public participation model to any spatial planning project should make developers and officials take note; a willing public is now able to force engagement and negotiation using real-time immersive visualization. The success of these tools in completely altering the development process in Toronto is evidence of the communicative and democratic power the technology has to offer. Furthermore, including real time visualization early on in the design process as a communicative bridge between the public and professionals can only benefit all parties by avoiding costly trials and wasted time, positively affecting the developer's bottom line. Returning to Arnstein's ladder of public participation, it is clear that by rejecting in 2001 the outcome of the 1995 public consultation that those newly appointed at the City of Toronto had reduced the 1995 public consultation to one of tokenism and placation. The value of the 2001 process was that through a confrontational process the input of the public shifted significantly up the ladder to the first true form of public participation, that of a partnership between the public and professionals. This is the first truly participatory model using visualization in the development process, one that has been created by a public with the desire to be involved in the process.

7. CONCLUSION

There has been a dramatic shift in potential now that tools such as the ones used in this case are increasingly accessible, from a process of public participation that has failed to utilize adequate tools for engagement to one where the public are able to harness the tools to engage the professionals in visual-spatial dialogue and debate themselves. As has been discussed, the shift in power from the professionals to the public can be attributed to the technological tools that enabled an informed discussion. While the Friends of Fort York were not successful in convincing the OMB, developers or those in control at the City of Toronto that the ground level experience from within the Fort was worth protecting, there were significant outcomes from the process. The major impact was that all future planning for this area of the City is evaluated using real-time immersive visualization at the CLR when the citizens ask for it. The public is involved from the early stages, and has forced the cooperation of other developers from adjacent sites who do not want to go through the time consuming and costly process of OMB hearings. The entire process is now much more democratic, with agreement sought from the initial stages of design rather than nearer the construction approvals stage of permits issuance.

8. BIBLIOGRAPHY

ARNSTEIN, S. R. (1969) *A ladder of citizen participation*. Journal of the American Institute of Planners 35, 216-224

BISHOP, I. D. (2005) *Visualization for participation: the advantages of real-time?* In: E. Buhmann, P. Paar, I. Bishop & E. Lange (eds.): Trends in Real-Time Landscape Visualization and Participation: Proceedings at Anhalt University of Applied Sciences, Dessau, Germany, May 26-28 Herbert Wichmann Verlag, 2-15

DANAHY, J. W. (2001) *Technology for dynamic viewing and peripheral vision in landscape visualization*. In: Spec. Issue, Our Visual Landscape. Landscape and Urban Planning 54, 125-137

DANAHY, J. W. (2005a) *Dynamic Immersive Visualization: Negotiating Landscape Images.* In: M. Koll-Schretzenmayr, M. Keiner, G. Nussbaumer (eds.): The Real and Virtual Worlds of Spatial Planning

DANAHY, J. W. (2005b) *Negotiating Public View Protection and High Density in Urban Design.* In: I. Bishop & E. Lange (eds.): Visualization in Landscape and Environmental Planning. Technology and applications. Taylor & Francis, London

The Friends of Fort York and Garrison Common (accessed November 2005): http://www.fortyork.ca/History%20Files/FOFY%20News%20V.7%20N.1.htm

Ontario Municipal Board (accessed November 2005): http://www.omb.gov.on.ca/

KREK, A. (2005) *Rational Ignorance of the Citizens in Public Participatory Planning.* In: M. Schrenk (ed.): Corp2005 & Geomultimedia05: Proceedings at Technical University of Vienna, Austria, February 25-27 2004 167-171

KWARTLER, M. (2005) *Visualization in Support of Public Participation.* In: I. Bishop & E. Lange (eds.): Visualization in Landscape and Environmental Planning. Technology and applications. Taylor & Francis, London

LANGE, E. (2005) Issues and Questions for Research in Communicating with the Public through Visualizations. In: E. Buhmann, P. Paar, I. Bishop & E. Lange (eds.): Trends in Real-Time Landscape Visualization and Participation: Proceedings at Anhalt University of Applied Sciences, Dessau, Germany, May 26-28 Herbert Wichmann Verlag, 2-15

RENN, O., et al. (1995) *Fairness and Competence in Citizen Participation: Evaluating Models for Environmental Discourse.* Kluwer, Dordrecht, The Netherlands

ROSE, B. (1980) *Toronto: St. Lawrence Neighborhood.* In: Urban design international 1 (6) 32-33,40

Improved reconstruction and rendering of cities and terrains based on multispectral digital aerial images

Konrad KARNER, Gerd HESINA, Stefan MAIERHOFER, Robert F. TOBLER

(VRVis Research Center, Donau-City Str. 1/3, A-1220, Wien)

1. ABSTRACT

In this paper we describe the 3D modeling and interactive visualization of 3D city models generated from multispectral digital aerial images. The proposed 3d modeling approach integrates spectral classification to obtain a semantic description of the reconstructed scene. The workflow consists of several consecutive steps, namely an initial land use classification (LUC), the aerial triangulation (AT), a dense matching process, a refined LUC using the DSM to fuse redundant information from all input images and a texture extraction step.

Based on the available, reconstructed geometry data optimized rendering methods are employed in the subsequent visualization stage. Due to the reconstruction process, most data is available in a 2½ D format, i.e. height values are available for a grid of locations. In order to render this type of data, a chunked level-of-detail approach is employed, based on the work Ulrich. By extending Ulrich' level of detail method to run multiple instances of the algorithm in parallel we make it possible to visualize arbitrary ranges and layers of data at arbitrary precision.

Together, the proposed reconstruction and visualization methods result in a very fast, and economical pipeline for visualizing large parts of a city or landscape within a very limited timeframe. The resulting real-time visualization can be used in a number of urban applications that need up-to-date information on changes in the vegetation or building suituation of a city.

2. INTRODUCTION

The traditional workflow for reconstructing urban geometry is a multi-step process that is costly both in time and money. Speeding up the process and automating the workflow will therefore automatically result in a cheaper more viable method for generating urban models. In order to achieve this goal, we use images from an aerial camera to perform an improved reconstruction of urban geometry by using specialized Land Use Classification methods (LUC).

For rendering terrain data a number of algorithms have been published, the most recent ones being the one by Lasasso and Hoppe [2004], Asirvatham and Hoppe [2005] and Ulrich [2005]. These algorithms are based on chunked levels of detail, i.e. the geometry for levels of detail is not switched on a per-triangle basis, but based on large chunks of triangles. The speed of current graphics hardware makes this approach significantly more effective than previous more fine grained approaches. In order to render the reconstructed geometry in an optimized manner, we extended the chunked-level-of detail approach to handle large areas of data and added additional layers to cope with data that is not arranged in a 2½ D format.

The following sections describe our improved methods for reconstruction and interactive visualization.

3. 3D CITY MODELING FROM DIGITAL AERIAL IMAGES

Digital aerial cameras change the way of 3D city modeling completely. The availability of high redundant aerial images at almost no additional cost results in a paradigm shift where a transition from minimizing the number of film photos due to human operator intensive processing to maximizing the robustness of automation due to this high redundant image information takes place.

In our fully digital aerial workflow we use images from UltraCam-D cameras which deliver 16 bit pan-sharpend RGB-NIR images with a size of 11500 x 7500 pixels. The camera is able to deliver images at intervals down to 1 sec.

Our workflow includes the following steps: a classification of all images, the aerial triangulation (AT) using area and feature based point of interests, a dense matching to generate a dense digital surface model (DSM), a 'true' orthophoto production, a refined classification using the DSM, and the estimation of roof and façade polygons.

3.1 Land Use Classification (LUC)

The initial land use classification is a supervised classification performed on each of the overlapping color images with 4 color channels RGB and NIR. Our classification approach is based on support vector machines (SVM). Figure 1 shows the RGB image and the corresponding LUC for a small area on the ground.

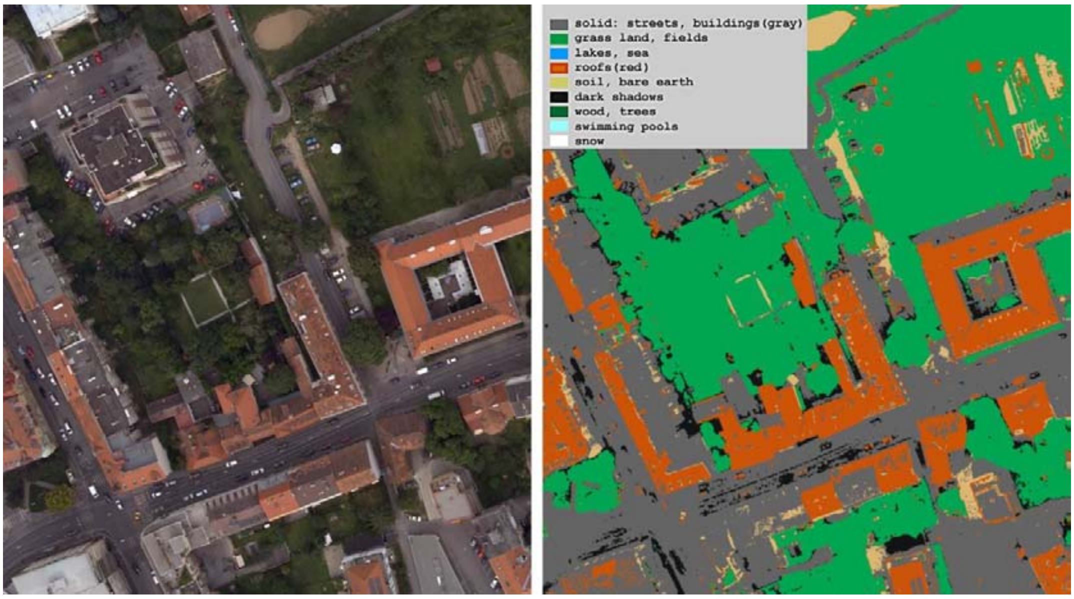


Figure 1: The RGB image (left) and the corresponding initial LUC (right) for a small area within the city of Graz.

3.2 Automatic Aerial Triangulation

Our aerial triangulation starts with a POI (point of interest) extraction which is based on Harris points and POIs from line intersections (Bauer et al. 2004). The POIs from line intersections which we call 'zwickels' are very suitable for urban areas. Zwickels are sections defined by two intersecting line segments, dividing the neighborhood around the intersection point into two sectors. After the POIs extraction in each image we calculate feature vectors in the close neighborhood. Feature vectors are used to find 1 to n correspondences between POIs in two images. Using affine invariant area based matching the number of candidates is further reduced. For all remaining candidates we iteratively apply an affine transformation to maximize the crosscorrelation score. As a result we get a list of corresponding points. In order to fulfill the nonambiguous criteria, only matches with a high distinctive score are retained. The robustness of the matching process is enhanced by processing a back-matching as well. Figure 2 illustrates corresponding POIs from line intersections.

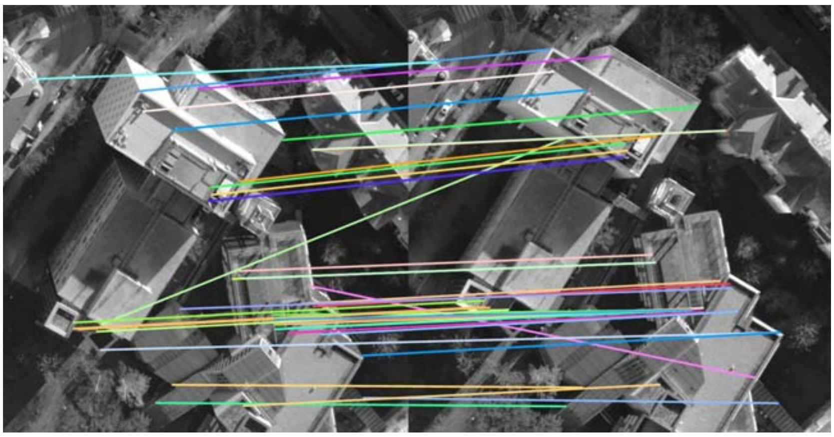


Figure 2: Line intersections are used as POIs in the aerial triangulation. These POIs have a high location accuracy and low outlier rate (there are only two outliers within the best 25 matches) even before the epipolar constraint is enforced. Corresponding POIs are connected by lines.

Another restriction is enforced by the epipolar geometry. Therefore the RANSAC method is applied to the well known five point algorithm (Nister 2003). As a result we obtain inlier correspondences as well as the essential matrix. By decomposition of the essential matrix the relative orientation of the current image pair can be calculated.

This step is accomplished for all consecutive image pairs. In order to get the orientation of the whole set, the scale factor for additional image pairs has to be determined. This is done using corresponding POIs available in at least three images. A block bundle adjustment refines the relative orientation of the whole set and integrates other data like GPS, DGPS, IMU or ground control information. Figure 3 shows an oriented block of 7 x 31 aerial images together with the used 3D tie points on the ground. The whole block of images was processed without any human interaction.

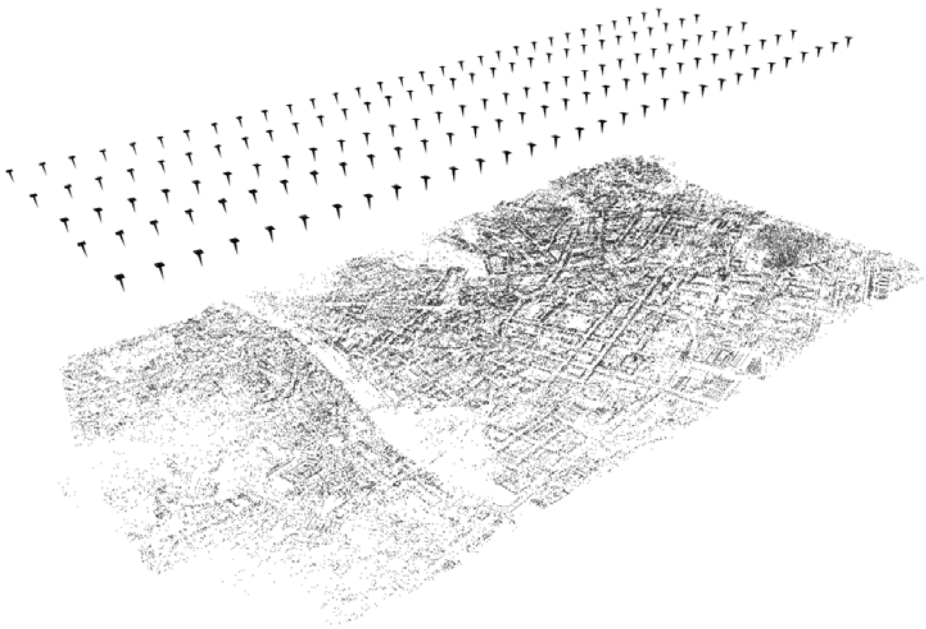


Figure 3: 5 strips of about 31 images each denoted by small arrows are oriented to each other using about 70.000 tie points on the ground which are shown as black dots.

3.3 Dense Matching

Once the AT is finished we perform a dense area based matching to produce a dense DSM (digital surface model). Recent years saw more new dense matching algorithms were introduced. A good comparison of stereo matching algorithms is given in a paper by Scharstein et al.(2002). Recently, a PDE based multi-view matching method was introduced by Strecha et al. (2003). In our approach we focus on an iterative and hierarchical method based on homographies to find dense corresponding points. Figure 4 shows a dense matching results using our approach for the inner city of Graz.

Figure 4. A dense height image with a GSD (ground sampling distance) of 30cm for the inner city of Graz is calculated fully automatically from oriented aerial images.

3.4 True Orthophoto

A 'true' orthophoto is obtained by orthoprojection of the DSM. The color information of the orthophoto is calculated using all available aerial images and is based on view-dependent texture mapping described in (Bornik et al. 2001).

3.5 Refined Classification

Refined classification performs data fusion in a way that the classification results are less scattered, see Figure 5: the initial classification – top middle image – has the roof correctly classified but the chimney and a small roof over a window are classified as solid. The height data – top right image – as well as the height gradients – bottom left image - and the building blocks – bottom middle image - cause a classification of the whole roof as one block, see bottom right image.

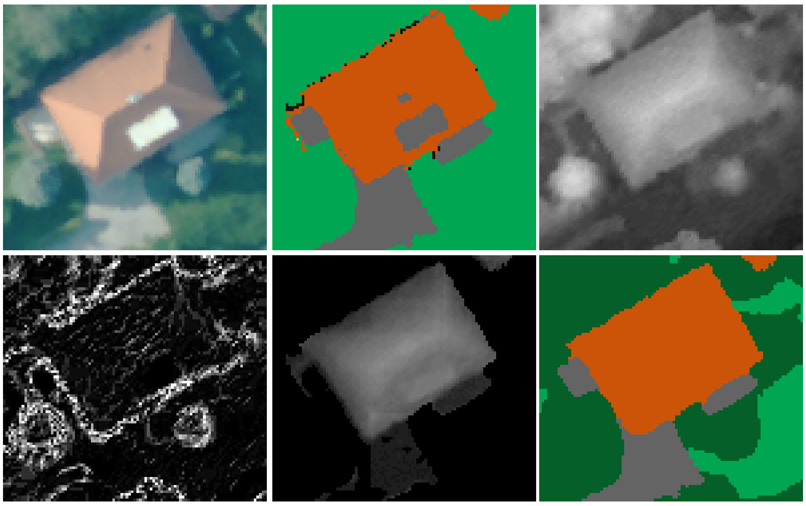


Figure 5: Different stages within our modeling workflow. Top row: one input image (left); initial LUC (middle); height image produced by dense matching (right). Bottom row: height gradients (left); fusion of LUC and height image; refined LUC (right).

3.6 Modeling of Roof and Façade Planes

The information from the height image (Figure 4) together with the refined LUC (Figure 5 bottom right) is used to extract building blocks. Local planes are fitted inside these building blocks. Neighboring planes are intersected to obtain roof polygons. The height gradients at the border of the building blocks are used to estimate façade planes which are refined in a constrained plane sweeping approach and again intersected with the roof polygons and the ground planes. In a last step the best input images, incorporating the visibility information, are searched to texture the façade planes. Figure 6 shows a small area within Graz.

Figure 6: 3D city model of a small area in Graz. Additionally to the geometry and texture information, the semantic of single objects (building block, tree, street, water region, …) is known as well.

4. RENDERING AND VISUALIZATION OF THE RESULTING GEOMETRY

The available reconstructed geometry consists of two types of data: tha actual terrain, which is available in a a 2½ D format, i.e. height values are available for a grid of locations, and the classified, reconstructed data such as facades and roofs.

For rendering the terrain data we use an algorithm based on Ulrich's chunked level-of-detail method for fast rendering of terrains [Ulrich]. This method is optimized for visualizing large terrains, using a qaud-tree based approach for loading the geometry and associated textures into memory as needed. However, in its original form, Ulrich's algorithm is limited in its precision: due to the use of IEEE 32-bit floats of current rendering hardware, very large terrains will result in a loss of precision the further one moves out from the origin.

In order to overcome this problem we extended Ulrich's method by running multiple instances in parallel. Each instance uses its own, optimized coordinate system and the instances are rendered with the users camera subsequently mapped into the coordinate system of each instance. The computation of the camera coordinate system with respect to the coordinate system of each instance can then be performed in double precision (IEEE 64-bit floats), thereby retaining the available precision of the original data.

Using this technique it is possible to stitch the renderings of multiple instances of Ulrichs algorithm and thereby render huge terrain models without loss of precision. The actual instances of the algorithm are started and discarded as the user moves through the large model.

Figure 7: Screenshots from an interactive walkthrough/flyover application.

The reoncstucted façade and roof geometry cannot be rendered using Ulrich's algorithm, since the data is not representable as a 2½ D Grid, but consists of arbitrary geometry. Thus this geometry is handled in a separate layer that is only displayed for all tiles in Ulrich's algorithm that are close enough to be visible in detail. This is sufficient to provide the user with a nearly seamless walkthrough or flyover of the reconstructed terrain and urban model (see figure 7).

5. CONCLUSION AND FUTURE WORK

We demonstrated a significantly improved method and worflow for fast reconstruction of urban geometry based on aerial photography. Due to its fast turnaround time the new method allows new applications of aerial reconstruction such as quick verification of available data or repeated reconstruction for detecting changes. Combined with a fast and interactive visualization method especially optimized for viewiing the resulting data, a very short turnaround time from acquiring the data to visual analysis of the data is achieved.

The current algorithms are based only based on the data obtained from the aerial images. By extending the matching algorithm to incorporate data from additional sources such as municipal land use databases, additional information for improving the quality of the resulting urban model is possible.

The land use classification algorithms can also be extended to provide the locations of additional object types as an input for the visulazation engine: vegetation can be classified as individual trees with height and categorized into different types, vehicles can be detected and classified into different types as well. The resulting information can then be used in the visualization step to render detailed models of the detected tree and vehicle instances.

6. REFERENCES

A. Asirvatham, H. Hoppe, 2005: Terrain rendering using GPU-based geometry clipmaps. GPU-Gems 2 (M. Pharr and R Fernando eds.), Addison-Wsley.

J. Bauer, H. Bischof, A. Klaus, K. Karner, 2004, Robust and fully automated Image Registration using Invariant Features, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XXXV, Istanbul, Turkey, ISSN 1682-1777.

A. Bornik, K. Karner, J. Bauer, F. Leberl, H. Mayer, 2001, High-quality texture reconstruction from multiple views, *The Journal of Visualization and Computer Animation*, Volume 12, Issue 5, 2001, Online ISSN: 1099-1778, Print ISSN: 1049-8907, John Wiley & Sons, pp. 263-276.

C.-.W. Hsu, C.-C. Chang, and C.-J. Lin, 2003, *A Practical Guide to Support Vector Classification*, Department of Computer Science and Information Engineering, National Taiwan University, Taipei 106, Taiwan.

C. Huang , L.S. Davis, J.R.G. Townshend, 2002, An assessment of support vector machines for land cover classification*, Int. J. Remote Sensing*, Vol. 23, No. 4, pp. 725-749.

A. Klaus, J. Bauer, K. Karner, K. Schindler, 2002, MetropoGIS: A Semi-Automatic City Documentation System, *Photogrammetric Computer Vision* 2002 (PCV'02), ISPRS - Commission III, Symposium 2002, September 9 - 13, 2002, Graz, Austria.

F. Leberl, J. Thurgood., 2004, The Promise of Softcopy Photogrammetry Revisited. ISPRS 2004, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XXXV, Istanbul, Turkey, ISSN 1682-1777.

F. Leberl, R. Perko, M. Gruber, 2002, Color in photogrammetric remote sensing, *Proceedings of the ISPRS Commission VII Symposium*, Hyderabad, India, Vol. 34, pp. 59-64.

F. Losasso, H. Hoppe, 2004: Geometry Clipmaps: Terrain rendering using nested regular grids. ACM Siggraph 2004, 769-776.

D. Nister, 2003, An efficient solution to the five-point relative pose problem, *CVPR 2003*, pp. 195–202.

F. Roli, J. Kittler, 2002, Fusion of multiple classifiers, *Information Fusion*, Vol. 3, pp. 243.

D. Scharstein and R. Szeliski, 2002, A taxonomy and evaluation of dense two-frame stereo correspondence algorithms. *IJCV*, 47(1/2/3), pp. 7-42.

M. Sormann, A. Klaus, J. Bauer, K. Karner, 2004, VR Modeler: From Image Sequences to 3D Models, *SCCG* (Spring Conference on Computer Graphics) 2004, ISBN 80-223-1918-X, pp. 152-160.

C. Strecha, T. Tuytelaars, L. Van Gool, 2003, Dense Matching of Multiple Wide-baseline Views, *ICCV* 2003, Vol 2, pp. 1194-1201.

J. Thurgood, M. Gruber, K. Karner, 2004, Multi-Ray Matching for Automated 3D Object Modeling. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XXXV, Istanbul, Turkey, ISSN 1682-1777.

T. Ulrich: Chunked Level of Detail Homepage. http://tulrich.com/geekstuff/chunklod.html

C. Zach, A. Klaus and K. Karner, 2003, Accurate Dense Stereo Reconstruction using 3D Graphics Hardware, *Eurographics* 2003, Short Presentations, pp. 227-234.

MAIS4D – An Example of Spatial and Temporal Visualization Methods for Urban Development in 4 Dimensions.

Peter FERSCHIN, Sigrun SWOBODA, Andreas JONAS, Gabriel WURZER
Klaus VATTER, Hans Peter GRANER, Markus OLECHOWSKI, Robert SCHWEIGHOFER

(* IEMAR, Digital Architecture and Planning, Institute of Architectural Sciences, Vienna University of Technology
** Municipial Department 21A, Urban Planning and Land Use; District 1-9, 14-20, Vienna (Austria))

ABSTRACT

Urban Develeopment Strategies have always integrated spatial and temporal representations of regional structures. However a combined digital representation in 4 Dimensions (3 spatial and 1 temporal dimension) is very seldom used in urban planning, This paper will introduce a pilot project (MAIS4D), covering a region of Vienna called “Erdberger Mais”, together with a large collection of planning documents for these region (3D models, aerial images, 2D plans, photographic and rendered images, metadata, etc). These planning documents have been combined to several interactive documents that represent the historical development, the present situation and the future development of this region. As the technological base, the 3D PDF file format (from Adobe) has been extended to represent 3D data together with temporal annotations as well as additional metadata. The resulting 4D planning documents provide a very suitable base to discuss planning intentions in a very broad sense.

S.O.U.P. - Sustainable Operative Urban Principles

Roberto BOTTAZZI

(Roberto Bottazzi, Visiting Professor, Royal College of Arts, Dept. of Architecture, London, bba_studio@katamail.com)

1. INTRODUCTION

The need to attempt to re-formulate the professional tools has been brought up by two main phenomena: on the one hand, the world of economy and social trends is becoming more and more volatile and uncertain. As a consequence, large schemes struggle to be viable for a sufficient length of time to be implemented [1]. On the other hand, there is a growing desire for people to become more active in any aspect of society. Be it through customized objects, direct democracy, wireless communication or web sites, the need to participate is now a shared concern that extends to planning as well.

Though, these two tendencies still violently clash against the current tools we have at hand. Despite their merits as regulatory procedures, traditional masterplans are still heavily based on zoning; complex programs weaving together different needs, people's desires and, the heterogeneous nature of almost any urban environment are almost completely left out. This is mainly due to the quantitative nature of zoning; it determines height restrictions, density indexes, minimum distances, etc.; but it does not tell us anything about the quality of urban experience.

Still, how to make urban design that can be considered as a piece of art that is not just a cosmetic intervention unable to activate public/urban life? Is it possible to integrate the existing planner's toolbox with processes that can help us to seek and explore quality? What are the paradigms we have to change in order to meaningfully operate in contexts characterized by shifting factors?

2. CONTENT: ORGANIZATION, PRINCIPLES AND PARTICIPATION

The first move S.O.U.P. proposes is to replace form with organization and ideology with principles. By making these fundamental shifts, S.O.U.P. sets out an attempt to integrate current techniques with new ones able to tackle urban quality and provide an informed space for discussion and participation. Still, what do organization and participation mean in this context? How can these two worlds be of help in this endeavour?

Organization shifts the focus from single objects to the relations taking place between them. In fact, at this stage architectural form is still a secondary element that cannot grasp much of the dynamics at work simply because they are neither architectural nor formal yet. Hence, the relevance of organization. If we define quality as difference in kind – as opposed to quantity as being difference in number – we realize that this meshwork of relations comes to form an abstract space that represents the systems' qualities in difference. Its relevance is characterized by its capacity to constitute the actual space where discussion and experimentation can occur by connecting different bodies with each other. This touches one of the most debated points about zoning. Zoning has the tendency to limit discussion by imposing fixed sets of parameters. In some regards, we could simply argue that zoning is a device that allows us to go from many (inputs, requests, etc.) to one (for instance: plan). As such, it can constitute a bottleneck in which public participation struggles to come through. With S.O.U.P. we are actually proposing to keep possibilities and scenarios open so that the process could be described as going from many to many. By doing so, S.O.U.P. also responds to one of the most important needs of the profession: that of being able to operate at different levels, scales and to connect diverse institutions to foster and support change.

Still, such a space would be bereft of any value if we were not able to make any use of these differential qualities. By adopting a number of precise principles is possible to turn qualities into operational elements. Principles differ from models because they are based on and only evaluate what the system can do and not what the system looks like. In other words, they are performative by definition rather than formal. In this regard, they do not set up formal criteria that will constitute the fixed parameters against which to test system's behaviours. Principles do not have any transcendental or metaphysical meaning.

S.O.U.P. can thus be defined as an ongoing research that proposes a series of techniques to introduce qualitative parameters in a territory largely dominated by quantity and introduce choice as an experimental technique based on rigorous analysis and consequent exploitation of design opportunities. The techniques proposed here heavily rely on the use of digital tools. The capacity that digital tools have to compile several sets of data and the possibility that some pieces of software have to study phenomena in time make them ideal for this research. This allows making an even more radical departure from current strategies: on the one hand, we can begin to map phenomena that are not initially spatial but that nevertheless constitute the urban culture of a place. The presentation shows some of these mapping exercises: behavioural patterns, programmatic mixes, geographical factors are studied through animations and diagrams. As a result, specialist and disciplinary skills start to co-exist with more cultural factors that allow cutting across diverse territories.

Still, the main aim of the research is to devise a space where discussion and participation can occur. The importance of exploring this point through maps is also reinforced by Gilles Deleuze and Felix Guattari in their "A Thousands Plateaux" when they affirm: "Make a map, not a tracing…What distinguishes the map from the tracing is that it is entirely oriented toward experimentation in contact with the real…The map is open and connectable in all of its dimensions; it is detachable, reversible, susceptible to constant modification. It can be torn, reversed, adapted to any kind of mounting, reworked by an individual, group, or social formation." [2]

Therefore, each active map will point out drawbacks, strengths, and most importantly, potentials for further developments to study and exploit. The techniques used are quite simple and intuitive in order to create a seamless continuum between mapping and creation or in other words, between modelling and forecasting. The sum of these procedures we call urban prototyping. Exactly as in rapid prototyping and similar manufacturing techniques, simulation is the instrument through which people are brought together to discuss and ultimately innovate. The prototyping culture, as it has unfolded in the corporate world over the last decade, materializes problems as well as political and strategic issues in order to constantly formulate and refine questions. Its main question is "What if?". As Micheal Schrage describes in "Serious play: how the world's best companies simulate to innovate": "Prototypes and simulations can do more than answer questions; they can also raise questions that had never been asked before. Playing with a prototype can stimulate innovative questions as surely as it can suggest innovative answers. There are profound cultural differences between organizations that build prototypes primarily to create questions and those that do so to answer questions. The ratio of questions asked to questions created says a lot about the organization 's innovation culture." [3]

The possibility to solve, innovate, trigger discussion through urban prototyping is also what this research conceives as sustainability. In the context of systems and planning tools, sustainability cannot regard devices to reduce energy consumption or so-called green-building technologies. It is rather about providing the instruments to support, change, adapt, and eventually implement a plan so that it becomes sustainable for a community. Perhaps, we should name this cultural and social sustainability instead.

3. TECHNIQUES: S.O.U.P. AND URBAN PROTOTYPING

This section of the paper will delve into the specifics of S.O.U.P. giving a description of how it really operates and demonstrating how some of the more theoretical claims become part of an operative tool. This will be achieved by going over the propositions for two projects in which S.O.U.P. was deployed. Particularly, it will be shown the work done on the "Finley site" (Vancouver, Canada, 2002) where the four major academic institutions of the city were coming together to create an innovative Campus. This piece of research was carried out in collaboration with School of Architecture, University of British Columbia, Canada (research awarded Wolfang Gerson scholarship and International Council for Canadian Studies Award. Similar techniques were also applied to the entry for the international competition "Martyrs' Square Axis" (Beirut, Lebanon, 2004) carried out in collaboration with Chora Architecture and Urbanism in London and Arup – Advanced Geometry Unit.

First of all, S.O.U.P. maps out the variables shaping a given site. Specific programs, views, infrastructure, land values, rent levels, physical densities, event densities, single points of interest are some of the variables mapped. Against this set of parameters, programs are then tested to measure their importance. A simple graph representing the change of value along the vertical (z axis) axis will help to visualize them in space. By stringing together each individual curve, a series of surfaces materialize; their forms directly represent the values of one of the parameters over the area studied. By using animation techniques, specific aspects can be modelled individually and then layered on top of each other; similarly, the degree in which a singular event affects the overall configuration can be taken into account according to its capacity to affect surrounding zones in diverse fashions (i.e. singular, gradient or diffuse). The case study carried out in Vancouver accounted for four types of programs to house: housing, spaces for private companies, educational spaces, and landscape.

It is possible to reconfigure the software parameters to produce as many maps as needed. The presentation will give an account of a matrix of maps issued during some of the testing exercises carried out on a specific site in Vancouver and Beirut.

Each of the maps will express one or several specific set(s) of constrains and will give rise to precise opportunities. As previously mentioned, this practice can be called urban prototyping. It is important to point out that these variations do not merely mean more possibilities. Each change in the parameters is based on different needs or desires and thus each outcome corresponds to a scenario that is qualitatively different from the others.

This space, which we defined as space for discussion, would not be valuable if we did not have a mechanism through which extracting information to proceed. A series of rules is introduced in order to encode these active maps. Vertical Permeability, Compression, Sewed/Smooth, Zero, Watershed and, Noise are the encoding principles each describing a precise behaviour in the system. For instance, Vertical Permeability registers a programmatic condition in which two or more programs co-exist and are both relevant in a specific area. Consequently, the plan must devise a strong exchange mechanism between them. Watershed marks a particular behaviour where two programs form a clear-cut separation by intersecting one other. Others just aim at introducing rigor and legibility in the whole system (i.e. Zero), and finally, Noise deals with a very particular condition. When two or more curves intersect each other several times without generating any clear pattern, an overall principle cannot be extracted. These points could be thought of as areas in which the noise-to-signal ratio is too high to make them legible. This occurs because the relations among programs become so complex that can no longer be read, and thus it is necessary to explore them as "one-off" solutions. These points will be the actual catalysts where a unique programmatic interaction should give rise to innovative solutions. The punctual nature of the noise nodes also ensures a form of sustainability of the whole system. Any large development, in fact, needs a balanced mix between large gesture with a peculiar programmatic character and fine-grain developments characterized by more traditional programs (the most frequent of which is residential).

There are some important concepts related to these principles that ought to be pointed out. First, the set of principles coming out from each set of maps still represents just a set of qualities, not architecture. These principles do not describe formal outlines to trace. In fact, this presentation does not endorse the notion of diagrams as metaphysical devices whose outcomes have value in themselves. In other words, diagrams are not used to dictate or provide an excuse for form to be justified. Here, diagrams are rather used to refine issues and focus the debate and trigger discussion. The sets of maps emerging from discussion and interaction are to be understood as a series of inputs that still presupposes individuation. Similar to how physicists operate, these maps need to be transformed to become fully architectural propositions; they need functions to allow this translation to occur. These mechanisms are provided by the encoding set; however, this set supplies a particular kind of functions that allow multiple developments and link parameters in a many-to-many fashion [4].

Second, these principles are complementary. It is not possible to extract any information from the maps unless at least two curves are considered. This allows shaping each individual parameter by itself without knowing the effect that it will have on the overall configuration.

4. EVALUATION AND CONCLUSIONS

With this presentation we hope that the examination of issues of complexity, uncertainty and participation pointed out why they are relevant to urban planning and how these elements can threaten the importance of urban interventions. At the same time, they are also proposing new problems and potentially new opportunities for architects. What this research is beginning to indicate is that in order to explore these opportunities some shifts have to be made.

Our attention should shift from form to organization; that is from the analysis of single parameters or individual objects to the investigation of the space between them, which we called qualitative or relational space. This allows us to link any project to the deeper dynamics shaping urban design, which have to do with economics, society and ultimately, culture. The problem immediately moves from being a purely disciplinary question to an interdisciplinary one.

Second, the participatory process should be encouraged by setting up techniques capable of both immediately transform people's inputs in something spatial (namely, by visualizing the value of a single parameter through surfaces) and provoke further discussion by allowing them to experiment and "play" with the tools provided. By delaying the emergence of a defined architectural proposition, the aim is to involve groups of citizens, artists, and teenagers in a process they would not normally take part to.

If we observe and understand the changes occurring in our cities, we will also understand that in order to be relevant in the field of urban design we will have to be innovative, culturally engaged, and interdisciplinary rather than formulaic, disciplinary and form-driven.

5. NOTES

1. For instance, this was the case for the area where S.O.U.P. was first applied. The site had originally masterplanned to house office for the growing Internet economy. The abrupt stop of the growth of such market caused the entire plan to be stopped and then entirely dismissed. Regardless of the architectural quality of that scheme, this episode reiterates the relevance of grasping large phenomena that go beyond architecture to involve economy, culture, etc. before engaging resorting to formal solutions.

2. DELEUZE, G., GUATTARI, F.; quoted in Allen, S., Colossal Urbanism (New York: cpa, 1996), 8.

3. SCHRAGE, M., Serious Play: how the world's best companies simulate to innovate, (Boston: Harvard Business School Press, 2000), p.77.

4. This discussion mainly refers to similar topics carried out in two books: DE LANDA, M., Intensive Science and Virtual Philosophy, (London: Continuum, 2002), p.79. B. Russell, Principles of Mathematics, (New York: W.W. Norton), 265-6.

🏆 reviewed paper

The social - cultural ecosystem of the neighborhood in Athens, the children and the bicycle

Nikolaos K. MITOULAS

(Phd, National Technical University of Athens, Laboratory of Urban Design, nmitoulasgr@yahoo.gr)

1. INTRODUCTION

The city as place and social ecosystem is experienced by the children in a special way, determined by the psychosomatic scale of children's age. The present research focuses on seasonal movement by bicycle in the neighborhood as well as on the impact it has on everyday routine, the level of familiarization with space and the suitability of the built-up frame, as regards the needs of children.

The innate need of children for seasonal movement, which achieves greater speeds than walking, is presented diachronically and cross-culturally. The catholic character of this phenomenon, recorded in literature and illustrated works, is empirically confirmed when somebody observes the games of children in the communal spaces. Children use anything that ensures movement, such as rollers, go-carts, sledges. The instrument, however, judged by them themselves as corresponding perfectly with their wishes, is the bicycle.

Cycling offers children fast locomotion with the least muscular effort. It contributes to their intellectual and biological growth as it allows the exploration of distant parts of the neighborhood, parts which they would difficultly attempt to approach on foot. The characteristics of environment can have repercussions in such an extension of action. Moore and Young [1] described the cycling routes of eight-year-old children in Berkley, California, as a formal transgression of the familiar limits of residence and space. On the contrary, Hart [2] noticed that in a small town in Connecticut which was divided by one of the busiest streets in the state, the cars prevented cycling, making it dangerous. The children moved carefully along the street covering smaller distance by bicycle compared to the one covered when they walked. The researcher observed that, up to the age of ten, children realize their abilities concerning the use of bicycle in relation to the favourable or unfavourable environment they act in.

Cycling provides unique experiences which help children to impress in their memory the characteristic traits of their environment. It reduces the effort for the localizations of distant points, objects and events, while it contributes to the acquisition of information on the activities that take place in these regions. When the route is easy then the children are encouraged to reach continuously even further destinations. It has been found that with the bicycle they reach destinations that are 2,5 times further, related to those they approach on foot. Still cycling presents to the eyes of children the objects and events that take place in these routes in a different way, since the quality of observation is completely different when compared to that through a speeding car or slow walking. The children moving by bicycle on a path that they have first crossed on foot will have a new experience of the space. They discover landmarks [3] that define space in the basic ancient relation "inside and outside" where "the existential inside" of the familiar is structured along with "outside" which does not belong there and is alien. [4] The outlines and the forms of self-knowledge and layout are defined from space which becomes place. This variety allows the intensification of perception and the discovery of immutable attributes of the environment.[5]

Because learning via the exchange of many opinions and aspects produces more bonds between notions, facilitating thus the future retraction of recollections, those children that have walked and crossed a space by bicycle, are expected to recognize more environmental characteristics when compared to children who have only walked.[6] Even if it is expected for the riders to continuously focus their attention on the street and not on the byways and the details of streets, however it was proven that the children that walk and go around by bicycle in a region know in-depth a lot of environmental details.[7] At first, they use the bicycle in order to explore the distant regions and then in order to have frequent and direct access to the regions of game. The passage to the seasonal movement comes little by little. The phase when the child feels strong enough to walk on his own in exterior public spaces precedes all these, and is followed by distant walks and later on cycling routes to distant destinations. Usually, however, the distant destination has first been discovered on foot and was then easily approached by bicycle. [8]

Through cycling, different qualities of space are presented which the child necessarily becomes aware of. Such is the bent of ground, even if she is slight, bumps on the street, the corners of turns, the winds that blow in the region depending on the season and the hour of day, hot and chill points of the neighbourhood, and the points of reflection of solar light. The cyclists, while crossing the streets, stop to check for cars and observe all the background and the landscape in his depth, further familiarizing with that.

A basic characteristic of childhood is the thirst for ecstasy and admiration, the search of adventure and limits. Cycling affects the feelings of children that often seek danger in order to learn the limits of the objective world and their body. The will for surmounting of these material limits that nature has placed for the child, is inherent in their nature. Space and time, the basic factors of existence that are presented together bringing each entity in "being", are exceeded by the human spirit and its aim which is to dominate the universe. In this will for the surpassing of time and space, in the child's scale, he bicycle helps as a suitable vehicle. Despite all, it offers psychological realxation mainly in urban locations of residence.

The use of bicycles creates, for the young cyclists in pre-adolescence years, intense excitement and the sense of identity that they belong in the homeland of neighbourhood and in its race. The groups of children - cyclists that go around in the neighborhood and in the surrounding regions are of a raiding nature. The speed and change of place, the chance to run fast without they being discovered or trapped in a place, suit the instincts of the hunter which actively appear in the child who has still not become a full participant of culture. Cycling can simply be a form of exercise, without planning or could be planned by the group by processes appointing of heads, followers and loyal companions. As in team sports, played in specific places, thus through seasonal cycling certain function become obvious which prepare the integration of children in the social form of region-residence. Besides, the additional information of anthropologic data and geography makes possible the maturation and growth of skills in children. The roaming in spaces which they would not approach with other means strengthens the autonomy and self-confidence and renders the city to friendly surroundings for them. [9]

The way from home to school becomes a daily routine for many years throughout the life of children. Usually the school is in a short distance or in the neighbourhood for primary school students. According to the European Committee for Environmental Issues [10] 50% of the children want to go to school by bicycle. Cycling the distance takes at about 10 minutes.

The present work researches the degree of satisfaction of children for seasonal movement via bicycle in the neighborhoods of Athens. The intensive urbanisation that takes place in the last decades degraded the scale of structured space. The traditional neighborhoods disappeared by the manufacture of motorways which split, with the speed of vehicles, the everyday life patterns. It is attempted to present the current situation of living conditions for children in the city concerning the quality of game in exterior spaces, as the children are a numerous and sensitive group of residents.

2. METHOD

The research was carried out with the method of questionnaire. The three questions that are unified in an interrogative proposal are of closed type, concerning the first one, and of two open type, regarding the other two.

The question "Do you have bicycle, and if yes where and when do you have a ride?" has three parts. To the first part, the students answer positively or negatively if they are holders of bicycle or rollers. To the second part, the question is open and the parts of the neighbourhood where one has the possibility of being enjoying seasonal movement, are mentioned. To the third part, which is also an open question, children are asked about the time, the particular days and hours. From the answers, it appears how much the structured environment of modern Athens is shaped in a way that allows the children to satisfy the biological and psychological need of seasonal movement.

3. SUBJECTS

209 students took part in the research, both boys and girls, aged 10-12 years old, attending 10 primary schools in municipalities of the Greek capital. The neighbourhoods of the selected schools were chosen according to the physiognomy of the typical neighbourhood of a Greek city with the disappearance of all natural elements, the serious problems of accessibility and transport and the absence of open public spaces that could be used for playing and recreation from the underage students. The schools are the following: 8th Municipal School, Vironas, 15th Municipal School, Galatsi, 19th Municipal School, N. Erithrea, 19th Municipal School, N. Ionias, 2nd Municipal School, Pefki, 6th Municipal School, Perissos, as well as 1st, 8th, 22nd and the 40th Municipal School, Peristeri.

4. DISCUSSION

The research showed that in the congested capital most children are bicycle holders.

161 (percentage 80,4%) answered positively that they have a bicycle while 41 (percentage 19,6%) answered negatively. The results showed that only when the environment is excessively structured with heavy traffic and without free public spaces, can the children be not holders of bicycles. A typical example is the neighbourhood of the 6th Municipal School in Perissos where 9 students out of 19 do not have a bicycle. The density of blocks of flats combined with the movement of cars make seasonal movement difficult for children. On the other hand, in the 2nd Municipal school in N. Erithrea and the 2nd in N. Pefki, only 2 students out of 17 that were asked in each one of the schools does not have a bicycle. It is obvious that the spaciousness of thin layout gives children the chance to use the neighbourhood space for cycling.

To the question "where do you cycle" 163 students answered focusing their answers on 8 places.

Where you ride bicycle?

Everywhere	17,7%
Country	17%
School	6,1%
Sidewalk	11,6%
Square	22,4%
Street	13,6%
Pedestrian street	6,8%
Park	4,8%

33 (22,4%) students declared that they cycle in the square. The square of the neighbourhood is a meeting place and a playground for children. Children prefer it because the open space allows cycling. 20 (13,6%) students cycle in the street near their house, 17 (11,6%) in a park with vegetation. Pavements (7 percentage 4,8%) and the pedestrian streets (10 percentage 6,8%) are not attractive to children for cycling or roller-skating. It is important that students do not prefer school ground for cycling. Only 9 (6,1%) children claimed to cycle in the school yard. Students have a code of behavior which orders not enter the space where organised games with ball are carried out. Basketball courts in the school yard are in a lot of cases the only ones that exist in a extensive urban surface. 17,7% (26 students) cycle anywhere in the neighbourhood. They feel comfortable and familiar with the environment so they move with self-confidence and safety in the neighbourhood. 25 (percentage 17%) of them cycle in the countryside and not in the city, where they permanently live. Others cycle when they go to their country houses and others only in summer time when they go to their village.

41 students out of the 209 subjects of the research, who study in 10 schools of the capital, do not have a bicycle or rollers. If we also add here the 25 that are holders but use it only away from the urban environment, it seems that the modern configuration of neighbourhood and city creates problems for the children. 31,57% of children do not experience the joy that seasonal movement offers. They are deprived of chances for self-activity and familiarization with the vital space of neighbourhood with consequences for the sentimental and social constitution of their personality.

The frequency and the time allowed for the children to cycle or rollerskate shows the quality of everyday routine and their free time. The following table presents the percentages of students that stated the time and the frequency they used their bicycle.

When you ride bicycle?

Every day	4,2%
Weekend	38,3%
Often	16,7%
Rarely	40,8%

Out of 209 students, 120 answered (percentage 57,42%). The low percentage of children that answered shows that it is difficult to evaluate the relation of child-bicycle-time. As it appears from the following analysis of results, the children believe that they do not have frequent contact with their bicycle. 49 of them (percentage 40,8%) consider that they seldom cycle, 20 (16,7%) believe that they often do so. 46 children (38,3%) cycle only during the weekend while 5 cycle every day (4,2%). The 79,1% of students (seldom and every weekend) although they possesses a bicycle, they do not use but occasionally. It is also worrying that only the 4,2% plays with the bicycle.

5. RESULTS

The research showed that the children of Athens desire to possess a bicycle. Despite the high rate of possession, half of the children do not satisfy the biosomatic need of seasonal movement in the environment of modern neighborhood as it appears in our days. Many of them exercise only when they go on an excursion or short breaks to areas away from the city while a great number seldom cycles in public spaces, such as squares. Only a small percentage of children has the opportunity to go around in the neighborhood streets, which is indicative of the worrying urban reality of Athens. The existing situation is due to historical, economic and mainly cultural data and makes the structured environment inadequate for cycling, as a pastime, not only for minors but also for the mature residents. The city deprives this joy from the children, the demographic category that needs most to familiarize with the environment of the neighborhood and city. The deprivation of cycling in combination with the lack of the sufficient feeling of safety, green and open spaces influences negatively the quality of life of children and reverses vital functions of children's neighborhood biotope.

The possibility of use of bicycle which is part of the game is a reliable indicator of suitability of urban environment for all the population. For this we propose the "Children Seasonal Movement Indicator" (DPEK) as a additional useful tool of measurement of viability of built space and viable mobility. The presence of children with bicycles in the neighbourhood means that the serious problems that threaten modern cities such as traffic, criminality, noise, pollution and others are in low levels. The children who play in the neighbourhood while cycling declare that the neighbourhood is alive. The interaction and communication are not only among the children but also exist among parents and other adults. The health of the social ecosystem of the neighbourhood is confirmed when the bond of present with the future, that is the children, are present in the neighbourhood.

6. REFERENCES

MOORE R. L. & YOUNG D.: Children outdoors: Toward a social ecology of the landscape, In I.

ALTMAN & J. WOHLWILL (Eds.): Human Behavior and Environment: Vol. 3., Children and the Environment., ed: Plenum Press, New York 1978, pp. 83-130

HART ROGER: Children’s Experience of Place, ed: Irvington Publishers, New York, 1979

LYNCH K.: The image of the city, Cambridge, MA: MIT Press, 1960

SEAMON D: A sigular impact, Environmental and Architectural Phenomenology Newletter, 7, 3, 1996, p.p. 5-8

GUSTAFSON P.: Meanings of place: Everyday experience and theoretical conceptualizations, Journal of Environmental Psychology, 21, 2001, p.p. 5-16

SPEAR, N.E.: The processing of memories: Forgetting and retention, Hillsdale, NJ: Erlbaum, 1978

DOHERT S. & PELLEGRINO J. W.: Development changes in scene recognition, Children’s Environments Quarterly, 2, 1978, p.p. 38-43

SUDESHNA CHATTERJEE: Children’s Friendship with Place: A Conceptual Inguiry, Children, Youth and Environments. 15 (1), 2004

DEKOSTER J., & SCHOLLAERT U.: The city goes front with the bicycle, Service of Official Publications of European Communities, Luxembourg 1999

reviewed paper

Exploring Spatial Behaviour of Visitors in Peri-Urban Recreational Areas - Multi-attribute Analysis of Individual Route Profiles

Karolina TACZANOWSKA, Arne ARNBERGER and Andreas MUHAR

(Institute of Landscape Development, Recreation and Conservation Planning,
BOKU – University of Natural Resources and Applied Life Sciences, Peter-Jordan-Strasse 82, 1190 Vienna, Austria, www.boku.ac.at,
karolina.taczanowska@boku.ac.at, arne.arnberger@boku.ac.at, andreas.muhar@boku.ac.at)

ABSTRACT

Understanding human spatial behaviour in natural settings is a critical issue when working out sustainable strategies in the field of social and ecological management for heavily used peri-urban recreational areas. The aim of this study is to characterize spatial behaviour of individual recreationists by exploring attributes of their spatially manifested acts. The case study area – Lobau is situated east of Vienna, Austria and is part of the Danube Floodplains National Park. It is characterised by high use levels impacting wildlife and causing conflicts with conservation goals. On-site visitors (N=511) were interviewed about the route that they took on one of the sampling days. Attributes of the routes comprising physical features of the environment, route geometry and topology as well as spatial information provided on site, were analysed in order to identify the types of routes. Finally, route profiles were linked to visitor characteristics. For data storage and analyses GIS, database management and statistical packages were used. Outcomes of the study deliver practical information on spatial requirements and the demand for outdoor recreational activities, as well as about obeying site regulations by visitors. The results might be also very useful for creating, testing and calibrating recreational behavior models and simulations.

1 INTRODUCTION

1.1 Motivation

Assuring sustainable urban development and at the same time providing high quality of life for city inhabitants belong to the most challenging issues in the field of spatial planning nowadays. High standard recreational opportunities and appealing open spaces contribute to the improvement of wellbeing of citizens (Cox, 1972; Rogerson et al., 1988; Kendle & Forbes, 1997).

As the populations of most Western countries become more urbanized, and as work becomes less and less connected with the land, many more people are seeking to regain a connection with nature and with wild landscapes. Urban forests, increasingly common in Europe and North America, can provide opportunities for solitude and quietness well within the city limits (Bell, 1997).

These areas, due to the intensive level of recreational use, often face problems of balancing visitor needs and site capacities (Arnberger, 2003). Planning sustainable recreation requires satisfying visitors' expectations on the one hand, and protecting values of natural resources on the other one. There is a need for greater commitment to resolve problems through management, through environmental education, and by strategic planning of the means of access in terms of roads, parking facilities and footpaths (Bell, 1997).

Comprehensive understanding of recreational use is necessary for effective management of natural areas (Heywood, 1993). Investigating spatio-temporal patterns of recreational activities as well as deepening knowledge on human-environment interactions are particularly important from the spatial planning perspective. The need for systematic monitoring and management of visitor flows was strongly emphasised during the Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas in 2002 (Arnberger et al., 2002).

There are two major ways to analyse spatio-temporal data of recreational use: an aggregate and individual-oriented one. The aggregate approach supports analysis of use intensity (e.g. number of people visiting particular destination or using certain facility, visitor load per trail segment). Such information is often used as background for habitat disturbance analyses. It might be helpful for identifying conflict areas, evaluating effectiveness of management measures, analysing effects of infrastructure changes, considering potential locations for new facilities, etc. An individual-oriented approach delivers information on how a particular visitor or group of visitors use the recreational space. Data of this type might be used to analyse spatial requirements for performing different types of activities, analyses of people's recreational needs and preferences as well as other aspects of human-environment interactions.

1.2 Aim & Scope of the Study

The aim of this study is to characterize spatial behaviour of individual recreationists. The term spatial behaviour refers to spatially manifested and overt acts of people performing a range of daily or other episodic activities (e.g., journey to work, shopping, recreation, education, etc.). These acts yield data such as distance and direction of movement, directional bias, trip frequency, episodic interval, and repetitiveness, and are represented and analysed as occurrences in space (Golledge, 2001; Golledge & Stimson, 1997) Another term, namely behaviour in space involves investigating choices underlying spatially manifested acts. This aspect, however, is not the subject of our study. The paper focuses on the characteristics of routes, based on individual visitor trip reports, integrating route geometry, topology and physical features of the environment.

2 CASE STUDY AREA

The case study area – Lobau is situated east of Vienna, Austria, and is part of the Danube Floodplains National Park (Figure 1). It lies within the city boundaries and is a traditional local recreational site. In 1996 the Danube Floodplains were declared a National Park which in 1997 received international recognition – IUCN category II. This obligates the park management to fulfil both the demands posed by intensive daily recreational use and by the need to protect the floodplains' ecosystem (Brandenburg, 2001). A long-term monitoring of visitor flows in the Lobau allowed to identify spatio-temporal patterns of recreational use as well as to characterize the visitors. This relatively small area (approx. 10 km long and on average 2 km wide) attracted 600 000 visitors in 1999. Dominating recreational activities here are biking and hiking. Minority of visitors is jogging (3%) and swimming (1%) (Arnberger et al., 2000).

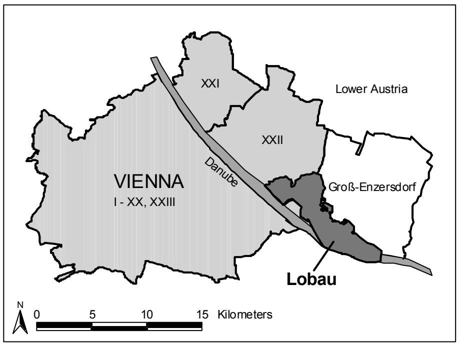


Figure 1 Case study area – Lobau

(Source: Hinterberger, 2000)

3 METHODS

In order to investigate the spatial distribution of visitors, a survey on recreational use, comprising visitor characteristics and a short trip report, was conducted (Arnberger et al. 2000). Additionally, detailed data covering attributes of the Lobau physical environment have been collected. Spatial and statistical analyses were used to explore attributes of routes. Figure 2 illustrates methodology used in this study.

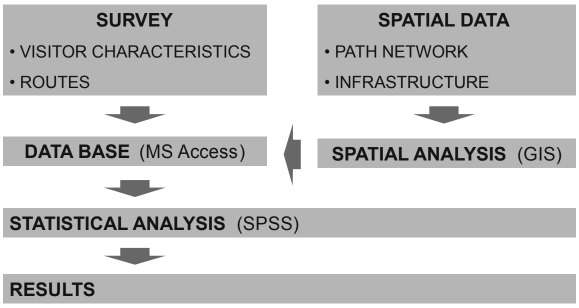


Figure 9 Methods used for analysing route profiles

3.1 Data Collection

On-site visitors were interviewed about their outdoor activities, visiting motives, length of stay, local knowledge, etc., at main entrance or intersection points at randomly selected days. As part of the interviews, respondents were asked to mark on a map (1:25.000) the route that they took or planed to take on that day. The sample size was 511 for complete surveys comprising route and visitor characteristics. Additional 21 visitors reported about their route only.

Based on the Austrian topographic map 1:50.000 and field work the trail network was digitised. Next, the route information from the interviews was spatially referenced and stored into a database. All records have been checked for topologic consistency, e.g. contiguous route segments (Hinterberger et al., 2002).

Additionally, as a part of the field work, environmental and infrastructure data have been collected. Information on physical features of the area such as type of surface, width of trail, landcover along paths, views, accompanying tourist infrastructure, locations of information boards and signs were collected.

3.2 Input Data Structure

Various types of data have been used in this study. Table 1 illustrates the structure of input data covering visitor characteristics, routes, network of trails, environmental features along path segments and at node points. All the data were stored in a database (data model: Hinterberger, 2000; Taczanowska, 2004). MS Access and ArcGIS geodatabase were both considered as possible frameworks for data storage and data preparation for final analysis. Eventually, MS Access package was used, due to the ease of establishing relations between different entities and extensive possibilities of performing SQL queries.

Input data	Source	Type	Input for final analysis
Visitor characteristics	Survey	Non-spatial	=> **visitor characteristics**
Routes	Survey (trip report)	Spatially referenced	
Trail network	Map & field study	Spatially referenced	=> **route characteristics**

Environment characteristics	Field study	Spatially referenced

Table 1. Structure of input data

3.3 Generating Route Attributes

The characteristics of routes are the main subject of final analysis. The presented above 'raw' input data do not deliver route attributes directly. Those must be additionally generated with the help of SQL queries. Table 2 summarizes route attributes covering physical appearance of trails, encountered tourist infrastructure, route geometry and topology.

Attribute class	Description / measures
Length	Total sum of used path segments (m)
Shape	Loop/traverse (category); level of retracing paths (%)
Signage	Marked trail; marked multi-use trail (m); share of marked and not marked trails (%)
Surface	Asphalt; gravel; unpaved track; grass; other (m); share of different surface types (%)
Width	Width classes: >4 m; 3-4 m; 2-3 m; 1,5m; <1m (m); share of different width classes (%)
Landscape type	Riverine forest; pine forest; bushes; meadows; agriculture; water, industry, building (m); share of different landscapes types (%)
Infrastructure	Number of benches per trail km (count)
Attractions	Picnic spot; restaurant; museum; (category)

Table 2. The summary of route attributes

3.4 Statistical Analysis

Exploratory methods were applied to investigate spatial behaviour of individual recreationists. In an exploratory data analysis process many variables are taken into account and are compared, using a variety of analysis techniques in the search for systematic patterns. Basic statistical methods were used in this study. Distributions of the variables, correlation matrices and multi-way frequency tables were analysed. Additionally, some a priori hypotheses were tested. The analyses of route attributes were performed with the help of SPSS statistical package.

4 RESULTS

4.1 Visitors Characteristics

More than 90 percent of the visitors interviewed reside in Vienna. A high frequency of visits could be observed; more than 60 percent of interviewees visit the Lobau at least once a week. An analysis of visitors surveys lead to the differentiation between three types of visitors, characterized primarily by their residential address, the frequency of their visits and their motivation for visiting the Lobau. The visitor types are:

Regular recreational visitors from a residential environment: home less than two kilometres away from entry point, very high frequency of visits (at least once a week), short length of stay in the park (less than two hours); the motive for the visit is the proximity to the Lobau and the opportunities offered for sporting and recreation.

Occasional recreational visitors from other parts of Vienna and Lower Austria: home more than two kilometres away from entry point, go there frequently (a least once a month), but stay for more than two hours and are motivated to visit the landscape

National Park visitors: home further away from the Lobau, low frequency of visits, the motive for a visit is the whish to see the National Park. This type accounts only for 2 percent of the total number of visitors.

(Arnberger et al., 2001)

4.2 Characteristics of the Lobau Trail Network

Recreational use in the Lobau area concentrates along the trails. Therefore description of the physical environment was based on the path segments characteristics. The trail layout in the Lobau is a complex network offering extensive opportunities for performing various types of activities (Fig. 3). The paths are very diverse and comprise paved as well as natural surfaces of different width, marked and not marked paths accompanied by a range of landscape types and infrastructure along trails. The tables below present general spatial characteristics (Table 3) and selected attributes of the trail network (Table 4).

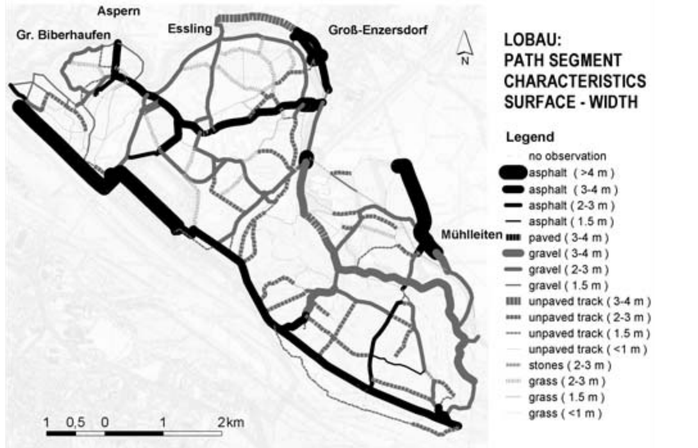


Figure 3. Lobau recreational area - layout, surface and width of trails

Network characteristics	Quantity
Area (km^2)	20
Number of links	349
Number of nodes	225
Length of trails (km)	132.6
Average density of trails (km/km^2)	6.6

Table 3. Spatial characteristics of trail network

Class	All	Surface				Width of path					Signage		
Attribute		Asphalt	Gravel	Unpaved	Grass	>4m	3-4m	2-3m	1,5m	<1m	Marked	Marked Multi-use	Not marked
Length (km)	132.6	24.6	36.3	53.4	16.7	5.5	21.3	60.3	24.2	21.3	61.8	27.1	71.1
Share (%)	100	18.6	27.4	40.3	12.6	4.1	16.1	45.5	18.3	16.1	46.6	20.4	53.6

Table 4. Summary of the selected trail network attributes.

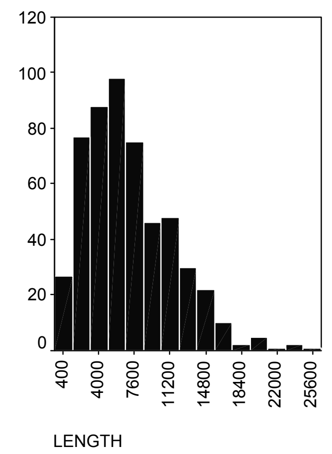
4.3 Exploring Selected Attributes of Route Profiles

Exploring the attributes of route profiles combined with visitor characteristics delivers practical information on how different people use the suburban recreational setting. Selected attributes describing length of routes, shape, signage, type of surface and width of trails are presented below. Further analyses of landscape characteristics and infrastructure such as type of vegetation, presence of water, sun exposure, views as well as locations of picnic spots, restaurants, view platforms, etc. are currently in progress and were not included in this paper.

4.3.1 Length of Routes

The length of route is one of the most important attributes delivering knowledge on how much space is needed to perform recreational activities. Visitors to the Lobau vary a lot in terms of distances travelled. The shortest route reported in the Lobau was only 163 meters long, leading from the entrance point to the lake and return. The longest one (25.7 km) was reported by a biker, spending his time in the Lobau on a Sunday in spring (Hinterberger et al., 2002). The mean value of route length was 7.0 km (Figure 4).

Significant variations between different user groups were observed (Figure 5). Bikers tend to perform the longest distances, followed by joggers and hikers. However, if considering the maximum lengths of routes, some hikers took longer trips than joggers. As there were no significant differences in the duration of stay between the activity groups, it can be assumed that the variation of route lengths was caused by the speed of movement.



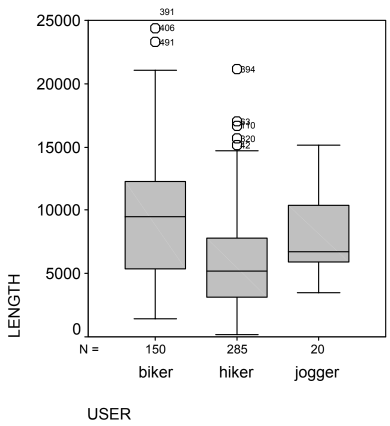


Figure 5. Distribution of route lengths among user groups

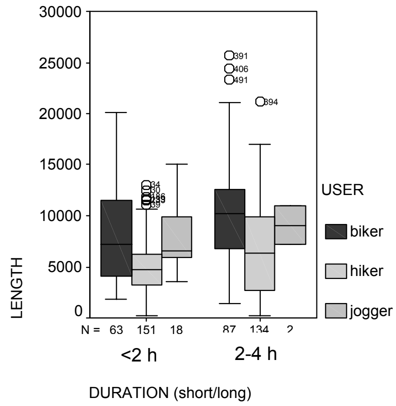


Figure 6. Distribution of route lengths grouped by duration of stay and type of activity

Time budget had a significant influence on distances (Figure 6). Generally, the length of routes raised while the duration of visit increased. However, stays exceeding four hours demonstrated higher variance of distances than one- to two-hour visits. This measure implicates that a high share of long-term visitors was more passive. This group of visitors (mostly hikers) made longer stops, while performing their recreational activities. Short-term visits seem to be more 'effective' in terms of movement across the recreational space.

Slightly seasonal variations of the route length were also observed. Summer visitors tended to be less active than spring visitors. In summertime a large number of people hiked or biked only for a short distance in order to get to their favourite swimming spot (Hinterberger et al., 2002).

4.3.2 Shape of Routes

From the recreation planning and infrastructure design perspective the shape of route belongs to one of the most important measurements. In highly diverse and dense trail networks, in areas without any particular point attractions (the whole site may be regarded as attraction), people can choose among different combinations of paths. Such network is an ideal area to investigate the spatial behaviour. Figure 7 illustrates examples of routes taken by the Lobau visitors. Consequently, in this study two measures were considered to describe the shape: the distance between start and end points, and the share of repeating the paths (retrace).

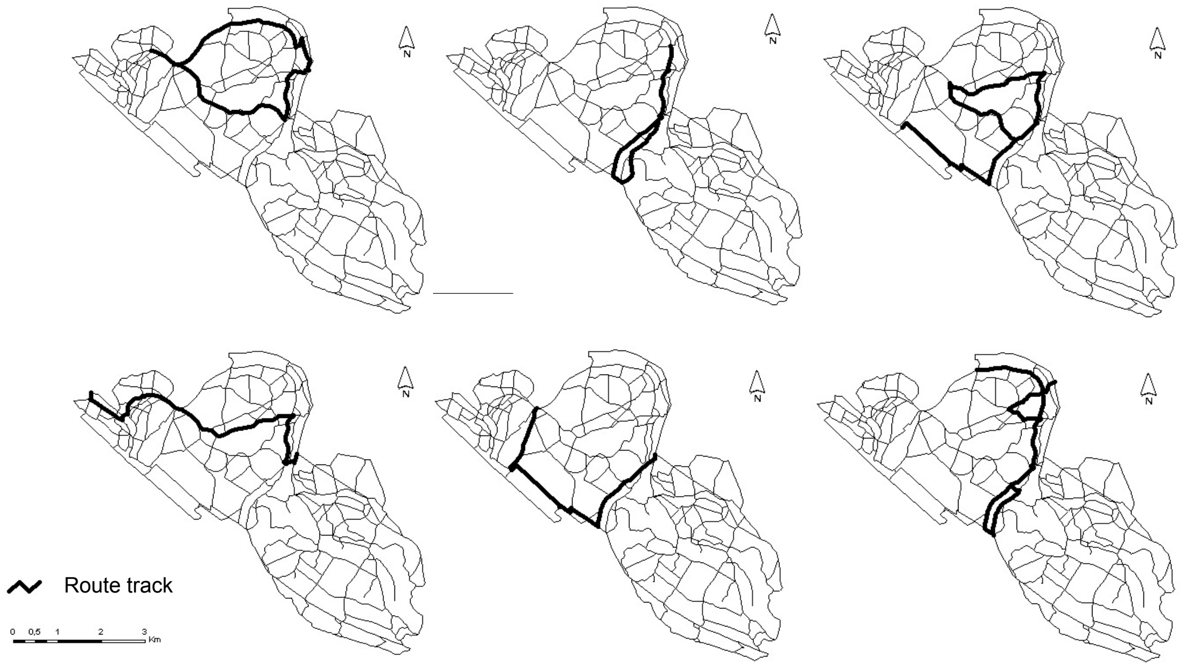
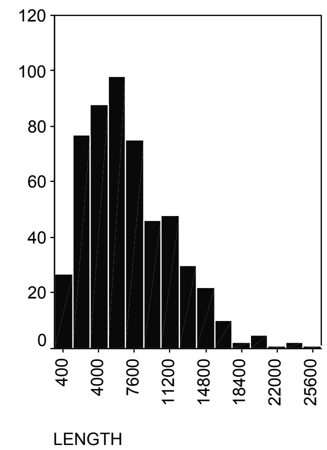


Figure 7. Examples of routes reported by the visitors. Lobau recreational area

Generally, two types of route shapes could be distinguished: a loop and traverse. The large majority of the respondents made loops (80%), getting back to their starting location. This result can be explained by the fact that many visitors reached the recreational site by car. People living close to the Lobau also tended to make loops. One quarter of the interviewed visitors traveresed the area (Fig. 8). Many bikers cross the Lobau as leg of a longer trip towards the eastern part of the Danube Floodplains National Park or as part of larger loops in the surrounding area.

The majority of the respondents (52%) did not retrace their paths, however considerably large shares of visitors partly or totally repeated the trail on their way back (Fig. 9).



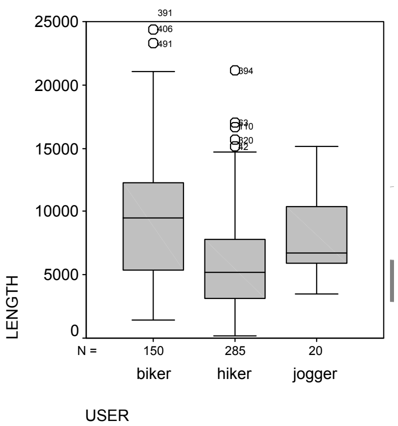


Figure 5. Distribution of route lengths among user groups

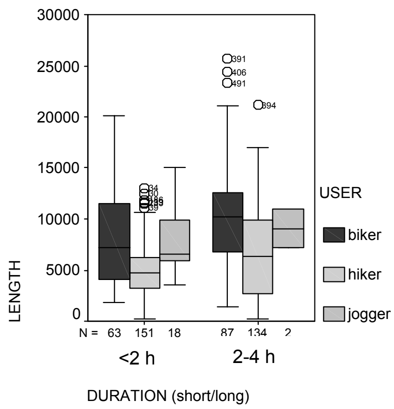


Figure 6. Distribution of route lengths grouped by duration of stay and type of activity

Time budget had a significant influence on distances (Figure 6). Generally, the length of routes raised while the duration of visit increased. However, stays exceeding four hours demonstrated higher variance of distances than one- to two-hour visits. This measure implicates that a high share of long-term visitors was more passive. This group of visitors (mostly hikers) made longer stops, while performing their recreational activities. Short-term visits seem to be more ‘effective’ in terms of movement across the recreational space.

Slightly seasonal variations of the route length were also observed. Summer visitors tended to be less active than spring visitors. In summertime a large number of people hiked or biked only for a short distance in order to get to their favourite swimming spot (Hinterberger et al., 2002).

4.3.3 Shape of Routes

From the recreation planning and infrastructure design perspective the shape of route belongs to one of the most important measurements. In highly diverse and dense trail networks, in areas without any particular point attractions (the whole site may be regarded as attraction), people can choose among different combinations of paths. Such network is an ideal area to investigate the spatial behaviour. Figure 7 illustrates examples of routes taken by the Lobau visitors. Consequently, in this study two measures were considered to describe the shape: the distance between start and end points, and the share of

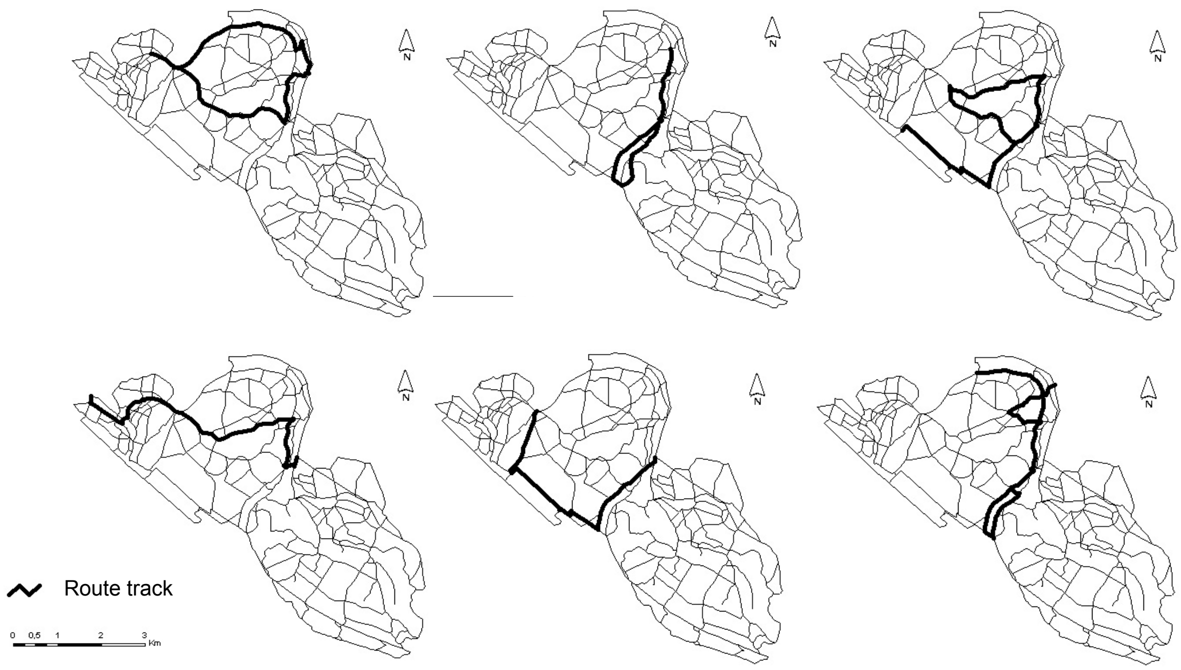


Figure 7. Examples of routes reported by the visitors. Lobau recreational area

repeating the paths (retrace).

Generally, two types of route shapes could be distinguished: a loop and traverse. The large majority of the respondents made loops (80%), getting back to their starting location. This result can be explained by the fact that many visitors reached the recreational site by car. People living close to the Lobau also tended to make loops. One quarter of the interviewed visitors traveresed the area (Fig. 8). Many bikers cross the Lobau as leg of a longer trip towards the eastern part of the Danube Floodplains National Park or as part of larger loops in the surrounding area.

The majority of the respondents (52%) did not retrace their paths, however considerably large shares of visitors partly or totally repeated the trail on their way back (Fig. 9).

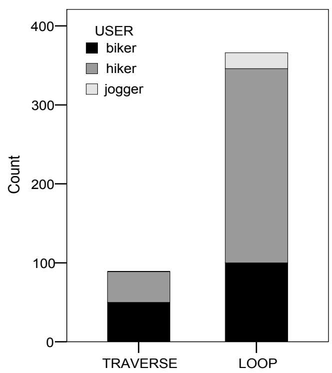


Figure 8. Proportion of non-natural trail surfaces used across user groups

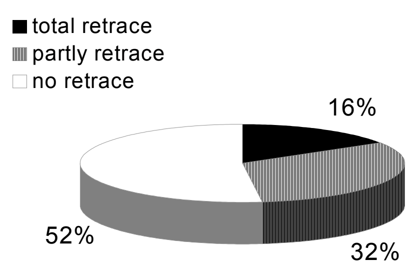


Figure 9. Distribution of grass trails used, clustered by user groups

5 DISCUSSION & CONCLUSIONS

This study delivered practical information on how individuals use a recreational setting. The outcomes may be very useful for planning and management purposes, especially in terms of provision and allocation of recreational infrastructure. Strategic planning of the access to natural areas and visitor flow management are powerful tools for assuring sustainability of suburban natural sites. Studies of this kind may be very helpful for verifying a priori assumptions concerning distribution of individual visitors in the outdoors. Exploring this subject seems to be critical, while developing visitor guidance strategies and attempting to provide high quality recreational opportunities for city inhabitants. So far, investigation on human spatial behaviour at individual scale belongs to the underreported fields in outdoor recreation research.

The results demonstrate great diversity of routes respondents took or planned to take during their visit to the Lobau. Reported trips ranged from long-distance loops, following marked and well paved trails, up to the destination-oriented shortcuts leading from a parking place to the nearest picnic or swimming spot. Analysed routes differ considerably in terms of length, type of surface, width, shape and signage. However, those large spatial differences can not be easily explained by visitor characteristics. It implicates that spatial behaviour should be considered as additional feature for defining visitor profiles and building recreationists typologies. Such comprehensive ‘picture’ of a visitor, covering demographical data, recreational behaviour characteristics and spatial dimension of his or her acts, would be of great value for visitor flow management purposes.

Results of empirical studies can support developing guidelines for planning areas of a comparable kind. This investigation demonstrated several spatio-temporal similarities of recreational use with other urban areas in Europe. These analogies refer particularly to the quantities of route lengths and duration of stay (Zundel & Völksen, 2002). Layout of trail system, design of recreational infrastructure and provision of information affect the distribution and experiences of visitors (Barth, 1982; Bell, 1997; Job, 1991). Feeling secure, without the danger of getting lost is necessary when spending time in outdoor leisure areas (Findlay & Southwell, 2004). Results of this study also confirm these findings. Visitors to the Lobau generally use well-defined paths and follow marked trails. Nevertheless, our investigation revealed a group of visitors who does not follow the site regulations. Particularly bikers tend to use all possible trail combinations, not considering any limitations for this type of activity. The number of off-trail users is an important measure from the nature protection point of view, as this way of exploring the outdoors is regarded to strongly impact wildlife (Job, 1991). Spatial behaviour delivers information on the effectiveness of management strategies and actions.

Access to a recreational setting and mode of transport used to reach the site determine much of the spatial behaviour pattern. Parking places encourage car born visits and consequently promote the ‘loop’ type of trips. Public transport could enable traversing the area, without the need to finish a trip in a starting point. Closer cooperation between recreational site managers and public transportation providers would be desirable to address these issues (Sammer, 2005). Minimising the level of retracing paths could be achieved by designing attractive loop trails of different lengths and by providing adequate information.

Additionally, social context is regarded as an important factor influencing recreational experience (Arnberger, 2003; Manning, 1999; Cessford, 2002). Investigating perception of crowding and conflicts between different users contributes to better understanding the spatial patterns observed in recreational settings. Including these aspects into the analysis of human spatial behaviour could be considered for future studies.

The findings of this exploratory study were the first step to understand spatial behaviour of visitors in a recreational setting. In the next stage, multivariate techniques will be used to identify different groups of spatial behaviour and to build on the typology of visitors based on their spatially manifested acts.

As the current technologies enable modelling complex phenomena, such as people’s movement across urban space, the need for detailed real-world data became an emerging topic in the field of spatial planning. Modern decision support tools, such as traffic or visitor flows simulations allow to evaluate alternative management scenarios in order to apply strategies that work (Gimblett, 2002; Itami & Gimblett, 2002). Agent-based modelling technique is extensively used for this kind of simulations. Artificial individuals (agents) interact with surrounding environment according to predefined rules of behaviour. However, when expecting plausible results that mirror actual human behaviour, reliable input is a must. Comprehensive empirical data and studies of this kind contribute to better understanding of complex phenomena of human spatial behaviour. The findings of our study might be a valuable basis for creating, testing and calibrating models of recreational use.

6 REFERENCES

ARNBERGER, A., BRANDENBURG, C., MUHAR, A. (Eds.) Monitoring and Management of Visitor Flows in Recreational and Protected Areas.. Conference Proceedings, Wien, p 493; published by Institute for Landscape Architecture and Landscape Management, 2002

ARNBERGER, A., BRANDENBURG, C., CERMAK, P., HINTERBERGER, B.: Besucherstromanalyse für den Wiener Anteil am Nationalpark Donau-Auen, Bereich Lobau.. Im Auftrag des Magistrats der Stadt Wien, MA 49, Forstverwaltung Lobau, 2000

ARNBERGER, A., BRANDENBURG, C., MUHAR, A. An Integrative Concept for Visitor Monitoring in Heavily used Conservation Area in the Vicinity of a Large City: The Danube Floodplains National Park, Vienna; In: Todd S. (Eds.): Northeastern Recreation Research Symposium; Proc.; 195-201; published by State University of New York, Cortland, 2001

ARNBERGER, A.: Modellierung sozialer Tragfähigkeitsgrenzen von Erholungsgebieten - Dargestellt am Erholungsgebiet Wienerberg. , Dissertation Thesis: Universität für Bodenkultur, 2003

BARTH, W.E. Tourismus in Waldgebieten. Erfahrungen über Steuereungsmöglichkeiten von Touristenströmen; Neues Arch. F. Niedersachsen, 31 (3): 270-289, Göttingen, 1982

BELL S.: Design for outdoor recreation; London [u.a.]; Spon, 1997

BRANDENBURG, C.: Erfassung und Modellierung von Besuchsfrequenzen in Erholungs- und Schutzgebieten - Anwendungsbeispiel Nationalpark Donau-Auen, Teilgebiet Lobau.. Dissertation, Institut für Freiraumgestaltung und Landschaftspflege, Universität für Bodenkultur Wien. 2001

CESSFORD, G.: Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand. In: Arnberger, A., Brandenburg, C., Muhar, A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas; Proc.; 102-108; published by Institute for Landscape Architecture and Landscape Management, 2002

COX, K. R. Man Location and Behavior, Wiley, 1972

FINDLAY, C., SOUTHWELL, K.: 'I just followed my nose': understanding visitor wayfinding and information needs at forest recreation sites; Journal of Managing Leisure (9) Oct, 227-240, Routledge, Taylor & Francis Group, 2004

GIMBLETT, H, R.: Integrating Geographic Information Systems and Agent-Based Modeling Techniques for Simulating Social and Ecological Proccesses. New York, Oxford University Press, 2002

GOLLEDGE, R. G; ROBERT J. STIMSON: Spatial Behavior: a Geographic Perspective. - New York, NY [u.a.]; Guilford Press, 1997

GOLLEDGE, R.G.: Behavioral Geography, International Encyclopedia of the Social & Behavioral Sciences, 1105-1111, Elsevier Science Ltd, 2001

HEYWOOD, J. Behavioral Conventions in Higher Density, Day Use Wildland/ Urban Recreation Settings: A Preliminary Case Study, Journal of Leisure Research, Vol.25, No. 1, 39-52, 1993

HINTERBERGER, B., ARNBERGER, A., MUHAR, A.: GIS-Supported Network Analysis of Visitor Flows in Recreational Areas.. In: Arnberger, A., Brandenburg, C., Muhar, A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas; Proc., 28-32; published by Institute for Landscape Architecture and Landscape Management, 2002

HINTERBERGER, B.: Besucherstromanalyse im Wiener Anteil des Nationalpark Donau-Auen, der Lobau: Routenanalyse mit GIS; Wien.. Diplomarbeit, Institut für Freiraumgestaltung und Landschaftspflege (IFL), Universität für Bodenkultur in Wien; Wien, 2000

ITAMI, R. M., GIMBLETT H. R.: Intelligent recreation agents in a virtual GIS world. Complexity International 08, 2002

JOB, H.: Freizeit und Erholung mit oder ohne Naturschutz?: Umweltauswirkungen der Erholungsnutzung und Möglichkeiten ressourcenschonender Erholungsformen, erörtert insbesondere am Beispiel Naturpark Pfälzerwald; Bad Dürkheim: Pfalzmuseum für Naturkunde, 1991

KENDLE, T, FORBES S.: Urban Nature Conservation: Landscape Management in the Urban Countryside; London; Spon, 1997

MANNING, R. E.; VALLIERE, W; WANG, B; Crowding Norms: Alternative Measurement Approaches, Journal for Leisure Sciences, Vol. 21 (2) June 1, Routledge, Taylor & Francis Group, 1999

ROGERSON, R., FINDLAY, A. and MORRIS, A: Indicators of quality of life: some methodological issues, Environment and Planning A, 21, pp. 1655-1666, 1989

SAMMER G., Organisation von Verkehrsströmen in und um Schutzgebiete, In: Pröbstl, U., Sterl, P., Wirth, V., Tourismus und Schutzgebiete – Hemmschuh oder Partner?, Proc, 22-23, 2005

ZUNDEL, R.,VÖLKSEN, G.: Ergebnisse der Walderholungsforschung : eine vergleichende Darstellung deutschsprachiger Untersuchungen; Oberwinter; Kessel, 2002

Setting up a multi modal urban transport system. “Learning by doing”

Marten VAN DER TEMPEL and Gérard VAN WAESBERGHE

(City Link, the Netherlands)

ABSTRACT

The Netherlands – like other urban regions in Europe – accommodates a vast road network connecting a “sprawl” of urban nodes, in which peak – hour traffic congestion has become intolerable. In Holland’s “polder model” environment, nothing appears to be more valuable than producing ideas and plans for solving congestion problems, yet the relevant organisations and institutes lack the ability to convert ideas into reality. They keep on getting entangled in coalitions, cartels and monopolies. Can we allow ourselves this state of inaction ? No. Inaction inhibits even more innovative progress and degrades rather then enhances the environment. It seems inevitable that serious clashes between mankind and nature will grow worse.

Let there be no illusion. Taking effective action towards sustainability, the mobilisation of technology and more importantly, political rethinking, co-operation and sacrifice is mandatory. All that matters is not how many ideas you have, it is how many you actually make happen. The conclusion seems unavoidable: we do not have generations, we only have years in which to attempt to turn things around.

When comes to intelligent Urban, Environment and Transport Technologies and the contribution of ICT to it, our task is to enhance our networks, physically and virtually.

Any network has two ingredients: nodes/clusters and connections. These two realms need reconsideration: the nodes/clusters and the connections need optimising measures in terms of quality and capacity. It is the belief of the two participating – speakers that tackling meant network reconsideration c. q. enhancement need inter-disciplinary task forces, following step by step procedures, rather than indulging in a “grand design”. Based on our network philosophy, we – since 1996 - actively pursued small “bottom up” business opportunities to expand multi-modal passenger transport systems, including car-sharing projects. Speakers – together with relevant stakeholders from the world of PT and automotive” started and are starting up a series of pilots and try outs. Once bitten, twice shy, our credo: To make things happen, just start up “small is beautiful” projects. They will be more easily “dispossessed” and made a common property. In the end the grand design for an inter modal – and city car system will crystallize. Making ideas to happen is learning by doing.

Quantitative and Qualitative Information Tool about the Central Paradigms in Sustainability Research

Heidi DUMREICHER, Bettina KOLB

(Oikodrom – The Vienna Institute for Urban Sustainability)
Brunhildengasse 1/3, A-1150 Wien, Austria: e-mail: office@oikodrom.org

ABSTRACT

This paper shows how highly sophisticated information technology tools can support sustainability research, linking different qualitative and quantitative methods. It is based on the study "From Information to Knowledge" ("Von der Information zum Wissen"), an innovative research project which deals with the allocation and use of knowledge in the realm of the emerging research field "sustainability". It uses highly specialised advanced information technology methods to build an information system that facilitates the analysis of large research texts. The study combines the bibliometric method BibTechMon with a qualitative analysis of artifacts combined with interviews.

The study investigates the case of the research programme Austrian Landscape Research ("Kulturlandschaftsforschung) as an example of the new scientific discipline of sustainability and develops an integrative picture of this emerging knowledge, yielding a combination of quantitative as well as qualitative results.

The basic data basis consists of 40 research reports from phase 1 of the research programme 'Sustainable development of Austrian landscapes and regions' ("Kulturlandschaftsforschung" - Austrian Landscape Research, ALR) combined with other material and interviews for the qualitative research.

The investigated text contains altogether 389 803 words. The standardised vocabulary of 20 489 words is the final basis for the analysis. The study combines the statistical analysis (BibTechMon) with a qualitative social approach (objective hermeneutics).

The research questions are: Which topics are characteristic for the sustainability scientific community? What are the inner structures of this new community, which represents a societal subsystem of the knowledge society? What are the central terms, words and combinations of words characteristic for sustainability research? Which main interdisciplinary interrelations are typical for sustainability research?

The results of the study are a dynamic data bank ("Informationssystem KLF 1"), containing all scientific reports of the first phase of the ALR programme. The data bank allows the user to locate terms and words in their original context (389 803 words, thesaurus: 20 489 words) and to detect visual clusters of Co-Word Analysis that highlight interrelations between terms and words used by the different ARL scientists.

The study combines the statistical output with the theoretical model that describes and reflects the main subjects of the ALR Scientific Community by means of the seven qualitative theses. The theses are the results of the qualitative approach using an artefact and interviews analysed with the methodology of the objective hermeneutics. This paper presents the results from combining the statistical methods with the theoretical approach of the theses of sustainability in the form of frequent bridge words and a data walk-through along the notion "protection", as well as the word familiy sustainability.

1 INTRODUCTION

A huge amount of available information is the capital and potential of the information society, but the organisation of this information needs further steps to become a knowledge. In the scientific discourse, scientists are mostly orientied to the scientific community through their own disciplines and the produced knowledge is increasing constantly. But the challenge of the mode-2-research is to establish interdisciplinary research programmes and to communicate beyond the different disciplines. where the scientific knowledge increases year by year. The Austrian Landscape Research, ALR ("Kulturlandschaftsforschung) is an example of an interdiciplinary research programm, addressing the new scientific discipline of sustainability. 500 Researchers, representing 40 scientific disciplines and 170 institutions were working in about 70 interdisciplinary modules on questions like biodiversity, life quality, perception, genesis and change in the landscape, multifunctionality, conflicts of usage, operationalisation, societal and physcial infrastructure, water and humid areas, town and region and as well as rural development.

2 BIB TECH MON

Reports of large research programmes contain huge amounts of environmental information. The interdisciplinary exploitation of this information encounters numerous barriers like different interests and available time potentials which prohibit an efficient application of this generated knowledge. The method of BibTechMon is a software programme to analyse extensive text material which applies "Co-Word Analysis" and restructures the content of the material. With this software application, a different approach to existing information and a new handling of large amounts of text is possible.The software was first developed by the Austrian research center Seibersdorf, with the aim of monitoring limited information systems like databases of patents or scientific quotations. The innovative feature of the project "From Information to Knowledge" is the fact that we have extended this software to analyse large amounts of running texts in full text of scientific reports not only in abstracts.

The procedure in the project was the following: "The running text and the textual description of tables and figures were stored as a whole in an access-database. To support more detailed analyses, formal units of the reports, as for example the abstract, introduction, conclusion were encoded separately. The applied code allows the identification of all parts of the original reports, and of the modules. Finally a set of 344 text sections was analysed. The final database includes the relations to the original database of the whole texts, in order to support the identification of the primary context of a word in the reports" (Knoflacher et al 2002).

With the software of Bib Tech Mon, the electronic data material was restructured in a new system:

"Not focused on analyses of single reports, but on interdependencies among all reports. For this purpose, the relationships among the reports were calculated on the basis of the standardised word list by the Jaccard index (Jij). Jij = cij (cii + cjj – cij)-1. The Jaccard index measures the number of couples between two words (cij) in relation to the occurrence of these two words (cii and cjj) in all reports. Results of these calculations are formal descriptions of the coupling intensities among all standardised words" (Knoflacher et al 2002).

We interpreted the writing of the reports as an encoding of the research texts, which normally leads to a decoding in the process of reading. Each scientific discipline applies particular code for representing its observations or ideas. In this new way, the bibliometrical method serves an interdisciplinary approach as it further continues the process of encoding and decoding which is typical for any written communication, and opens it for further interpretation in a new context.

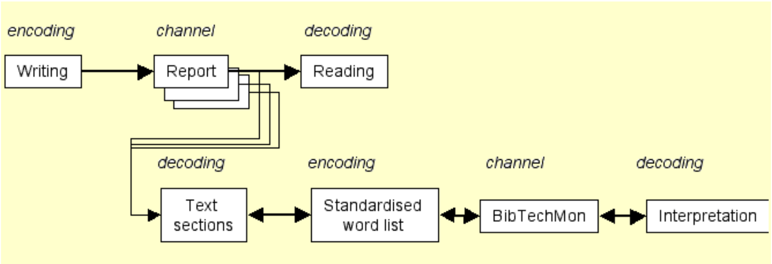


Figure 1. Impacts of the BibTechMon application on the transfer of information.

The text material of the ALR programme is now available in a visual design, established with the software programm of BibTechMon in a dynamic data bank (Informationssystem KLF) This data bank allows the user to locate terms and words in their original context of the ARL reports (389 803 words, thesaurus: 20 489 words) and to detect visual clusters of Co-Word Analysis that highlight interrelations between terms and words used by the different ARL scientists.

The result of this bibliometric analysis is a network of keywords originating from all reports of the Austrian research programme on cultural landscapes which in the present analysis serves as typical example for sustainability research. It invites for qualitative as well as quantitative interpretation, even a way back through the decoding process to the original context: "All words can be presented with the whole section of the texts in the reports without any further consultation of the original reports"(Knoflacher et al 2002).

With the restructuring of keywords in a new logic, a new connection between the disciplinary information is available. As there is a common understanding of sustainability as a place for interdisiplinary communication, we now proceeded to a next interpretation loop: how can a striclty qualitative hermeneutical approach be combined with the Bib Tech Mon results?

3 ARTEFACT ANALYSIS

The qualitative methods of sociel sciences supplemented the methods of BibTechMon and introduced its potential and capacity of deep and structered analysis of process oriented paradigms. The empirical material for the qualitative approach were an artefact and a set of interviews, both were analysed using the techniques of objective hermeneutics (Oevermann 1993).

Figure 2: the artefact: folder of the ARL Research Programm, first page of six

With the analysis of the artefact, the research follows the basic ideas and the paradigm of the scientific community of the ALR Scientific Community. In the objective hermeneutics loop, the meaning, expectation, and the appearance of the material, including the inputs of production, are under consideration. In addition, we conducted several interviews with scientists related to the ARL programme as programme manager, scientists or observers. After transcription of the interview material, systematic analyses, and interpretation circles with specific experts, the research continued with the process of hypothesis building in a process of verification and falsification of the emerging theses within the given material. The following theses are the results of this qualitative approach representing a theoretical model that describes and reflects the main subjects of sustainability research.

Thesis 1: Future

Sustainability research deals with the perspective of future ways of life and considers "to protect and to maintain" as basic values.

Thesis 2: Causality

Sustainability research has a larger view than the cause-effect-theorem of natural sciences and sets the context of a more complex notion of reality based on understanding.

Thesis 3: Idyllic Nature, Demiurgical Man

The concept of a safe and sound nature is an underlying perception in sustainability research as well as a concept of "man as a master of nature".

Thesis 4: Spaces of Possibilities ("Möglichkeitsräume")

Sustainability research is based on the idea that man/woman disposes of spaces of possibilities for his or her actions; but it tends to overestimate and overrate the possibilities of decision making by the singular individual and underestimates the societal context and the constraints of value systems, of culture and politics.

Thesis 5: Relocalisation ("Verortung")

Sustainability is related to place and space and shows conflicts of usage at the example of common living places.

Thesis 6: Complexity

The integrative approach of sustainability research creates a compatible research methodology: interdisciplinarity, transdisciplinarity and thereby team research.

Thesis 7: New Research Questions

Sustainability research takes up new research fields: this research reveals latent aspects that are not yet fully thought out and are therefore a challenge for science.

4 THESES ABOUT SUSTAINABILITY IN A COMBINATION OF QUALITATIVE AND QUANTITAVE DATA: BRIDGEWORDS

By the term information, this study understands structures with inherent rules for order like reports, images and texts. The same source of information can carry different levels of information (a picture or a photo, for example, carries the direct and manifest impression as well as a latent symbolical message). Knowledge, to the contrary, is the application of information in a new context – like the developing of new thoughts, the formulating of texts or the manufacturing of products. As sustainability is such a new context where information form different disciplines should be put together to form new knowledge, a combination of the existing information according to new rules constitutes a promising approach, based on information theory to guide into a harmonisation between the qualitative and quantitative methods.

Main research question: Which words and topics are typical for the emerging research field of sustainability?

The horizontal statistical analysis goes beyond the level of specialisation and the thematical definitions and shows which words are equally distributed over all report texts (within their disciplinary context, some words are used much more often than in another one). It gives a comprehensive profile of frequency (Häufigkeitsverteilung) for every keyword according to the studied reports. It came up with the following results, showing which words constitute a thesaurus of sustainability through all the reports of the Austrian Landscape Research. Statistically speaking, the bridgewords are those whose frequency above the modules in the texts have a low variance. These results represent a combination of part of the bridgewords like "system" or "environment", which are words that are used in the different scientific disciplines and contexts that deal with sustainability. The precise definition of these words may be different from discipline to discipline, yet they form a bridge between the disciplines and can be considered as anchor words for the interdisiciplinary communication. Our results allow for the thesis that sustainability has a special jargon which BibTechMon describes as words with high horizontal presence.

In this procedure, we used all sorts of words - nouns as well as verbs or adjectives, in some cases even grammatically interesting forms. They are the result of several steps of cluster analysis. Conducted by the qualitative approach, we applied a horizontal anlaysis (Querschnittsanalyse) and we came up with the following template.

The 86 most frequent keywords in ALR with high horizontal presence (Querschnittspräsenz):

entwicklung	169	entwickeln	66	hilfe	48	ermöglicht	30
unterschiedlich	163	theoretisch	65	einsatz	48	detailliert	30
wesentlich	141	zukunft	62	erfahrungen	48	gesamt*	29
österreich	127	ergeben	62	zeitlich	46	rasch	26
ökologisch	123	gesamt	62	viele	46	europa	25
beispiel	115	veränderung	61	praxis	44	unbedingt	24
ökonomisch	105	haupt*	58	trotz	44	änderung	24
sinn	103	wenig	57	vielzahl	44	regelmäßig	23
ziel	99	intensiv	56	erfassung	42	pflege	22
bereits	98	system	56	reihe	41	dauer	21
zeit	93	struktur	55	bewertung	40	beobachten	19
grund	84	definition	55	verwendet	40	beobachtung	18
daten	84	boden	54	pflanzen	40	eignen	18
basis	78	gruppe	54	relativ	40	erlauben	18
ressourcen	78	möglichst	53	zeitraum	39	institut	17
grundlage	78	kein	53	erhebung	36	verbessert	17
konzept	77	weg	52	wegen	35	zusammengefasst	16
schritt	77	methode	50	ansätze	34	digital	15
wasser	76	auswahl	50	bericht	34	flüsse	14
notwendig	71	anzahl	49	erkennen	32	universität	14
komplex	68	qualität	49	wiesen	32		
sollte	67	komplexität	49	zielsetzung	31		

Table 1: The 86 most frequent words in ALR with high horizontal presence (Querschnittspräsenz)

When combining the qualitative thesis process with the quantitative analysis, we can now define these notions on a combined basis. Starting from the statisticial incidence, we combine the thesis of sustainability focusing on the meaning of the counted words by lingustic interpretation. Thereby the extraction as well the contextual application of the words were considered.

Thesis 1: Future

For the ARL programme, future orientation is a relevant factor considering it as the point of encounter between research and societal development. In the sustainability research, this aspect influences the focus of studies and research questions.

The following bridge words support the thesis that sustainability deals with the future and future strategies of development (in decending order):

Entwicklung (development), Ziel (target), Konzept (concept), Schritt (step), entwickeln (develop), Zukunft (future), Veränderung (change), Weg (pathway), Änderung (change).

The word “Entwicklung (development)” is one of the most frequent words: This word certainly suggests that the researchers, when thinking of the future, think of change and not of a continuous extended present. They have concepts, targets and objectives, they think in concrete terms of steps to do or pathways to show.

At the same time, they show their hesitations and the fact that the sustainable change might not be so easy: many things “should” happen, “if possible”(möglichst) and are often in contradiction with the given situation – “notwithstanding” is also a term often used. In the word “future”, time is a relevant factor, representing the context of societal development: The words Zeit (time), Zeitraum (period), rasch (rapid) and Veränderung (change, diversification) show the context of time in the reports.

Thesis two: Causality

The ARL research focuses on societal as well as on natural processes research offers a paradigm that considers systemic interrelations. The sustainability research tends to understand the present situation in its complexity as a basis for acting in society. Therefore, words representing the causality contravene with words of a new circular thinking. Among the 86 most frequent bridge words, a set of words supports the thesis that the concept of causality is at stake in the sustainability research. In opposition to the concept of causality, sustainability moves towards a process oriented approach which is exemplifyed through the following horizontally frequent words: Sinn (meaning), komplex (complex), Komplexität (complexity).

Notwithstanding these hints that the ARL-researchers consider the cause-effect-theorem as obsolete, in their day-to day business they still use sets of words relating to linear processes:

Grund (cause), Grundlage (basis), notwendig (necessary), ergeben (produce), Hilfe (help), Erfahrungen (experiences), trotz (notwithstanding), wegen (because), verbessert (ameliorated).

Circular as opposed to Causal: A linguistic analysis that looked not only into the horizontal analysis, but into the overall body of words showed that both, the concept of causality as as well as words representing circular approaches, find several ways of reverberation in the reports.This means that the researchers are questioning the old paradigm of cause-effect-relation, but by doing so, they get into a serious field of contradictions.

Causal: anfanglose Schleifen (loops without start), basieren (to be based), bewirken (leading to), deswegen (therefore) , falls (in case), mithin (therefore), mittelbar (indirect), Sequenz (sequence), Trend (trend), Verursacherprinzip (principle auf cause), worauf (hereon), zugrundeliegend (basic), zurückzuführen auf (caused by).

Cirkular: Denkkoppelung (plugging in the thinking), dreifach disziplinärer Zusammenhang (triple disciplinary context), Entgrenzung (end of limits), zyklisch (cycical), Wissenszusammenhänge (contexts of knowledge).

Several combinations of words show the insecurity in formulating a thought that does not yet have its precise linguistic counterform: analytischer Brückenschlag (constructing an analytical bridge), Ein-Zweckbewegungen (movements that have one scope).

In sustainability research, the concept of systemic interdependencies and of networking starts to substitute the preexisting theorem of causality We have identified a whole field of words concerning interweaving and netting that supports this thesis:

Austauschprozesse (process of exchange), eng verknüpft (strongly linked), Verschmelzen (to merge), Schnittpunkt (intersection), benachbart (neighbouring), Bündel (bunch), enge Verflechtung (narrow interweaving), Entflechtung (de-interweave), Gefüge, gekoppelt (coupled), gemeinsam (together), Konnex (connex), Landschaftsmosaik (mosaique of landscape), Mindestkomplexität (minimal level of complexity), Puzzle, synoptisch (synoptical), Uneinheitlichkeit (non conformity), Überlappungen (overlapping), Verzahnung, Verknüpfungsregel (rule for interweaving), vielschichtig (mulitlayered).

As the scientific jargon does not yet offer enough wordings to reflect the new concept of systemic interdependencies, these words are often taken from a day-to-day-spoken language and transported into a scientific context. This tendency also shows that sustainability research has a more direct link to daily life issues than other traditional research fields.

Thesis 3: Idyllic Nature, Demiurgical Man

The ARL programm was developed out of the research of natural scientists observing the harmful ecological change of the natural landscape. Thus, the scientific community starts to consider the landscape as a cultural setting and as an aesthetic product of the human being. An idyllic connotation of nature shows up in some natural scientists appoaches, especially when presenting strategies to protect nature in an innocent state ("as it is"). But the human being – including the researcher - acts as "man as a creating individual". The self-conception of the sustainability researcher as a demiurg heading towards a changing world is supported by different terms – for instance "help"(Hilfe). The presence of this word shows that sustainability as world view looks for support and shows a self image of the researcher as the guiding force in the process of change. The frequency of the combination "ermöglichen" (to make possible) shows the same direction.The researchers are also aware of the urgency of their work: their results need a "basis" (Basis), and are "essential" (wesentlich). Essential is the third frequent horizontal word in the whole ARL (only development and diverse have a higher horizontal rate). When looking at phrasemes, we found images like "intakter Lebensraum" (habitat in good order) to describe what could be the aim of a sustainability approach.

Both streams, the view of nature as an idyllic entity to be protected and the wish for change and intervention, as contradictory as they may seem, are both observed in the wording of the ARL scientific community.

The fact that, in some remote corner of their being, the sustainablity researcher has an idyllic, idealistic image of the world as it should be lead to what we have called "the lyric approach" that counterbalances the idea of men as creating individuals.. A linguistic analysis of the writing style and vocabulary shows that here and there, this idyllic background slips even into a scientific text. Some examples of this "research lyrics":

Forschungslyrik (lyric of reserach): Agrarromantik (romance of agriculture), Alpenherrlichkeit (delightfulness of the alps), jungfräuliche Erde (maiden earth). These words are examples and out of the context of the reports, but they show the interpretation of nature in its lyric appearance.

Other orginal quotations from the text that are near to non translatability:

Bauernherrlichkeit (glorious farmership), charmantes Misstrauen (charming suspiciousness), chice Aufgeregtheit (chique excitement), heroische Erhabenheit (heroic sublimity), intakte Dörfer (villages in good order), intakte Natur (nature in good order), übersinnlich wunderbar (transcendentally wonderful), lieblicher Dorfcharakter (mellifluous village character), sich in der melancholischen Unendlichkeit verlieren (to get lost in a melancholic unboundedness), romantisches Refugium (romantic refuge), rosig leuchtende Almkuppeln (pink luminescent mountain pasture domes).

Methodological remark: These last examples can also be taken as a proof that not one single word gets lost in our data base: these phrasems are all singular compositions made by just single reserachers out of the 40; yet it is possible to detect them in our information system and even to re establish their original context.

Thesis 4: Spaces of Possibilities ("Möglichkeitsräume")

Thie notion of spaces of possibilites was developed in previous theoretical work of the authors and proved to be helpful even in the context of the huge amount of texts that this study is interpreting (Dumreicher, Kolb 2003). Sustainability research is based on the idea that human beings dispose of spaces of action and that, by trying out their possibilities, they can further develop their radius of influence. In order to do this, they need examples (Beispiel), they make things possible (ermöglichen), and these actions will allow (erlauben) for new expansion of activities.

Besides the spatial context that the studies all consider as basis for their work, we can also analyse the fact that the forth dimension – time in which the change shall occur – is a notion considered by the scholars. They have a time frame that shows the urgency and need for change in short time (rasch).

These spaces of possiblities have a target (Zielsetzung), have facilitated (ermöglicht) actions and change and are necessary without fail (unbedingt). We would certainly be curious to know what the individual researchers thought that these spaces of possibilities might allow (erlauben), and the data base "from information to knowledge" would help identifying every single orignal text and wording.

Thesis 5: Relocalisation ("Verortung")

ARL shows different kinds of spaces – local, terrestrial space and space in the sense of universe. It shows the space for local action and space for local and global pollution: act locally, think globally.

ARL deals, from the very beginning, with concrete political spaces like towns, regions and other space-related, localised case studies. Although ARL is an Austrian study programme, the researchers take the larger space of possibilities into account which is Europe(Europa).

Bridge words that concern the spatial aspects of sustainability show that relocaltisation, a topic counterbalancing the global aspects of change, show up with high frequency in the horizontal words. They are mostly related to ecosystems: Wasser (water), Pflanzen (plants), Wiesen (meadow), Flüsse (rivers).

Several of the space related words can be understood in a direct as well as in a metaphoirc usage. This is the case for words like Boden (base), Grund (ground), Weg (path). The word base can be related to the actual question of property or soil just as well as for describing the basis for a development, or for a hypothesis. Applied in a disciplinary context like agriculture or landscaping, its meaning and context may also vary.

Thesis 6: Complexity

Sustainability cannot be subdivided and constantly follows a stream of complex, integrative issues. This reverberates in the methodological approaches like inter- or transdisciplinarity; it is also mirrored by the fact that most researchi in sustaianblitiy is done as teamwork.

The data base shows the theoretical acknowledgement of complexity with words like komplex (complex), gesamt (overall), System (system), Struktur (structure), Komplexität (complexity), Vielzahl (big number of). These words, too, follow the order of horizontal presence and show a high rate of studies that use the word.

What is not present is a vocabulary of methodology. This leads to the assumpiton that , although the need for complexity is recognized by the sustainability community, there is still a need for application and operationalisation.

Thesis 7: New Research Questions

Sustainability is often seen as a concept that is in narrow linkage with the concept of modernity and of development. This leads to a new research question: is sustainability the last outcome of the modernity theorem – or is it already an emerging post-modern era subject?

The language used in the reports shows that sustainability research opens new linguistic spaces. It is an emerging language, and there is not yet a confirmed language ductus within a terminology of sustainability. The new subject leads to uncertainty in the speech and to a series of new word creations not be found in dictionaries and to conflicts between factuality and norms. We see an emerging specific scientific jargon with its own internal code. The decoding works within the discipline even with words that are newly created – the longest word we found was „Düngemittelbeschränkungs(jahr)response“ (literary translation: yearly limitation response for fertilizer).

In order to identify the new research questions, quantitative methods obviously have a limited potential: they can serve as a counterform for missing notions. Several topics that are not mirrored in the horizontal analysis have come up in the qualitative hermeneutics interpretation loops – topics like the change of paradigm from research "against" something (namely against pollution) towards research "pro something" – for spaces of possibilites, for systemic approaches etc. Other empty spacies and black wholes is the question of power relations, several levels of self reflection, and a critical apprehension of value and thinking systems in the sustainability research community.

5 5. OUTLOOK: FUTURE APPLICATIONS

Certainly, this analysis of the words without their context can only give an overall, rough image of the possibilities of such a data basis. In a next step, with Bib Tech Mon, we could look for partnerwords in the orginal texts ("What are the terms that frequently show up in relative nearness to the chosen term). in this way, one can find out what concepts for the future have been developed by the different studies. We can also re establish the original context in the whole sentence or paragraph in order to check whether our first understanding corresponds to the contectual situation.

5.1 A Visual Information system

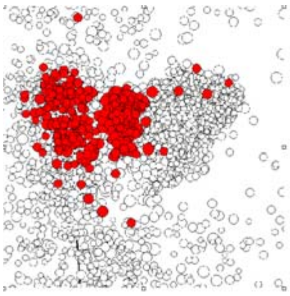


Figure 3. Example of a selected word group within the word map.

The wordmap is an interface that "delivers a two dimensional map of the relationships among all analysed words. Each word position on the map is determined by its relation intensity to all other words. In general, words of high occurrence in the reports are positioned in the centre of the map because of the high relation intensity. In contrast, rare words have their position on the margins of the map. Word groups of common occurrence are characterised as nested within the map. Additional features of the software, like selective presentation of words within a range of occurrence, flagging of selected words, or presentation of information from the database are supporting the interactive interpretation of the maps" (Knoflacher et al 2005).

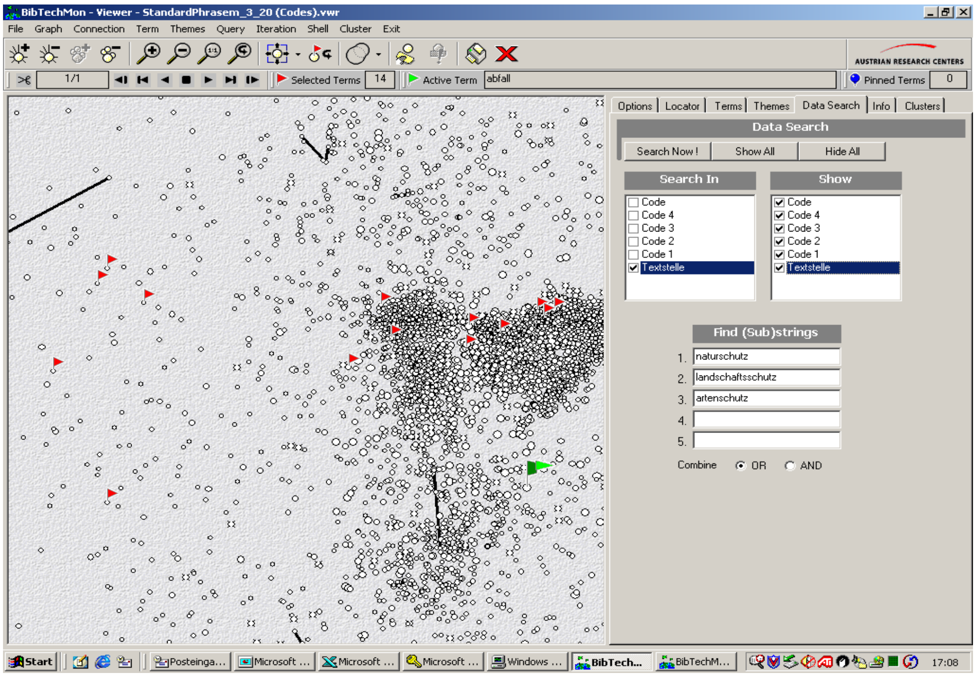


Figure 4: Wordmap presenting the selected words from the word family "Protection" which is a keyword in the traditional environmental community. Red: Nature protection. Green: protection of landscape.

The data basis itself is composed of the original text paragraphs, the phrasems and all standardised words. The context between the standardised words and the original writing in the texts is documented in the data basis. In the most simple application, the databasis can be used as catalogue of keyword. But what is more interesting is the possiblity of contextual searching: starting form one specific keyword, the information system allows for discovering different sorts of connectivities, providing a basis for further research.

In the Co-Word-Analysis, the intensity of relationality between notions (words or phrasems) are analysed in relation to all other relation intensities occuring in all the reports; the graphic representations allows for quick and intuitive recognition of these relationships. Interactive maps of interdependencies among all standardised words in the reports can be devleoped using the BibTechMon software. With these results it is possible to identify the intensity of integration among the scientific disciplines involved in the programme, as also the relationships between scientific language and common language considered in the reports.

5.2 Data Walk through

The data walk-through shows how the developed data base has a possibility to manage the huge amount of information of the scientific reports even in relation to one selected word.

ample: Walkthrough along the word *protection*

Protection, as shown above, is a typical notion in sustainablity research; the list of items that need protection can be extended endlessly.

Data walk through, step one: The data walk thorugh starts with descovering the contextuality of words containing the particle *protection* (Schutz). The table shows the word protection in its combination with other notions. The fact that "protecting" has the lowest variance shows that indead, a high percentage of all the reports contain the notion of protection as a horizontal bridgeword.

wort	Häufigkeit (code)	Varianz	BMA	IN2	IN4	IN5	KG2	KIK	LQ1	MP1	MU1	MU2	MU7	ÖR7	SU1	SU2
schützenswert	6	0,11	0	0	0	0	0	0,2	0,3	0,17	0	0	0,17	0,17	0	0
schützen	8	0,12	0	0	0	0	0,13	0,4	0,1	0	0	0	0,25	0	0,1	0
geschützt	11	0,12	0	0	0	0	0	0,3	0	0	0	0	0,36	0,09	0,2	0,1
naturschutzfachlich	12	0,12	0	0	0	0,3	0,08	0	0	0,17	0	0	0,33	0,08	0	0
landschaftsschutz	6	0,13	0	0	0	0	0	0,3	0	0,17	0	0	0,17	0,33	0	0
naturschutzgebiet	6	0,13	0	0	0	0	0	0	0,2	0,33	0	0	0,17	0	0	0,3
schutzwürdig	5	0,13	0	0	0	0,2	0,2	0,2	0	0	0	0	0,4	0	0	0
bodenschutz	4	0,15	0	0	0	0	0	0	0,3	0,25	0	0	0	0	0,5	0
schützend	4	0,15	0	0	0	0	0	0,5	0,3	0,25	0	0	0	0	0	0
landschaftsschutzgebiet	7	0,16	0	0	0	0	0	0,1	0	0	0	0	0,43	0	0	0,4
schutzgebiet	7	0,16	0	0	0,1	0	0	0	0,1	0,57	0	0	0	0	0	0,1
klimaschutzpolitik	10	0,16	0	0	0	0	0	0	0,1	0	0,1	0	0	0	0,6	0,2
vertragsnaturschutz	10	0,16	0	0	0	0	0,1	0	0,1	0,6	0	0	0	0	0,2	0
naturschutzgesetz	8	0,18	0	0	0	0	0	0	0	0,5	0	0	0	0	0,5	0
artenschutz	6	0,18	0	0	0	0	0	0	0	0,5	0	0	0	0,5	0	0
denkmalschutz	4	0,21	0	0	0	0	0	0,3	0	0	0	0	0,75	0	0	0
naturschutzfachliche bedeutung	4	0,21	0	0	0	0	0,25	0	0	0	0	0	0,75	0	0	0
schutzgut	4	0,21	0	0	0	0	0	0	0,3	0	0	0	0	0	0,8	0
naturschutzfachliche bewertung	5	0,22	0	0	0	0,2	0	0	0	0	0	0	0,8	0	0	0
schutzfunktion	6	0,22	0	0	0	0	0	0	0,2	0	0	0,83	0	0	0	0
naturschutzrecht	7	0,23	0	0	0	0	0	0	0	0	0	0	0	0	0,9	0,1
gefahrenschutz	8	0,27	0	0	0	0	0	0	0	1	0	0	0	0	0	0
donauschutzübereinkommen	5	0,27	0	0	0	0	0	0	0	0	0	0	0	0	1	0
landschaftsschutzrecht	4	0,27	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Figure 5: words containing the word *protection*.

The most frequent horizontal words shown in this table have a general character- schützenswert (worth protecting), schützen (to protect), geschützt (protected). But they are accompanyed by wordcompositions that contain the protection of specific items – protection of landscape (Landschafdtsschutz), of nature reserves (Naturschutzgebiet), protection of soil (Bodenschutz) or even juridiction of protection of landscape (Landschaftsschutzrecht). This shows how broad the field of protection is laid out in sustainability research, and we can also deduce that the topic of protection is actually carried out in the reports, pointing at specific issues that the respective research is studying in detail.

Data walk through, step two: Once we have identifyed the fact that protection is a horizontally present target in the ARL Research, we can now proceed to a next step.

One can now follow up the listed word and discover the original text, thereby getting a localised example for the need of protection (see also Thesis 1).

The following example shows the context of the word "protection" in one of the reports of the ARL programme:

"How do you imagine the Mühlviertel in 20 Years? .I expect the Mühlviertel to look more or less like in 1999 and 2000. The farmers are working actively and are proud of their landscape. This is how it should be: one is proud of nature. The learning process is that what we called "care for Landscape" was often unfortunate for the **protection of nature**, for the protection of landscape and for the protection of species. Often what is given priority is "to make everything proper and clean" or "this needs mowing and three times mowing". … the fact that something can grow where it wants to grow is slowly getting in the consciousness of people.

Wie stellen Sie sich das Mühlviertel in 20 Jahren vor? Ich erwarte das das Mühlviertel in 20 Jahren nicht recht viel anders aussieht als 1999 und 2000 (....) Da sind Landwirte die aktiv arbeiten und stolz sind auf ihre Landschaft. Und so muß es sein daß man auf die Natur stolz ist. Der Lernprozess ist der daß das was wir "Landschaftspflege" nennen häufig für den Naturschutz für den **Landschaftsschutz** und für den Artenschutz nachteilig war. Sehr oft steht "das ganz sauber herrichten" im Vordergrund: "Und das gehört gemäht und dreimal gehört gemäht." Im Mühlviertel stehen die vielen Leiten und Steine der Bewirtschaftung im Weg. dass etwas dort wachsen darf wo es wachsen will dringt erst allmählich ins Bewusstsein. Und das es toll ist die Kulturlandschaft die sie haben wenn sie in den Talbö-den die Wiesen noch haben und wenn das sogar feuchte Wiesen sind die einen gesunden Wasserhaushalt anzeigen (Favry, Hiess 1999)".

6 CONCLUSION

In the emerging scientific landscape of sustainability, a theoretical approach accompanying the published research can give a picture about the interdisciplinary qualities of the reports and about the topics dealt with. The following table shows the wordfamiliy sustainability and the manyfold connotations that the reseracher have mentioned.

nachhaltige entwicklung	67		nachhaltiges ressourcenmanagement	3
nachhaltigkeit	63		nachhaltigkeitsforschung	3
nachhaltig	56		nachhaltigkeitsprinzip	3
nachhaltiger umgang	9		nachhaltigkeitsprobleme	3
nachhaltige kulturlandschaftsentwicklung	8		nachhaltigkeitsstrategien	3
nachhaltigkeitsindikatoren	8		nachhaltigkeitsszenarien	3
nachhaltigkeitskriterien	7		nicht nachhaltig	3
nachhaltige landschaftsentwicklung	6		lokale nachhaltigkeit	2
nachhaltige mobilitätsentwicklung	6		nachhaltige kulturlandschaft	2
nachhaltigen kulturlandschaftsentwicklung	6		nachhaltige raumentwicklung fe	2
nachhaltiger	6		nachhaltige verkehrsentwicklung fest	2
nachhaltige nutzung	5		nachhaltigen ressourcenmanagements	2
leitbild nachhaltige entwicklung	4		nachhaltigen systemen	2
nachhaltige mobilitätsabwicklung	4		nachhaltigen verkehrssysteme	2
nachhaltige regionalentwicklung	4		nachhaltiger entwicklung zweckmäßig	2
nachhaltiges bauen	4		nachhaltiges wirtschaften	2
ökologische nachhaltigkeit	4		nachhaltigkeitsdebatte	2
soziale nachhaltigkeit	4		nachhaltigkeitsdiskussion	2
nachhaltig konzipiert	3		nachhaltigkeitskonzept	2
nachhaltige landwirtschaft	3		nachhaltigkeitsorientiert	2
nachhaltigen mobilitätsabwicklung	3			

nachhaltige entwicklung	67		nachhaltiges ressourcenmanagement	3
nachhaltigkeit	63		nachhaltigkeitsforschung	3
nachhaltig	56		nachhaltigkeitsprinzip	3
nachhaltiger umgang	9		nachhaltigkeitsprobleme	3
nachhaltige kulturlandschaftsentwicklung	8		nachhaltigkeitsstrategien	3
nachhaltigkeitsindikatoren	8		nachhaltigkeitsszenarien	3
nachhaltigkeitskriterien	7		nicht nachhaltig	3
nachhaltige landschaftsentwicklung	6		lokale nachhaltigkeit	2
nachhaltige mobilitätsentwicklung	6		nachhaltige kulturlandschaft	2
nachhaltigen kulturlandschaftsentwicklung	6		nachhaltige raumentwicklung fe	2
nachhaltiger	6		nachhaltige verkehrsentwicklung fest	2
nachhaltige nutzung	5		nachhaltigen ressourcenmanagements	2
leitbild nachhaltige entwicklung	4		nachhaltigen systemen	2
nachhaltige mobilitätsabwicklung	4		nachhaltigen verkehrssysteme	2
nachhaltige regionalentwicklung	4		nachhaltiger entwicklung zweckmäßig	2
nachhaltiges bauen	4		nachhaltiges wirtschaften	2
ökologische nachhaltigkeit	4		nachhaltigkeitsdebatte	2
soziale nachhaltigkeit	4		nachhaltigkeitsdiskussion	2
nachhaltig konzipiert	3		nachhaltigkeitskonzept	2
nachhaltige landwirtschaft	3		nachhaltigkeitsorientiert	2
nachhaltigen mobilitätsabwicklung	3			

Table 1: Wordfamily sustainability

Conclusions concerning a new methodology of scientific management:

Besides new knowledge about the nature of the upcoming new research field sustainability as shown in this paper, the project “From Information to Knowledge” also shows how such a combination of qualitative and quantitative methods can sort out central targets out of a huge compound of texts. This can be a tool to make these results available for interdisciplinary communication. It can also be a tool for managing large research programmes.

Conclusions concerning the combination of qualitative and quantitative methods:

From the methodological point of view, the cooperation between natural and social sciences was beneficial. In the first phase which established the list of standardised words and up to the last steps namely the interpretation loops, the software specialised recognized how beneficiary the combination of qualitative and quantitative methods in the research team proved to be:

“In comparison with former analyses of large reports with BibTechMon, an essential improvement of the results could be found out by the integration of qualitative and quantitative methods. These effects are caused in particular by much more sophisticated approaches in identification of text sections, and in standardisation of words by the integration of hermeneutic and linguistic methods. Caused by the huge dimension of the standard words database, no singular result of these analyses can be expected. Interpretations by the project team are therefore exemplary, and not complete. Consequently, the main result of the project was achieved by integration of the word databases in the BibTechMon software.” (Knoflacher et al 2002.)

Conclusions concerning sustainability research:

The young research field sustainability is developing its own specific scientific language and can also be characterised by a set of topics that differ this research field from the previous field “environmental sciences”. The qualitative as well as the quantitative research show the following notions as a set of topics that constitute sustainability research: Thesis 1: Future, Causality, Idyllic Nature and Demiurgical Man, Spaces of Possibilities (“Möglichkeitsräume”), Relocalisation (“Verortung”), Complexity, New Research Questions.

7 BIBLIOGRAPHY

Note 1: The study “From Information to Knowledge” was carried out by Oikodrom, The Vienna Institute for Urban Sustainability, in cooperation with the Austrian Research Centre Seibersdorf - Dr. Markus Knoflacher (Biology, BibTechMon), DI Alexander Kopcsa (Technical Mathematics).

Note 2: The research programme 'Sustainable development of Austrian landscapes and regions' (short Austrian Landscape Research, ALR “Kulturlandschaftsforschung”) is a cooperative initiative of the Austrian federal government, the state governments and several municipalities, initiated and coordinated by the Federal Ministry of Science.

DUMREICHER H. (Hg.): Von der Information zum Wissen, Die Forschungslandschaft der Nachhaltigkeit aus bibliometrischer und hermeneutischer Sicht, Das Beispiel österreichischer Kulturlandschaftsforschung, Bundesministerium für Bildung, Wissenschaft und Kultur, Wien 2004, ISBN 3-85224-228,9

DUMREICHER H., KOLB B. (2003): Seven Theses on Town and City Quality. In Benzing Brigitte, Herrmann Bernd (2003): Exploitation and Overexploitation in Societies Past and Present, IUAES – Series edited for the International Union of Anthropological and Ethnological Sciences by Brunetto Chiarelli, Peter J: M. Nas: Vol 1, Münster, LIT

FAVRY, H.; HIESS, H.(1999) Zukunftsbilder und Zukunftsgeschichten der Kulturlandschaft, Schlussbericht, Modul BMZb

KNOFLACHER, M.; KOPCSA, A.; DUMREICHER H.; KOLB, B. (2002): Integrated Method for Extraction of Environmental Information from Research Reports. In: Pillmann W., Tochtermann K. (Eds.): Environmental Communication in the Information Society. pp. 256- 261, IGU/ISEP, Vienna, ISBN 3-9500036-7-3, 2002

OEVERMANN, U. (1993) Die objektive Hermeneutik als unverzichtbare methodologische Grundlage für die Analyse von Subjektivität. In Jung, Thomas, Müller-Dohm, Stefan Hg.: Wirklichkeit im Deutungsprozess, Suhrkamp, Frankfurt

Addressing the Arnstein Gap: Improving Public Confidence in Transportation Planning and Design through Structured Public Involvement (SPI)

Keiron BAILEY, Ted GROSSARDT

(Department of Geography and Regional Development, University of Arizona, Email: kbailey@email.arizona.edu
Kentucky Transportation Center, 176 Raymond Building, University of Kentucky, Email: thgros00@uky.edu)

In the United States, public involvement has been mandated in transportation infrastructure projects since 1969 through the National Environmental Policy Act (NEPA) and its associated protocols for Environmental Impact Statements (EIS) and, more recently, Environmental Justice. Moreover, since most large transportation infrastructure investments involve public investment, there is an obligation on the part of designers and planners to respect the wishes of the public regarding aspects of the proposed development such as its form and location.

1 BACKGROUND TO PUBLIC INVOLVEMENT

The Transportation Equity Act for the 21st Century, or TEA-21, enacted in 1998, *(1)*, following the Intermodal Surface Transportation Equity Act (ISTEA) of 1991 *(2)*, defines the "public" as "citizens, affected public agencies, representatives of transportation agency employees, freight shippers, private providers of transportation, representatives of users of public transit, providers of freight transportation services and other interested parties." More recently the Federal Highway Administration (FHWA) has expanded this definition to include underrepresented groups "such as low income or minority households and the elderly" (*3*). In the last decade public involvement has been mandated for all metropolitan and statewide planning processes (TEA), and it has been integrated explicitly into a variety of programs such as Context Sensitive Design (4,5) and the Transportation and Community and Systems Preservation (TCSP) program (6).

Ideally, public involvement facilitates the understanding and incorporation of community values into the plans and designs for new infrastructure (7). This feedback permits the engineer or planner to assess accurately the level of understanding the public has acquired regarding the project. A positive signal occurs when the public begins to supply useful and insightful comments regarding a proposed activity. Because they better understand costs and benefits, as interpreted by the public, the professionals work more productively and accurately toward satisfactory trade-offs. This knowledge interchange can in turn help to avoid and resolve public opposition to particular aspects of a proposed project, and even whether the project should be pursued in the first place. Construction delays are minimized and consequently, more time and money is spent on building projects that the public really supports. In the long run meaningful public involvement increases public confidence in the sponsoring agencies and public officials in general; this is sometimes termed improved "civic capacity" (8). For many reasons, then, public involvement should be prioritized.

2 PROBLEMS WITH PUBLIC INVOLVEMENT

However, the ideal is not often seen. Frequently, small sets of pre-formed options are prepared in advance by consultants or engineers and then presented at public forums. Feedback on these options is then gathered in some random verbal form and used in some generally unspecified way to determine which one should be built. This limited involvement and restricted-choice paradigm, which we term Decide, Announce and Defend (or DAD), reinforces the suspicion that many stakeholders exhibit toward public planning processes. This suspicion can manifest itself in hostility toward consultants and planners at public forums, or, worse, in a feeling of pointlessness: that since the options are already decided by those in power there is no point in participating in public forums (9). While this typifies a worst-case scenario, it is easy to see why responsible authorities have been reluctant to initiate public input processes. In some cases they have seen them more as an unproductive requirement rather than as an opportunity to improve the design product (10). This self-fulfilling prophecy ensures that satisfaction with the planning process remains low on all sides (11,12,13). The situation is worsened by the wide variety of stakeholder groups whose participation is mandated. Many of these groups have competing goals and objectives. Under these circumstances there may be a suspicion that officials will use sophisticated technologies, such as visualization, to obscure options and so override the original goals of increased public satisfaction and better service provision. Without adequate structuring of public involvement such advanced methodologies will not necessarily relieve stakeholder suspicions, either of responsible highway agencies or of each other (14).

Therefore, despite the fact that since ISTEA public involvement in the transportation planning process is espoused as a desirable and necessary goal (7,15), its realization is a more complicated matter. As far back as the early 1980's, transportation professionals were predicting the inevitability of greater public involvement, and the need for better training of engineers to accommodate that potential (16). The contrast was drawn between the 'hard' sciences of engineering and planning and the 'soft'sciences of psychology and sociology. The problem was one of professionals being trained to develop the correct technical answer, and not being trained to solicit or process input from nonprofessionals (17,18). While transportation research continues to call for public involvement in large-scale planning exercises, it sometimes fails to include detailed consideration of that aspect while describing thoroughly all other phases of the planning effort (19). Alternatively, if there is an organized effort to gather public input on a planning design, the input may be ignored either because it is seen to somehow interfere with the process of gaining acceptance of the plan itself (20) or it becomes characterized as a failure in that it led to 'loss of management control' (21,p.98).

Once the commitment to public involvement is made, problems still persist. Sometimes the main disagreement might not be between the public and the professional, but among various members of the public, who have a variety of interests in a given project (22). Those disagreements can even become formalized, so that they reproduce themselves over and over again in the form of a Citizens' Advisory Committee in a form of permanent dysfunctionality (23). Perhaps in reaction to this, efforts have been made to identify the 'proper' public for a given project (21).

These dynamics create a negative feedback cycle for those charged with public involvement. Professionals face a dilemma: long-term engagement in an extended planning process taxes the patience and time reserves of most citizens, resulting in poor levels of engagement or dysfunctional interactions. Thus the recommendation is sometimes made to limit the scope of public involvement to specific recommendations and issues (23,24,25). However, focusing citizen attention on specific, nearterm goals and projects often means the practitioner must invest more time in the details of those projects because the public demands more information and considers more issues in making a decision (26). Frequently, professionals are surprised that public groups do not 'run themselves', that is, the participants in a public meeting do not spontaneously arrive at a unitary decision. In these cases a frequent post hoc recommendation is to engage the services of a facilitator or other process leader when working with the public.

3 THE ARNSTEIN LADDER

A significant question that emerges in practice is the question of the 'level' or 'quality' of engagement with the public. While Arnstein (27) famously pointed out the question of degrees of involvement many years ago, it remains a perplexing problem (28). Figure 1 shows the Arnstein Ladder.

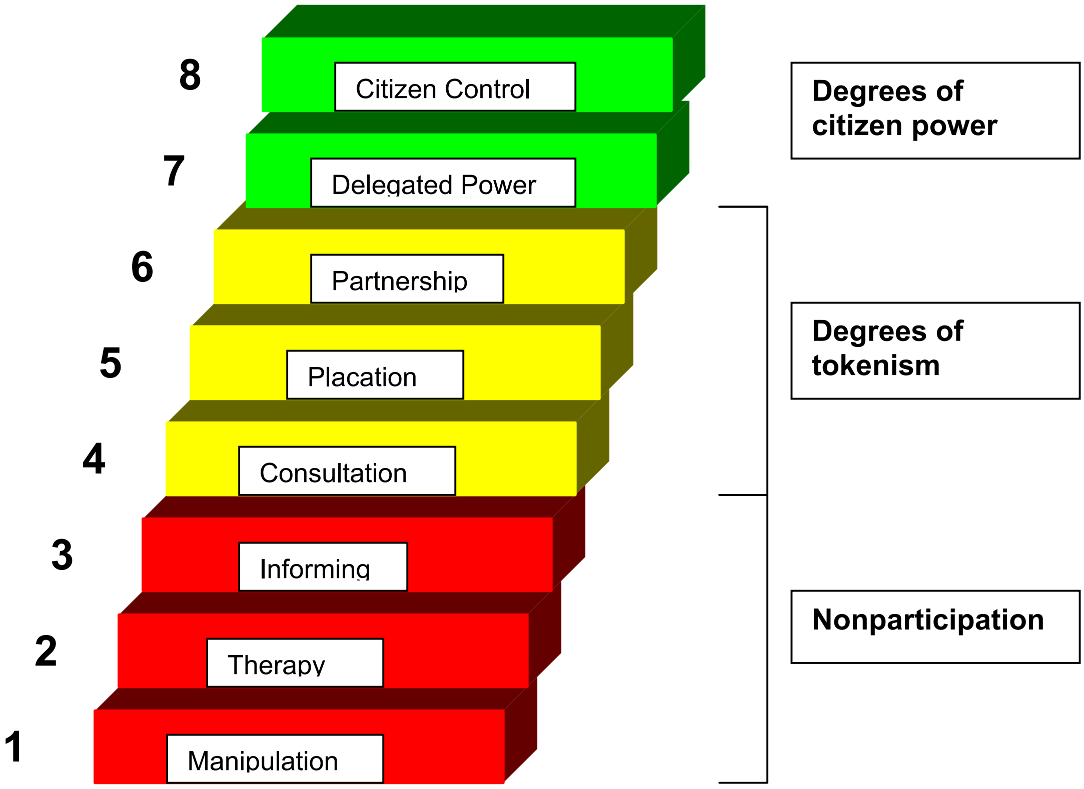


Figure 1. Arnstein's *Ladder of Citizen Participation* (1969)

Although arguably somewhat tongue-in-cheek, Arnstein's Ladder continues to be cited by planners (28,29,30). This indicates that it resonates with planners as an effective way of characterizing levels of public involvement.

4 CHARACTERIZING CONFIDENCE IN PUBLIC INVOLVEMENT IN TRANSPORTATION PLANNING

The results of this historically poor relationship between citizens and transportation professionals are evident in public attitudes towards transportation projects. Since 2003 the research team has been investigating this question. Using the SharpeDecisons electronic polling system in SPI protocols, the team has polled a range of professional and public meetings dealing with transportation improvements. The Arnstein Ladder, Figure 1, is shown, and the following questions are asked:

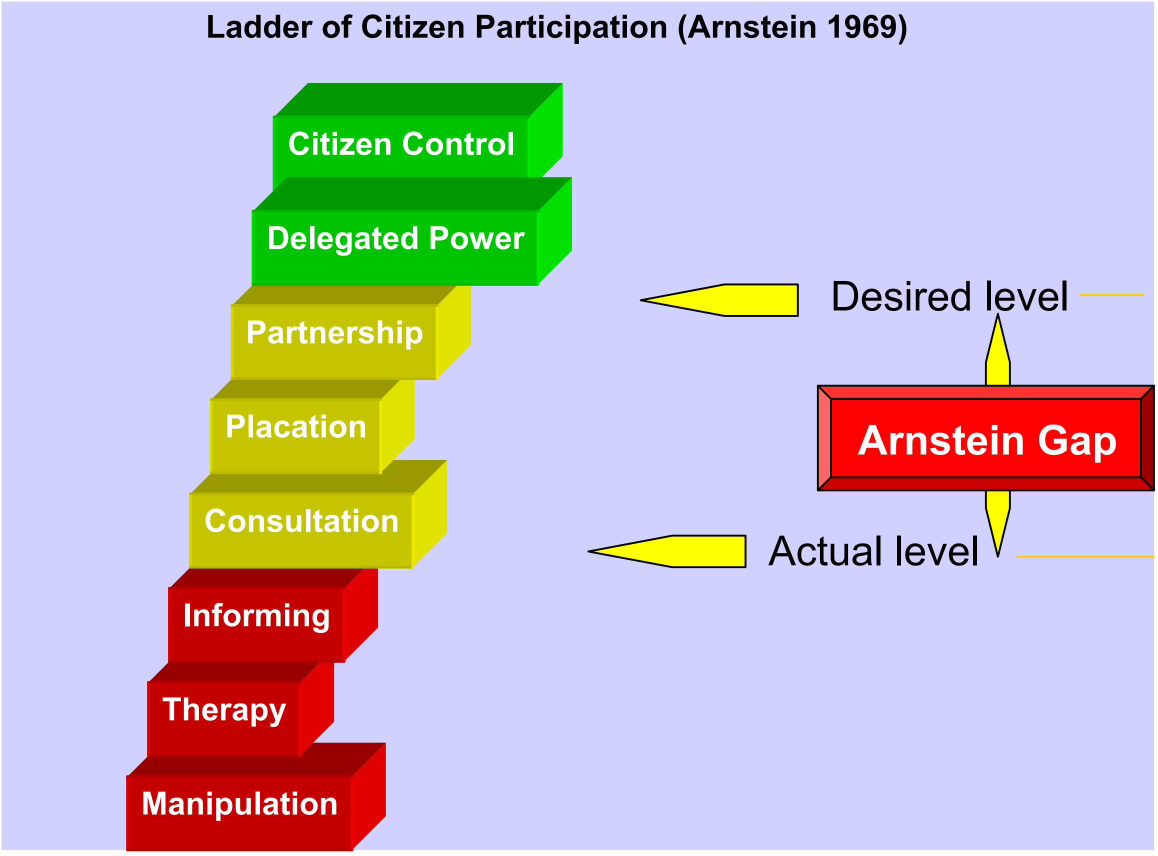
1. From your experience, how would you characterize public participation in transportation planning processes using this Ladder?
2. Where should public participation in transportation planning processes be located using this Ladder?

Each question was polled anonymously in turn. Responses were coded using integer numbers 1 through 8 corresponding to steps on the Ladder (Figure 1). The software allows responses to be collected and aggregated in real time. This database currently contains over 300 responses from various forums in KY and AZ, including citizens and State and private sector transportation professionals. So far the results of this vote are strikingly similar among these groups and between the states. The mean scores are:

Question 1: 3.8, which is between "informing" and "consultation," although closer to "consultation."

Question 2: 6.3, which is slightly above "partnership," towards "delegated power.

Figure 2. The Arnstein Gap



The difference is 2.5 steps on the Ladder. We call this difference between the perceived and desired positions the Arnstein Gap (31). This is shown in Figure 2. The Arnstein Gap clearly measures the difference between where public participation in transportation planning is situated in the public eye, and where it should be in the eyes of the respondents. While it is clear that the situation is not ideal, it is interesting to note that actual public confidence in these processes is not in fact at rock bottom as indicated by the terminology "manipulation" and "therapy". It falls somewhere between "informing" and "consultation." Moreover, in no case so far does the public indicate it prefers full "citizen control." This finding suggests that the public clearly recognizes a need for expert domain on the part of engineers and planners. The closest named step on the Ladder to the ideal point is "partnership." The problem is that the first number is lower than the second, indicating that the public – and the professionals polled - would like to see a system that is more responsive to public needs. It is here that transportation professionals must work at increasing satisfaction with process and product. Regardless of rhetoric, then, the Arnstein Gap is the metric by which the existing deficiency of public involvement can be measured.

Unfortunately, public involvement tends to be conducted on an ad-hoc basis with little or no theorization of how to integrate the public's wishes into the designer's systems. Under these conditions, the Arnstein Gap is not adequately addressed. Without working to close the Arnstein Gap using more analytic methods to solicit participation and to incorporate it into designs and plans, the public's rather negative view of public involvement is not likely to improve.

5 CONTEXT SENSITIVE DESIGN (CSD)

CSD is aimed at respecting the values of individual communities and regions rather than imposing a uniform design template over the landscape. The idea behind this is to improve public satisfaction with the process and the designs. However, CSD is a principle and to be achieved it requires a methodology that allows professionals to access public values and opinions prior to the presentation of specific design options. This way, public desires can be integrated into the design options prior to their evaluation. This means that, to realize its potential benefits, CSD requires a structured approach to implementation. Structured Public Involvement addresses this need and has demonstrated its success.

6 STRUCTURED PUBLIC INVOLVEMENT

Since 1999 the research team has been developing and applying a protocol called Structured Public Involvement or SPI (32,33,34,35,36,37). Theoretically SPI research is situated at the intersection of decision theory, cultural geography, geographic information science and planning. In practice SPI is aimed at understanding how groups make sense of information using specific geospatial and geovisual media. Key questions include how do groups use and deploy GIS and urban 3D and Virtual Reality visualizations; which aspects of these technologies are useful and to whom; and how the sociotechnical system, comprised of many actors with sometimes competing interests and differing understandings of the tools, creates knowledge from these tools. Methods embedded within the SPI framework include Casewise Visual Evaluation (CAVE) and the Analytic Minimum Impedance Surface (AMIS). Since this work deals primarily with real planning or design questions it requires intensive collaboration with a wide range of stakeholder groups to design, test and implement suitable methods.

SPI research has already shown its impact. Successful applications include participatory interstate corridor routing (37), rural highway design in central KY (36); a transit-oriented development in Louisville, KY (32, 34); noisewall design in KY and AZ; and now, the Ohio River Bridges project. SPI has demonstrated its performance on several occasions. For example, in 2001 during the rural highway study, citizens were asked to characterize their satisfaction with the SPI process on a scale of 1 (totally unsatisfied) through 10 (totally satisfied). The mean score was 8.6, which was a higher score than any of the specific design options polled (32). In another case involving bridge design, public participants rated satisfaction with the SPI process at 7.5 while the most preferred design option registered a mean score of 5.7 on the same scale of satisfaction.

These evaluations are significant for several reasons. First, the scoring was conducted anonymously in accord with SPI protocol. Second, the team conducted these evaluations at public meetings after design options had been evaluated. This process demonstrated clearly to the public that their opinion counted because the research team had no way of knowing beforehand which options would be preferred or what the mean scores or standard deviations would be. This data was displayed to the participants in real time. The anonymous evaluations indicate that SPI is achieving a significant measure of procedural justice, where procedural justice is defined as the meaningful inclusion of stakeholder viewpoints resulting in increased satisfaction with the planning and design process.

This data shows that, through SPI, planners and engineers can generate high satisfaction with process even if none of the potential design options are ideal. Other indications of increasing public confidence generated through SPI include steadily increasing attendance at open public meetings using SPI protocols and requests from engineers, planners and designers exposed to SPI for more use of the protocol (33, 35).

One issue with public confidence in planning and design processes is the very long timeframe over which trust is built, and the relatively short timeframe over which it can be eroded by unresponsive or poorly designed public involvement. This means that methods aimed at overcoming the skepticism indexed by the Arnstein Gap, such as SPI, are necessary and welcome but even in cases where these improve the quality of involvement on an individual project, much remains to be done. Consistent and equitable public participation remains an ambitious goal.

During the development and delivery of these SPI protocols the research team has developed an understanding of the role of, and the relationship between, transportation professionals and the public; between planners, engineers and designers, architects and landscape architects; between various involved organizations such as anti-growth groups, non-profits, MTO's, and a range of public group as well as individual citizens. This knowledge of the public involvement sphere and experience in design and delivery of successful CSD projects strengthens the team's proposal.

Overall, the prospects for improving what has been a highly problematic domain (38) using SPI appear promising. Current applications include major civil engineering projects such as the Ohio River Bridges Project and smaller, context-sensitive infrastructures such as noisewalls in Arizona.

7 REFERENCES

(1) FHWA (2001) Transportation Equity Act for the 21st Century, http://www.fhwa.dot.gov/tea21/legis.htm.
(2) FHWA (1991) Intermodal Surface Transportation Efficiency Act of 1991, http://www.fhwa.dot.gov/environment/istea.htm.
(3) FHWA (2001) How do FHWA and FTA define the "public"? http://www.fhwa.dot.gov/environment/pub_inv/q7.htm.
(4) Federal Highway Administration (1997) Flexibility in Highway Design. Washington DC: US Department of Transportation.
(5) Federal Highway Administration (2001b) Context Sensitive Design, Kentucky Transportation Cabinet, http://www.fhwa.dot.gov/csd/kty.htm.
(6) Federal Highway Administration (2001c) Transportation and Community and Systems Preservation Pilot Program, http://www.fhwa.dot.gov/tcsp/.
(7) FHWA (2001d) Public Involvement, http://www.fhwa.dot.gov/environment/pubinv2.htm.
(8) Docherty, I., Goodlad, R., and Paddison, R. (2001) Civic culture, community and citizen participation in contrasting neighbourhoods, *Urban Studies*, 38:12), pp.2225-2250.
(9) Lidskog, R. and Soneryd, L. (2000) Transport infrastructure investment and environmental impact assessment in Sweden: public involvement or exclusion? Environment and Planning A 32:8, p.1465-1479.
(10) North Central Texas Council of Governments (1984) Community Involvement in Transportation Planning. Technical Report Series 37. Washington, DC: U.S. Department of Transportation.
(11) Dorcey, A. (1994) Public involvement in government decision-making: choosing the right model, Vancouver, B.C: The Round Table.
(12) Unsworth, D. (1994) Redefining public involvement. (public-involvement requirements in government public-works projects), Journal of Management in Engineering, 10:4, p13-16.
(13) Rubin, R. and Carbajal-Quintas, B. (1995) Environmental regulation and public participation in project planning, Journal of Professional Issues in Engineering Education and Practice 121:3, p183-187.
(14) Kane, A. (1990) Technology's role in advancing transportation infrastructure in the 21st century, Urban Studies 27:1, p119-139.
(15) FHWA (1996) Public Involvement Techniques for Transportation Decisionmaking. Washington DC: FHWA.
(16) Adams, D. (1981) Landscape and Environmental Design. Transportation Research Board, National Research Council, Washington, D.C.
(17) Khisty, C. Jhotin (1996) Education and Training of Transportation Engineers and Planners vis-à-vis Public Involvement. Transportation Research Record 1552: Transportation Planning and Land Use at State, Regional, and Local Levels. Transportation Research Board, National Research Council. Washington, D.C., pp.171-176.

(18) Checkland, P.B. (1981) Researching Systems Methodology: Some Future Prospects. In Systems Prospects: The Next Ten Years of Systems Research. (R.L. Flood, M.C. Jackson, and P. Keys, eds.) Plenum Press, New York, pp. 9-15.
(19) Rienke, D. and Malarkey, D. (1996) Implementing Integrated Transportation Planning in Metropolitan Planning Organizations—Procedural and Analytic Issues. Transportation Research Record 1552: Transportation Planning and Land Use at State, Regional, and Local Levels. Transportation Research Board, National Research Council. Washington, D.C., 1996, pp.71-78.
(20) Cunningham, L., Christiensen, K., Dunn, D., Gonzales, E. and Hirsch, M. (1996) Recommendations for Developing Customer Focus in Statewide Transportation Planning Process. Transportation Research Record 1552: Transportation Planning and Land Use at State, Regional, and Local Levels. Transportation Research Board, National Research Council. Washington, D.C., pp.19-26.
(21) Comeau, S. and Rodriquez, D. (2000) Picking Publics Properly: An Artful Science. Transportation Research Record 1706: Transportation Planning, Public Participation, and Telecommuting. Transportation Research Board, National Research Council. Washington, D.C. pp.92-99.
(22) Boyd, David; and Gronlund, Amy G. The Ithaca Model—A Practical Experience in
Community-Based Planning. In Transportation Research Record 1499: Transportation
Planning, Management Systems, Public Participation, and Land Use Modeling. Transportation Research Board, National Research Council. Washington, D.C. 1995. pp. 56-61.
(23) Graves, Scott; and Casey, Sean. Public Involvement in Transportation Planning in the Washington D.C. Region. Transportation Research Record 1706: Transportation Planning, Public Participation, and Telecommuting. Transportation Research Board, National Research Council. Washington, D.C., 2000, pp.100-107.
(24) Taylor, B., Godschalk, D., and Berman, M. (1995) On Native Ground: Collaborative Transportation Planning on Indian Reservations. Transportation Research Record 1499: Transportation Planning, Management Systems, Public Participation, and Land Use Modeling. Transportation Research Board, National Research Council. Washington, D.C., pp.11-18.
(25) Bryson, J. and Einsweiler, R. (1988) Strategic Planning: Threats and Opportunities for Planners. Planners Press. Chicago, IL.
(26) Speicher, D., Schwartz, M. and Mar, T. (2000) Prioritizing Major Transportation
Improvement Projects: Comparison of Evaluation Criteria. Transportation Research
1706: Transportation Planning, Public Participation, and Telecommuting. Transportation Research Board, National Research Council. Washington, D.C., pp. 38-45.
(27) Arnstein, S. (1969) The Ladder of Citizen Participation. Journal of the Institute of American Planners 35:4, pp.216-224.
(28) Maier, K. (2001) Citizen Participation in Planning: Climbing a ladder? European Planning Studies, 9:6, pp.707-719.
(29) Brenneis, K. and M'Gonigle, M. (1992) Public Participation: Components of the Process, Environments 21, p.5-11.
(30) McCoy, K.L., Krumpe, E.E. and Cowles, P.D. (1994) The Principles and Processes of Public Involvement. Moscow, Idaho: Department of Resource Recreation & Tourism. http://www.iap2.com/library/pipaper.htm.
(31) Bailey, K., Grossardt, T. and Jewell, W. (2005) Participatory Electric Power Transmission Line Placement using the EP-AMIS methodology" in Schrenk, M. (ed) Proceedings of the 10th International GeoMultimedia Symposium 10:137-142. CORP2005. Vienna, Austria.
(32) Bailey, K. and Grossardt, T. (2004) Structured Public Involvement in the Design of a Transit Oriented Development pp. 13-15 in Stephens, R. (ed) InfoTEXT: IT Newsletter of the American Planning Association 79.
(33) Bailey, K. and Grossardt, T. (2003) Structured Public Involvement: Problems and Prospects for Improvement, Transportation Research Record 1858: 95-102.
(34) Bailey, K. and Grossardt, T. (2003) Enhancing Public Involvement Through High Technology, Transportation Research News 220: 16-17. Washington, D.C: Transportation Research Board.
(35) Bailey, K. and Grossardt, T. (2002) Integrating Visualization into Structured Public Involvement: A Case Study of Highway Improvement in Central Kentucky, Transportation Research Record 1817: 50-57.
(36) Bailey, K., Grossardt, T. and Brumm, J. (2001) Towards Structured Public Involvement in Highway Design: A Comparative Study of Visualization Methods and Preference Modeling using CAVE (Casewise Visual Evaluation), Journal of Geographic Information and Decision Analysis 5: 1-15.
(37) Grossardt, T., Bailey, K. and Brumm, J. (2001) AMIS: Geographic Information System-based corridor planning methodology, Transportation Research Record 1768: 224-232.
(38) Federal Highway Administration (2005) Public Involvement, http://www.fhwa.dot.gov/environment/pubinv2.htm

reviewed paper

Public Private Partnership – A Sustainable Solution for the Information Society? Experiences in the UK, Germany, and Austria

Ronald W. MCQUAID, Walter SCHERRER

(Prof. Ronald W. McQuaid, Napier University, Employment Research Institute, Craiglockhart Campus, Edinburgh, UK, r.mcquaid@napier.ac.uk; Prof. Dr. Walter Scherrer, University of Salzburg, Department of Economics and Social Sciences, Kapitelgasse 5-7, Salzburg, walter.scherrer@sbg.ac.at)

1 CHALLENGES FOR ECONOMIC POLICY

In spite of the recent economic slowdown the spread of Information and Communication Technologies (ICT) and its importance for growth is set to continue. The diffusion of ICT may both increase and decrease the complexity of the production process, and economic globalisation is an inherent ingredient of the spread of ICT. The diffusion process does not occur evenly across regions, and the potential gains are not evenly distributed across regions. For firms it has become easier to avoid high taxes and strict regulations in individual countries due to its improved mobility and flexibility. This has increased the intensifying of international competition between the business investments of regions and nations.

Economic policy thus has been confronted with a need to re-consider its role in order to pave the way for grasping the full benefit of a potential long-term economic upswing (a "Kondratieff"-wave) based on the diffusion of ICT throughout the economy (Scherrer 2001). From a long-term perspective, the most important economic policies may be those which aim at fostering creativity and facilitating change in order to enhance the economic agents' abilities to unfold the economic potential of ICT (Michalski et al. 1999, McQuaid 2002). These policies target: first, the redesign of the regulatory framework which has been set up in the pre-ICT era of mass-production and which has partly become either obsolete or even an obstacle to reaping the economic benefits of the spread of ICT; second, the re-arranging of traditional work and incentive schemes; and third, the design of a framework which is conducive to experimental initiatives that create new spaces where entrepreneurship can succeed. Public Private Partnerships (PPPs) are relevant with respect to all three aspects. While the successful implementation of PPPs requires some re-regulation and has a somewhat experimental character, the redesign of the traditional incentive structure in a market economy is at the core of the concept.

The scope of economic policy to help shape the economic impact of ICT, and national economic policy autonomy in particular have been restricted by a variety of causes (Scherrer 2005). Thus the search for answers to the question asked in this paper's title "Public Private Partnership – A Sustainable Solution for the Information Society?" must not be restricted – maybe not even focused – to applications in the information and communication technology sector but has to be based on a more general view and a broad range of activities and fields of economic policy. Budget constraints have become a major restriction of national policy autonomy, and the concept of PPP has become relevant in this context in most European countries. More precisely: PPP has become relevant again, especially since the 1980s, because it is not an entirely new concept but it has had a long history in many countries. There are many reasons for (and against) public and private bodies considering working in public private partnerships such as: resource availability; effectiveness; and legitimacy (McQuaid 2000). The motivations for, and types of, PPPs have varied over time, across sectors and between countries (see for example: the European Community's Green Paper on PPPs, CEC 2004; Grout and Stevens 2003).

In this paper the term PPP will be restricted to those projects involving the private provision, but continued public funding, of services formally provided by the public sector, although it is recognised that PPPs may include other forms of partnership. The paper does not seek to consider the many advantages and disadvantages of individual types of PPP (see for instance: Coulson 2005; Budäus and Rüning 1997), but rather concentrates on comparing the broader motivations and implications of PPPs in the U.K., Germany, and Austria. After a brief overview of a typology of PPPs, sections 3 and 4 consider more general reasons for government involvement. Section 5 discusses the potential for sustainable overall (i.e. macro-economic) efficiency gains deriving from the implementation of PPPs. Conclusions are drawn in Section 6.

2 TYPES OF PUBLIC PRIVATE PARTNERSHIP

Historically both Germany and Austria have had experience with public-private sector partnerships dating back to at least the 19th century (e.g. the construction of parts of the Austrian railroad network by PPP) and more recently in the second half of the 20th century (e.g. key urban development projects in Germany in the 1980s). Nevertheless both countries have been latecomers within the recent PPP-movement (compare: Bastin 2003 and Beirat 1998, for Austria; and Friedrich Ebert Stiftung 2002 and Sack 2003, for Germany). The overall amount of investment has been very limited, notwithstanding a few large investment projects (e.g. the heavy goods vehicles toll systems which have been deployed, more or less, successfully in both countries) several smaller projects (see DIFU (2005) for Germany and Schaffhauser-Linzatti (2004) for Austria).

However, the UK has been a leader in the large-scale introduction of PPPs across the economy (for example: Ball et al. 2002). The UK government considers PPPs "to cover a range of business structures and partnership arrangements, from the Private Finance Initiative (PFI) to joint ventures and concessions, to outsourcing, and to the sale of equity stakes in state-owned businesses" (Treasury 2000, p. 8). The private sector has also played an important role in the dissemination of PPPs as the UK has a quite highly developed set of private institutions (funders, developers, project managers, operators as well as banks, legal firms etc.) and a growing secondary market whereby PPP projects can be 'sold on' by the developers of the project to other firms to carry on the contracts. The public sector (locally and nationally) has also considerable experience in the UK. However, at a local level, individual public bodies may be inexperienced, so for any individual project the private sector will often have considerably more experience than the local public body, and may be better able to manipulate the long run return on the project to their advantage.

By the end of 2004 the UK government had signed 677 PPPs (or PFIs), worth nearly £43 billion (€65 billion), across 20 departments (or devolved governments) and particularly in Transport, Defence, Education and Skills, and Health (Treasury 2005a). The UK government set out three main categories of public private partnerships concerning: ownership; provision of services (including infrastructure) to the public sector; and the selling of public sector services to others (such as through the exploitation of patents). In addition PPPs have, fourth overlapping role in providing enabling organisations to provide common ground between public, private and third sectors to promote economic and social development policies. Under the first category PPPs are concerned with the introduction of private sector ownership into state-owned businesses. This involves a range of possible structures including a stock market flotation, or the introduction of a strategic partner, or with the sale of either a majority or a minority ownership stake to the private sector. Hence this can be seen as a continuation of the privatisation philosophy of the 1980s and 1990s primarily introduced by the Conservative government after 1979.

The second form of PPP concerns the provision of and/or operation of infrastructure. The Private Finance Initiative (PFI) and other arrangements are where the public sector contracts to purchase services on a long-term basis, so as to take advantage of private sector management skills and also to provide an incentive for the private sector by having a risk element in the private finance. This type of PPP includes concessions and franchises, where a private sector partner takes on the responsibility for providing a public service, including maintaining, enhancing or constructing the necessary infrastructure (e.g. many school or hospital investments or, in transport, the ill fated Skye Bridge PFI which was returned to public ownership after less than a decade). Basically such PPPs may be classified on two continuums, with different levels of ownership and involvement, of: who operates the service; and who provides the facilities (building and/or equipment etc.). PPPs may involve build and operate schemes (where the private sector both builds a facility and operates it for a defined period, such as 25 years, before handing it back to the public sector); to purely operating a service, while using public sector owned and constructed facilities; to providing a private sector facility, to be operated by public sector staff (or using private sector staff to maintain the facility and public sector staff to provide services basedin the facility, such as health services). In some cases the private firm may sell on their interests to other firms with, as mentioned above, a market for aspects of the ‘second phases’ of PPPs being developed in countries such as the UK.

The third type of UK PPP is generating commercial value from public assets, such as selling Government services into wider markets, and other partnership arrangements where private sector expertise and finance are used to exploit the commercial potential of Government assets. For example innovations from government research laboratories, including defence research, may be exploited through a joint PPP.

Fourth, PPPs have also been used to provide organisations to promote specific policies. These may range from general local economic development policies (McQuaid 2000) to more specific policies aimed at helping the UK to improve the ICT infrastructure and to meet the Lisbon Agenda targets for employment and productivity growth through ICT (HM Treasury 2005b). To take a specific case, the UK Government set targets for both the competitiveness and the extensiveness of the broadband market, including having the most extensive and competitive broadband market in the G7 by 2005, although in the short term there may be a trade-off between these goals, and focussing on rolling out broadband may be at the expense of competition (DTI 2004). To advise them on the development and implementation of the government’s broadband strategy a UK public/private partnership, the Broadband Stakeholder Group (BSG), was established in April 2001. The BSG is co-funded by the Department of Trade and Industry (DTI) and a number of private sector companies. The BSG notes that a wide range of broadband initiatives are being planned or implemented across the country with differing levels of public sector intervention, including: integrated public private partnerships; public sector funded infrastructure provision; public sector demand aggregation; subsidised broadband trials and technology pilots; promotion and content commissioning schemes and community network initiatives (DTI 2004). Hence PPPs are seen as one of a number of options for different circumstances (particularly where there is likely to be little commercial provision due to, for instance, low population density as in rural areas).

There is a range of economic, social and political reasons and motives for the growth of PPPs in the three countries over the last two decades. These revolved around: firstly budget or macro-economic factors (the availability of public investment resources); and secondly around more micro-economic arguments concerning the efficiency and effectiveness of public spending. It is argued that in Germany and Austria the main drivers of PPPs have so far appeared to focus predominantly, but not exclusively, upon macro-economic budget factors, such as the gap between public expenditure requirements and desires and potential revenues. In the UK, while these may be important, there has been an emphasis upon micro-economic factors – bringing in greater innovation and efficient management, as well as, especially in the 1980s and 1990s, being linked to a transfer of ownership and control from the public to private sector. Hence the comparison of the countries is of some interest.

3 MACRO-ECONOMIC DRIVERS OF PPP

In each of the three countries there has been a large requirement for public investment in services and infrastructure, especially since the 1990s. This investment need is due to a variety of factors, some of them being specific to, or at least significant in, Germany and Austria compared to other countries (Budäus 2003). In the transport sectors the enlargement of the European Union has shifted both countries from the border into the centre of the European Union, with a strong need to improve transport infrastructure to the new Member States. In some traditional utility sectors, like water supply and wastewater disposal, urbanisation trends and re-investment requirements have increased the current investment need. In all three countries demographic change and technological advances require heavy investment in the health sector. In the UK in the late 1990s there was also a legacy of under-investment in public infrastructure (schools, hospitals, transport etc.) from the previous two or three decades. This was worsened as during the 1980s and 1990s as local government, in particular, had often reacted to budget constraints through reducing maintenance, resulting in a long-term repair and rebuilding backlogs, together with requirements to bring in new technology infrastructure.

As public finances are insufficient for the levels of investment required private resources were used to fund services and facilities previously paid directly through public expenditure. In Germany the cost of re-unification turned out to be much higher than expected, and PPPs have been increasingly considered as a means to relieve public budgets. So, for example, from the public’s point of view this has been a major motivation for establishing the highway-toll system – which is set to raise finance for highway construction – as a PPP. Nevertheless in the recent academic debate on PPPs in Germany the argument has been called a “wide spread misunderstanding” by the members of the scientific board of the Journal of Public and Non-profit Enterprises (ZögU 2004), the leading German journal in this area, claiming that private sector financial contributions regularly are only of a transitory nature.

In Austria, the central government's budget was hit by the impacts of the increases in public consumption and transfer spending programmes in the early 1990s and by relatively increased demands for public funding due to slow economic growth. Therefore tapping new sources of finance for public infrastructure was one of the major motives for PPP in Austria listed by the Beirat für Wirtschafts- und Sozialfragen (which is a committee of the informal but still influential Austrian "social partnership"; Beirat 1998). Accordingly budget reasons were the major motives for PPPs in a variety of fields, particularly in the construction and operation of waste water treatment plants by municipalities (Föller and Freitag 1999), and in the transport sector where a few roads have already been realised (see a critical report by Oberösterreichischer Landesrechnungshof/court of audit of the province Upper Austria, 2002), and major highway links in the Vienna area are to be realised using PPP.

In the UK in some local cases the PPP mechanism is used to raise public investment for realising land values that would normally be unavailable to the public body without the PPP. For example, some local authorities have promoted PPPs that would result in greenbelt or recreation sites (such as sports fields) being developed. Normally such sites could not be developed because they are 'protected' by the planning system and other local and national policies (e.g. to promote sports and maintain the provision of sports fields). Private housing would not normally be allowed to be developed on such sites, and local authorities permitting such developments would be accused of succumbing to the interests of private developers. However, under the PPP, proposals are made to build the school (or other facility) on such 'protected' sites, in the expectation that local people will not oppose a new public facility. The local authority (or other public body) is then able to sell the former school site as housing. The net result is that the previous greenbelt has been built upon and there has been an increase in housing development in locations that local planning policies often would not necessarily have permitted.

In Germany and Austria, which are members of the European Monetary Union (EMU), public finances are constrained by the requirements of the European Monetary Union and the stability and growth pact, particularly in times of weak economic conditions. The impact of the restrictions has been felt at all levels of government due to intra-national "stability pacts" which require state and municipal governments to keep in line with the national requirements to meet the targets stipulated in the national stability programmes as part of the EU's stability and growth pact procedure. As state and municipal governments cover the bulk of public investment expenditure PPPs have become particularly attractive for them as a measure to relieve their budgets. The pressure to use PPPs to relieve pressure on government budgets has been stronger in Germany, compared to Austria, as public finances are strained more severely. In the UK policy has been to maintain state finances somewhat similar to the requirements of the European Monetary Union. The 'Golden Rule' whereby public finances are balanced over the economic cycle may limit the amounts that taxes should rise and encourage 'off balance sheet' funding where PPP finances do not appear as large capital expenditures in the year in which they occur, but rather as a series of smaller annual 'revenue' expenditures over the life of the project.

Reducing the overall tax burden (including social security contributions) is another driver of PPP, particularly in Germany and Austria, which are countries in which the tax burden on Gross Domestic Product (GDP) is well above EU-average. Tax competition within and outside the European Union – in particular with the new Member States – has made it difficult and risky to raise these ratios further. Thus the size of the tax burden has become a key issue of political debate both in Germany and Austria in which (micro-) economic arguments have begun to play a role. In the UK, in general, there is also pressure from opposition parties, which may make most governments reluctant to raise direct taxation. Pressures from globalisation and the ageing demographic structures of the countries also suggest that in the longer term significant tax rises are likely to be more difficult than in the past.

The greater use of user charges (rather than paying for individual services out of general taxation) can also more generally be seen as a move towards using market mechanisms to achieve more efficient management of demand for infrastructure rather than primarily providing new infrastructure to meet existing or expected demand. It can be seen as partly linked to wider user or polluter pays principles, whereby market mechanisms are used to change behaviour and the distribute the costs concerning environemntal pollution. Road user charging is an example of the greater use of usetr charges in transport, with some pilots schemes being developed in the UK as a possible forerunner for national road pricing, while Germany has already developed a scheme for heavy goods vehicles. The technology for such large scheme may well require the greater use of ICT based PPPs in future, in order to develop the necessary technology and the implementation of the policies, although Fietelson and Solomon (2004) suggest that adoptioning transport innovations is the outcome of a political process rather than simply diffusing technical innovation.

Deregulation and economic structural change has made some sectors, which had been dominated by public firms, attractive for PPPs. Formerly sheltered sectors such as parts of the transport or health services have turned or are expected to become more competitive markets with the entry of private competitors or the transfer of organisations from public to private, or the creation of 'internal markets' (internal to the public providers, as in the UK health service in the 1990s).

Finally, the European Union Green Paper on PPPs (CEC 2004) and other development policies at the local, national and European Union levels (Jones 1999) deliberately promoted network building between private and public partners, particularly in the fields of structural and regional policies and the creation of PPPs in order to reinforce collective entrepreneurship (Silva and Rodriguez 2005).

4 MICRO-ECONOMIC DRIVERS OF PPP

Part of the PPP agenda, particularly in the UK, is to improve the efficiency and effectiveness of the provision of public services. This is done mainly through innovations from other, usually private sector, approaches, and the development of appropriate incentives to each party. These incentives are claimed to include the introduction of competition or the threat of competition in the early stage of deciding upon the PPP (as firms compete to have their PPP chosen) and a transfer of real risks to the developer or operator.

The UK government (Treasury 2000) argues that PPPs enable them to tap into the disciplines, incentives, skills and expertise that private sector firms have developed in the course of their normal everyday business, while releasing the full potential of the people, knowledge and assets in the public sector. An analysis of the internet-based provision of information about a business location (Scherrer 2002) shows that these arguments seem to be particularly relevant for providing ICT based public services. Here PPPs might be supportive for changing the organisational structure of the units which provide the service, for adjusting the organisational culture in order to enable these institutions to meet the needs of customers, including those in the private business sector, better and for closing specific knowledge gaps. The private sector involvement, the Treasury (2000) argues further, should result in greater commercial incentives for delivering efficient and effective services, a greater focus on customer requirements, and new and innovative approaches to providing services or infrastructure. PPPs then may help improve the operation of state-owned enterprises or replace them with private providers. Meanwhile Government retains the responsibility and democratic accountability for: deciding between competing objectives; defining the chosen objectives, and then seeing that they are delivered to the standards required; and ensuring that wider public interests are safeguarded.

The micro-economic drivers of PPPs emphasize the importance of choice and implementation schemes to exploit possible efficiency gains in the provision of public services. This reflects the outcomes of the debates in the 1980s concerning whether the public sector should have an enabling role, determining the form and level of public services, or a role as sole provider of services (see for instance: Giloth and Mier 1993). In other words the public sector has to decide whether they should provide services or carry out activities themselves or should they get someone else (in the private or Third-sector) to do them for them? The increased role of PPPs suggests that the enabling view of government and governance has to a degree prevailed. In addition to the benefits of an enabling approach, PPPs have potential problems concerning: the ability to learn the lessons from providing the service in order to develop a policy; the availability of actors who can carry out the service, be they in the private, public or Third-sectors; and the danger of the organisation failing to ‘learn’ from past experience and so repeating mistakes of the past or ‘reinventing the wheel’ as there may be a lack of corporate memory. The theoretical and empirical benefits of economies of scale may be outweighed by the disadvantages of lack of local knowledge and the lack of continuity on the part of large-scale providers. In the UK PPPs have also restricted the ability of decision makers to reduce their maintenance, or even provision, of facilities at times of budget tightening (see below). Some of the constraints on decision makers related to PPPs are now considered.

In Germany and Austria micro-economic factors are not neglected, of course, but compared to the UK, ‘Value for Money’ considerations are less prominent in the debate about advantages and disadvantages of PPP. As in the UK, “privatisation-type” PPPs and “PFI-type” PPPs have to be distinguished. Due to the historically large share of state owned enterprises in sectors like mining, heavy industries, and banking (particularly in Austria) a process of privatisation has aimed at reducing government interference in management decisions, partly as government pursued goals other than micro-economic or efficiency-oriented ones. While formally, in many cases, more or less private sector-type corporate governance mechanisms existed in most of these firms, actual interference by governments at the federal, state, and sometimes even local levels, was common. The formal corporate governance structures are likely to converge towards private sector governance structures as most formerly government owned enterprises have become at least partly privatised. In the public, and even in the scientific, debate this process was labelled “privatisation” both in Germany and Austria, even in those cases when only a minority ownership stake was sold to private investors. The public to (partly-) private-enterprises in most cases have not been considered as being PPPs (for example the survey of PPP projects in Austria by Schaffhauser-Linzatti (2004) includes virtually no fully privatisation-type PPPs).

PFI-type PPPs have been less important in Germany and have only rarely been implemented in Austria. In both countries the provision of public infrastructure (particularly in the transport sector) has been largely state provided and funded. Most infrastructure which is provided by central, regional and municipal government is in relatively good condition and, although the quality of some government services has been criticized, this criticism has been limited. The scientific community both in Austria (e.g. Puwein et al. 2004) and in Germany (e.g. ZgöU 2004) formulated very differentiated positions towards the possible efficiency gains through PPP. Such efficiency gains could only be expected if a wide range of conditions are met, and to realise efficiency gains of increased private sector involvement in the provision of public infrastructure would not necessarily require PPP models as traditional public investment (based on the concept of “Generalunternehmer” taking comprehensive responsibility for the construction process) could yield similar results in terms of efficiency (ZgöU 2004, p. 412). Reports about the negative implications of privatisation of public infrastructure in other countries have added to the concerns about private sector involvement in the provision of infrastructure in the German and even more so in the Austrian public debate.

Public awareness and interest in PPP has been increased in Germany and Austria by some major domestic firms’ involvement in PPP projects. Interest increased in order to help make these and other firms fit for international competition and to warrant that a bigger piece of the PPP-cake would be distributed to domestic firms. This motive is particularly important in the the two countries’ construction industries, which have suffered severely from a drop in domestic public investment, and thus had been forced to focus more on the export business. Construction firms, partly due to international competition, have often tried to become infrastructure operators; a few have achieved this very successfully. In addition large firms with core businesses in a variety of industries – like Siemens and Deutsche Telekom in Germany, and the national highway operator ASFINAG in Austria – have entered this market. The firms’ lobbying for PPP-financed infrastructure gained more momentum when a few banks, which started to specialize in PPP-finance in the second half of the1990s, joined the effort.

Finally, the distribution of costs and benefits of new ICT PPPs on different parts of society is important, especially where they are funded out of public expenditure (McQuaid et al. 2004). The proposed use of ICT in the provision of public services has been argued, in the UK and elsewhere, as reflecting a belief in the potential for new technologies to promote the social inclusion of disadvantaged individuals and communities. This is partly based on the idea that: “ICT can have a far-reaching impact on the quality of life of marginalised segments of the population, by providing more responsive and transparent governance as well as improving the reach and delivery of health, education and other social services” (ILO 2001). The UK government has argued for using ICT as a tool for social inclusion policy (DTI 2000). For example, the New Opportunities Fund invested over £250 million to develop a national ‘electronic library network’ which provided web-based facilities and resources through existing public libraries and dedicated ‘ICT learning centres’ in disadvantaged areas (Liff and Steward 2001). The UK government’s ‘WiredUp Communities’ initiative provided broadband Internet access, digital television, mobile and standard telephone links, and advice and support services for all residents in selected pilot areas (DfES 2002). The objective was to assess how individual access to the Internet can transform opportunities for people living in these communities, by developing new ways of accessing learning, work and public services. The take up of Internet services has varied widely between and within communities, with overall Internet use in pilot areas ranging between 50% and 90% (Devins et al. 2003).

It has also been argued that the Internet's capacity to help in the sharing of information, and in increasing the participation of individuals, can lead to the growth of more demand-responsive services from the 'bottom up', and so facilitate a more democratic and dynamic relationship between public service professionals and their clients (Carter and Grieco 2000). However, the introduction of new technologies has generally tended to benefit the more advantaged, (Servaes and Heinderyckx 2002) and ICT infrastructure development (including broadband) lags behind in many rural and disadvantaged urban areas, when compared with more affluent communities and centres of employment (US Department of Commerce 1999). By carefully specifying the terms of PPPs it may be possible to improve (or make worse) such distributional effects.

5 EFFICIENCY GAINS OR LOSSES THROUGH PPP

For most OECD member states it may be assumed that so far there exists only a minor macro-economic impact of PPP on macro-economic efficiency because – the United Kingdom, Australia, New Zealand being possible exceptions – this dimension of PPP may be assumed to be relatively small. As infrastructure and services are provided by the public sector, and thus financed by taxes, resources are distributed from the private sector to the public sector. Assuming the – debatable – position that PPPs may be instrumental in reducing government activity to its core competences, because private production of goods is claimed by some to be "always more cost efficient" and "stronger oriented towards the needs of demand than public production" (Oberender and Rudolf 2004, translation by the authors), PPPs would potentially lead to sustainable gains in overall economic efficiency which would be reflected by a reduced tax burden (tax to GDP ratio) and/or by an improved quality of services. The argument is based on the idea that the distortion of the allocation restricts economic freedom, which might reduce overall economic efficiency and competitiveness; and also a high (marginal) taxation is further considered a major cause of tax avoidance.

Although it is of limited significance, the tax to GDP ratio has become an influential indicator of the tax burden and thus of the intensity of government intervention. Thus, in the context of PPPs and overall efficiency, a major issue of concern is whether PPPs are used as a means to reduce the apparent tax burden as measured by the tax to GDP-ratio? If activities can be shifted, at least partly, from the public sector to the private sector then it can be argued that, ceteris paribus, a reduction of the tax burden should be achieved. This may be only an apparent shift in tax burden as public sector liabilities will remain even if capital or operating expenditure is reduced in the short term. However, if PPPs actually improve efficiency then there could be a reduction in tax to GDP-ratios without a loss of public sector provision (and the reverse if PPPs are less efficient overall). For identifying the potential impact of PPPs on overall efficiency and tax to GDP-ratios several dimensions of PPPs have to be distinguished in order to define the relevant scenario for comparisons with alternative forms of providing and financing.

First, what is the alternative to PPP finance of a project that is relevant for comparison? The impact of a PPP-project on overall efficiency and tax to GDP-ratios will be different: if the project could not be accomplished otherwise; if it could be achieved only at a later period when the financial situation of public budget would have improved; or if it could be achieved only by debt finance. If most of a construct and operate-type PPP project's construction is funded by government debt, then PPP normally will reduce debt, interest payments, and government spending on public sector staff and other costs. However, if the costs of the contracts are allocated to current government expenditure, then there should not be any difference in operating costs between a PPP situation and direct government provision (assuming efficiencies are the same in each case and that all labour, capital and other costs, including pensions are fully costed in). The capital expenditure on a public sector project will normally lead to an increase in debt, while the PPP expenditure may not be allocated against government capital expenditure (although in a perfect market the long-term costs of each should theoretically be the same).

Second, experience with public private partnerships has been mixed so far (Joumard et al. 2004; Puwein et al. 2004). Some projects have been considered a success, having been completed on time and budget and having proved to be a cost effective method of delivering public services, while others have failed to deliver the expected gains. There have been significant delays associated with the interpretation of relevant contracts, cost overruns have been experienced because parts of projects had not been fully submitted to competitive pressures, and PPPs have also entailed bailouts by the public sector in a number of countries (see for example, WATIAC 2004). A recent survey of approximately 200 PPP projects in Germany, sponsored by the "PPP Task Force" of the German Ministry of Transport and Construction, suggests a more optimistic view of the experience PPPs finding out that the public adminstration's efficiency expectations have been regularly met (DIFU 2005). However, care needs to be taken concerning these optimistic views as it may be that the efficiency of PPP projects has been solely measured by overall efficiency judgements of those persons who initiated the projects and were responsible for its implementation, and that most respondents in the survey did not answer the question about efficiency expectations. So assumptions have to be made on the efficiency of a PPP project in comparison with other forms of service delivery. If a PPP project – particularly of the construct and operate type – is less financially efficient than a debt financed project then taxes will go up and vice versa. In the case of ICT projects there are many UK, and other, examples of large cost and time overruns and poorly performing projects (e.g. the Inland Revenue etc.), due to accountability, technology and project management issues (POST 2003), each of which can be affected by the use of PPPs although it is not necessarily clear if a purely public sector procurement would have been more efficient.

Third, it makes a difference if a PPP project is financed by government taxes or by user charges over its life cycle. User charge financed PPP projects may have a downward impact on the tax burden and tax to GDP-ratios, although some sort of a financial illusion might be involved: citizens might prefer paying user charges for the use of (semi-) private services to paying taxes for public goods. However, if it is hard to avoid such expenditure there is – given equal efficiency of the alternatives – an equal burden on private income in both cases. Economically user charges then come very close to taxation, which is unproblematic if the principle of equivalence finance is considered to be superior to ability-to-pay-finance and if the supply of the service is the same in each case (arguably tax funded public provison could over or under estimate the supply and demand). Nevertheless it is likely that efficiency considerations may stand against equity considerations. There may also be distributional and equity issues and the burden of taxes and user charges may vary between individuals.

If a PPP project is financed by government debt, and if taxes are collected during the use and pay-back period of the project, then the contractual design could make a difference for tax burden-comparisons. Assuming that PPP and government funded projects are equally efficient there should be no cash flow if the debt to pay for the project is paid back evenly every year. However, if the debt is paid back unevenly (e.g. in early years more interest but even amounts of capital are paid) then PPPs might result in less expenditure in early years and more in later years – which is attractive for government, of course. However, when inflation is considered the picture may differ according to contract details: if PPP payments go up with inflation then in later years there could be greater real public expenditure – and overall efficiency could be reduced.

Fourth, the statistical treatment of public expenditure may play a role in the time path of tax to GDP-ratios and thus in the interpretation of "efficiency gains". Conventional public investment is treated as expenditure in public account statistics in the periods when projects are undertaken. In the case of PPP – e.g. when the public sector purchases services from infrastructure utilities – public expenditure is spread over a much longer period. Consequently in periods when reliance on PPPs are increasing there will be a transitory reduction of public expenditure and of the tax to GDP-ratios.

Fifth, as discussed earlier, PPPs can be used to realise the value of public assets that could not normally be achieved (for political reasons). The example of building new schools on greenbelt land and then selling the former school site for housing has been discussed earlier. While such a transaction could possibly be carried out solely through public transactions, it is much more difficult to argue to do so politically, as opposed to 'blaming it' on private developers. In such cases PPPs could contribute to raise overall efficiency.

However, sixth, there may be changes in future freedom of action. There is a danger of long-term PPP contracts tying an organisation (such as a government department) into a specific type of technology (or a particular building layout and usage) for decades, and hence reducing flexibility and the introduction of newer techologies in the future. For example a major issue is if a PPP is used to build a school or hospital suitable for 2000 IT technology, but then technology, and/or the organisation of the activity, changes it may be very expensive to change the IT and other infrastructure and building layouts and so reduce future adaptability and efficiency and effectiveness.

As the dimensions of PPP interact, a comprehensive analysis would have to take into account quite a large number of different cases or scenarios. Our analysis demonstrates that there is a broad scope of potential outcomes regarding the impact of PPP on overall efficiency and tax to GDP-ratios, and that there is no straightforward answer to the relationship between PPP and overall efficiency.

6 CONCLUSIONS

The political context of governments differs between the UK, Germany and Austria, but each government has an optimistic view of PPP. In Germany, and even more so in Austria, there is a strong preference for a consensus society, and the call for reduction of government intervention is, arguably, not as strongly motivated by ideological concerns as in Anglo-Saxon countries. In the UK the current government has argued for PPPs on resource availability, efficiency and quality of delivery grounds while accepting continued government control and financing of most services and infrastructure. The consensus preference has been stronger in Austria although a change occurred in Austria after 2000, as reducing government intervention and the tax to GDP-ratio has since been formulated as a deliberate policy goal, and PPPs could serve as one way to achieve this. In all three countries there appears to be a reluctance to increase the level of direct privatisation in most cases, although PPPs can in some cases be seen as a middle way between privatisation and public delivery.

There are more significant multi-tiered levels of government in the Federal systems of Germany and Austria, with many autonomous players including federal government, states and municipalities. Investment by the latter two exceeds investment expenditure of the federal government. In the more centralised UK system, there has been the devolved government in Scotland, Wales and Northern Ireland since the late 1990s. However, public expenditure and infrastructure investment in these devolved territories is still highly controlled by central UK government, who fund the vast majority of their income. Hence policies towards PPPs have been relatively rapid and similar, although not identical across the UK. In Germany the search for a comprehensive approach ("Gesamtkonzept") has slowed the dissemination of PPP; Austria seems to handle the issue more pragmatically.

There are many similarities to the drivers for PPPs in Austria, Germany and the UK. The UK has had more experience, and the conservative-led government in Austria has been moving towards greater use of PPPs of the "privatisation"-type, but only very cautiously towards PPPs of the "PFI-type". The major motives for moving towards PPPs are macro-economic or budgetary, especially in Germany and Austria, but also micro-economic or improving the efficiency of public service delivery, especially in the UK. In all three countries PPPs appear to be a systematic middle response to the alternatives of privatisation or public service provision of infrastructure and operational support.

In summary, being confronted with enormous investment needs, with tax income increasing only slowly and overall tax burdens being high, and with restrictions being placed on government's ability to draw on borrowed money, new forms of investment finance received the attention of policy makers. PPPs are therefore primarily considered as a possible means to raise private funds and thus to close infrastructure gaps faster, and to improve the efficiency of the provision of infrastructure. In addition, however, PPPs restrict the choices of future decision makers. Although PPPs have so far only played a minor role in Austria and Germany, there is considerable potential for expansion, as has occurred in the UK. More theoretical analysis of PPP would be useful, for instance through adapting principal-agent models, theories of co-operation, trust and partnership (McQuaid, 2000). One issue that remains crucial to the future impacts of PPPs is whether they offer genuine and sustainable increases in efficiency and effectiveness compared the alternatives. If they do then they should have a positive impact on future public resource availability, but if they do not then they may provide short-term financial and political benefits but at the cost of constraining future decision makers and placing greater pressures on public finances in the longer-term. Our analysis demonstrates that there is a broad scope of potential outcomes regarding the impact of PPP on overall efficiency and that it is unclear if Public Private Partnerships are a sustainable solution for the information society.

7 BIBLIOGRAPHY

BALL, R., HEAFEY, M., and D. KING: The Private Finance Initiative and Public Sector Finance; Environment and Planning C: Government and Policy 20, 2002

BASTIN, J.: Public-Private Partnerships: A Review of International and Austrian Experience; Studiengesellschaft für Wirtschaft und Recht (ed.): Public Private Partnership, Vienna, 2003

BEIRAT: Innovative Kooperationen für eine leistungsfähige Infrastruktur. Eine Bewertung des Potentials von Public Private Partnership; Wien: Beirat für Wirtschafts- und Sozialfragen, 1998

BUDÄUS, D. and G. RÜNING: Public Private Partnership. Konzeption und Probleme eines Instruments zur Verwaltungsreformdiskussion und Darstellung eines Public-Choice-Modells des öffentlichen Sektors; BUDÄUS, D. and P. EICHHORN (eds.): Public Private Partnership. Neue Formen öffentlicher Aufgabenerfüllung, Baden-Baden, 1997

BUDÄUS, D.: Neue Kooperationsformen zur Erfüllung öffentlicher Aufgaben; J. HARMS and Ch. REICHARD (eds.): Die Ökonomisierung des öffentlichen Sektors: Instrumente und Trends; Baden-Baden, 2003

CARTER, C. and M. GRIECO: New Deals, no wheels: Social exclusion, tele-options and electronic ontology; Urban Studies 37, 2000

CEC: Green Paper on public-private partnerships and Community law on public contracts and concessions; COM (2004) 327, Brussels: CEC, 2004

COULSON, A.: A plague on all your partnerships: theory and practice in regeneration; International Journal of Public Sector Management, 18, 2005

DEVINS, D., DARLOW, A., BURDEN, T. and A. PETRIE: Connecting communities to the Internet: evaluation of the Wired up Communities Programme 2000-2002; London: Department for Education and Skills, 2003

DfES (Department for Education and Skills): Wired up Communities – an overview; available on-line at: www.dfes.gov.uk/wired/over.shtml, 2002, accessed 19 August 2003

DIFU (Deutsches Institut für Urbanistik): Public Private Partnership Projekte. Eine aktuelle Bestandsaufnahme in Bund, Ländern und Kommunen. Im Auftrag der PPP Task Force im BM für Verkehr, Bau- und Wohnungswesen; Berlin, 2005

DTI (Department for Trade and Industry): Closing the digital divide: Information and Communication Technologies in deprived areas; London: HMSO, 2000

DTI: Second Report from the Trade and Industry Committee, Session 2003–04, UK Broadband Market, HC 321; London: HMSO, 2004

FIETELSON, E. and I. SOLOMON: The Political Economy of Transport Innovations; BEUTHE, M., HIMANEN, V., REGGIANI, A. and L. ZAMAPRINI (eds): Developments and Innovations in an Evolving World, Berlin, 2004

FÖLLER, P. and M. FREITAG: 1. Betreibermodell Österreichs; Kommunales Management 19, 1999

FRIEDRICH EBERT STIFTUNG: Public Private Partnership – Mehr Qualität und Effizienz im öffentlichen Güter und Dienstleistungsangebot; Bonn, 2002

GILOTH, R. and R. MIER: Co-operative Leadership for Community Problem Solving, in: Mier, R. et al. (eds) Social Justice and Local Development Policy; Newbury Park CA, 1993

GROUT, P. and M. STEVENS: The Assessment: Financing and Managing Public Services; Oxford Rev.of Economic Policy 19,2003

ILO (International Labour Organisation): World Employment Report 2001 – Life at work in the information economy; Geneva: International Labour Organisation, 2001

JONES, R.A.: The European Union as a Promoter of Public-Private Partnerships; International Journal of Public and Private Sector Partnerships 1, 1999

LIFF, S. and F. STEWARD: Community e-gateways: locating networks and learning for social inclusion; Information, Communication and Society 4, 2001

MCQUAID, R.W.: The Theory of Partnerships – Why have Partnerships; S.P. OSBORNE (ed.), Managing public-private partnerships for public services: an international perspective; London, 2000

MCQUAID, R.W.: Entrepreneurship and ICT Industries: Support from Regional and Local Policies; Regional Studies 36, 2002

MCQUAID, R.W., LINDSAY, C. and M. GREIG: Re-Connecting the Unemployed: ICT and Services for Job Seekers in Rural Areas; Information, Communication & Society 7, 2004

MICHALSKI W., MILLER R. and B. STEVENS: Anatomy of a Long Boom, in: The Future of the Global Economy. Towards a Long Boom?; Paris: OECD, 1999

OBERENDER, P. and T. RUDOLF: Public Private Partnership; Wirtschaftswissenschaftliches Studium – WiSt 33, 2004

OBERÖSTERREICHISCHER LANDESRECHNUNGSHOF (Court of Audits of the Province of Upper Austria): Initiativprüfung Umfahrung Ebelsberg; Linz, 2002

POST (Parliamentary Office of Science and Technology): Government IT Projects; London: HMSO, 2003

PUWEIN, W., CZERNY M., HANDLER H., KLETZAN D. and M. WEINGARTLER: Modelle der „Public Private Partnership" im Lichte der theoretischen Diskussion und der empirischen Erfahrungen; Austrian Institute for Economic Research, Vienna 2004

SACK, D.: Gratwanderung zwischen Partizipation und Finanzengpässen. Ein Überblick über die deutsche Public Private Partnership Entwicklung; Zeitschrift für öffentliche und gemeinwirtschaftliche Unternehmen 26, 2003

SCHAFFHAUSER-LINZATTI, M.: The Presence of Public Private Partnership Models in the Internet: An Austrian Survey; paper delivered at the 10th International Conference on Public and Private Partnerships, Faro 2004

SCHERRER, W.: The employment impact of communication and information technology in 2005: A possible application of the "long wave" concept?; KYRER A. (ed.): Neue Politische Ökonomie 2005; München, 2001

SCHERRER, W.: Information deficiencies in place marketing and the scope for PPP: Evidence from the City of Salzburg; MONTANHEIRO L. et al (eds.): Public and Private Sector Partnerships: Exploring Co-operation; Sheffield 2002

SCHERRER, W.: Tackling core issues of regional economic policy: Some considerations and recent experience from Salzburg; SIR-Mitteilungen und Berichte Nr. 31/32, 2005

SERVAES, J. and F. HEINDERYCKX: The 'new' ICTs environment in Europe: closing or widening the gaps?; Telematics and Informatics, 19, 2002

SILVA, M.R. and H. RODRIGUEZ: Public-Private Partnerships and the Promotion of Collective Entrepreneurship; paper delivered at the 11th International Conference on Public and Private Partnerships; Iasi, 2005

TREASURY, The: Value for Money Assessment Guidance; London, The Treasury, 2004

TREASURY, The: PFI Signed Projects List - December 2004, London: HM Treasury, available on-line at: http://www.hm-treasury.gov.uk/media/D90/70/PFI_signedprojects_dec04.xls, 2005a, accessed 05/01/06

TREASURY, The: Lisbon Strategy for Jobs and Growth: UK National Reform Programme; London: HM Treasury, 2005b, available on-line at: http://www.hm-treasury.gov.uk./media/093/DD/lisbon_jobs131005.pdf, 2005b, accessed 05/01/06

TREASURY, The: Public Private Partnerships: the Government's Approach; London: GSO, 2000

US DEPARTMENT OF COMMERCE: The emerging digital economy II; Washington DC: US Department of Commerce, 1999

WATIAC (Western Australia Technology and Industry Advisory Council): Initiating and Supporting Major Economic Infrastructure for State Development: Opportunities for Government; Perth 2004 (Access 10 September 2005) http://www.wa.gov.au/tiac/opportunities/index.htm

ZgöU: Public Private Partnership. Positionspapier des Wissenschaftlichen Beirats der Gesellschaft für öffentliche Wirtschaft; Zeitschrift für öffentliche und gemeinwirtschaftliche Unternehmen, 77, 2004

🏆 reviewed paper

The role of soft-factors in the success of collaborative planning information systems

Hany ELGENDY, Sebastian WILSKE

(Institute of Urban and Regional planning, university of Karlsruhe, Germany, elgendy@isl.uka.de, wilske@isl.uka.de)

1 ABSTRACT

Planning information systems (PIS) play an important role in supporting collaborative spatial planning processes especially in complex planning tasks. In such a process different actors from different organizations and different planning levels deal with ill-structured or unstructured problems. During the development and implementation of planning information systems in this type of planning processes, main emphasis is usually given to technical, administrative, and operative aspects - the so-called hard-factors. In this paper we argue that the success and failure of these systems in supporting the planning process depends to a large extent on the so-called soft-factors.

In this paper we attempt to shed some light on soft-factors and their impacts on the success and failure of planning information systems in supporting the planning process as observed during the project "Sustainable Regional Land Management - RESIM" in Stuttgart region, Germany. One of the main aims of this project was to get an overview about inner development potentials in the 179 municipalities of Stuttgart Region. This overview was considered as a foundation for preparing a strategy for land management on the regional level. To get this overview and then to keep it up-to-date, an internet-based planning information system was developed. In this project, the concept of collaborative planning implies cross-organization and cross-municipal cooperation, where few or no obligatory basis could be realized beyond the borders of organizational or jurisdictional entities. Furthermore, the existing legal framework for spatial planning does not cover these types of planning tasks. The complexity of the process emerged from three main factors: the subject is new and politically loaded; the relation between the region and the municipalities is historically burdened with some negative experiences and the number of participating actors is large. After developing the system and during the implementation phase, it was evident that beside hard-factors different soft-factors play an important role in the process. Through the identification and observing of soft-factors, it is plausible that considering of these factors can further increase the chances of successful design and implementation of PIS.

After a short introduction to the concept of planning information systems and their application in collaborative spatial planning processes, we discuss the subject of hard-factors and soft-factors in the development and implementation of PIS from the view of spatial planning. Then we discuss different groups of these factors according to their source and their impacts on the outcome of the planning process. These soft-factors could be classified mainly to the following major groups: problem-oriented (planning theoretical); System-oriented and human factors (individual and group dynamics). In the last part we introduce a framework for dealing with these factors to enhance the quality of the proposed PIS as well as the success chances of the planning process. This part covers some technical, operative and communicative measures. While most of the aspects that are discussed in this paper apply for other information systems, main emphasis here is given to ill-structured problems in cross-organizational spatial planning processes in the public domain.

2 COLLAPORATIVE PLANNING INFORMATION SYSTEMS: CONCEPT & APPLICATION

2.1 The concept of PIS

As collaborative planning information systems (PIS) are ought to support different information processes in a complex planning situation, several aspects should be considered in the development and implementation of these systems from the very beginning of the process, namely: a) characteristics of the spatial problem that should be solved; b) characteristics of the planning process that should be used; c) characteristics of the planning information generally and in the specific context of this problem and d) characteristics of the human processing of information (Elgendy 2003).

In general, complex planning situations are characterized by a high degree of interconnectivity among different levels of planning, sectors, actors, and regions. These interconnectivities are mostly not well known in advance. Subjects of these complex planning situations are not static; they change through time and during the planning process. In addition, there is a time lag between making a decision, implementation of the determined actions and realizing the outcomes of these actions. Another important characteristic of these situations implies that the side effects and the long-term impacts of these activities may extend beyond the wished outcomes and the targeted space. In many cases these outcomes are unpredictable.

This type of problems could be classified either as an unstructured problem or an ill-structured problem. This type of problems can not be approached only in the formal planning framework or using the traditional planning process and methods. The needed planning process could not be considered as a plan making process; it is a continuous process of problem solving and conflict resolution among a group of individuals and/or organizations. The knowledge and expertise needed to solve the problem are not available for one person or organization. It is usually distributed over many persons and organizations (Rittel 1982). Hence, exploring and attempting to solve a planning problem in such a context set specific pre-requirements on the organization of the planning process, in which the number of actors who may take part is large - 30 to 50 individuals and organizations (Scholl 1995). These actors have differentiated roles and they are spread across various public and private organizations. They are from a variety of disciplines and have different backgrounds. In many cases, they have different and in some cases conflicting objectives. The distributed knowledge should be shared and communicated among the concerned parties. Meanwhile, in such a process, planning information have limited accuracy, are changing, losing their precision rapidly and originated from different sources and in different types.

2.2 Main features and applications of PIS

Highly structured administrative tasks are easy targets for automation exercises, and as the processes and outputs did not fundamentally change, efficiency gains were relatively straightforward to quantify (Johnstone 2004). Hence, in developing conventional information systems major emphasis is usually given to the “hard-factors” i.e. technical factors (infra-structure, system analysis, data structure, compatibility, security, etc.), administrative (contracts, finance, control, etc.) and operative (task formulation, coordination, training, etc.). All these areas are well studied. Different tools and methods are developed to improve the performance in project management, system development and programming (Rey, 2004).

But contrary to the development approach of information systems for well-structured or semi-structured problems the needed systems for ill-structured problems can not be realized in a traditional modeling process. As at the beginning of the planning process neither a problem definition nor a solution direction is given, system requirements could not be stated comprehensively in advance as in the traditional approach. Hence, it is a vital mistake to consider the development of PIS as a sole technical task that could be conducted by information experts without pairing with the planning process. An integrated approach among planning process, problem exploration and system development could not be avoided. Table 1 covers the major difference areas between planning information systems and geographic information systems, including: nature of the system, contents of the system and functions of the system.

Aspect	PIS	GIS
Nature	Normative	Positive
Purpose	Aiming at changing space	Aiming at describing space
Information	Information that is processed or produced during a planning process (space, time, organization, etc.)	Information describing the earth, its features and peoples’ activity on it.
Relation	Specific planning context, process or subject.	Related to a specific spatial context.
Orientation	Process-, problem- or subject-oriented	Space-oriented
Processes	Establishing and preserving the overview about complex planning situations Collaborative exploration of planning problems Process Support (Coordination, Communication, Documentation) Management of planning knowledge	Management of Spatial date and information Spatial analysis Visualization /Overlaying Buffering Network analysis Site selection
Development	Iterative / explorative (*The system can start by a core information and function and grow with use*)	Comprehensive (*The system should be complete to be useful*)

Table 2: A comparison between PIS &GIS

One of the major application areas of PIS in complex planning tasks is to support establishing and preserving the spatial overview on ongoing or planned spatial activities. This overview should be made available for the participating actors in the planning scene to reach a common understanding about the planning context. Common understanding does not mean that all actors must have the same viewpoint but at least they should have access to the same background. Another application area of PIS is supporting the organization of the planning process and supporting the communication process among the participating actors (Elgendy 2003). Furthermore, PIS could be implemented to manage planning knowledge that is related to a specific planning subject. In other words, PIS could be problem-orientated, process- orientated or knowledge- orientated. It could also cover a combination of two or all of these aspects.

2.3 General structure of PIS

In addition to the common components of any distributed information system i.e. hardware and networking facilities, four main components are considered the structural fundamentals of PIS i.e. planning information, functions, rules scheme and user interface.

Different types of planning information in a database or as documents of different media types.

A set of tools to facilitate information manipulation, file and media management, analysis and simulation, etc.

The rules scheme includes declaration rules and access rights.

The user interface.

These four components are further divided into sub-components. The structure of PIS in form of components and sub-components facilitates the definition of the required and optional parts regarding the circumstances of the system application. In addition, as information and communication technology is witnessing continuous innovations at a very fast rate, this structure will be developed regardless of specific techniques or programs.

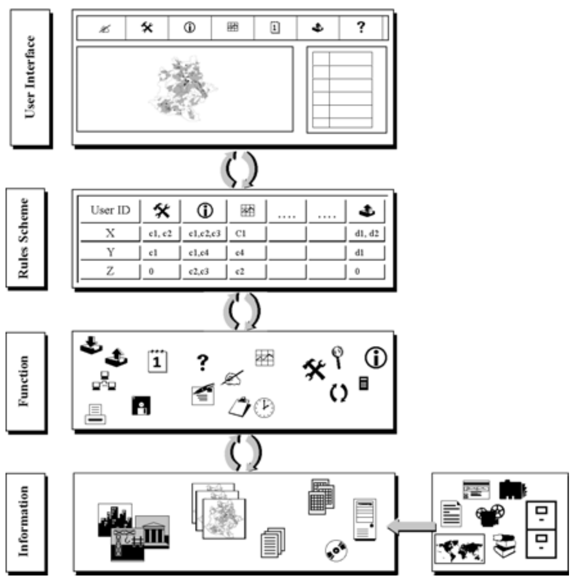


Fig. 1: Main components of a PIS

Splitting presentation, content and functions allows the autonomous development of each component and the implementation of new technologies without affecting other components. Menawhile, adopting new technologies in the back-end, the presentation and the information will not be affected. Furthermore, it facilitates presenting the same information in different ways. Updating and extending the information without affecting the presentation and the functionality.

2.4 Realization of PIS

The development process of PIS in a collaborative planning process should have an iterative manner rather than a comprehensive one to correspond to the explorative nature of the planning process. Iterative development allows starting the implementation with a core of information and functions and then extending and modifying the system according to the evolving needs. This approach allows obtaining quick results at an early stage. Meanwhile, it allows reacting to the soft-factors that usually arise during the implementation. On the contrary, a comprehensive approach or the so-called "water-fall" approach* requires a well-structured problem definition and longer time to produce results. A synthesis process for the development of PIS for a collaborative planning process would have the following main phases:

The **orientation phase** aims at defining the system requirements according to the specific circumstances of the situation.

The **planning phase** aims at preparing a general system layout according to the system requirements.

The **development phase** is organized in several cycles. In each one, a specific part of the proposed PIS is developed in a way that makes it operating independently from other parts of the system. After each development cycle, a test and consolidation cycle is organized to test the system and adapt to the feedback from the users.

The **implementation phase** starts after the first cycle of development, as the system should be operating partially. Each cycle of implementation should include an introduction or training for the target group.

From information technology viewpoint, the proposed structure could be realized using any suitable set of technologies. In the Project RESIM, the following technologies were used:

> At the back-end, a database application e.g. MS Access in which information and Meta information are organized in different tables for each class of objects.
>
> The tools and functions are server and client side scripts that are written using a standard scripting language such as JavaScript.
>
> The rules scheme is organized as tables in the database. For class of objects the declaration rules are defined in a separate table. Users' access rights are defined also in DB table. A record for each user includes his access rights to the functions and the information.
>
> The user interface (UI) is a standard HTML page through which each user gets access to specific functions and classes of objects according to his access rights. It also serves as a visual environment to present results of user's queries and requests.

2.5 Soft-factors in PIS

PIS - as well as any other information systems - do not exist in isolation from their context. They are applied in teams or work-groups that usually comprise members from different organizational units or even from different organizations. These systems represent more than a technical instrument for improving performance especially in ill-structured problems. They interact, influence, and are influenced by the surrounding individual, social and organizational environment. Introducing a new system is not less than initiating a change process that takes place in an organization or among different organizations. It influences different actors as individuals and as groups. Individuals or organizations have a tendency - in spatial planning as well as in other disciplines - to conduct their tasks using the means and the methods they are used to. Kirkpatrick (1985) argued that it is a basic tendency of human behavior that any belief or value that has been previously successful in meeting needs will resist change. Through the above-mentioned change processes different values, means or methods are called into question. Furthermore, existing organizational relations, communication structures and information methods are challenged.

Soft-factors could be then defined as those factors that are more qualitative in nature i.e. planning theoretical; human factors; group dynamics and psychological aspects. It is argued here that considering these factors in the development and implementation of these systems is a major success or failure factor. Different experiences and studies show that the major cause of most IT applications failures is the human, social and organizational issues rather than technical issues (Kunda & Brooks 2000). Baltzer (1991) supports this argument through the following observation *"... a university chief information officer relate the story of how members of his staff had decided to interview users of one of their administrative computer systems to determine the user satisfaction level with the system. He was amazed to find that only a very small percentage of the users surveyed expressed satisfaction; in fact, over 65 percent of them were actually dissatisfied with the system. Upon further investigation, it was discovered that none of the reasons for user dissatisfaction had anything to do with the system itself or with the technology being used. The dissatisfaction really stemmed from the lack of training and awareness-building to acquaint users with the benefits of the new system."*

The central source of soft-factors in the development and implementation of PIS in collaborative planning processes is the human component. It could be described as a three dimensional complex. The first dimension emerges from the perception of problem or the planning subject. The second dimension emerges from the perception of the needed system or the proposed system. The third dimension results from the relation among the participating actors as individuals as well as organizations. Hence in this paper we classify soft-factors into three main groups: problem-oriented, system-oriented, and human factors.

The first group of soft-factors implies the planners' view to the problem. This view is influenced by the planning culture in the organization or this of individual planners. This planning theoretical background or the planning culture influences the problem

* A waterfall methodology structures a project into distinct phases with defined deliverables from each phase. The first phase tries to capture What the system will do (its requirements), the second determines How it will be designed, in the middle is the actual programming, the fourth phase is the full system Testing, and the final phase is focused on Implementation tasks such as go-live, training, and documentation. The phases are always named something different, depending on which company is trying to differentiate its own particular flavor, but the basic idea is identical (Marks 2002)

perception, the approach how the problem should be solved and what is the suitable process to deal with the problem. These aspects are usually overlooked at the beginning of many collaborative planning processes, as it is often considered improper at the beginning of a collaborative planning process to start a discussion about the planning views of the participating actors. But ignoring these differences might cause major problems later on. Consequently, their views to the needed information system are also different, the thing that produces the system-oriented group of soft-factors. The third group, namely the human factors, is merely the result of the difference between how different actors react to the change and to the introduction of new methods. On the organization level and cross-organization levels, different unites should communicate in a new way that has not existed before. Others who have communicated earlier must change the way they communicate. These changes create uncertainties and lead often to resistance. The proposed information system is usually the target of this resistance, mostly as a reflection for the resistance against change in the current cooperation practice.

In the following chapter the application of PIS in a collaborative spatial planning process will be demonstrated through the case study of the project "Sustainable Regional Settlement Management" (RESIM). This project was conducted 2003-2005 in Stuttgart Region in Germany. After an introduction of to the application of planning information systems to explore the planning problem, the subject of soft-factors will be discussed.

3 THE CASE STUDY OF "SUSTAINABLE REGIONAL SETTLEMENT MANAGEMENT" IN STUTTGART REGION (RESIM)

In Stuttgart Region one of the key challenges for regional planning is to manage intra-regional migration and to avoid uncoordinated land use on the green fields as a result of the demand for low-priced land for settlement development on the municipal level and the inter-municipal competition on attracting inhabitants and work places. To face this challenge, the regional plan of Stuttgart Region applies quantitative management to solve this problem which includes approaches to guarantee an efficient and sustainable land use. However, the demographic trends and the resulting shrinking process, which was delayed by the economical prosperity, will start sooner or later in certain parts of the region. To meet some precautions for mitigating the negative impacts of this foreseeable perspective, the strategy of inner development combined with defining focus areas for settlement and the cooperation between the municipalities in the region can play an important role in this context. The experiences on the municipal level have shown that without a regional strategy the success of their efforts soon reaches its limits.

The decision to follow a certain strategy needs an overview on the status of the relevant area. As such an overview is often missing on the municipal level, getting the overview on the more complex regional level is even more complex. Nevertheless this regional overview is essential to compare urban growth with the inner development possibilities and to concentrate actions and investments in social and technical infrastructure where they are most efficient. Getting such an overview requires bundling many separate pieces of information from many sources, especially from the municipal planners (or the mayor in smaller municipalities).

3.1 Tasks of the project RESIM

Aiming at setting a strategy that promotes sustainable development in Stuttgart Region, the Project RESIM had the following tasks:

a. Getting an overview about inner development potentials:
  Development of an enquiry-method for the regional level.
  Enquire settlement potentials.
  Development of a web-based overview about the potentials.
b. Exploring the tools and instruments that support this strategy
  Exploration of innovative tools and instruments for implementing "inner development".
  Adaptation of these tools according to the specific requirements of Stuttgart Region.
c. Setting a strategy for Stuttgart Region
  Using the overview on inner development potentials and the available tools and instruments a strategy should be develop.
  Identification of focus areas for inner development and areas for pilot studies.

3.2 Application of PIS in RESIM: getting the overview

The backbone of this project is the overview on settlement growth potentials represents. This overview covers both "yet unrealized urban growth" as well as "inner development potentials". To establish this overview, an internet-based PIS was developed. In this system the following basic criteria were essential:

- Different overview-levels: municipality, region and public.
- Different levels of abstraction e.g. the regional overview is limited to basic-information
- Open system: to allow import and export of information with existing GIS, CAD, Office and database software
- Stand-alone system without specific programs.
- Online-input of spatial information

This PIS made the collaborative work of the many participants (179 municipalities) possible. However, for inquiring these potentials a communicative approach was adopted in the form of on-site interviews either with one municipality or with a group of neighboring municipalities. During this phase, interviews with about 80 municipal planners were conducted in several cycles. After a pilot phase (March 2004) with 4 municipalities, the second phase (April 2004) covered 20-25 municipalities. Further parts of the region were completed in a third cycle (till October 2004). During the project approximately 1000 areas with a total of 2000 hectares were identified as inner development potentials and up to 5000 hectares were identified as vacant urban growth potentials that are permitted in the current land use plans (*more information about the project's results in Elgendy, Seidemann & Wilske 2004*). This approach allowed the direct communication of the project idea to the municipal planners or mayors. Meanwhile through the direct dialogue it was possible to name development potentials in a communicative manner. During these interviews, the system was used on portable machines (laptops) to input the information.

Organizing the process in more than one cycle and in an integrated manner with the development of the PIS has allowed the implementation of the experience and feedback that are gained during the interviews. Further, the structure of the proposed information system allowed the decentralized administration of the information. The responsibility for checking the municipal information and keeping this information up-to-date were the sole task of the municipalities. Officials of each municipality have limited access to administrate the information of their municipality.

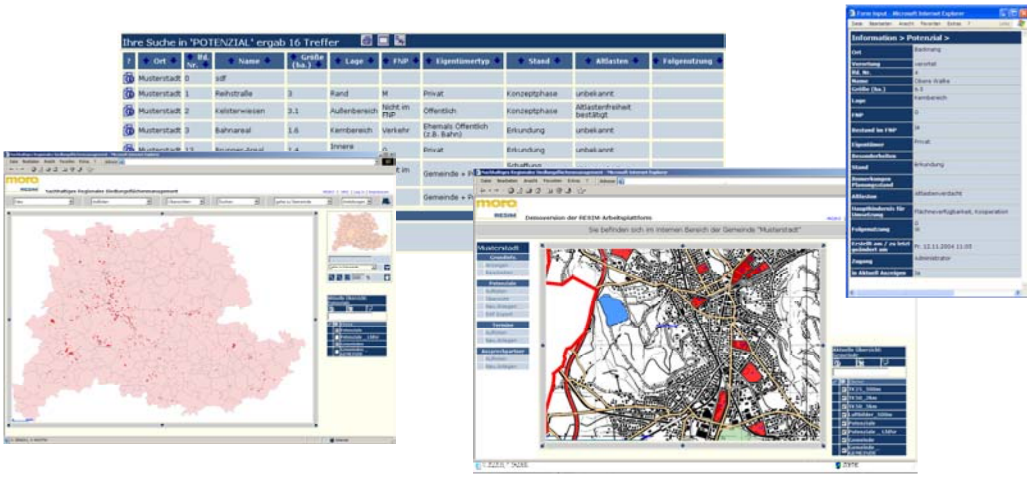


Fig. 2: Screenshots of the information platform of the project RESIM

3.3 Results of the project RESIM

a. Regional strategy: Based on the above-mentioned overview and through the assessment of the situation the main components of the regional strategy for promoting inner development in the region of Stuttgart were identified. The region should follow an active settlement land management policy and implement it in cooperative manner. Meanwhile, the regional association should differentiate among the different situations in the sub regions.

Active: this aspect implies that the regional planning association as the responsible authority for regional planning should consider inner development as a main component of the regional land management strategy. Further it implies that conflicts and problems that are connected to the implementation of this strategy should be actively clarified with the municipality.

Cooperative: The regional planning association can facilitate experience exchange among the municipalities. In addition, specific problems of inner development could only be clarified and solved in cooperation among several municipalities. These two aspects represent the cooperative dimension of this strategy. This cooperation takes place between the regional planning association and the municipalities on one hand, and among different groups of municipalities on the other hand.

Differentiated: The situation in the region is not homogeneous. Different circumstances and development perspectives govern the development in different sub-regions. Hence, the regional planning association should identify the focus tasks in each of these sub-regions to reach success in implementing the strategy.

b. Action program: The implementation of this strategy is based on an action program of three main issues:

Establishing a regional competence centre on sustainable land management as a platform for experience and knowledge exchange among the municipalities and the regional association.

A program for promoting inter-municipal cooperation in settlement management and inner development.

A funding program for inner development conception both on the municipal and inter-municipal level.

In addition to these three components the following formal instruments should be applied: land budgets; balance of land consumption during the planning processes and monitoring of the land consumption.

c. Transferable results: While the recommendations for the action program is justified for the specific situation in the sub-regions of Stuttgart, the experience in establishing a regional overview on settlement development potentials in inner parts and outskirts of cities could be implemented in other regions. The applied methodology and the process organization allow other regions to achieve such a regional overview with limited resources. Further, the tight connection between exploring the problem, establishing the PIS and producing the overview in cooperation with the municipalities on one hand and developing the strategy on the other hand represents an important experience. Regional settlement land management represents a mean to face the challenge of the increasing competence among the municipalities on limited resources in a closely networked space. Through this project it was possible to achieve, the technical, organizational and methodological requirements for emerging from municipal settlement land management to a regional settlement land management. In the following section main emphasis is given to the role and impacts of soft-factors in the project.

4 SOFT-FACTORS: TYPES AND IMPACTS

Each of the above-mentioned three groups of soft-factors - i.e. problem-orientated, system-orientated and human factors - was apparent in the project RESIM. In each of these groups several factors, which have played an important role in all dimensions of this project, could be identified. Discussing and handling these factors played a major role in the success of such a process. Some of these factors that were observed in this process will be discussed in this section.

4.1 Problem-oriented factors

The first dimension of soft-factors implies how different actors view the subject of the project. This dimension emerges from the different planning approaches or the planning cultures of different organizations and actors. It influences perception of the problem; design of the planning process and the way how to find a solution.

In general, three types of tasks should be distinguished: Routine tasks, project tasks and focus or focal point tasks. Each of these tasks has specific features and requires specific organization of the process and responsibilities as illustrated in the following comparison. In each type of tasks, the application of information systems should be corresponding to the problem's type and to the organization of the process. Especially in focus tasks that are needed to deal with ill-structured planning spatial problems, the applied system should also support connecting the participating actors, facilitating information processing and communication according the process organization. These dimensions must be clearly discussed and clarified at the beginning and during the process to get a common consensus among the participating actors. Meanwhile the system should be flexible to adopt the developments and changes that might occur during the process. From a different point of view, this flexibility is a demonstration of openness for all participating actors.

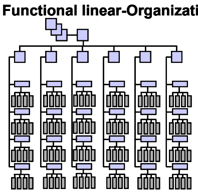
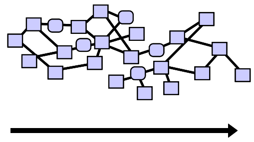
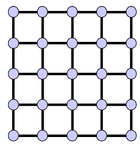
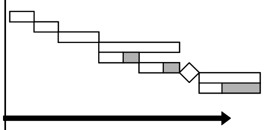
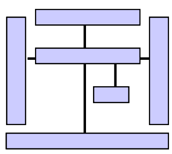
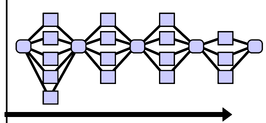
Type of Tasks	Features	Organizational structure	Process organization
Routine task i.e. issuing building permit	•The problem is known •The process is known •Results / solution are known •Continuous routines •Predefined subjects •Predefined actors	**Functional linear-Organization**  **permanent**	**Routines** 
Project Task i.e. realizing a development project	•The problem is known •The process, for the most part, is known (phases) •Target / solution are known •The process includes some routines •Subjects, for the most part, are known •Actors, for the most part, are known	**Matrix-Organization**  **Exists till a project ends**	**Phases** 
Focus tasks i.e. clarification and solving tasks related to inner development of existing settlements	•The problem is not defined •The process is undetermined •Target / solution are undefined • Few routines • Subjects, for the most part, are unknown • Many undetermined actors	**Ad-Hoc-Organization**  **Temporally limited**	**Rhythm** 

Table 3: Typology of tasks (Modified and translated after Scholl 1995)

In the Project RESIM, these different perceptions of how the planning process should be organized were evident. Two main planning approaches could be distinguished among the participating actors. The first one is the linear proceeding following the rational schema: data collection, analysis, and synthesis of solutions and development of concepts. In several situations, the presumption was expressed the project RESIM will follow this planning approach. Different actors have indicated that following this approach has only resulted in unsatisfactory results. The second approach is an iterative one that follows different cycles. Promptly at the beginning of the process an overview is established. Then based on this overview, the main issues are defined that should be the focus of the process and where the main effort should be devoted. Only then major solution directions can be developed. Consequently, in the next cycle the aim is to prove which solution is plausible. Therefore, specific information that is missing could be purposefully obtained and open questions could be explored.

In many interviews during the project, the discussions were not only limited to investigating information about inner development potentials, but they also covered these different planning approaches. It was important to make clearly and to demonstrate that the PIS is not only used for collecting information but mainly as a supporting instrument for the iterative planning process. This was clearly demonstrated for example by the openness to integrate new objects promptly when several actors showed their importance for the project. E.g. several municipalities indicated that they find it reasonable to include beside the inner development potentials also areas where major urban restructuring is needed or increasing the built up density on the building level is possible as a new category or as a new class of objects in the PIS. This new class of objects was integrated directly. Although it became aware in the further interviews that in these situations additional actions from the regional planning are not necessary in this way it was possible to respond to the different as well as to the evolving problem perceptions during the process.

4.2 System-oriented factors

The above-mentioned planning theoretical aspects, which result from cooperation among actors from different disciplines and from different administrative unites either in the same organization or among different organizations taking part in a process beyond existing organizational borders, affect how these actors observe the problem, define how the process should be organized and how a solution could be found. Furthermore, these differences influence directly the discussion about the needed system. Three points are identified in this context and discussed hereafter: goal of the system, content of the system and access rights to the information.

Goal of the system: In many cases of PIS development, although the general goal might be clear at beginning of the process., the participating actors show limited interest in an in-depth discussion of the system objectives – e.g. what the system is and what is it not - This is a usual practice under pressure of the need for quick results and the ambiguity of the problem. However, as different actors have different viewpoints to the objectives of the system, these differences might appear during the system implementation, when each actor tries to carry out his viewpoint in the form of different - some time contradicting - requirements. In the contrary, an attempt to define in details all the functions and objectives of the system is not a proper mean for this type of problems. The system development should be closely connected to the problem clarification process. Therefore, an open discussion about the general goal and main objective of the system should be conducted at the beginning of the process. These aspects should be also clarified for any new participant who joins the process in a later phase. Further, a systematic periodical discussion should also take place to check if the defined system' objectives are leading to improve the problem solving process or does the system needs additional work.

It is important to mention here that if the users' knowledge of computer and software is good, then their capability of communicating their requirements and comments better. They can also estimate the effort that is needed to realize a specific proposal or requirement. Hence it is important for the process to have participants who have both technical as well as planning experience.

Content of the system: In the classical planning approach, it is normal at the start of an information system development process to implement a comprehensive information modeling process among the participating actors to cover all information that might be needed for the problem solving. This coordination normally takes place on the executive level. Then an information expert or a company starts the development in the so called "water fall" approach. In the modern information systems development approach an early integration of the end-use is considered as a solution to avoid this situation.

A special characteristic of planning processes is the necessity of dealing with a large number of subjects simultaneously. Consequently for producing the overview many objects should be included. However, another characteristic of planning processes is that through the process it is usually found out that only a small number of these objects are significant for the problem solving. During the development process of PIS main emphasis should be given to these objects and if needed more detailed attributes. Hence, information in PIS should be organized hierarchal, so that at the beginning of the process only abstract or core information are collected and when needed more detailed information could be added for those objects that are proved to be important for clarifying the situation. By starting with a very limited effort, planners could be motivated to cooperate. A further possibility to minimize the start effort could be reached be using the same approach with the functions, by starting with a core set of essential functions. In contrast to GIS, these systems should be mainly tailored for the specific task.

In collaborative planning processes where actors from different disciplines, different planning levels and different planning cultures are participating in a process dealing with an ill-structure problem, different and imperfect information requirements represents the normal case. If the traditional approach of a comprehensive information modeling is used, the amount of information will remarkable increase and the attribute list to cover all possible requirements during the system application will be very detailed. In later phases it is usually realized that there are very limited attributes that are needed for all records (the overview) and only in few cases there will be a need for further information (focal points). Consequently a lot of information is not added or at least not actualized.

Further more, the problem understanding evolves during the problem solving process. Hence, new information objects might be needed or new attributes might be essential for existing classes of objects. This fact should be discussed and agreed upon early in the development process, so that the main concentration is given to define the core information that are expected to improve clarifying the problem or contribute to solve it. Therefore, the system should be designed in a way that allows adding new classes of objects or new attributes for existing classes without major changes in the system. Keeping the actuality of information in PIS requires a high level of responsibility consciousness and a large engagement from the participating actors. The motivation for updating the information can be promoted by facilitating some direct benefit for the own work of each actor. Hence, in the development process most of the participating actors should have the possibility to be involved in the process. The development process should not be a work for only programmers and IT experts. In addition specific areas and functions could be added in the PIS to support the specific interests of some actors beside the functions that are needed for the common main goal. In the project RESIM was the detailed level of information of the potentials not of interest for the regional level, however it was useful for the municipalities.

Access rights: In collaborative planning information systems, the problem of sharing and exchanging information usually represents an obstacle against efficient cooperation. The reason for this problem is often the lack of interest or the unwillingness, to hand over control over the information and its usage. It is evident that in many organizations that the control of information is frequently observed as a source of power. This problem is not new and is not only limited to the application of PIS - e.g. works like "The bureaucratic phenomenon." (Crozier 1964). As PIS is mainly aimed at improving the exchange and communication in complex planning situations, hence, the development and implementation of a system should include beside the technical aspects also a course of action that promote the willingness to exchange the needed information among the participating actors. The following three aspects are considered significant in this context. Firstly, the proposed PIS should concentrate on basic and core information that is needed to deal with the planning problem. Secondly, before exchanging information, there should be a possibility for discussing how information will be used an agreement about which actors are allowed to see which pieces of information.

In the case of RESIM, it was agreed among the participating actors that the regional planning association can only get access to a specific part of information about the municipal potentials. In addition, planners from the regional planning association have no access-right to add or to edit inner development potentials of any municipality. The responsibility here is completely exclusive for the municipality. Also each municipality can define whether specific potentials should be only kept for internal use. Meanwhile it can define if other municipalities could access its specific information. In other words, each municipality can define if its potentials or specific attributes should only be kept for internal use, which gives the municipality the chance to administrate and to have full control over its information, while giving the regional planning association the possibility to get the regional overview.

In general, the following aspects should be considered in developing and implementing PIS to reduce the impacts of soft-factors:

Barriers against using the PIS should be minimized as far as possible to avoid discouraging interested actors just because of the system. On the other hand those who are not interested should not find an easy argument to refuse the cooperation.

A contact group or person should be support users who face problems or enquiries about technical or planning issues.

Training for interested users should be offered accompanying the planning and system development processes. These training possibilities could be also used for clarifying content questions as well as technical questions.

4.3 Human factors

The third group of soft-factors results from the human interaction within the process and with the system on one hand and among individuals and organization on the other hand. This group of factors can be demonstrated by the following aspects:

Resistance to change and self protection: Facing new innovations such as the introduction of new information systems many planners show skepticism even if these information systems are supposed to improve communication and exchange of information among participating actors in a planning process. Loeb (1989) argues that this is not the fear that machines will replace people that grew in the 40s and 50s in response to the introduction of mainframe computers. Nor is it the fear that we personally will have to learn something new. The fear lies much deeper: new technologies offer options to change the very nature of how we do our jobs and we don’t have the slightest idea what these new ways of doing work are all about. In this case, some concerned actors may regard PIS as a way to break up conventional structures and practices to introduce new ones that aim at improving cooperation and collaborative work. It is also observed that if some actors have stipulations against the cooperation or about the sense of the planning – expressed in sentences like „It will not work anyway”; “I don’t have any information!”, “this will not solve the problem!” or in the case of RESIM “in our municipality, there are no potentials over 5000 sq.m!”- can lead to rejection and refusal of the proposed PIS, although they might have actually nothing to do with the system itself. In this situation, it should be examined if the refusal or the rejection is a result of shortcomings in the PIS, then these shortcomings as expressed in users’ comments and suggestions should be considered. But if the refusal or the rejection is a result of the lack of interest for cooperation or exchanging of information, then counter-arguments should be discussed in the framework of the planning process. Though it is essential to avoid any weakness in the PIS that can be used as an argument for rejection, such a situation could only be handled if the development process of PIS and the planning process are paired together in a way that allows discussing such aspects in an appropriate environment.

Achieving foundations for cooperation (common language and commitment): It is evident from experiences in different planning processes that achieving a common language and confidence among the participating actors is essential. Consequently, process-components that grant occasions for building common understanding and common confidence should be integrated in planning processes, especially in planning processes that deal with complex planning situations. Such process components should be also integrated in the development process of PIS. Furthermore, a third level is important, namely those process-components that allow connecting the spatial planning process and the PIS development process should be also integrated.

In this process, conflicts among participating actors should not be ignored, the thing that may cause fear that information could be used from higher planning levels or competitors. In such a process as in RESIM, the lack of willingness to disclose and circulate information results from the lack of confidence that the regional planning authority will not use this information as an argument against municipal plans e.g. getting approval for urban growth on green fields. An important argument to explain why conflicts should be externalized during the process is that existing conflicts will arise anyway, but if they are discussed on the basis of objective information, the chance for the conflict solution is much larger. In addition, it should be clearly discussed about how to deal with sensitive information. This was the reason that in every interview during the project a contact person from the regional planning accompanied the interview team. Hence, in the project RESIM, on-site interviews were used for clarification of stipulations and critique points on one hand and on other hand discussing enhancement proposals that concern both the planning process and the development process of PIS. These interviews have represented the above mentioned third level. These interviews took place in small groups usually 4 to 5 persons - and maximum of 10-15 persons, the size that allowed an open atmosphere for discussion and free alternation among the different discussion levels. The success of this type of discussions has a basic pre-condition, namely that in these interviews specialists are participating who are capable in the development of PIS as well as in the planning process in addition to representative from the regional planning association. Further, the specific planning information was used as occasions to deal with both of basic and specific issues, methodological and organizational as well as theoretical and practical issues.

Dealing as counterparts: Information that is collected by a central office is usually neither complete nor totally up-to-date. In spatial planning this phenomenon is more evident on higher planning levels where knowledge about local conditions is missing. In this case significant information can not be found out by the plain observation. If in spite of this fact, information is added centrally - e.g. the regional planning authority add information for all municipalities- this might force the concerned municipal planners to start searching for errors, inconsistencies or obsolete information to give evidence in advance for any conflict that might arise later. In addition, any decisions that are based on this information are put in question. To avoid this conflict, centralization of responsibilities should be avoided. Rather full responsibility over information should be given to the corresponding actors each in his spatial or functional field as described above. Herewith, the central authority has a limited control on the comprehensiveness and the actuality of the information. The intensity how often the information is actualized depends mainly on the individual actors. The probable unbalance in the information could not be avoided under these circumstances. However the above-mentioned disadvantages of a central control will influence the results negatively more than a guided decentralized responsibility. Decisions that are based on this information are considered robust as the major critique points are dismissed through decentralization. But as the participants are responsible for the content of the information system, each in his filed, a higher level of commitment among them could be reached.

Herewith, a large step is done in increasing commitment for the results of the process that are based on this information system. This self commitment gets higher importance if the process implies a high level of cooperation beyond formal and administrative responsibility fields and other informal process and instruments are used.

Another possibility to avoid this conflict is starting the dialog with the participants without performing pre-judgment from the higher planning level on municipal aspects. In the project RESIM, although an analysis of aerial photos was conducted in an early phase in the project, it was not used as a start point for the on-site interviews. Using unverified information with a high risk of error as a base for discussion might create an obstacle against cooperation. The used approach was to use plain municipal maps and in the course of the discussion to find out together where are the potentials. Instead of loosing a lot of effort in discussion about the errors in the aerial photos analysis it was made accessible for the municipal planners after the interviews to check it for consistency.

Dealing with uncertain information: In complex planning situations important information are often not available or only available as unconfirmed information such as speculations and rumors– e.g. "*when will project X that has financial problems start?*", "*if company Y that owns several hectares of land in city C will change its production location?*" or general statements like *"We discussed this area for a long time. We did also a development study for the area but the owner does not accept any action by the municipality", "Do you think it is a potential even if there is no realistic chance for a development now?"* or "*This area is a potential but the company is still working and any discussion about the problems they have might cause problems!"*

It is evident that stipulations are larger to input unverified or imprecise information into an information system, even if this information is significant for clarifying the planning situation. Adding such information causes unease and can only be decided upon difficultly. As there is no general rule for dealing with type of information, it should be evaluated on case-to-case basis. Even if no general rules can be defined, two measures can help in overcoming this situation:

- The process for getting the overview should take the form of a dialogue. In this dialogue decisions about an individual case of uncertain information can be made. Decisions in such a case can be supported if external experts are participating in this process. (E.g. should a specific area be considered as an inner development potential? In many situations this is a case-to-case decision). This approach emphasizes that establishing the overview should consider the specific characteristics of each case.
- The decision and interpretation responsibilities are exclusively reserved for those who deliver the information, e.g. each municipality has the absolute autonomy to decide which potentials and which information could be included in the system.

5 CONCLUSIONS

1. With the case study of the project RESIM we demonstrated some important soft-factors that influenced the development and implementation of PIS and how to deal with them. An essential element is the pairing between the development process of PIS and the planning process. Through such a pairing between both processes, it is possible to create diverse occasions to clarify any subject or conflict that might arise in an appropriate context. It is not possible to plan or to predict which subject or question might arise in which occasion. It also important to make pairing between both aspects on the personnel level so that a contact group or at least a contact person is always available to improve the possibility to response to any question and to promote willingness to cooperate. This can be only achieved in direct contact and dialogue. This dialogue should not only be limited to general and superficial subjects. It should also give opportunity for dealing with conflicts. Only if these conflicts are discussed on a faire basis, a proper atmosphere is reached in which a PIS could be successful. If the development process of PIS is designed as mentioned here, the system can reach further impacts beyond the primary functions to evolve into a catalyst for improving the cooperation among the participating actors.

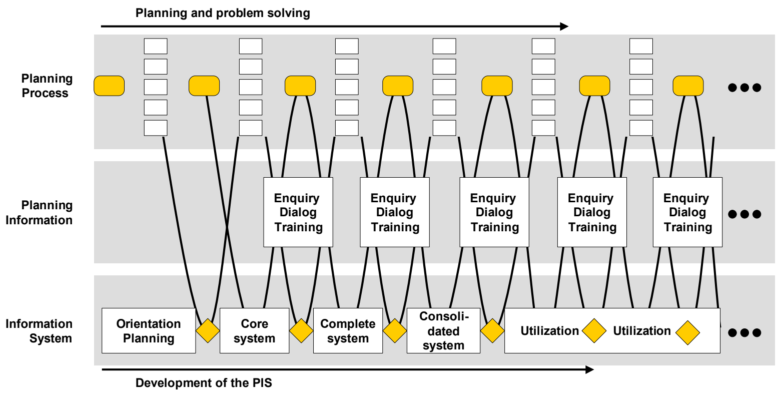


Fig. 3: Pairing between the planning process and the system development process

2. In the development process of PIS a very high level of flexibility must be considered to adapt modifications in user interface, functions, information definitions and rules scheme. Although modifications might cause methodical disadvantages (e.g. inconsistencies) it opens enormous chance for PIS implementation in a way that does not hinder the planning process but supports it not only in the primary tasks of PIS – e.g. establishing the overview, exchanging of information and supporting communication – but also regarding the development a common problem perception, confidence, commitment etc. If these criteria are considered in the development of PIS it opens large possibilities for dealing with soft factors. This does not only increase the quality of the PIS but it also enhances the chances for a successful implementation of PIS in the planning process.

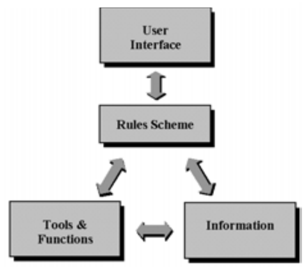


Fig. 4: General structure of a PIS

3. Different technical, operative and communicative measures can be considered in the

development process of the PIS as well as in the design of the planning process not only to minimize the negative impacts of soft-factors can be minimized but also to maximize their positive impacts. The following table concludes these measures.

Soft Factor		Planning process	Development process of PIS
Problem-oriented	Planning theoretical / planning culture	- Systematic assessment of the situation to control the goals and to find common consents about further proceeding - Opportunities for discussing the planning approach or the planning culture	- Contact group for questions about the process and the planning approach in the in the team - Openness for including further components in the process and the system.
System-oriented	Goal of the system	- Systematic assessment of the situation to control the goals and to find common consents about further proceeding	- Creating occasions for using the system so as to get feedback from most of the participating actors
	Content of the system	- Systematic assessment of the situation - Working in several levels of details to control the constancy"	- New object classes should be easily added. - Flexible definitions of the attributes to adapt to new requirements. - Integrate self interest for all actors (Win-Win)
	Access rights	- Clarification of the organizational structure - Openness to include new participants during the process:	- Flexible rules scheme for the access rights (subjects, spatial, functional)
Human factors	Resistance to change and self protection	- Open Process - External participants - Create occasions - Training	- Minimizing effort (start and maintenance) - Add comments and critique about the PIS - Transferring conflicts to the planning process if they are not resulting from the PIS - Simplicity (main functions and core information) - Customized solutions
	Achieving foundations for cooperation (common language, commitment and control)	- Open Process - Iterative proceeding - On-site contact - Differentiated roles - Discussing open questions and conflicts - Concerns of participating actors	- Combining technical and content questions in start meetings and in on-site interviews - Rules scheme for the responsibilities - Decentralize responsibilities for the information - Avoiding pre-judgment for higher planning levels - Decision autonomy is exclusive for the actor who delivers the information.
	Dealing with uncertain information	- Working in several cycles with increasing level of precession	- Unconfirmed but relevant information could be included. - Dialog with external experts - Limited number of attributes

Table 4: Conclusion of soft factors in PIS

6 REFERENCES

Baltzer, Jan (1991) "People and Process: Managing the Human Side of Information Technology Application", Professional Paper Series, #7. The Association for the Management of Information Technology in Higher Education.

Crozier M. (1964) "The bureaucratic phenomenon", Univ. of Chicago Press, Chicago.

Elgendy, Hany (2003), "Development and Implementation of Planning Information Systems in collaborative spatial planning processes", Karlsruhe.

Elgendy, H.; Seidemann, D.; Wilske S. (2004), New challenges for city and regional planning: inner development of cities and regions for promoting sustainable development. In: ISoCaRP 40th International Congress: "Management of Urban Regions"

Kunda D, and Brooks L. (2000) "Identifying and Classifying Processes (traditional and soft-factors) that Support COTS Component Selection: A Case Study", in Proceedings of ECIS 2000, Vienna University of Economics and Business Administration, Vol. 1.

Kirkpatrick, Donald L. (1985), "How to Manage Change Effectively: Approaches, Methods, and Case Examples" The Jossey-Bass Management Series)

Looeb, Robert E. (1989), "Technology is not the answer", NY: Telecommunications cooperative network

Marks, Dan (2002), "Development Methodologies Compared: Why different projects require different development methodologies", (http://www.ncycles.com/)

Maurer, Jakob (1993), „Über Methodik der Raumplanung" In: Strohschneider & von der Weth (eds.) 1993

"Nachhaltiges regionales Siedlungsflächenmanagement in der Region Stuttgart, MORO-RESIM" research project 2003-2005 (http://www.isl-projekte.uni-karlsruhe.de/moro)

Rey, Dani (2004), "Project Soft-factor Check Up (PSF Check Up)", http://www.danirey.ch/psf_checkup/PSF_Check_Up_Doku.pdf

Rittel, Horst (1982) "Structure and usefulness of planning information systems" In: Laconte, Gibson& Rapoport (ed) Human and Energy Factors in Urban Planning: a systems approach, proceedings of the NATO Advanced Study Institute on " Factors Influencing Urban Design " Louvain-la-Neuve, Belgium, 1979.

Schelin, Shannon H. "Managing the Human Side of Information Technology: A Public-Private Comparison of Chief Information Officers" North Carolina State University

Scholl, B. (1995), „Aktion Planung zur Behandlung komplexer Schwerpunktaufgaben in der Raumplanung". ETH - Zürich.

Extracting and Maintaining Geo-Referenced Data during the Application Processing

Joze SENEGACNIK

(Permanent associate of S&T Hermes-Plus d.d., Slovenia, e-mail: joze.senegacnik@snt.si)

1 ABSTRACT

A lot of governmental offices process every day customer requests for obtaining different kinds of permissions, certificates and other kinds of legal documents. The majority of data collected and used in these documents could be geo-referenced and combined together with other geo-referenced data. Such combined information layers are excellent data sources for a variety of analysis used either for operational purposes or strategic planning. A particular case of processing the applications for the water usage permission will be our polygon to observe the extraction of this important information level from business.

2 THE STUDY CASE

Ministry for Environment and Spatial Planning, The Environmental Agency of the Republic of Slovenia is in charge issuing the permissions for water usage. S&T Hermes-Plus developed an IT solution to automate and support this process. On the Figure 1 we can see the top level process decomposition of the process for application handling.

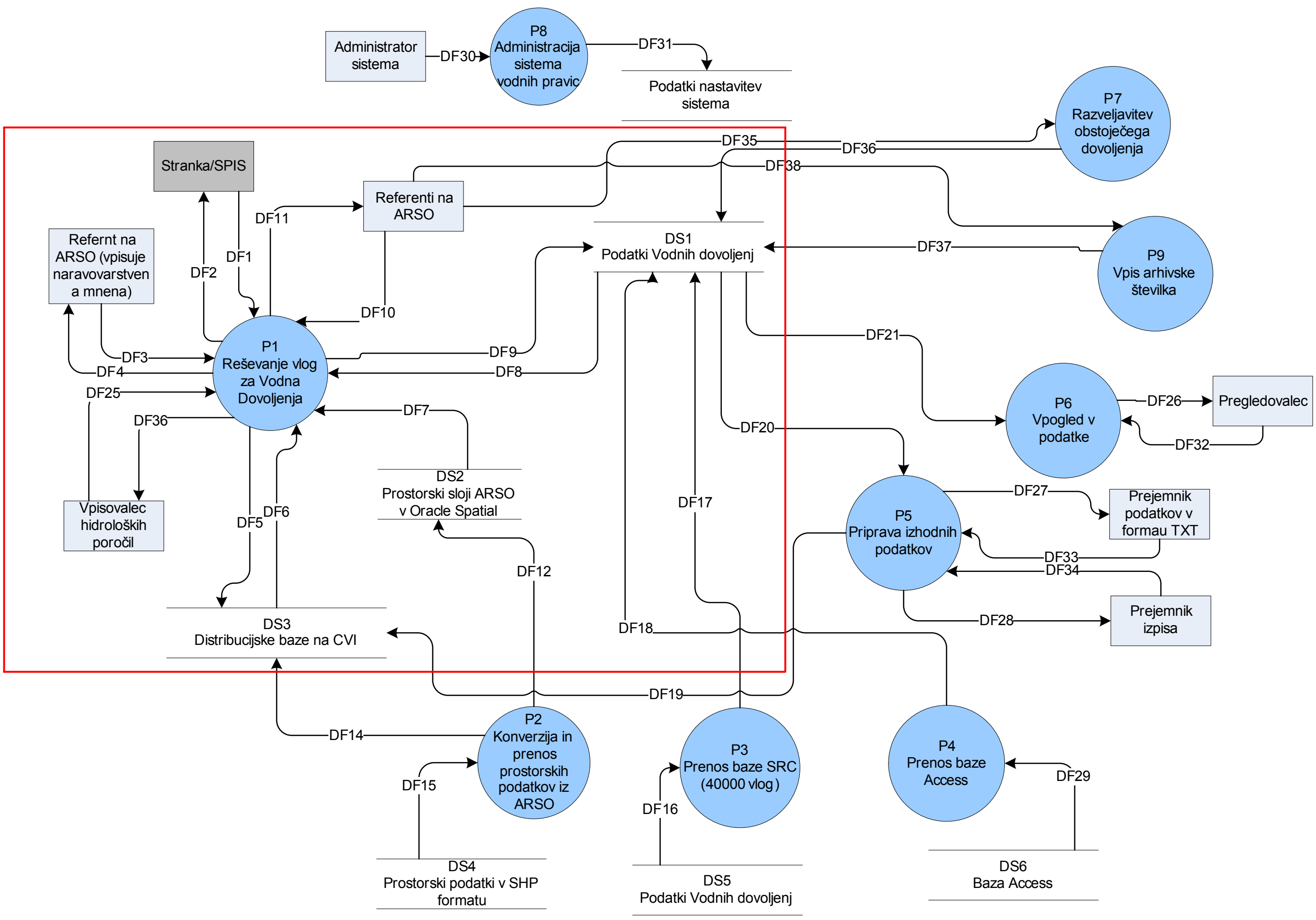


Figure1: External actors, data stores, data flows and processes

The process P1 (on the left part of the Figure 1 enclosed with the red rectangle) is the process of our interest. The purpose of this process is handling of the applications and issuing the permission for water usage. The P1 process, named "Handling of applications for water usage", contains the following data flows:

DF1 – The paper application send by the requestor together with necessary data that form a file

DF2 – The permission issued

DF11/DF10 – Interaction of the clerk working on the application

DF8/DF9 – Data produced while handling the application together with the data from the application

D4F – Data from the environmental report

DF3 – Environmental report

DF5 – Spatial data (geo-referenced), produced as result of handling of the application stored in the distribution databases

DF6 – Existing spatial data required for proper application handling

DF7 – Existing spatial data of Environmental Agency stored in Oracle Spatial

DF25/DF36 – interaction required to capture the data from hydrological report

The further decomposition of the P1 process can be observed on Figure 2.

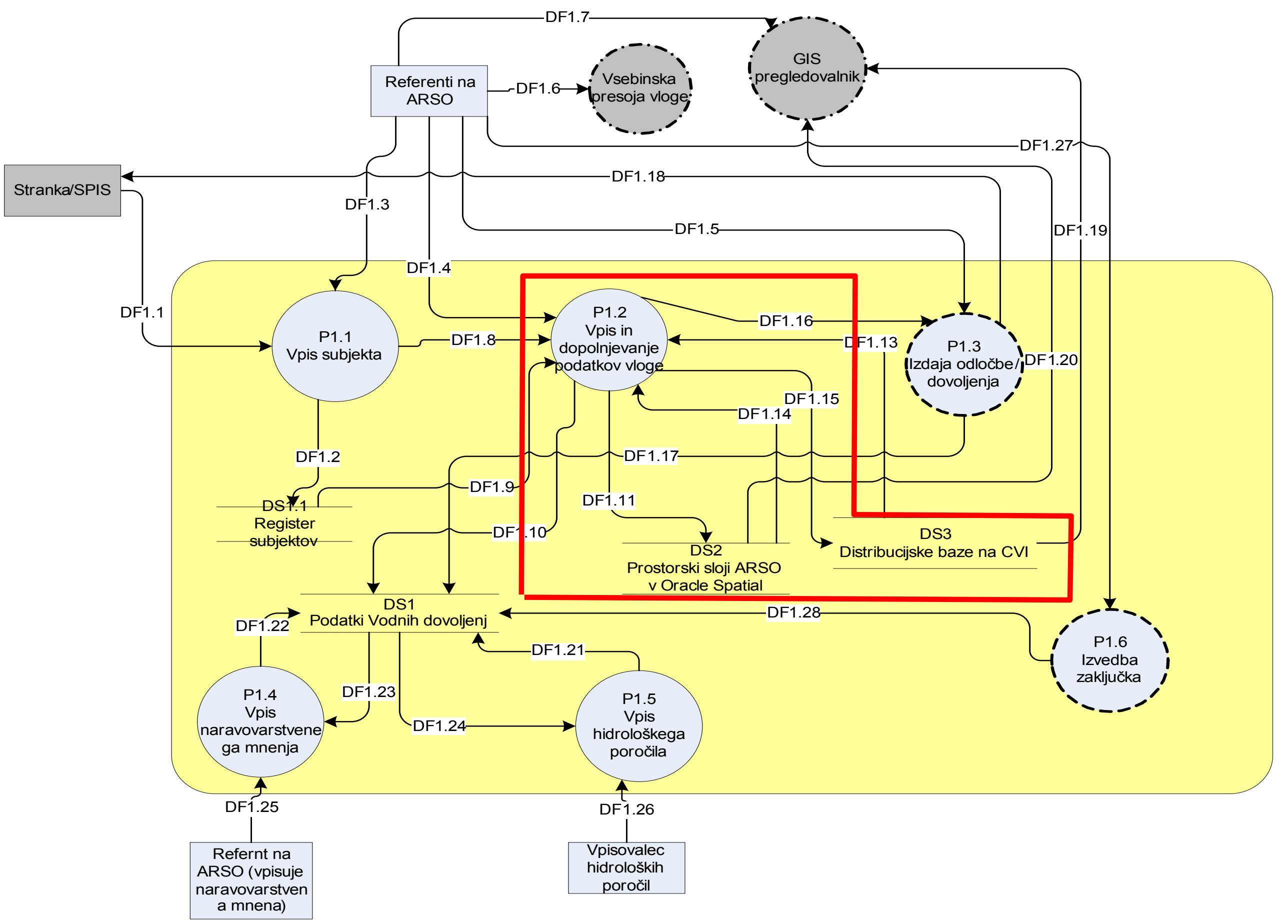


Figure2: Process P1 detailed decomposition

During the starting phase of this process the data from the application is entered into the system and later on if some of the data is missing, the required data is added. Thus in the final phase all the required data is present in the system and the permission for water usage can be generated.

- DF1.4 – Clerk's interaction
- DF1.9 – Customer data
- DF1.10 – Data from the application and data from the water usage permission
- DF1.11 – Spatial (Geo-referenced data) that form a special layer
- DF1.14 – Spatial data of the granted permissions for water usage
- DF1.15 – Spatial data that is extracted to the dissemination database
- DF1.13 – Spatial data from different sources that are used as reference data during the application processing

The process of data entry is controlled by different controls that were defined in the form of business rules. Some of the controls are executed during the data entry operation, but majority of them is executed at the end when the user presses the save button. The goal is to capture all the data from the application which may be even wrong. If the business rule is not broken no message is reported. For all broken rules the data entry module prints out the identification of the broken business rule and the error description. Then the user has to make an appropriate correction in order to clear the data entry errors immediately or later whne the correct data is acquired.

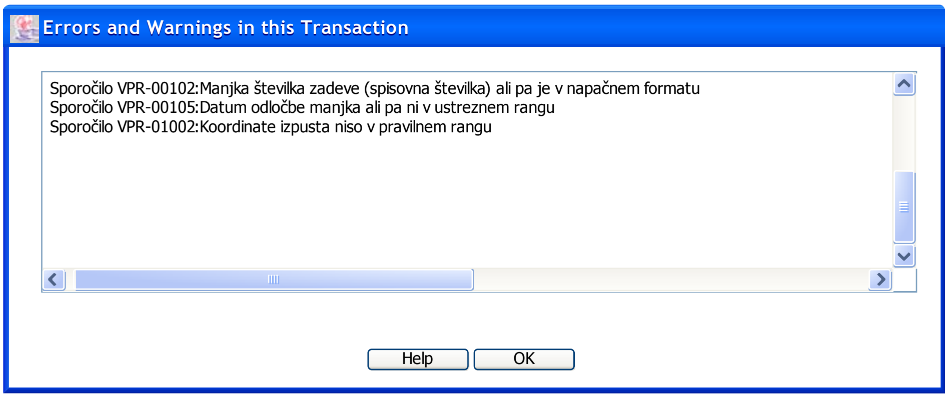


Figure 3: Broken Business Rules Report

There are different types of permissions for water usage and according to the type of the permission the customer must select the right form.

3 SPATIAL DATA ENTRY

To maximize the opportunity for future spatial queries the software solution determines the relationship with the spatial data layers for the place of water abstraction and water outflow. The result of this determination is the name of the element (data layer) where the water is abstracted (where water is physically moved from its natural site of occurrence) and the place of the outflow.

The relationships for water abstraction place and for the potential outflow are determined during this process and saved in the database. The data stored in the database is like the following:

MAP_ID	ABSTR_OUTFLOW	WATER_SOURCE	SPATIAL LAYER	OBJECT_NAME
12	Z	LJUBLJANICA	DKN	15/0
1244	Z	LJUBLJANICA	NASELJE	ZALOG
134	Z	LJUBLJANICA	OBCINA	LJUBLJANA
22	Z	LJUBLJANICA	HIDROOBM	LJUBLJANICA
7765	Z	LJUBLJANICA	DKN	15/0
283	Z	LJUBLJANICA	NASELJE	ZALOG
11	Z	LJUBLJANICA	OBCINA	LJUBLJANA
22	Z	LJUBLJANICA	HIDROOBM	SAVA
54	Z	LJUBLJANICA	HIDROPOSTAJE	ZALOG
7727	I	SAVA	DKN	45/1
1245	I	SAVA	NASELJE	PODGRAD
124	I	SAVA	OBCINA	LJUBLJANA
...	...	.....		

Table 1: Spatial Layer Relationship

Table 1 represents a schematic relationship to different spatial layers for a hypothetical case of water usage permission. This permission allows the water abstraction from river Ljubljanica at place called “Zalog” and the outflow is in river “Sava” near the same place called “Podgrad”.

As we can see from the Table 1 a spatial relationship with different data layers is determined when the location of the eater abstraction and outflow is entered in the system. This relationship is later on used for creation of a special query mask which combines the spatial location together with different attribute data.

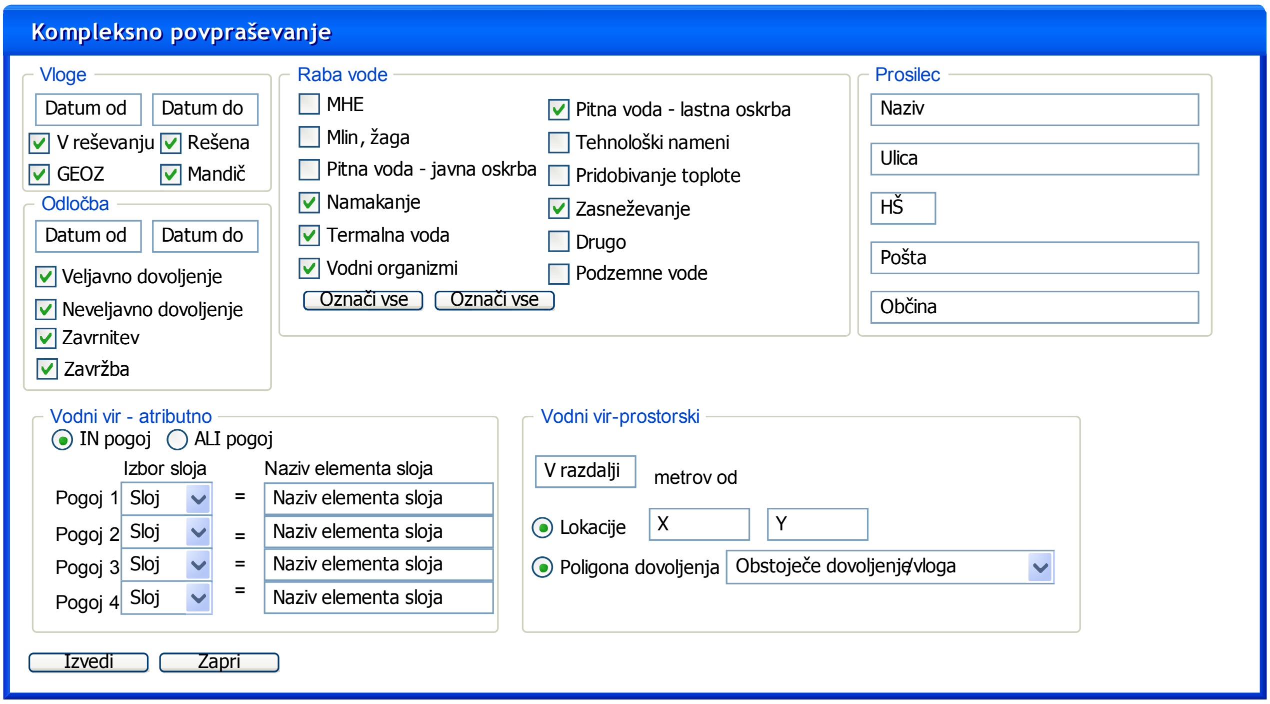


Figure4: Screen mask for entering complex query conditions (combination of attribute and spatial conditions)

The mechanism used for spatial layer determination is using a lookup table of all spatial layers. For each spatial layer we can define a different size of the buffer around the point of water abstraction or outflow. Then the spatial relationship operation is used to determine the interaction of this buffer with the objects in certain layer.

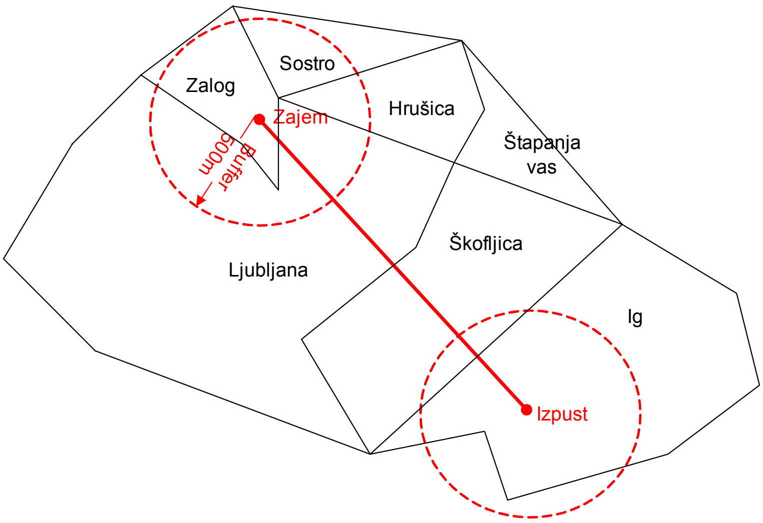


Figure5: Hypothetical spatial layer „settlements“ with buffer size of 500m

In Figure 5 the word “zajem” stands for the place of water abstraction while word “izpust” stands for the water outflow. The spatial determined relationship can be seen in Table 2.

MAP_ID	ABSTR_OUTFLOW	WATER_SOURCE	SPATIAL LAYER	OBJECT_NAME
1244	Z	LJUBLJANICA	NASELJE	LJUBLJANA
1244	Z	LJUBLJANICA	NASELJE	ZALOG
1244	Z	LJUBLJANICA	NASELJE	HRUŠICA
1244	Z	LJUBLJANICA	NASELJE	SOSTRO
1244	I	IŠKA	NASELJE	ŠKOFLJICA
1244	I	IŠKA	NASELJE	IG

Table 2: Spatial relationships for the „Settlements“ layer

A similar spatial relationship is defined for the cadastral layer. In the cadastral layer the water abstraction and outflow place are determined as point objects without any buffer. Thus we get only relationship to one land parcel (sometimes there can be more parcels what depends of the type of the abstraction). Figure 6 displays such a theoretical case.

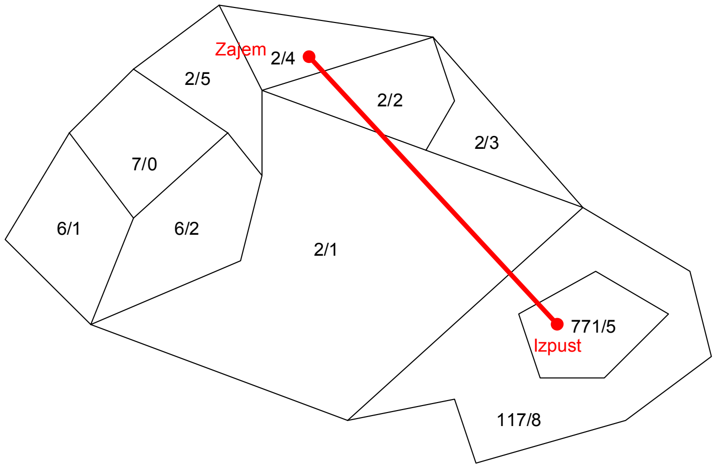


Figure 6: Spatial relationship for cadastral layer

4 CONCLUSION

One can ask the question why the spatial relationship is determined as a relationship that is stored in the database because the relationship could be dynamically determined when necessary. The answer to such question is quite simple and somehow obvious – the reason lies in improved performance and simplified combination of combining attribute and spatial conditions. Of course there is always a possibility to perform a complex spatial analysis to get an answer for very specific questions. Nevertheless, the base data about water abstraction and outflow place are stored in the database and therefore can be used anytime to re-determine the spatial relationship and perform complex analysis as well. The drawback of such solution is that it uses additional space on disks for storing predetermined relationship with predefined conditions (like the buffer size, etc…). On other hand the benefit is highly improved response time for complex queries which doesn't include almost no spatial relationship processing. It is not just the improved response time that is the benefit of this solution but it also requires less capable underlying hardware what means less initial costs.

In the previous paragraph we were discussing only the technical benefits of the solution. We must emphasize as well that this solution integrated the administrative procedure of issuing water usage permission with entering the spatial data in one complex process. When the spatial relationship is determined it is stored in the database and checked against the set of predefined business rules that are defined in the system. In many systems which are GIS-centric the main purpose of the solutions is to maintain spatial data. Such kind of an approach can be very dangerous as it is focused only on GIS functionality and capability of the system. The opposite approach used in this solution is business-process oriented where GIS adds just a "graphical" environment for displaying attribute data and extends the capabilities of the system. The main focus of the system is not GIS-oriented, but an integrated administrative environment that contains all the necessary control functions for processing application requests. The vast conceptual problem in past was that many systems had a wrong focus on extending the system with spatial data and making them GIS-centric what somehow led to separate systems. The capabilities of relational databases to store GIS-data together with attribute data enabled integrated solutions where adding spatial data in the system extends the system functionality. Separation of capturing attribute and GIS data in different processes is never a good solution and leads to sub-optimal support for business processes. Therefore the optimal solution is a highly integrated solution which is focused mainly on support of business process(es). Such solutions improve the productivity and reduce the cost of the administrative tasks.

The potential of accessibility indicators as a tool to measure cohesion effects of transport infrastructure investments

Elena LÓPEZ-SUÁREZ

(TRANSyT, Centro de Investigación del Transporte, Universidad Politécnica de Madrid; E-mail: elopez@caminos.upm.es)

ABSTRACT

Cohesion is considered one of the main policy goals both at EU and national levels. However, there is currently a lack of a common approach to measure cohesion effects of large-scale transport infrastructure investments.

Accessibility indicators have an unexploited potential in transportation assessment methodologies. Accessibility is considered an added value of locations, which represents one of the elements contributing to a region's welfare. Therefore, spatial distribution of accessibility may be used as a proxy to assess regional cohesion.

This paper suggests an approach consisting in measuring changes in the spatial distribution of four different accessibility indicators, computed and mapped using a GIS support. Cohesion is subsequently measured calculating a set of inequality indices of the resulting accessibility distribution. It is possible then to assess whether disparities in regional accessibility are increased or reduced after the implementation of a new transport infrastructure.

This approach is tested assessing regional cohesion effects of road and rail network developments in Spain in the period 1992-2004. Comparing the results obtained with accessibility indicators and inequality indices allows identifying the main critical factors and sources of bias. The conclusion is that for the road mode, cohesion has improved, while regional disparities have increased for the rail mode.

1 INTRODUCTION

National transport infrastructure assessment methodologies agree on the treatment of direct impacts: most of them follow either a cost-benefit analysis (CBA) or a core CBA-approach complemented by a multicriteria analysis (MCA) (Hayashi and Morisugi, 2000). These appraisal methods may be adequate for limited-scope individual projects, but they have certain limitations for the assessment of transport infrastructure plans or programmes. Recent studies have shown interesting attempts to develop a more strategic approach, covering a wider range of impacts (Beuthe, 2002).

Infrastructure provision is considered a key factor in achieving territorial cohesion (EC, 2004), and deficiencies in accessibility are seen as an obstacle for economic development. However, the treatment of distributive effects of transport infrastructure is uneven and scarce (Grant-Muller et al, 2001). In addition, some authors argue that certain investments may lead to increasing rather than reducing regional disparities (Martín et al, 2004; Vickerman et al, 1999).

Distributive effects –often referred to as equity or cohesion effects – are one of these impacts. In this research area, accessibility indicators have an important role to play. Recent development of GIS techniques have turned accessibility indicators into useful tools to evaluate some of the so-called "wider" impacts.

This paper suggests an accessibility approach to assess distributive effects of transport plans or programmes. The approach consists in taking changes in the equality of the spatial distribution of accessibility indicators as a proxy for measuring cohesion impacts. However, several factors may affect the conclusions taken, mainly the selection of the accessibility indicator and inequality indices, special features of each transport mode, or the spatial scale of the study.

All the above issues are investigated in this paper. First, section 2 reviews the literature on the treatment of cohesion and accessibility impacts of infrastructure investments. Later, section 3 suggests an accessibility approach to measure infrastructure cohesion impacts. This approach is then tested in Section 4, assessing cohesion effects of large-scale surface transport infrastructure investments, occurred in Spain in the period 1992-2004. Finally, section 5 includes the main conclusions taken.

2 THE TREATMENT OF ACCESSIBILITY AND COHESION EFFECTS OF INFRASTRUCTURE PROJECTS

2.1 The relationship between accessibility and cohesion

There are many possible definitions of accessibility. The definition that best fits with this study refers to accessibility as a feature that "describes the location of an area with respect to opportunities, activities or resources that exist in other areas or in the same area" (Wegener et al, 2000).

In land-use/transport planning, accessibility is considered as a means to economic activity and social cohesion, rather than a desirable good by itself (Vickerman et al, 1999). For the individual, accessibility represents an aspect of freedom of action, which is of fundamental importance both economically and socially (Simmonds, 1998). Hence, accessibility is considered an added value of a location and an important factor of quality of life (Schürmann et al, 1997), while lack of accessibility is undesirable because it is considered partly responsible for lagging economic development. However, the regional economic development implications of transportation improvements are highly complex and difficult to determine methodologically (Bökerman et al, 1997).

Despite this debate on the effects of accessibility and economic development, spatial distribution of accessibility is one of the output variables used to measure the existing disparities among regions. In fact, it is one out of a long list selected by the EU (EC, 2004), in their periodical Cohesion Reports, which includes macroeconomic indicators as GDP per capita, employment levels or R&D investments. In this sense, "equality of access to "services of general economic interest" is a key condition for territorial cohesion (EC, 2004). Special interest is placed in regions with geographical handicaps characterized by problems of accessibility and integration with the rest of the EU. Accessibility is thus a key factor in the achievement of the cohesion objective of the EU: to provide a fair distribution of accessibility to all its regions and to reduce existing disparities in accessibility between them (Schürmann et al, 1997).

In this context, accessibility indicators are an important input to an equity assessment, although its potential has not been so far fully exploited (Simmonds, 1998). Since the first definitions of accessibility were developed in the early 50's, there has been a continuous evolution of the theoretical foundations of accessibility indicators, resulting in a wide range of available formulations (see Geurs and Ritsema Van Eck (2001); Bruinsma and Rietveld, (1998). However, refinements of accessibility indicators are only useful if they contribute to improve our understanding of why some regions grow and some decline (Vickerman et al, 1999).

Activity-based accessibility measures, focused on the distribution of activities in space, ore often used in geographical studies but are not put to the same use in transport policy evaluation (Geurs and Ritsema van Eck , 2003). In the past , accessibility concepts have been widely reported within appraisal, but its use in the final assessment score has been quite limited, mainly because of concerns about double counting of effects (Beuthe, 2002).Recent research has identified the role and application of robust quantitative approaches, allowing accessibility measures to take a more central role within transport appraisal (Halden, 2003). A survey on the usability of different accessibility measures for evaluation purposes can be found in Geurs and van Wee (2004).

2.2 Cohesion as a policy goal

Cohesion is one of the main policy goals of the EU. The still un-ratified Treaty Establishing a Constitution for Europe (OJEU, 2004), includes "the promotion of economic, social and territorial cohesion" as one of the Union's objectives (article I-3). Moreover, cohesion is defined as one of the areas of shared competence between the Union and the Member States (Article I-14), and there is a complete Section devoted to cohesion (Section 3, Articles III-220 and the following). This Section states that: "(…) particular attention shall be paid to rural areas, areas affected by industrial transition, and regions which suffer from severe and permanent natural or demographic handicaps such as the northernmost regions with very low population density and island, cross-border and mountain regions (…)". Finally, (Art. II-96), "The Union recognises and respects access to services of general economic interest (…) in order to promote the social and territorial cohesion of the Union".

Another important institutional support to cohesion objectives comes from the European Spatial Development Perspective (ESDP) (EC, 1999). This policy document stresses that "spatial development policies can contribute in a decisive way to the achievement of the goal of territorial and social cohesion, in particular transport infrastructure investments in lagging regions". These ideas are coherent with the European Commision's position on the achievement of the cohesion objective. In particular, the Third Cohesion Report (EC, 2004) introduces the concept of territorial cohesion: " (…) the objective is to help achieve a more balanced development by reducing existing disparities, avoiding territorial imbalances and by making both sectoral policies which have a spatial impact and regional policy more coherent".

The creation of the trans-European networks (TENs) is considered one of the essential EU policy instruments to achieve the cohesion goal. In this sense, the recently updated version of the Community Guidelines for the development of the TENs (EC, 2004a), states that the TENs must "contribute to strengthening economic and social cohesion".

Changing the scale to the national level, Spanish policy documents also include cohesion as a key policy goal, and investment in transport infrastructure as an essential instrument to achieve it. In particular, the recently published "Infrastructure and Transport Strategic Plan (PEIT)" for the period 2005-2020 (Ministry for Development, 2004), includes social and economic cohesion among the most relevant policy objectives. This policy goal is specifically cited in the PEIT, states that the development of the transport system should be aimed at "ensuring equity of accessibility conditions to the whole national territory".

2.3 The treatment of cohesion effects in assessment methodologies

The ESDP (EC, 1999) includes in the "to-do" list the "Introduction of territorial impact assessment as an instrument for spatial assessment of large infrastructure projects, especially in the transport sector" There is little concept of how the appraisal should handle this issue, even at the level of indicators or qualitative assessment (Mackie and Nellthorp, 2003).

The review carried out in subsection 2.2. confirms that infrastructure investment is considered a key policy instrument in achieving the cohesion goal both at EU and at a national scale. However, this concern has not been translated to the practice of evaluation, where cohesion is not usually included among the evaluation criteria of transport infrastructure assessment methodologies (Grant-Muller et al, 2001).

The complexities involved in the inclusion of equity as an evaluation criterion are not only methodological, but also related to value judgements on the weight to be assigned to the cohesion criterion. Therefore, planners have tended to approach distributional equity in a rather ad-hoc fashion. The classical approach consists in computing a set of statistical variables, (cohesion or inequality indices) in order to characterize the sample's dispersion. In addition, recent attempts include measuring equity exploiting GIS capabilities to visualize the spatial distribution of the variable under study, via an "equity mapping" approach (Talen, 1998),

In general terms, regional cohesion effects refers to territorial impacts of a given policy on the spatial distribution of a selected variable representing each region, e.g. GDP per capita. In the context of this paper, the policy corresponds to large-scale transport infrastructure investments, and the selected variable is regional accessibility. Thus, the objective is to assess if, as a result of the implementation of a new infrastructure, the existing regional disparities in accessibility are increased (polarisation effects. i.e. reduced cohesion) or reduced (equalisation effects, i.e. increased cohesion).

This paper suggests to measure equity impacts both graphically, using a GIS to draw accessibility maps, and quantitatively, via the calculation of a set of statistical variables characterizing the regional distribution of accessibility values.

3 MEASURING COHESION EFFECTS: AN ACCESSIBILITY APPROACH

3.1 Selection of accessibility indicators

As detailed in section 2.1., there is a multitude of available formulations to measure accessibility (see Geurs and Ritsema van Eck (2001) for a comprehensive survey).

To carry out this study, four different formulations of accessibility indicators have been selected. The four of them refer to different approaches to the concept of accessibility, hence they offer complementary information: some of them are more infrastructure-oriented, while others are more strongly influenced by the geographic position of each location. They are briefly described bellow.

3.1.1 Location indicator

This indicator calculates a weighted –by destination population- average travel time between each node and a choice of region's centroids, according to the following formulation:

$$L_i = \frac{\sum_{j=1}^{n} I_{ij} \cdot P_j}{\sum_{j=1}^{n} P_j} \qquad (1)$$

where Li is the accessibility (location) of node I, Iij is the impedance: travel time by the minimal route through the network between node i and the centroid of region j (in min), and Pj is region's j population.

The mass of each destination is used as a weight in order to value the importance of the minimal-time routes (Gutiérrez and Urbano, 1996; Gutiérrez, 2001). The results obtained in each node strongly depend on its geographical position, showing clear core-periphery patterns. Remote locations inevitably appear with low accessibility values, as a good provision of transport infrastructure is not enough to overcome the negative effects of a large geographical distance to the main activity centres.

This indicator has the advantage that its results are easily interpreted, as they are expressed in familiar units -travel times- and therefore changes in this indicator are usually used as a proxy for computing travel time savings. However, it has some limitations, mainly stemming from the fact that it does not discriminate between far and nearby destinations, therefore their values depend heavily on the selected sets of destinations, i.e. the arbitrary cut-of point of the Pj that determines which destinations are included.

3.1.2 Gravity-based network efficiency indicator

The fact that the results offered by indicators like the location one are heavily influenced by the geographic location of the nodes makes these measures unsuited for determining the transport infrastructure needs of each region. The formulation of the efficiency indicator neutralizes the effect of the geographic location, and allows making judgements on the relative "ease of access" -network efficiency- of each location (Guiterrez et al, 1998). Its formulation is as follows:

$$E_i = \sum_{j=1}^{n} \frac{\frac{I_{ij}}{II_{ij}} \cdot w_{ij}}{\sum_{j=1}^{n} w_{ij}} \qquad (2)$$

where Ei is the network efficiency indicator, IIij is the "ideal impedance": expresses travel time between i and j "as the crow flies" or Euclidean distance (in min), wij is a ratio between destination population and distance between i and j, and the rest of the terms are already known.

This is a gravity-based accessibility indicator, as the importance of each relation i-j in the final calculation of the accessibility of node i increases with destination´s mass and decreases with the distance between i and j.

This indicator gives important information on how efficient are the network connections from a given node, independently from its geographic situation: the closer the value is to 1, the higher the accessibility the network provides to that node. Therefore, it may occur that a region which is peripheral according to the location indicator is highly accessible in terms of network efficiency.

3.1.3 Population potential indicator

The population potential is a gravity-based measure, adaptated from the standard approach of economic potential measurement following Hansen (1959), where GDP is replaced by population, as in Bruisma and Rietveld (1993), resulting as follows:

$$Pot_i = \sum_{j=1}^{n} \frac{P_j}{I_{ij}^{a}} \qquad (3)$$

where Poti is the population potential of node i, and a is a gravity parameter assumed to equal 1. This is the parameter value used most often in empirical studies: a higher value would over-weight relations over short distances and would also increase the problem of the measurement of the "internal accessibility" (Bruinsma and Rietveld, 1998, Gutiérrez, 2001). The rest of the terms are already known.

This indicator gives an aggregate measure of a region´s market area, resulting in a deceptively reduction in potential as we move away from the centre (Vickerman et al, 1999). Multimodal potential accessibility indicators (computing a multimodal travel time) have shown the highest explanatory value in the resulting economic development of each region (Schürmann et al, 1997).

3.1.4 Daily accessibility indicator

This indicator is based on the concept of a fixed budget for travel, usually set up between 3 and 5 h, so that it is possible to travel to a certain city, conduct business there and return within the day (Lutter et al, 1992). This is the reason why it is called "daily" accessibility indicator.

In this study, the indicator calculates, from each node, the number of inhabitants that can be reached in less than 4 hours:

$$D_i = \sum_{j=1}^{n} P_j \cdot \theta_{ij} \tag{4}$$

where Di is daily accessibility of node i, Tij=1 if Iij<4 hours, and 0 otherwise, and the rest of the terms are already known.

This indicator can be viewed as an extreme case of a potential market indicator because the distance-decay function takes the discontinuous form of all-or-nothing depending on the threshold of travel time considered (Gutiérrez, 2001). Although it has been widely used in studies at a EU scale (Schürmann et a 1997l, Martín et al, 2004), the arbitrary selection of the maximum travel time requires caution when interpreting differences in accessibility values after the implementation of a new infrastructure.

3.2 Methodological concepts: how to measure cohesion?

Cohesion (or inequality) indices are macro analytical indicators combining the accessibility values of individual regions into one single measure of spatial concentration or dispersion of accessibility (see Schürmann et al, 1997, for a review of existing formulations).

From the large list of available indices, five of them have been selected. For explanatory reasons, they have been classified into "static" and "dynamic" indices, indicating whether they allow measuring the sample's equity in any given moment, or they are only applicable for inter-temporal comparisons, respectively. However, changes in any static index result in a dynamic index.

Static analysis helps in identifying the importance of the choice of the accessibility indicator and the specific characteristics of each mode. Dynamic analysis allows assessing cohesion impacts of infrastructure investments.

3.2.1 "Static" indices

Two indices have been selected: the variation coefficient and the Gini index. They are briefly described as:

- *Variation* coefficient: it is defined as the standard deviation of the distribution expressed in percent of their mean. It ranges between 0 (no variation) and 100 (extreme polarisation).
- *Gini index*: it measures double the area between the accumulated distribution of sorted indicator values (i.e. Lorenz curve) and the straight line representing an equal distribution. It takes values between 0 (equal distribution) and 1 (extreme polarisation).

3.2.2 "Dynamic indices"

For this study, a selection of three indices composes this group of measures. Their description is as follows:

Spearman´s rank correlation coefficient: it compares two rank orders of values by decreasing or increasing accessibility. This coefficient is aimed at a dynamic analysis of accessibility, therefore not representing accessibility disparities for a specified moment in time. Its formulation is as follows:

$$r = 1 - 6 \cdot \sum \frac{d^2}{n \cdot (n^2 - 1)} \tag{5}$$

where r is the Spearman coefficient, d is the difference in statistical rank of corresponding variables, and n is the number of observations. The coefficient takes values in the interval -1 and 1. A correlation coefficient of 1 indicates that there has been no change in the rank order of regions, while a -1 value indicates that the rank order has been reversed.

Correlation coefficient relative change vs. level : this indicator examines the relationship between the percentage change of an indicator and its magnitude by calculating the correlation coefficient between them. The sign of the coefficient determines if disparities increase –positive correlation coefficient- or are reduced – negative correlation coefficient (Bröcker et al, 2004).

Correlation coefficient absolute change vs. level : the definition of this indicator is the same, except that absolute instead of relative change is considered

4 CASE STUDY: SPAIN, 1992-2004

4.1 Introduction

The study assesses regional cohesion effects deriving from surface transport infrastructure investments (i.e. in road and rail modes), carried out in the period 1992-2004. In these twelve years, the high capacity road network was enlarged from near 6,000 km to 9,000 km. For the rail mode, the HSR network was enlarged from near 450 km (Madrid-Seville HSR line) to 930 km, with the opening of the HSR Madrid-Lleida.

The geographical area includes the Spanish territory in the Iberian Peninsula. It comprises 15 Autonomous Regions, each of them subdivided in provinces (equivalent to NUTS-3 divisions), which are finally divided into municipalities (NUTS-5), up to a final amount over 8,000. The output of the GIS modelling work consists therefore of a set of over 8,000 municipality's values of accessibility indicators. For operational reasons, the aforementioned values have been subsequently aggregated to obtain one single value for each of the 47 Iberian provinces (which will be called regions from now on), using population as the weighting variable.

Population is the selected variable to measure destination's attractiveness. Population of 2004 has been kept constant in the 1992 and 2004 analysis, in order to separate the effect stemming from infrastructure improvements from the one derived from population growth. The selected destination centres correspond to the centroids of the aforementioned 47 regions. In addition, centroids in Portugal and the three southern French regions have been included not as origin nodes but only as destination centres, at a more aggregated level (NUTS-2).

Using GIS software, road travel times were calculated based on average travel speeds depending on the road type. In addition to this travel times, calculations include time penalizations in roads crossing mountainous areas or large urban agglomerations. For the rail mode, calculations are more complex. The spatial separation between stations makes the modelled rail network unavoidably multimodal. Road is therefore the connecting mode to the nearest train station, where a penalization for the intermodal change is applied. Rail travel times have been obtained from the fastest train service, according to Thomas Cook travel times. Node impedances when changing from Iberian to UIC track gauge, and penalizations due to transfer times when travel time exceeds 4 hours complete rail travel time calculations.

4.2 Accessibility results

4.2.1 Road mode

Table 1 includes a summary of the regional accessibility results for the road mode, for the four accessibility indicators described in section 3.1.

Table 1: Regional accessibility results. 1992, 2004, and change. Road mode

s	1992			2004			Change [h]
	Min [e]	Mean [f]	Max [g]	Min	Mean	Max	
Location [a]	491	365	271	458	350	270	4.1
Network efficiency [b]	1.84	1.60	1.24	1.74	1.55	1.24	3.0
Population potential [c]	89.876	134.639	397.602	98.476	139.349	404.788	3.5
Daily accessibility [d]	2.18	7.19	13.62	2.85	7.91	13.66	10.1

[a] minutes
[b] adimensional ratio
[c] inhab/minutes x 10^3
[d] million inhab
[e] minimum value
[f] mean value
[g] maximum value
[h] percentage change compared to 1992 situation

Results show that perceived improvement rates vary according to the indicator chosen, ranging from a 3.0 % in terms of the population potential indicator, to a 10.1 % for the daily accessibility indicator. For example, in terms of the location indicator, which is the more easy to interpret, mean weighted average travel times are reduced from 365 min in 1992 to 350 min in 2004 (i.e. a 4.1 % reduction).

As a result of the modelling work, a multitude of maps have been drawn, representing the four accessibility indicators, road and rail modes, and values corresponding to 1992, 2004 and % change with respect to 1992 situation. This results in a total of 4x2x3=24 maps. It is not possible to include all of them in this paper, so the choice has been to include the 4x2= 8 maps showing percentage change.

Figures 1 to 4 map differences in road mode accessibility values between 1992 and 2004, in percentage change of 1992 values, for location, network efficiency, population potential and daily accessibility indicators, respectively. In all cases, the resulting overall pattern is similar: the northwest (Galicia regions) concentrates the higher percentage of change, with values above 10% in some cases. This is mainly due to the completion of the highway link from Galicia to Madrid. As Galicia suffered from deficient accessibility values in 1992, the concentration of higher relative gains in this area signals a reduction in accessibility disparities. The cohesion analysis included in section 4.3. will determine the reliability of this early statement.

In descending order, next regions with higher benefits concentrate in the southeast area (Murcia, eastern Andalucia), along with some inner locations where particular links have been built. Finally, Cataluña, Extremadura and northwest of Andalucia are the areas whit lower relative improvements.

Figure 1. Changes in location accessibility indicator 1992-2004. Road mode

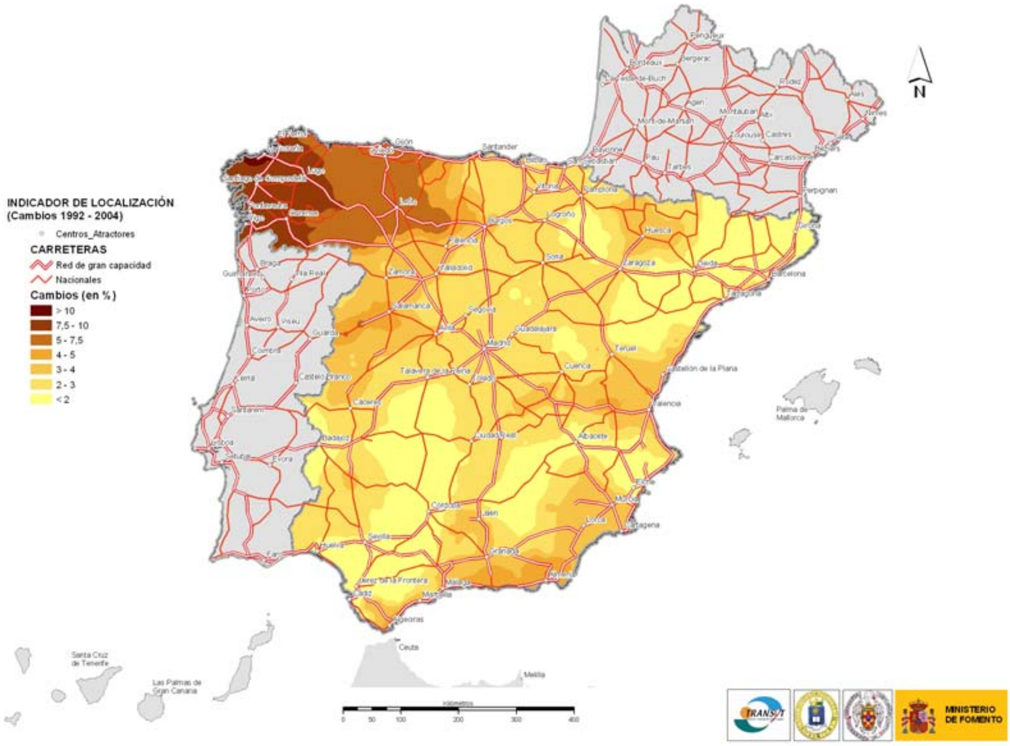


Figure 2. Changes in network efficiency accessibility indicator 1992-2004. Road mode

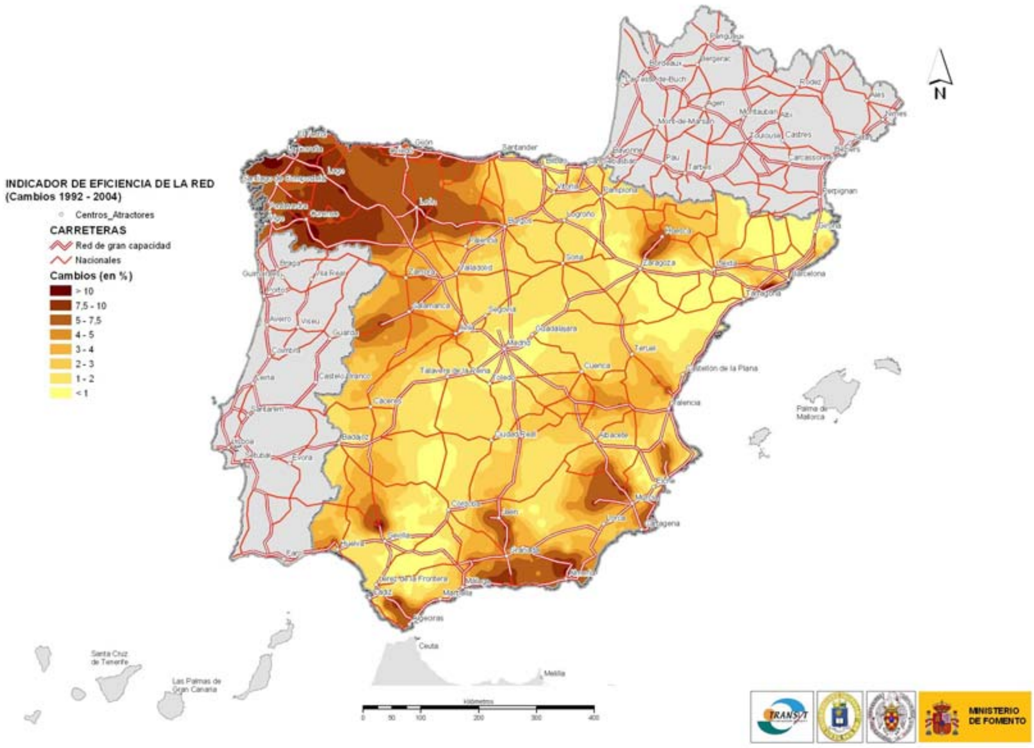


Figure 3. Changes in population potential accessibility indicator 1992-2004. Road mode

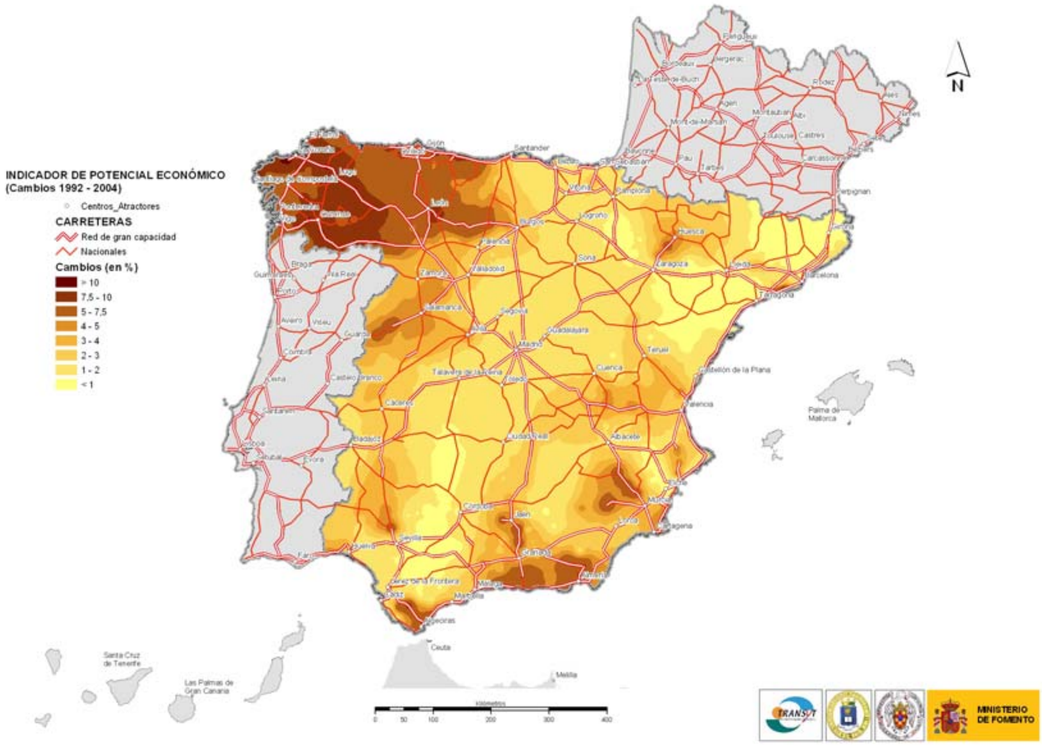
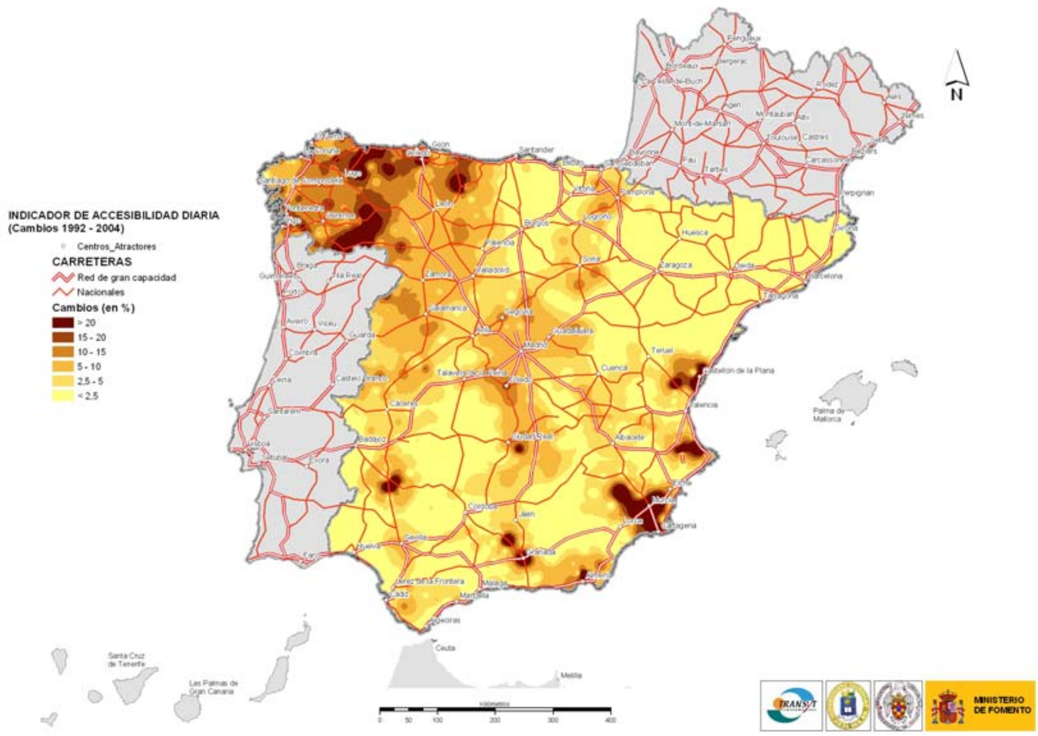


Figure 4. Changes in daily accessibility indicator 1992-2004. Road mode



4.2.2 Rail mode

Table 2 includes a summary of the regional accessibility results for the rail mode.

Table 2: Regional accessibility results. 1992, 2004, and % change. Rail mode

	1992			2004			Change [h]
	Min[e]	Mean[f]	Max[g]	Min	Mean	Max	
Location [a]	870	640	448	843	589	421	7.9
Network efficiency [b]	9.82	7.22	3.90	9.23	6.68	3.7	7.5
Population potential [c]	50.160	91.587	255.547	51.052	99.762	259.405	8.9
Daily accessibility [d]	1.05	4.27	8.69	1.07	5.13	11.54	20.0

[a] minutes
[b] adimensional ratio
[c] inhab/minutes x 10^3
[d] million inhab
[e] minimum value
[f] mean value
[g] maximum value
[h] percentage change compared to 1992 situation

Results show that change rates depend on the indicator chosen, ranging from a maximum 20.0 % for the daily accessibility indicator to a 7.5 % for the network accessibility indicator. For example, in terms of the location indicator, mean weighted average travel times are reduced from 640 min in 1992 to 589 min in 2004 (i.e. a 7.9 % reduction).

It can be noted that the ratios between the percentages of change remain similar to the ones resulting for the road mode (see Table 1): daily accessibility shows above double the percentage change of location, network efficiency and population potential indicators, which show similar percentage change.

The comparison of Table 1 and 2 values also shows that the overall accessibility levels are better for the road than for the rail mode, both in 1992 and 2004, for all accessibility indicators: in terms of the location indicator mean weighted average travel times are 589 min by rail, against a 350 min value by road.

Figures 5 to 8 map differences in rail mode accessibility values between 1992 and 2004, in percentage change of 1992 values, for the location, network efficiency, population potential and daily accessibility indicators, respectively. In all cases, the resulting overall pattern is similar: the Madrid-Barcelona corridor benefits from the opening of the Madrid-Lleida HSR, along with some improvements of the Mediterranean (Euromed) line. Therefore, this corridor shows the higher percentage improvements, with values over 20%.

The effects of this HSR also benefit indirectly the Madrid- Seville corridor, as it connects it with the second larger city in Spain after Madrid: Barcelona. Both the aforementioned corridors enjoyed above-average accessibility values in 1992, which signals an increase in regional disparities, as will be discussed in section 4.3.

Figure 5. Changes in location accessibility indicator 1992-2004. Rail mode

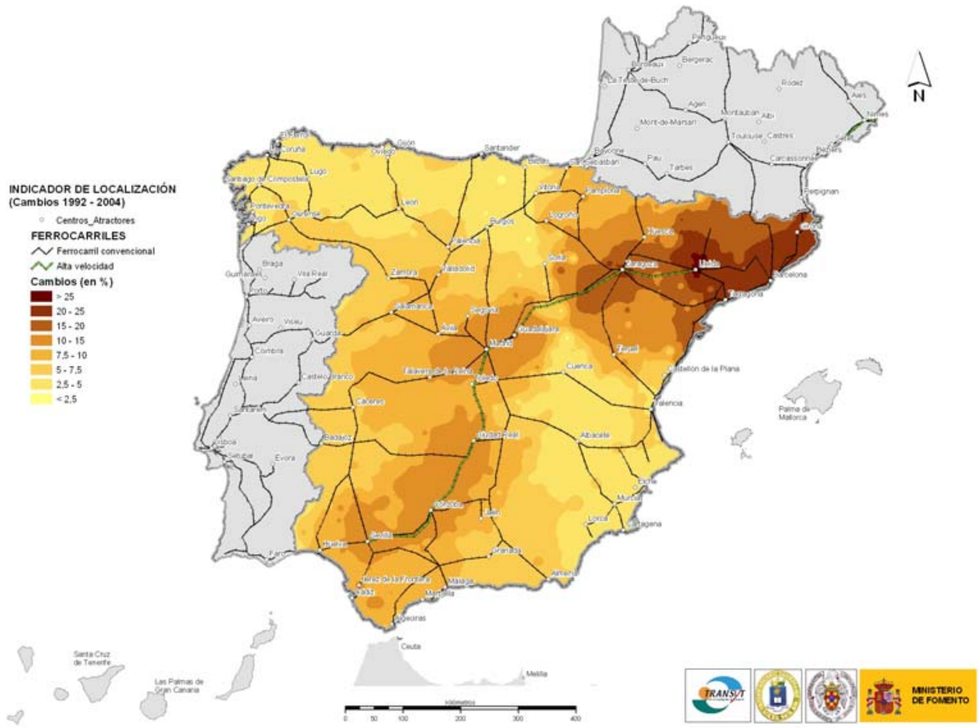


Figure 6. Changes in network efficiency accessibility indicator 1992-2004. Rail mode

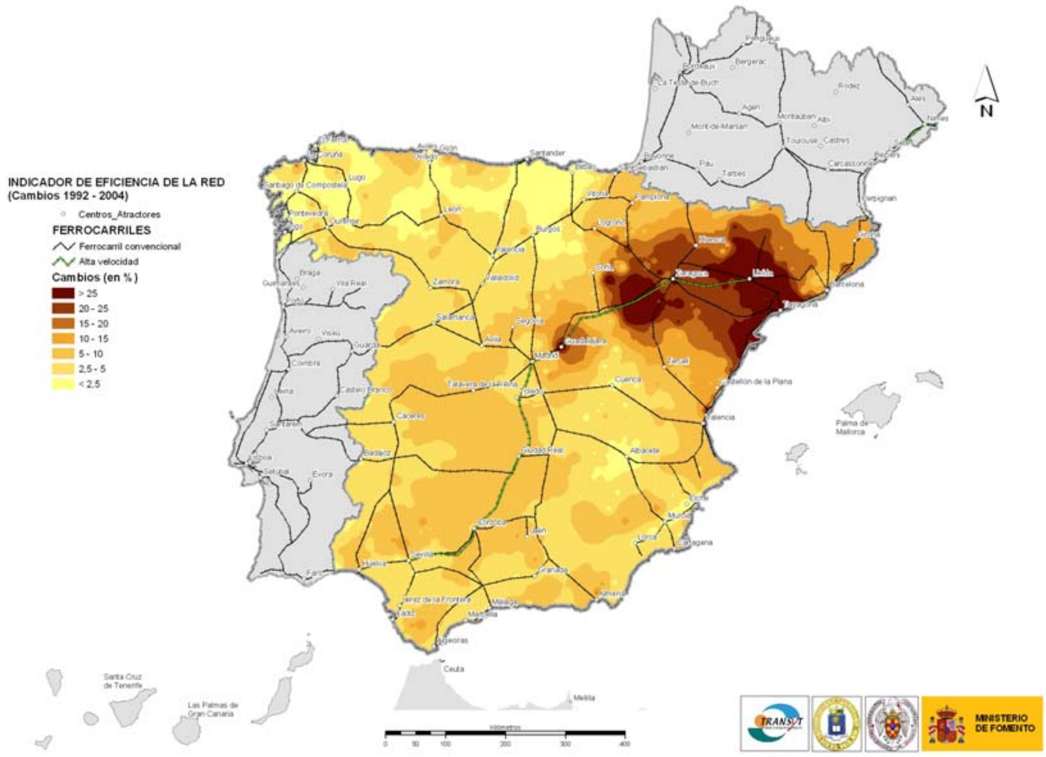


Figure 7. Changes in population potential accessibility indicator 1992-2004. Rail mode

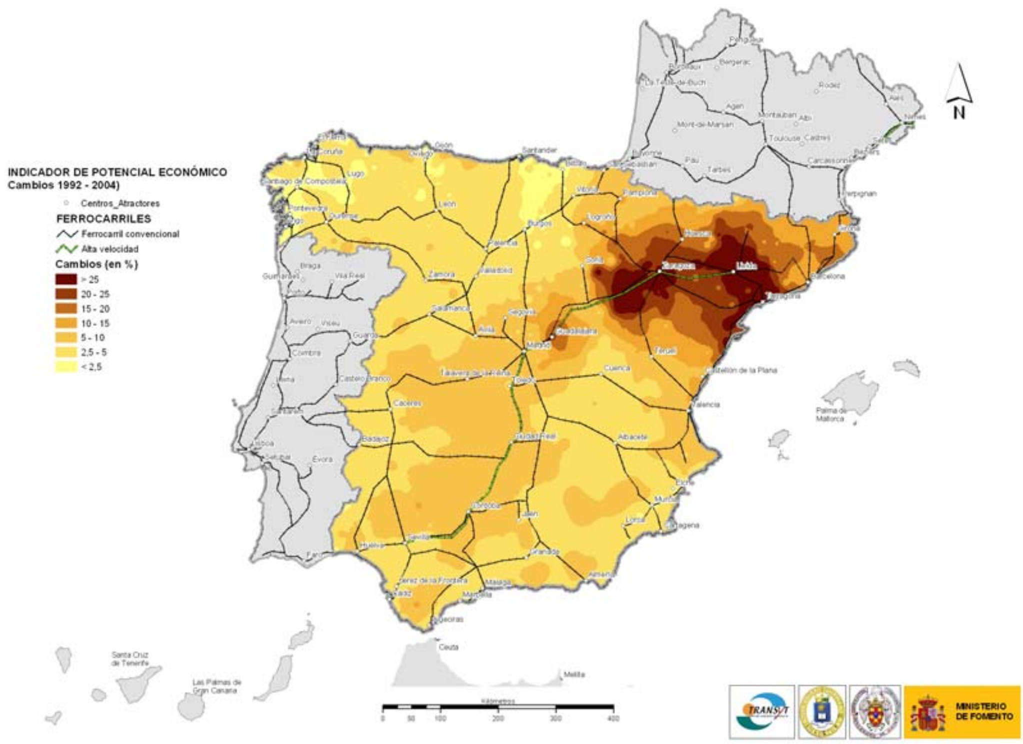
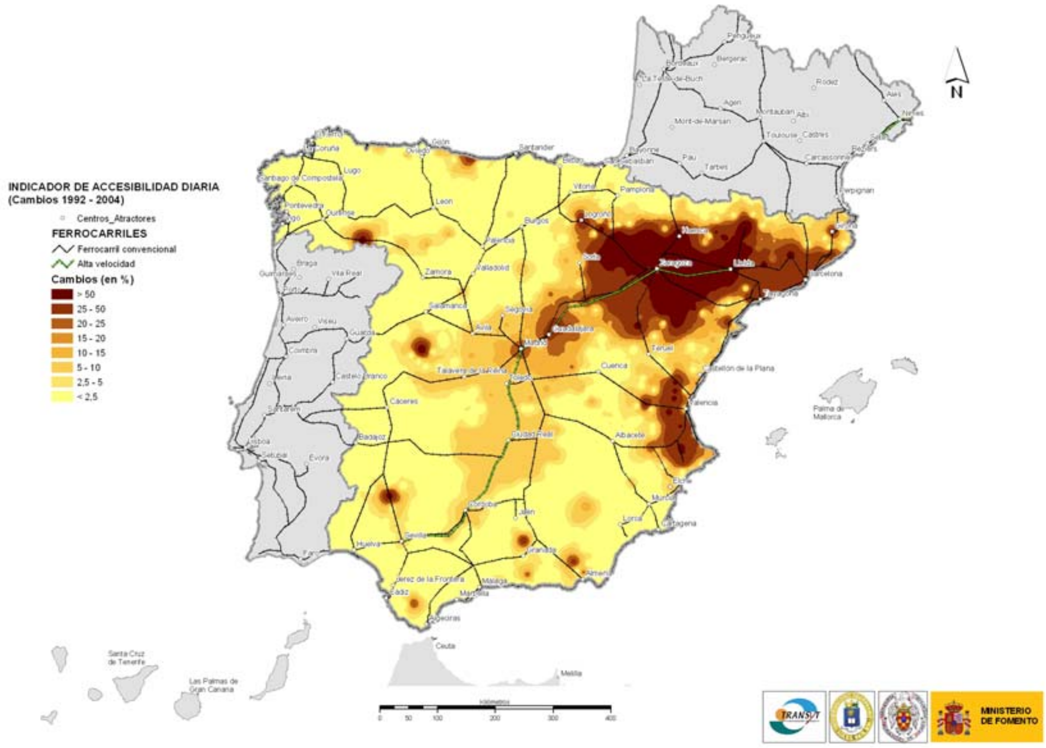


Figure 8. Changes in daily accessibility indicator 1992-2004. Rail mode



4.3 Cohesion/Inequality indices

4.3.1 Static analysis

4.3.1.1. Differences depending on the accessibility indicator

Results obtained for each accessibility indicator provide different information for the analysis. For example, the location indicator does not discriminate between far and nearby destinations, therefore the relevance of long-distance itineraries is higher than for indicators with a gravitational component, i.e. potential and network efficiency indicators. This feature of the location indicator may constitute an advantage for policy analysis at national/supranational scales, where the development of long range, strategic links is one of the main objectives. The analysis of cohesion effects on the basis of its results provides information on the equity of access to all potential destinations, in the assumption that the size but not the distance to the destination matters.

The potential indicator, on the contrary, is heavily influenced by its gravitational component, which is more coherent with actual behaviour (Morris et al., 1979). It is more suitable to analyze cohesion from an economic point of view, as its results can be interpreted as the "potential for interactions" (Hansen ,1959) of each location.

The network efficiency indicator eliminates the effect of the geographical location of nodes and highlights the effects of the infrastructure (Gutierrez and Monzón ,1998). It allows analyzing cohesion from a more infrastructure-oriented approach: disparities are measured in terms of the quality of the infrastructure in the connection between economic activity centres.

Finally, the results obtained with the daily accessibility indicator depend heavily on the artificial –and in a sense arbitrary- selection of the travel time limit. Its applicability for the assessment of cohesion effects is doubtful, given the perceived randomness of the results obtained.

The results included in Table 3 clearly show that, both for road and rail modes, the choice of the accessibility indicator is a key factor influencing the conclusions taken. For both indices, daily and potential indicators show significantly higher regional disparities than location and network efficiency indicators. This is consistent with previous similar studies (Schürmann et al, 1997, Martín et al, 2004).

Table 3: Inequality indices of selected accessibility indicators, 1992, 2004 and % change, Road and rail modes

	Road			Rail		
Inequality index /Accessibility indicator	1992	2004	% change	1992	2004	% change
Variation coefficient						
Location	15.328	13.694	-10.659	15.940	17.985	12.828
Network efficiency	7.884	6.763	-14.210	18.252	20.494	12.283
Population potential	34.588	33.262	-3.834	38.433	39.221	2.050
Daily accessibility	36.995	32.941	-10.958	55.461	58.702	5.843
GINI index						
Location	0.096	0.087	-9.300	0.107	0.119	10.644
Network efficiency	0.078	0.070	-9.512	0.186	0.188	1.294
Population potential	0.277	0.237	-14.379	0.299	0.293	-1.741
Daily accessibility	0.253	0.229	-9.418	0.332	0.361	8.710

In particular, for the road mode, the coefficient of variation in 1992 ranges between a 37 % for the daily indicator to only an 8% for the network efficiency indicator. For the rail mode, the resulting interval is even larger: 59% and 18%, for the daily and location indicators, respectively.

4.3.1.2. Comparison between modes

Comparing now between road and rail modes, results show that, for all indices and accessibility indicators, accessibility by road was in 1992 more equally distributed than by rail, in accordance with previous studies (Bruinsma y Rietveld, 1993; Gutiérrez et al, 1998). The following reasons appear as the main responsible for these differences:

first, in 1992 the High Capacity road network was far more developed than the HSR network. While the first covered most of the Iberian Peninsula, with over 5,800 km, the latter only included the Madrid-Seville line, with approximately 450 km.

second, independently from the aforementioned level of development of each network, the density of “access nodes” (i.e. junctions) in the road mode is significantly higher than for the rail mode, where access is only possible at the stations.

finally, differences between average speeds are much larger for rail mode (i.e. high speed vs. conventional rail speed) than for road mode (i.e. highway speed vs. conventional roads speed). Therefore, the implementation of a single HSR line may induce higher spatial polarising effects than a new highway.

In order to avoid this undesired polarising effect of HSR, an effort should be made to guarantee an adequate level of access from conventional lines-in which the spatial separation between stations can be reduced- to HSR stations. An improved quality of this “second-level” network will reduce the disadvantaged position of rural areas crossed by a HSR corridor and not provided with HSR stations.

In summary, the “intrinsic features” of each mode are the driving forces behind this road-rail differences in spatial cohesion effects. New infrastructure investments have therefore a limited potential to reduce these differences between both modes. Hence, it is not surprising to verify that the relative situation between both modes has not changed in 2004. Road and rail infrastructure implemented in the period 1992-2004 have not changed the final picture: accessibility by road is more equally distributed than by rail

4.3.2 Dynamic analysis: cohesion effects 1992-2004

4.3.2.1. Road mode

First, for this dynamic analysis, it is carried out a comparison of the values of the inequality indices in 1992 and 2004. For this purpose, Table 3 includes a row computing percentage changes (in terms of 1992 values). Results show that for all accessibility indicators, cohesion has slightly improved. Indeed, both the resulting variation coefficient and Gini index have dropped in a percentage ranging from -3.8% and -14.4%, depending on the accessibility indicator chosen.

In addition, this analysis is complemented with the values of the correlation coefficients included in Table 4. Starting with the Spearman correlation coefficient, the closeness to one of all values (higher than 0,940), indicates that the development of the road network results in a little impact on the positions of the regions in the rank order of accessibility. Finally, the negative sign of the relative and absolute correlation coefficients confirms the conclusions taken from the analysis of the variation coefficient and the Gini index: a reduction of regional disparities.

Table 4: Correlation coefficients 1992 vs. 2004. Road and rail modes

	Road	Rail
Spearman rank correlation coefficient		
Location	0.985	0.952
Network efficiency	0.943	0.922
Population potential	0.997	0.959
Daily accessibility	0.949	0.896
Correlation level vs. absolute change		
Location	-0.727	-0.036
Network efficiency	-0.609	-0.106
Population potential	-0.098	0.206
Daily accessibility	-0.221	0.238
Correlation level vs. relative change		
Location	-0.610	0.075
Network efficiency	-0.457	0.166
Population potential	-0.351	0.048
Daily accessibility	-0.488	-0.023

Therefore, it can be stated that, for the road mode, cohesion has slightly increased. This conclusion is coherent with the expected impacts from the changes of the road network in the 1992-2004 period. Investments were mainly aimed to close the remaining links to connect peripheral regions, like Galicia, to the High Capacity network. In addition, the aforementioned investments contributed to the completion of a denser grid, via the construction of cross and longitudinal links which have reduced the pronounced radial feature of the Spanish road network.

4.3.2.2. Rail mode

Table 3 includes the indices obtained for the rail mode, included in Table 3. Resulting values show that cohesion has slightly decreased in the period 1992-2004, in seven out of the eight computed indices. The different sign obtained in the potential indicator is due to the reduced relative improvement experienced by large agglomerations, due to the strong influence of their internal accessibility (the self-potential).

However, conclusions deriving from the analysis of results included in Table 4 are not clear, at least at a first look. In all cases, the Spearman correlation coefficients result in close to one values, (although slightly lower than for the road mode), therefore showing that there have been no significant shifts in the rank positions. The interpretation of the results of the correlation coefficients between change and level is more complex: they signal both cohesion (i.e. negative sign of the coefficient) and polarising (i.e. positive sign) effects. Notwithstanding that the resulting balance is more inclined towards polarisation effects (five out of eight coefficients are positive), caution should be paid before making categorical asserts about increasing or decreasing disparities on the basis of the aforementioned coefficients.

The observed tendency of HSR to introduce polarising effects is in accordance with previous similar studies at a national scale (Gutiérrez, 2001; Martín et al, 2004) and at an EU scale (Bruinsma y Rietveld, 1993, 1998; Vickerman et al, 1999; Gutiérrez y Urbano, 1996).

It can also be stated that results heavily depend on the cohesion index used (in line with Bröcker et al, 2004), therefore a set of indices should be used and their results analysed complementary.

5 CONCLUSIONS

This paper concludes that regional cohesion effects derived from the development of transport networks in Spain in the period 1992-2004 have been equitable for the road mode while polarising for the rail mode. HSR tends to improve the relative position of large urban agglomerations, most of them already enjoying above-average accessibility levels, therefore increasing regional disparities in accessibility.

Benefits derived from new HSR corridors are concentrated in those agglomerations provided with a station, in the detriment of intermediate rural areas, which result in a relative worst situation. This conclusion is consistent with previous studies, both at national and EU scales (Bruinsma and Rietveld, 1993; Gutiérrez, 2001;Vickermann et al, 1999), which alert of the "polarising proneness" of HSR lines. In order to avoid this undesired polarising effect of HSR, an effort should be made to guarantee an adequate level of access from conventional lines-in which the spatial separation between stations can be reduced- to HSR stations. An improved quality of this "second-level" network will reduce the disadvantaged position of rural areas crossed by a HSR corridor and not provided with HSR stations.

In addition, the paper also stresses that measuring cohesion effects should be done with caution, as there are many possible sources of bias in the process. First, the choice of the cohesion index: depending on the index chosen, the conclusions may be even opposite. Therefore, the best option is to calculate a set of indicators and integrate their results. Conclusions relying on only one indicator should be avoided (Bröcker et al, 2004).

Second, the selection of the accessibility indicator: in terms of the four selected indicators for this study, potential and daily accessibility indicators tend to show less equitable distributions than location and network efficiency indicators. The paper has explored the implications of the choice of the accessibility indicator, highlighting the strengths and weaknesses of four accessibility indicators -location, potential, network efficiency and daily accessibility- for its applicability in the analysis of cohesion effects.

Third, the geographical scale: it may happen that the results obtained are different depending on where we put the geographic boundaries of the study. At EU scale, a new infrastructure connecting a peripheral Member State, e.g. Spain, with the EU core may increase cohesion. The same infrastructure may have polarising effects if we move to a national level and investigate how disparities change within the national boundaries (Gutiérrez, 2001, Martín et al, 2004). The same problems are faced if the scale is changed to the corridor level.

In summary, the lesson learned is that it is far from obvious to assert that improved transport infrastructure brings improved cohesion. More research is needed to develop a common approach to measuring regional cohesion effects of transport infrastructure investments.

6 ACKNOWLEDGMENTS

Support from Ministerio de Fomento (Transport Research Aids), comments from J.Gutiérrez, and assistance in computing and mapping accessibility values from G.Gómez are gratefully acknowledged.

7 REFERENCES

Beuthe, M. (2002) Transport Evaluation Methods: from Cost-benefit Analysis to Multicriteria Analysis and the Decision Framework. In Project and Policy Evaluation in Transport (Giorgi, L., Pearman, A. (eds.)) Ashgate, London.
Bökeman, D., Hackl, R., Kramar, H. (1997) Socio-Economic Indicators Model and Report.SASI Deliverable D4. Report to the European Comission. Wien: Institut für Stadt-und Regionalforschung, Technische Universität Wien.
Bröcker, J., Meyer, J., Schneekloth, N., Schürmann, C., Spiekermann, K., Wegener, M. (2004) Modelling the Socio-Economic and Spatial Impacts of EU Transport Policy. IASON Deliverable 3. Funded by 5th Framework RTD Programme. Kiel/Dortmund: Christian-Albreschts-Universität Kiel/Institüt für Raumplanung, Universität Dortmund.
Bruinsma, F., Rietveld, P. (1993) Urban agglomerations in European infrastructure networks Urban Studies 30, p 919-934.
Bruinsma, F., Rietveld, P. (1998) The accessibility of european cities. Environment and Planning A, vol 30, pp 499-521.
European Commision (2004) A new partnership for cohesion :convergence competitiveness cooperation. Third report on economic and social cohesion. Office for Official Publications of the European Communities, Luxembourg.
European Commission (2004a) Decision No 884/2004/EC of the European Parliament and of the Council amending Decision No 1692/96/EC on 21 April 2004 on Community guidelines for the development of the trans-European transport network
European Commission (1999) ESDP European Spatial Development Perspective: Towards balanced and sustainable development of the territory of the European Union, Prepared by the Committee of Spatial Development, Luxembourg.
Geurs K.T., van Wee, B., (2004) Accessibility evaluation of land-use and transport strategies: review and research directions. Journal of Transport Geography, vol 12, pp 127-140.
Geurs K.T., Ritsema Van Eck J.R. (2003) Evaluation of accessibility impacts of land-use scenarios: the implications of job competition, land-use, and infrastructure development for the Netherlands, Environment and Planning B, vol 30, pp 69-87.
Geurs K.T., Ritsema Van Eck J.R. (2001) Accessibility measures: review and applications. Evaluation of accessibility impacts of land-use transportation scenarios, and related social and economic impacts. RIVM Rapport 408505006. National Institute of Public Health and the Environment. RIVM, Bilthoven
Grant-Muller S.M., Mackie P.J., Nellthorp J., Pearman A.D. (2001), Economic Appraisal of European Transport Projects- The State of the Art Revisited. Transport Reviews 21(2), p237-261
Gutiérrez, J. y Urbano, P. (1996) Accessibility in the European Union: the impact of the trans-European road network. Journal of Transport Geography, vol. 4, Nº1, pp- 15-25.
Gutiérrez, J., (2001) Location, economic potential and daily accessibility: an analysis of the accessibility impact of the high-speed line Madrid-Barcelona-French Border Journal of Transport Geography 9 (2001), 229-242.
Gutiérrez, J., González, R., y Gómez, G. (1996). The European high –speed train network. Predicted effects on accessibility patterns. Journal of Transport Geography, vol 4, Nº4, pp. 227-238.
Gutiérrez, J., Monzón, A., Piñero, J.M. (1998) Accessibility, network efficiency, and transport infrastructure planning Environment and Planning A, vol 30, pp 1337-1350.
Halden, D. (2003) Accessibility analysis: concepts and their application to transport policy, programme and project evaluation. In Pearman, A., Mackie, P., and Nellthorp, J. (eds.) Transport Projects, Programmes and Policies: Evaluation needs and capabilities. Ashgate, Hampshire.
Hansen W.G. (1959) How accessibility shapes land-use. Journal of the American Institute of Planners 25, 73-76.
Hayashi, Y., Morisugi, H. (2000) International comparison of background concept and methodology of transportation project appraisal. Transport Policy, vol 7, pp 73-88.
Lutter, H., Pütz, T., Spangenberg, T., (1992) Accessibility and Peripherality of Community Regions : the Role of Road, Long-Distance Railways and Airport Networks. Report to the European Comission DG XVII. Bundesforschungsanstalt für Landeskunde und Raumordnung, Bonn.
Mackie, P. and Nellthorp (2003) Transport Appraisal in a Policy context. In Pearman, A., Mackie, P., and Nellthorp, J. (eds.) Transport Projects, Programmes and Policies: Evaluation needs and capabilities. Ashgate, Hampshire.
Martín, J.C., Gutiérrez, J. y Román, C. (2004) Data Envelopment Análisis (DEA) Index to measure the accessibility impacts of new infrastructure investments: the case of the High-Speed Train Corridor Madrid-Barcelona-French border. Regional Studies, vol 38, pp 697-712.
Ministry for Development (2004) Infrastructures and Transport Strategic Plan (PEIT), Proposal Document, State Secretary for Infrastructures and Planning, Directorate General for Planning and Territorial Coordination, Madrid.
Morris, J. M., Dumble, P. L., and Wigan, M. R. (1979). Accessibility indicators for transport planning. Transportation Research A, 13A, 91-109.
Official Journal of the European Union (2004) Treaty Establishing a Constitution for Europe, Official Journal of the European Union, C310, 16.12.2004.
Schürmann, C., Spiekermann, K., Wegener, M. (1997) Accessibility indicators, Berichte aus dem Institüt für Raumplanung 39, IRPUD, Dortmund
Simmonds, D. (1998) Accessibility as a criterion in policy and project appraisal. Unpublished Report for the Department of the Environment, Transport and the Regions, David Simmonds Consultancy, University of Leeds, MVA, Oxford Brooks University.
Talen, E. (1998) Visualizing equity maps for planners Journal of the American Planning Association, vol 64, issue 1, pp-22-49.
Vickerman, R.W., Spiekermann, K., Wegener, M. (1999) Accessibility and economic development in Europe. Regional Studies, 33, pp 1-5.
Wegener, M., Eskelinnen, H., Fürst, F., Schürmann, C., Spiekermann, K., (2000). Indicators of Geographical Position .Final Report of the Working Group "Geographical Position" of the Study Programme on European Spatial Planning. Dortmund, IRPUD.

🏆 reviewed paper

Cloudy prospects in winter sport
How competitive are the Austrian winter sport destinations under conditions of climate change?

Wiebke UNBEHAUN & Ulrike PRÖBSTL

(Dipl.-Ing. Wiebke Unbehaun and Prof. Dipl.-Ing. Dr. Ulrike Pröbstl, University of Natural Resources and Applied Life Sciences Vienna, Institute of Landscape Development, Recreation and Conservation Planning, Peter-Jordan-Straße 82, 1190 Vienna, wiebke.unbehaun@boku.ac.at)

1 ABSTRACT

In many regions in the Austrian Alps winter tourism is an important source of income. A possible Climate Change will modify the snow cover depth as well as the characteristic and quality of winter sport tourism and therefore change the prospects of the ski destinations. The ski destinations react with strong investments in artificial snow-making, extensions in higher altitudes and alternative attractions. Not only the supply side is reacting to the modified conditions but also the customers. Some of them have already experienced unsatisfying snow conditions. Others are sensitised by press and media reporting. They also have various adaption strategies. In spite of this fact, there are some surveys dealing with climate impact assessments, but only a few consider the impacts on the travel behaviour patterns of winter sport tourists and very few studies have a strong individual orientated approach.

This study focuses on the destination choice and the examination of individual behaviour in winter sport tourism under conditions of climate change. To find answers on the question how winter sport tourists change their destination choice and winter sport travel behaviour, an inquiry of active skiers and boarders is conducted. Method is a standardised questionnaire added by a Discrete Choice Experiment. By using a Discrete Choice Experiment, the stated preferences of individuals related to the destination choice in winter sport will be analysed. The results will be presented in a decision support system. Added by spatial data and the information of regional and local climate and snow scenarios the results of the Discrete Choice Experiment permits the conduction of regional development scenarios. This helps local decision makers to trade off future investments and planning guidance.

2 INTRODUCTION

Millions of winter sport enthusiasts dream of a white Christmas and solid winters to ski to the very bottom of the valleys. However, recently the reality often differs from the dream. At the end of the 1980’th, a period of several winters without heavy snow gave the alpine communities a first idea of what climate change could mean for regions dependent on winter sport tourism. While scientists offer different views about the magnitude and the exact effects of climate change, the fact that climate change is established in the meantime. Literature shows that the relationship between tourism and temperature is generally positive, except in winter sport regions. Snow is the most important resource and the base of skiing and snowboarding. In the European Alps winter sport is an important industry which was build up rapidly during the second half of the 20th century. In the meantime many rural alpine communities are economically havily dependent on winter sport tourism with a rising tendency. There is concern about whether or not winter sport tourism can remain a sustainable economy if climate change, especially a global warming, continues.

Because of the current developments, additional investments in snowmaking equipment and other supportive measures became necessary to meet the warming. But not all regions have the necessary financial resources for these adaptations, others have ecological constraints. Many of the Austrian ski destinations run their businesses already with minimum profitability. Especially against the background of the fact that the winter sport tourists’ reactions on changing winter sport conditions are unsure, they need information in which infrastructure they should invest. Therefore this study focuses on attitudes, motivations, perception and preferences of winter sport tourists. The idea is to investigate the past visiting patterns of skiers, to analyse the individual destination choice and the preferences of skiers and boarders to estimate future trends in ski tourism as well as their consequences for the alpine skiing regions.

Observing tourists’ and visitors’ behaviour is a popular instrument to monitor the development in winter sport tourism, to evaluate the performance of an area, to investigate visitors’ satisfaction and to forecast future demand. Most of observational data is confined to past behaviour. These surveys have more or less a descriptive heuristic character and are providing only underlying explanations of the revealed behaviour and the dominating factors of decisions (Haider 2002: 115). Behavioural research provides insights into various behavioural aspects explaining why people acting one-way or another, why they decide in favour for a destination or an activity or not, and tries to predict future behaviour. In case of winter sport tourism, the questions are why people choose one ski area and how their destination choice will change under the conditions of climate change. Therefore behaviour research is offering several instruments to investigate future choice and behaviour intentions. In this study a Discrete Choice Experiment (stated choice) is used as a multivariate method combined with a standardised questionnaire. During the inquiry various scenarios of winter sport destinations under different conditions of climate change are presented to the test persons. The scenarios are composed of several attributes and the probands are asked to choose the most favoured alternative. Discrete Choice Experiments (DCE) offers the possibility to map individual behaviour and decision making processes and shows the significance of single factors for individual actions.

2.1 Climate Change in the European Alps

With about 50 Mio. skier days in the season 2004/05 Austria is next to France the most important ski destination in Europe. 90% of the winter sport visitors are motivated primarily by snow (Fachverband der Seilbahnen 2005). Snow is the most important resource for winter sport tourism and the physical basis of skiing. In the last years the discussion about a possible climate change arose to an important topic in press, media and science. Several teams of scientists are conducting climate and especially snow cover scenarios. Broadly discussed is the global warming caused by the glasshouse effect with a concentration of the warming in winter times and the shift of precipitation from winter to warmer periods. The consequences are - besides others - less days of assured snow and a temporal shift of precipitation to spring (Breiling 1993). A small group of scientists discuss the phenomenon of global dimming, which is caused by the increased contamination of the atmosphere especially by CO2, aerosols and water vapour and a reduction of the global radiation (Cohen 1993, Stanhill & Shabtai 2001).

Abegg (1996) gave a comparative overview of snow models designed with the purpose to assess the possible loss of snow for winter tourism under consideration of a warming. The models were conducted for Switzerland, Canada and Australia. Not any of these models are valid for particular destinations or small regions. They lead to the conclusion that a warming would be accompanied by a loss of snow cover. Ski destinations in lower altitude would be more affected by the loss of snow than higher areas. Swiss meteorologist expect that the altitude for sure snow cover will rise from 1,200 to 1,500m (Föhn 1990).1

A view in the snow statistics of the last 60 years shows that there always have been periods rich of snow and poor of snow in the Austrian Alps. The analysis of long term data illustrates that the amount of snow is a varying parameter (Föhn 1990, Brand 1991, Rohrer 1992, Beniston et al. 1994). Föhn (1990) lined out that there are winters poor of snow every three to six years. The scientists came to the conclusion that snow cover duration can hardly be used as an indicator of climate change. In contrast to the situation in the Alps, Pfister (1994) was able to deduce a clear tendency for the midlands of Switzerland. His data shows that from the end of the 17th until the end of the 19th century there have been on the average 60 days of snow cover duration a year. The number of days with snow coverage decreased to an average of 46 days a year for the period 1895-1987 and further to an average of 20 days a year in the period 1988-1994.

This accords to the result of a survey that was conducted in Austria. Hantler et al. (2000) identified regions in an elevation of 500 to 1,500m as extremly sensitive to decreasing seasonal snow cover duration under conditions of increasing temperatures. The snow models forecast for that areas decreases by 34-46% in snow cover duration, corresponding to a decrease of 31 days per season in winter and 42 days per season in spring. The authors have published this results with the addition that the results should not be over interpreted because of limitations of the methods and of the data analysis (Hantler et al 2000: 638).

The loss of assured snow in many winter sport regions is expected to get an important reason for declining visitor numbers especially in the lower areas of the alpine space. The use of artificial snow can only extenuate the circumstances. The production of artificial snow is also limited to specific temperatures in wintertime (average at least -3°C). Additional artificial snow is incriminated with a negative image especially at people coming from outside the alpine space (Pröbstl 2000) and its strong ecological impacts (e.g. consumption of resources and impacts on growing seasons). Therefore the scientists forecast a further spatial concentration of winter sport tourism in higher mountain areas with many days of snow including a intensive competition by prices and capacities (Abegg 1996, Bürki 2000, Bachleitner and Aigner 1998).

2.2 Winter sport under conditions of Climate Change

Winter sport tourism has some special characteristics, which distinguish it from other types of tourism. According to Jülg (2004: 249ff) these distinguishing marks are:

the comparativly short cyclical course of action,

the high creation of monetary value in a short period of time and

the strong temporal and spatial concentration and dependence on special spatial needs.

The development of the last decades shows some significant trends in winter sport tourism. The constancy of chosen destinations and the duration of stay decreases. The tourists are willing to travel further to holiday destinations that are assured of snow and have high quality of accommodation and entertainment.

The increasing skill levels of users, their ever increasing demands on quality, and their increasing travel expertise, combined with improved transportation infrastructure have increased the mobility of winter sport tourists to unprecedented levels.

The strong dependence of many regions on winter sport tourism and the strong power of the winter sport tourism related actors led to high investments that even overtop the benefits in the past. The alp media information service published the following statistic about the investments in French ski destinations on 23.01.2005:

"In 2004 France's winter sport resorts invested 348 million euros - more than ever before - in refurbishment and upgrade measures. In the last ten years, such investments have increased by about 200 percent compared with only 50 percent for ski area turnover. The number of skier days per season is now stagnating at 63 million" (http://www.alpmedia.net/d/index3.asp?newsdetail.asp?NewsID=1543&Sprache=1|2|navi.asp?0|1 at 23.01.2005).

The total annual turnover of Austrian cable car companies was 907 Mio. € in 2004/05. In addition to the running costs they invest 512 Mio. € in the season 2005/2005 again (Fachverband der Seilbahnen 2005). The daily expenditure of the cable car companies for each guest is € 18,50. Additional they have investments of about € 9,00 per guest and day. According to the Fachverband Seilbahnen Österreichs, Austria has the best costs-benefits relation in Europe (Fachverband der Seilbahnen 2005). But the cable car companies are already working at their profitability limits. The condition of a warming would require investments in the extension of ski areas in higher altitudes and in the further infrastructure for artificial snow making. In addition to the investments it would call for higher expenditure for artificial snowmaking itself. Already at the beginning of this winter, the discussion arose whether the cable car companies have to bear with the increasing costs on their own or with any support by other profiting winter tourism industries. They pointed out, that they cannot transfer the additional costs for artificial snow making to the customers by higher lift fares anymore (Der Standard, 07.11.2005).

It is sure that a climate change would affect the Austrian ski destinations in different ways. According to Breiling (1993) especially the ski destinations in lower regions of the Alps would have to bear with negative effects concerning their snow and ski quality.

1 There are some definitions, when a destination is called sure of snow. Widmer (1978) defines four levels of snow sureness based on the share of days between December and March with a snow cover of at least 30cm.

Scientists are expecting a spatial and temporal concentration of ski activities for the future (Abegg 1996, Bürki 2000, Bachleitner and Aigner 1998). The adaptation strategies of the winter sport related industries are diverse. The measures of the cable car companies to guarantee ski sport range possibilities from the extension of ski infrastructure to higher altitudes, the expansion in glacier areas to the investment in artificial snow making. Representatives of the regional tourist branch are discussing snow independent substitutes, investment in 4-season-tourism and further strategies to connect customers with the region (figure 1). Many practical and scientific projects are dealing with effectiveness and feasibility assessment.

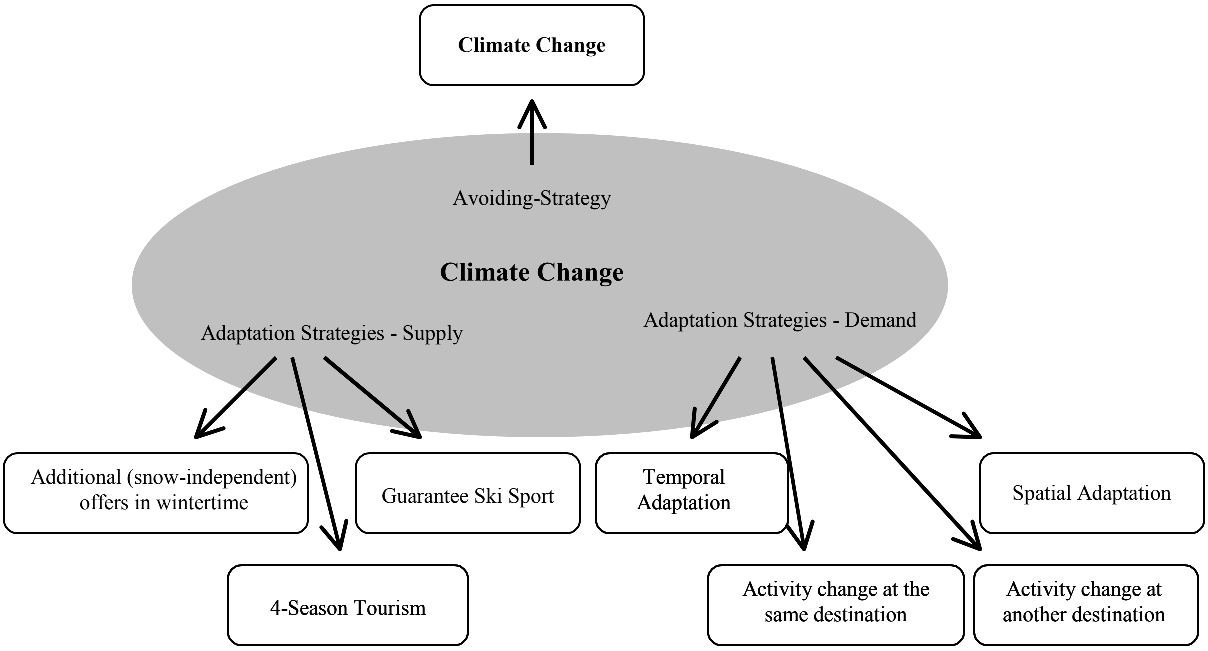


Figure 1: Adaptation strategies in winter sport tourism under conditions of Climate Change (according to Bürki & Elsasser 2003)

2.3 Characteristics of winter sport tourists

There are only few surveys about reactions and adaptation strategies of winter sport tourists and the topic what will happen, if the conditions are changing for example under conditions of a warming. How will the skiers and boarders react?

One of these surveys is conducted by Bürki (2000). He investigated the hypothetical behaviour of winter sport tourists by asking them, where and how often they would go skiing, if there are sequences of five winters lacking snow. The respondents could choose between standardised answers.

30% would haunt the same location with the same frequency and 11% would haunt the same location but less often.

28% would haunt locations that have a longer duration of snow coverage with the same frequency and 21% would go there less often.

4% would stop skiing and 6% did not know (www.ch-forschung.ch/index.php?artid=126 am 10.01.2005).

The association of Austrian cable car companies is regularly conducting costumer satisfaction surveys. The results of these surveys show, that the skiers are very satisfied with the skiing conditions in Austria. This is also proved by the high share of regular customers of 47%. According to an analyse of the market research company MANOVA the main motive of winter sport tourist to come to Austria is "Mountain and Snow" (MANOVA 2002).

But they also figured out, that snow doesn't mean the same to all winter sport tourists. The decision for the type of activity and the place where it takes place bases generally on a complex system of values. For winter sport it is a mixture of sport, fun and challenge, communication, entertainment and nature, landscape and recreation. The combination of this motives has strong impacts on the activity and destination choice of the tourists and therefore a strong relation to their adaptation strategies under conditions of climate change.

MANOVA (2002), for example, identified at least nine types of winter sportsmen out of a group of 6,300 active skiers:

Entertainment orientated winter sportsmen - they focus on the restaurant, Après Ski and nightlife (19% of the 6.300 test persons),

Snowboarders – they expect additional infrastructure on the slopes as well as nightlife and entertainment (7%),

Classic Skiers – for them the quality of slopes, cable cars and gastronomy is most important (12%),

Recreation orientated skiers – they focus on composition of the whole destination, including landscape, slopes, gastronomy but also prices (13%),

Sun & Fun Skiers – they often travel in groups and prefer sunny ski-runs and high quality gastronomy (7%),

Athletic nature orientated Skiers – they prefer an intact beautiful landscape and ski-runs of high quality (13%), Nature Connoisseurs – they want to experience an intact landscape, nice views and safe ski-runs of high quality (19%).

These motives influence the decision making process. According to an inquiry of MANOVA 56% of the visitors made their decision for a ski destination because of the snow situation in this destination. A share of 55% mentioned the size of the area as the strongest argument. Only 20% argued with the prices.

All these dynamics cause spatial and temporal fluctuations of tourists, which in turn lead to impacts on the economic and social development of the ski regions. But soever ecological impacts should not be neglected, which are consequences e. g. of intensive use of preferred ski regions, increasing utilisation of natural resources for technical snowmaking and shortening of growing seasons because of longer snow coverage by technical snow. Examples from Germany, Switzerland and Austria from the 1990ies show also that the shut down of ski services and the deconstruction of ski infrastructure offers new potentials for renaturation and groundwater protection (e.g. Dobratsch, Austria and Gschwender Horn, Germany). These impacts are of strong relevance for spatial planning. For an effective resource management, a foresighted spatial planning detailed information about actual and future preferences of people are needed as well as an instrument that facilitates the trade offs in decision making. The share of almost 50% of winter sport tourists who would change the ski destinations under conditions of less snow (Bürki 2000) emphasises the importance of further research on the changes in destination choice and the preferences of of skiers and boarders. The various intensions and values of winter sportsmen, which lead to the decision for an activity and the location, where it takes place, make it difficult to foresee the adaptation processes of winter sport tourists under conditions of climate change.

3 METHODS OF INVESTIGATION

Therefore this project is following an individual orientated approach trying to find out how people react on changes in winter sport conditions and to estimate the consequences for the alpine regions dependent on winter sport tourism. An adequate method for that approach is the Discrete Choice Experiment (DCE), which allows to ask for preferences and choices in hypothetical situations. Discrete Choice Experiments have been successfully applied to spatial consumer choice behaviour (Timmermans et al. 1992), to tourism and recreation issues (see Louviere & Timmermans 1990, Haider & Ewing 1990), to resource economics (Swallow et al. 1994, e.g. willingness to pay) and for comparison of stated and revealed preferences (Boxall et al. 1996). In this survey the DCE is combined with a standardise questionnaire. The samples consists of 600 active skiers and boarders, who are living in Vienna. To map the decision making process and the trade-offs between different ski destinations as close to reality as possible, the probands will be interviewed at their origins. Usually the destination choice is made at the place of residence. The interview of customers on site – in a ski destination – may overlap some important, the decision affecting determinants by liaising with the actual whereabouts.

The inquiry is conducted by an internet-based questionnaire. This instrument is offering some advantages. On one hand it is a cost-effective way to reach a high amount of test persons and allows to outread the data directly into a data base. On the other hand it offers comfortable options of visualisation the choice sets for the Discrete Choice Experiment and the individual adaptation of the questionaire.

In the first part of the questionnaire the test persons are asked about their former and current skiing behaviour. The aim is to find out:

the key aspects related to the skiing biographies, e.g. where the persons started skiing, which destinations they mainly visited

the reasons why they sometime changed their ski destination,

the amount of trips in former and current seasons,

the salient determinants for the destination choice respectively the individual important criteria for the quality of a ski destination,

the associations and own experiences with climate change and their adaptations in travel behavior in case of winters with lack of snow.

In the second part of the questionnaire the Discrete Choice Experiment is conducted. The Discrete Choice Experiment is chosen to model future hypothetical shifts in travel behaviour and destination choice under conditions of climate change (stated choice). It gives an idea of the contingent reactions and destination choices of tourists and helps to identify the dominant determinants for decisions. As modelling destination choice is the main purpose of this project, the method of multi-attribute-preference research is explained in the following.

In multi-attribute preference research it is necessary to distinguish between at least two approaches.

1. revealed preference/choice
2. stated preference

The approach of revealed preferences infers the importance of salient variables influencing the decisions by statistical analysis from actual behaviour. Discrete Choice Models relying on revealed preferences are successfully applied in transportation research, spatial analysis and recreation (Ben-Akiva 1985, Train 1986, Wrigley 1985, Stynes & Peterson 1984). According to the approach of stated preferences the survey respondents evaluate hypothetical questions. Among the stated preference approaches there is a distinction between compositional and decompositional methods (Timmermann 1984).

The compositional approach such as the theory of reasoned action (Ajzen & Fishbein 1980) assumes that each aspect, in this case of the destination performance, prices, snow cover duration and travel conditions is evaluated separately. Thereafter the researcher calculates the overall utility value for hypothetical alternatives by combining the attributes of each alternative. Decompositional models define alternatives as combinations of a set of attributes and the respondents evaluate each set separately and as it whole. Each alternative profile is different to the others.

This approach takes the multi-attribute nature of destination choice into account and allows also an exploration of non-existing alternatives that supports the scenario conduction (Haider 2002, Timmermans 1984, Timmermans & Golledge 1990). The construction of the alternative profiles bases on a fractional factorial design (Raktoe 1981). The method of ranking and rating a full profile is usually referred to the conjoint analysis (Haider 2002, Green & Srinivasen 1978).

Advantage of the DCE as an multi-attribute decompositional approach is that the analysis of choice is closer to actual behaviour than ranking and rating tasks of other surveys. The attributes are considered in the context of each other. The theoretical discussion about the different approaches shows that the approach of stated preferences and decompositional approaches is a suitable approach to survey future hypothetical behaviour of people. The destination choice is dependent on the characteristics of the alternatives and of the preferences of the travellers. The DCE integrates both and it also takes to complex nature of the survey question in to account to deal with both an unknown future according to the climate change, the former and current experiences with winter sport activities and the hypothetical adaptation processes of individuals.

Construction of a Discrete Choice Experiment

In a Discrete Choice Experiment (DCE) one or more hypothetical profiles are combined to choice sets. Each profile is described by some attributes and their levels. From each choice set the respondents have to chose the most preferred alternative (Louviere & Woodworth 1983, Louviere et al. 2000). For the analysis a multinomial logit regression model is used. According to Haider (2002) the DCE combines "the analytic elegance of the random utility model (see McFadden 1974) and the experimental rigour of conjoint analysis".

The construction of a DCE is basically organised in at least three steps:

1. Defining the attributes and attribute levels is the most important aspect in conducting DCE. The existing literature gives a lot of hints, what relevant attributes might be. Further information about relevant attribute is gained by interviews with experts of market and tourism research. Relevant attributes and attribute levels in case of this survey considering the destination choice of winter sport tourist are the following:

Attributes	Attributes levels	
Share of ski runs over 1.500m		
	10%	0
	50%	1
	70%	2
Total length of ski-runs in km		
	up to 50 km ski-runs	0
	50 to 120 km ski-runs	1
	more than 120 km ski-runs	2
Share and amount of days with guaranteed snow in the 90 days of the main season		
	50% (up to 45 days)	0
	66% (up to 60 days)	1
	90% (up to 81 days)	2
Share of ski runs with infrastructure for artificial snowmaking		
	30%	0
	60%	1
	90%	2
Waiting time at Gondola Peak Time		
	more than 25 min	0
	10 to 25 min	1
	less than10 min	2
Fares for Ski-Lift per day		
	€55	0
	€40	1
	€30	2
The ski destination has an Environmental Certificate.		
	yes	0
	no	12
Travel distance between Place of Residence and Ski Destination		
	less than 250 km	0
	250 to 500 km	1
	500 to 650 km	2

Table 1: Attributes and attribute levels of the first sequence of choice sets

Profiles or alternatives have to be defined by the combination of sets of attributes. The profiles of this experiement consists of nine attributes. Each attribute has two to three levels. Because of the high number of attributes and attributes' levels a fractional factorial design is applied, even if not all interactions may be estimable.

2. The hypothetical profiles are combined to a choice sets by following the factorial design plan (see Louviere & Woodworth 1983, Louviere 2000).

In this survey a design with two sequences is used (see figure 2). In the first step we show the test persons a choice set of two profiles of winter sport destinations. There is no base alternative in the first sequence, so the respondents are forced to decide for the most preferred alternative from the set they are asked to evaluate. In the next step a new frame is shown, where a third alternative is presented. It is comparable to the chosen one in almost all attributes but in sureness of snow, travel distance and costs. The third alternative destination is absolutely sure of snow but the costs and travel distances of this journey are much higher than of the already chosen destination. According to a rota system we also show the first choice and the snow sure alternative in the second sequence.

But this time the destination of the first choice is characterised by some excellent snow independent infrastructures like indoor- and outdoor-sport and leisure facilities, wellness, cultural programme, gastronomy and entertainment. In both cases the respondents have to decide whether they keep the first choice or turn to the new alternative. The idea of this design is to find out how the respondents evaluate the sureness of snow respectively the existence of snow independent substitutes.

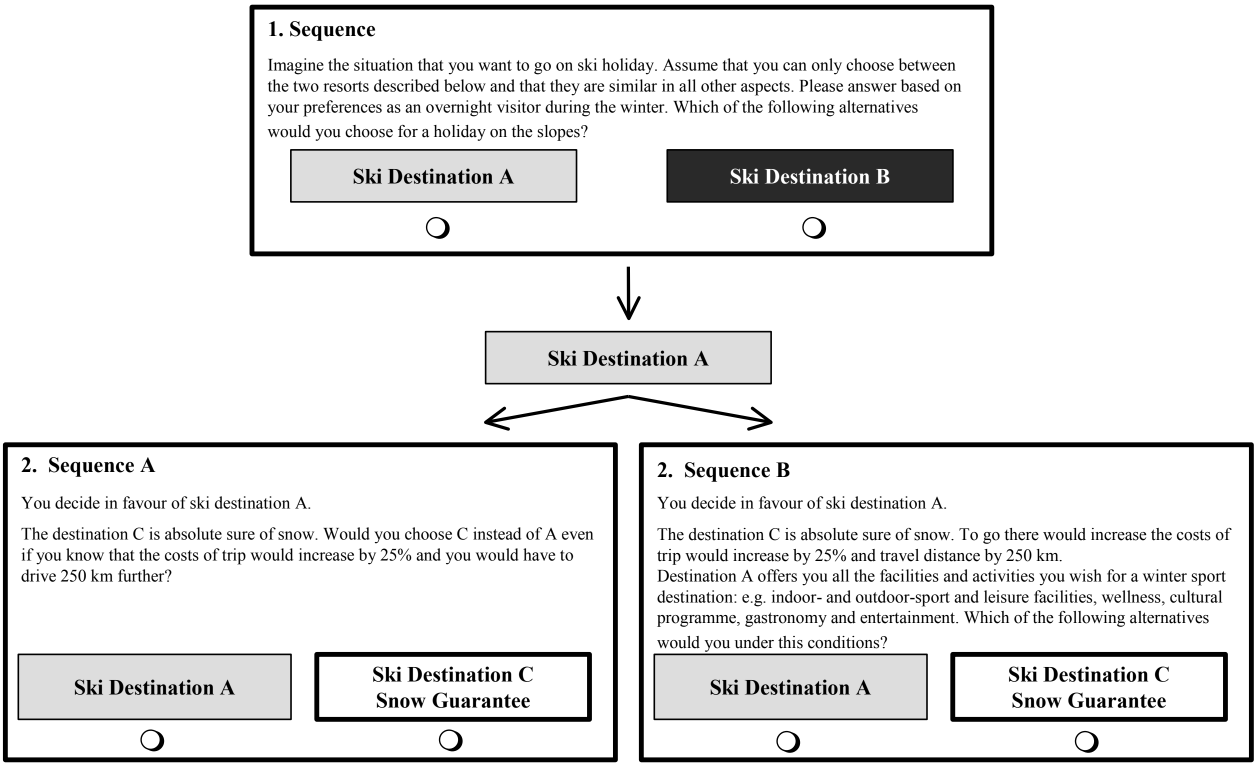


Figure 2: Design of the experiment (schematic graph)

3. Discrete Choice Modelling bases on the Random Utility Theory (RUT), which posits that the benefit an individual recieves from a given alternative is observable with some degree of uncertainity. The choice of an individual is taken as the choice of a representative individual. Each individual holds an own utility function, which is determined by the characteristics of the alternative, the charateristics of the available subsitutes and some interperson taste-differences, that explain the variety of preferences. The RUT assumes that the individual acts according to the principle of utility maximisation.

The statistical analysis bases on the general assumptions of random utility models (see Proenca 1995, I.; Halperin, W. C. et al. 1984). Random Utility Models model the factors that influence the destination choice of test persons.The selection of one alternative over another implies that the utility of the chosen alternative is higher than the other. Each alternative has an overall utility which is represented by an utility function containing a deterministic and a stochastic component $U_{ni} = V(Z_i * W_{ni} * Y) + \varepsilon_{ni}$ (McFadden 1974).

That means in a simple case that the overall utility gained by the i-th individual be expressed by the sum of determinante component V and the random number ε. V represent the utility expectation of an individual i influenced by the determining attributes. The factor ε represents the unknown factors of the individual decisions as well as the differences between the indivual behaviour and the behaviour of the representativ individual. V is a vector, which integrates the levels of all determining attributes of an alternative and the exogene variable z, the edogene attributes of the alternatives W and the unknown vector of parameters Y.

Because of the stochastic component the function describes the probability of choosing a single alternative. The regression estimates for each attribute level the part worth utility and therefore their relevance for the decision. The individual chooses that alternative, for which the expected utility is the highest of all other alternatives: $\Pr op\{i - chosen\} = prob\{V_i + \varepsilon_i > V_j + \varepsilon_j; \forall j \in C\}$ (McFadden 1974).

4 OUTLOOK

The survey aims to establish scenarios of future development potentials of Austrian alpine regions to estimate their attractiveness for winter sport under conditions of climate change. A Decision Support System (DSS) for future investment and planning guidance is offered to support a sustainable development involving trade offs between several desirable interests. It considers possible climate developments, trends in tourism, spatial resistances, the performance of skiing regions and socio-economic developments in the society. It gives local decisions makers and investors an idea about the future development potentials in winter sport tourism under conditions of climate change. The decompositional nature of the Discrete Choice Experiment added by the part worth utilities allows the evaluation of any profile that can be generated out of the used attributes and attribute levels and offers the opportunity to model the joint effects of changes in destination choice. By modelling the destination choice of winter sport tourists, the future demand on the regions and on their performances can be estimated. The DSS helps to estimate the development potentials of various destinations and to qualify the necessary supply and therefore supports the consideration of social, ecological and economic impacts for a sustainable regional development.

5 REFERENCE LIST

ABEGG, B.: Klimaänderung und Tourismus - Klimafolgeforschung am Beispiel des Wintertourismus in den Schweizer Alpen. Zürich, Hochschulverlag AG an der ETH Zürich. 1996

AJZEN, I. & FISHBEIN, M.: Understanding attitudes and predicting social behaviour. New York: Prentice Hall. 1980

BACHLEITNER, R. & AIGNER, A. [Ed.]: Alpiner Wintersport - eine sozial-, wirtschafts-, tourismus- und ökowissenschaftliche Studie zum alpinen Skilauf, Snowboarden und anderen alpinen Trendsportarten, 3., völlig neu bearb. Aufl.. Innsbruck; Wien. 1998

BEN-AKIVA, M. & LERMAN, S.: Discrete Choice Analysis: Theory and Application to Travel Demand. Cambridge, MA:MIT Press. 1985

BENISTON, M. et al.: Beniston, M.; Ohmura A.; Rotach M.; Tschu, P.; Wild, M.; Marinucci M.R.: Simulation of Climate Trends over the Alpine Region. Schlussbericht NFP 31, ETH Zürich. 1994

BOXALL, P.C.; ADAMOWICZ, W.; SWAIT, J.; WILLIAMS, M. LOUVIERE, J.: A comparison of stated preference methods for environmental evaluation. Ecological Economics 18(2), 243-253. 1996

BRAND, J.: Klimaänderung im Alpenraum – Schneehöhen und Temperatur der achtziger Jahre im Vergleich mit langjährigen Messrehen ausgewählter Stationen. Geographisches Institut Bern. 1991

BREILING, M.: Die zukünftige Umwelt- und Wirtschaftssituation peripherer alpiner Gebiete. Dissertation am Institut für Landschaftsgestaltung, Universität für Bodenkultur, Wien. 1993

BÜRKI, R. & ELSASSER, H.: Auswirkungen von Umweltveränderungen auf den Tourismus – dargestellt am Beispiel der Klimaänderung im Alpenraum. In: Becker, Ch; Hopfinger, H.; Steinecke, A. (ed.).Geographie der Freizeit und des Tourismus. München. 2003

BÜRKI, R.: Klimaänderung und Anpassungsprozesse im Wintertourismus. St. Gallen. 2000

COHEN, S.J.: Climate Change and Climate Impacts – please do not confuse the two! Global Environment Change Vol. 3(1), S. 2-6. 1993

DER STANDARD: Seilbahnen wollen Geld nicht alleine verpulvern. Wien. 07.11.2005

EWERT, A.T.: Outdoor Recreation and Global Climate Change: Resource Management Implications for Behaviours, Planning and Management. Society and Natural Resources Vol. 4, 365-377. 1991

FACHVERBAND DER SEILBAHNEN ÖSTERREICHS: Wintersport weiter im Aufwärtstrend-Österreichs Seilbahnen startklar für die Saison 2005/06. Presseaussendung vom 26.09.2005. (http://www.seilbahnen.at /presse/ presseaussendungen/pr/2005-09-26saisonstart am 29.09.2005)

FÖHN, P.: Schnee und Lawinnen. In: Schnee, Eis, und Wasser der Alpen in einer wärmeren Atmosphäre, International Conference, Mitteilung VAW ETH Zürich Nr. 108. 33-48. Zürich. 1990

GREEN, P.E. & SRINIVASEN, V.: Conjoint Analysis in Consumer Research: Issues and Outlook. Journal of Consumer Research 5, 102-123. 1978

HAIDER, W. & EWING, G.O.: A model of tourist choices of hypothetical Caribbean destinations. Leisure Science 12, 33-47. 1990

HAIDER, W.: Stated Preference & Choice Models – A Versatile Alternative to Traditional Recreation Research. In: Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings ed by A. Arnberger, C. Brandenburg, A. Muhar 2002, 115-121. 2002

HALPERIN, W.; GALE, N. : Toward behavioural models of Spatial Choice: Some recent developments. In: Pitfield, D.: Discrete Choice Models in Regional Science. London Papers in Regional Science, Nr. 14, 1984

HANTLER, M. et al. : Climate Sensitivity of Snow Cover Duration in Austria. International Journal of Climatology 20, 615-640. 2000

JÜLG, F. (Ed.):Tourismus im Hochgebirge. Symposium über Ökologische, Ökonomische und Soziale Fragen, Wiener Geographische Schriften, Nr. 64. Heiligenblut, Kärnten. 1993

LOUVIERE, J. & TIMMERMANNS, H.: Stated preference and choice models applied in recreational research: A review. Leisure Science 12, 9-32. 1990

LOUVIERE, J. & WOODWORTH, G.: Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data. Journal of Marketing Research 20(4), 350-366. 1983

LOUVIERE, J.; HENSHER, D.A.; SWAIT, J.: Stated Choice Methods. Cambridge, UK: Cambridge University Press. 2000

MANOVA Innovative Marktforschung – Strategische Marktberatung – Online Informationsmanagement: Wintersportler unter der Lupe: Zielgruppenanalyse für Österreich. Presseinformation vom 30.12.2002

MCFADDEN, D: Conditional logit analysis of qualitative choice behaviour. Frontiers in Econometrics ed P. Zamembka (new York: Academic Press), 1974, 105-142. 1974

PFISTER, Ch.: Während sieben Jahren kaum noch Schnee im Schweizer Mittelland: Einmalige Schneearmut seit mehr als 300 Jahren. NFPNR 31 info 5, Programmleitung NFP 31 (Ed.). 1-12. Bern. 1994

PRÖBSTL.U.: Beschneiungsanlagen im Alpenraum, Bestand - Auswirkungen -Tendenzen, in Technische Beschneiung und Umwelt. In: Bayerisches Landesamt für Umweltschutz: Fachtagung zur technischen Beschneiung, 15.November 2000, 15-24, Augsburg. 2000

PROENCA, I.: Testing the link specification in binary choice models. A semi parametric approach. In: Faculté des Sciences Économiques, Sociales et Politics (Ed.): Nouvelles Séri : Nr. 259, Louvain-la-Neuve, 1995

RAKTOE, B.L.; Hedayat, A.; Federer, W.T.: Factorial Designs. New York: John Wiley and Sons. 1981

ROHRER M.: Die Schneedecke im Schweizer Alpenraum und ihre Modellierung. Zürcher Geographische Schriften, 49. ETH Zürich. 1992

STANHILL, G. C. & SHABTAI: Global Dimming: a review of the evidence for a widespread and significant reduction in global radiation with discussion of its probable causes and possible agriculture consequences. Agriculture and Forest Meteorology 107, 255-278. 2001

STYNES, D.J. & PETERSON, G.L.: A review of logit models with implications for modeling recreation choices. Journal of Leisure Research 16(4), 295-310. 1984

SWALLOW, S.K.; WEAVER, T.; OPALUCH, J.J; MICHELMAN, T.S.: Heterogeneous preferences and aggregation in environmental policy analysis: A landfill sitting case. American Journal of Agriculture Economics 76, 431-443. 1994

TIMMERMANNS, H. & GOLLEDGE, R.G.: Application of behavioural research on spatial problems II: Preference and choice. Progress in Human Geography 14(3), 311-334. 1990

TIMMERMANNS, H.: Decompositional multiattribute preference models in spatial choice analysis : A review of some recent developments. Progress in Human Geography 8(2), 189-212. 1984

TRAIN, K.: Qualitative Choice Analysis – Theory, Econometrics and Application to Automobile Demand. Cambridge, MA: MIT Press. 1986

WITMER, U.: Die mittleren Seehöhen und die Schneesicherheit im Kanton Bern. Jahrbuch der Geographischen Gesellschaft von Bern, Band 52/1975-76, Liebefeld/Bern, p. 59-112. 1978

WRIGLEY, N.: Categorical Data Analysis for Geographers and Environmental Scientists. London: Longman. 1985

🏆 reviewed paper

Entwicklung einer Geodateninfrastruktur zur Ableitung von Geoinformationen aus distributiven Datenbeständen

Christian KIEHLE

(Geographisches Institut der Universität Bonn, Meckenheimer Allee 166, D-53115 Bonn;. kiehle@giub.uni-bonn.de)

1 ZUSAMMENFASSUNG

Im Rahmen des BMBF- / DFG- Sonderprogramms Geotechnologien „Informationssystem im Erdmanagement“ (vgl. Rudloff et al. 2001 und Stroink 2001) bearbeitete der Lehrstuhl für Ingenieurgeologie und Hydrogeologie der RWTH Aachen in Kooperation mit dem Forschungszentrum Jülich GmbH – Programmgruppe Systemforschung und Technologische Entwicklung – sowie mit der ahu AG ein dreijähriges Forschungs- und Entwicklungsvorhaben. Ziel des Vorhabens war es, eine offene Geodaten-Infrastruktur (GDI) zu entwickeln. Diese GDI dient der regelbasierten Ableitung von Geoinformationen aus distributiven, heterogenen Geodatenbeständen.

Neben diesem geomatischen Schwerpunkt wurde im Rahmen des Projektes eine geowissenschaftliche Fragestellung bearbeitet: die Ermittlung der Schutzfunktion der Grundwasserüberdeckung nach Hölting (Hölting et al. 1995) im Einzugsbereich der Flüsse Erft, Rur, Inde und Saubach. Diese Schutzfunktion, welche in drei unterschiedlichen Maßstabsbereichen ermittelt wird, dient als Anwendungsbeispiel zur Entwicklung der o. a. GDI.

Die interdisziplinäre Zusammensetzung des Projektteams (Geologen, Hydrologen, Geotechniker, Geographen, Informatiker, etc.) spiegelt die Interdisziplinarität der Fragestellung an der Schnittstelle zwischen Angewandter Geowissenschaft und Geoinformatik wider.

2 ABSTRACT

Within the scope of BMBF- / DFG- Special Programme Geotechnologies "Information Systems in Earth Management" (see Rudloff et al. 2001 und Stroink 2001) the chair for Engineering Geology and Hydrogeology of RWTH Aachen University carried out a Research-and-Development- Project in close collaboration with Research Centre Jülich - Programme Group Systems Analysis and Technology Evaluation - as well as ahu AG. The overall goal of the project was the development of an open Spatial Data Infrastructure (SDI). The SDI is used for the rule-based derivation of Geoinformation out of distributive, heterogeneous Geodata inventories. Besides this geomatic emphasis within the scope of the project a geoscientific problem is handled as well: the derivation of groundwater vulnerability after Hölting (Hölting et al. 1995) in the catchment area of rivers Erft, Rur, Inde, and Saubach. The groundwater vulnerability, which is acquired in three different scales, serves as an application example for the development of the above mentioned SDI.

The interdisciplinary formation of the project-team (Geologists, Hydrologists, Geotechnicians, Geographers, computer scientists, etc represents the multidisciplinary research aspects of the project ranging from applied geosciences to Geomatics.

3 PROBLEMSTELLUNG UND ZIELSETZUNG

Die Generierung von raumbezogenen Informationen zu Zwecken der Ressourcenplanung und des Umweltschutzes ist in Zeiten digitaler Datenverarbeitung wichtiger denn je. Zwar liegen durch den immer weiter verbreiteten Einsatz von Geo-Informationssystemen (GIS) und die steigende Verfügbarkeit digitaler Datenbestände durch das Internet immer mehr raumbezogene Daten vor, der Planer wird jedoch bei der Entscheidungsfindung nur selten unterstützt. Die für eine spezifische Fragestellung relevanten Informationen müssen aus einer immer unübersichtlicher werdenden Menge an Daten generiert werden. Dieser Prozess ist zeit- und personalintensiv. Darüber hinaus werden vielfach dieselben Daten in unterschiedlichen Institutionen mit unterschiedlicher Genauigkeit erhoben und in unterschiedlichen Dateiformaten vorgehalten. Bei der Informationsgenerierung aus diesen heterogenen (=unterschiedliche Genauigkeiten, unterschiedliche Dateiformate, unterschiedliche Nutzungsrechte) Datenbeständen tritt eine Vielzahl an Probleme auf:

- Mangelnde Interoperabilität: die Daten sind untereinander nicht kompatibel, da sie in unterschiedlichen GI-System erhoben wurden.
- Mangelnde Datenvernetzung: die Daten sind zwar vorhanden, jedoch nicht „vor Ort“ verfügbar; ein zeitaufwändiger Beschaffungsprozess muss in Gang gesetzt werden.
- Mangelnde Metadaten: die Daten sind nicht ausreichen dokumentiert.
- Mangelnde Auflösung: die Daten sind in zu geringer räumlicher Auflösung (Genauigkeit) vorhanden. Eine Neuerhebung ist i. d. R. zu kostenintensiv.

Das Forschungsprojekt hat diese Probleme durch den Einsatz von internetbasierten Technologien (Web- und Geodienste) und die konsequente Nutzung allgemein gültiger und frei verfügbarer Standards des World Wide Web Consortiums (W3C), der International Organization for Standardization (ISO) und des Open Geospatial Consortiums (OGC) überwunden, indem distributive, heterogene Geodatenbestände zur Informationsgenerierung verfügbar gemacht wurden.

Die Schutzfunktion der Grundwasserüberdeckung nach Hölting (Hölting et al. 1995) diente als geowissenschaftliche Fragestellung, an Hand derer die Probleme beispielhaft gelöst wurden. Sie ist eine typische kombinatorische Fragestellung im Bereich der Geowissenschaften, die mit Hilfe von GI-Systemen bearbeitet wird. Daher ist diese ein gutes Beispiel, um ein System zu entwickeln, welches auch auf andere geowissenschaftliche Fragestellungen übertragbar ist.

Die Betrachtung der Schutzfunktion in drei unterschiedlichen Skalenbereichen repräsentiert die typischen Arbeitsbereiche kommunaler Planungsbehörden (~ 1:5.000 Mikroskala), größerer Gebietskörperschaften (~ 1:25.000 Mesoskala) und Landes- bzw. Bundesbehörden (~ 1:50.000 Makroskala). Dabei ist die Schutzfunktion in allen drei Skalenbereichen mit den für die räumliche Auflösung typischen Basisdaten zu modellieren. Das Ergebnis hat dabei nicht den Anspruch höchster Genauigkeit, sondern repräsentiert eine Betrachtungsweise, wie sie in der Planungspraxis umsetzbar ist.

4 DIE SCHUTZFUNKTION DER GRUNDWASSERÜBERDECKUNG

Das Konzept der Schutzfunktion der Grundwasserüberdeckung nach Hölting (Hölting et al. 1995) beschreibt an Hand eines dimensionslosen Punktwertes die Verweildauer des Sickerwassers in der Grundwasserüberdeckung in einem Zeitraum von „wenige Tage bis etwa 1 Jahr (= sehr geringe Schutzfunktion)“ bis hin zu „>25 Jahre (= sehr hohe Schutzfunktion)“ (Diepolder 1995, S. 24). Dabei wird die Bewertung an Hand von fünf klassifizierten Eingangsdatensätzen vorgenommen und nicht aus Basisdaten abgeleitet. Die Eingangsdatensätze (vgl. Tab. 1) sind die für die jeweilige Skala typischen Datensätze, welche in der Planungspraxis zur Anwendung kommen.

Aus diesen Eingangsdatensätzen werden fünf Parameter bewertet (vgl. Diepolder 1995, S. 19ff.):

- Boden: Einteilung in fünf Klassen gemäß der nutzbaren Feldkapazität bis 1 Meter Tiefe
- Tiefere ungesättigte Zone: getrennte Bewertung von Locker- und Festgesteinen (insbesondere deren Mächtigkeit), wobei bei Festgesteinen zusätzlich strukturelle Eigenschaften bewertet werden.
- Sickerwasserrate: Ableitung auf Basis des GROWA-Modells (Kunkel et al. 2002)
- 2 Parameter zur Bewertung besonderer hydrogeologischer Situationen (schwebende Grundwasserstockwerke und artesische Druckverhältnisse)

Tab. 1: Eingangsdatensätze und deren räumliche Auflösung auf drei Skalenebenen (verändert nach BOGENA et al. 2004, S. 31)

	Mikroskala	Mesoskala	Makroskala
Maßstab	~ 1:5.000	~ 1:25.000	~ 1:50.000
Klima	Interpoliertes GRID (10 m x 10 m)	Interpoliertes GRID (25 m x 25 m)	Interpoliertes GRID (50 m x 50 m)
Boden	BK 50 (1:50.000)		
Geologie	Bohrdatenbank, diverse, z. T. analoge Quellen	HK 25 (1:25.000),	HK 100 (1:100.000),
Landbedeckung	Flächennutzungspläne (1:5.000)	DLM 25 (1:25.000)	CORINE Land Cover (1:100.000)
Digitales Gelände-modell	DGM 5 (10 m x 10 m)	DGM 25 (50 m x 50 m)	
Tiefe des ersten Grundwasserleiters	Interpolation über GW-Messstellen des StUA Aachen	Interpolation über GW-Messstellen des Erftverbandes	
Besondere hydro-geologische Situation	Mangels Datengrundlage nicht bewertet		

Diese Parameter werden gemäß der Abb. 1 zur Gesamtschutzfunktion verknüpft. Das Ergebnis ist für drei verschiedene Maßstabsbereiche ein Punktwert, der die Schutzfunktion der Grundwasserüberdeckung darstellt. Eine ausführlichere Vorstellung der Ergebnisse der Schutzfunktionsbewertung auf den drei Skalenebenen findet sich bei Bogena et al. 2004 sowie für die Mikroskala in Berger 2003. Ein klassischer Anwendungsfall für die Berechnung der Schutzfunktion ist die im Rahmen des Hydrologischen Kartenwerks NRW herausgegebene Karte „Risiko von Stoffeinträgen in das Grundwasser“ (vgl. Wimmer et al. 2001). An Hand dieser Bewertung kann beispielsweise eine a priori Analyse für die Standortplanung von Gewerbegebieten oder anderen emittierenden Infrastruktureinrichtungen erfolgen.

Die in Tabelle 1 aufgeführten Daten liegen in der Regel nicht an einer Stelle vor, sondern sind von diversen Institutionen der Öffentlichen Hand zu beiziehen. Um den Prozess der Datenbeschaffung, Reklassifizierung, Bewertung und Darstellung zu erleichtern, ist es sinnvoll sich Methoden der Informationstechnologie und der Geoinformatik zu bedienen.

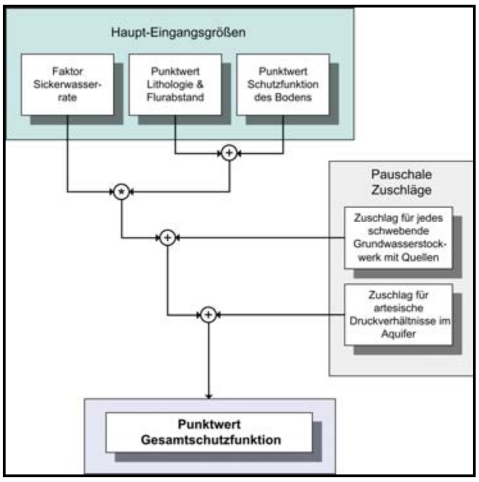


Abb. 1: Vereinfachte Darstellung der Eingangsdaten und Verknüpfungsregeln zur Ermittlung der Gesamtschutzfunktion (verändert nach WIMMER et al. 2001, S. 529)

5 VON DISTRIBUTIVEN GEODATEN ZU GEOINFORMATIONEN

Bei der Akquirierung und Nutzung verteilt vorliegender Datenbestände sind vor allem die o. a. Probleme der mangelnden Interoperabilität, Dokumentation, Vernetzung und Existenz zu überwinden. Zu diesem Zwecke ist zum einen das Konzept der Webservices (vgl. Snell et al. 2002) hilfreich, zum anderen das Konzept der Geodaten- Infrastrukturen (vgl. Bernard et al. 2004b, Nebert 2001).

Ein Webservice ist eine Abstraktionsschicht, die unabhängig von Programmiersprachen und Systemplattformen ist (vgl. Bettag 2003). So können mittels Webservices z. B. verschiedene GIS-Applikationen miteinander kommunizieren und Daten austauschen. Die Kommunikation erfolgt über SOAP und das Hyper Text Transfer Protocol (HTTP) (vgl. Snell et al. 2002). Das World Wide Web Consortium (W3C) beschäftigt sich mit der Standardisierung von Webservices (vgl. W3C 2003). Ein Webservice, welcher die Verarbeitung oder Bereitstellung von Geodaten ermöglicht wird auch als Geowebservice bezeichnet.

Standardisierungsprozesse für raumbezogene Daten werden im hohen Maße vom Open Geospatial Consortium (OGC) vorangetrieben. Insbesondere zu den Themen Kartendarstellung (Open GIS Consortium 2002a), Vektordaten- Darstellung und -Informationsabfrage (Open GIS Consortium 2002c), Rasterdatendarstellung (Open GIS Consortium 2001a), Koordinatentransformation (Open GIS Consortium 2001b), Katalogdienste (Open GIS Consortium 2002b) und zur Kommunikation mittels semi- strukturierter Daten (Open GIS Consortium 2003) in Form von GML-Features hat das OGC auf Basis intensiver Bemühungen in Kooperation mit Industrie, Wissenschaft und Verwaltung Standards im Bereich der Geodatenverarbeitung etablieren können.

Die vom OGC empfohlenen Standards garantieren ein hohes Maß an Interoperabilität und Herstellerunabhängigkeit. Damit liefern sie die Grundlage für ein zukunftsfähiges Geodatenmanagement. Die bislang divergierenden Entwicklungen im Standardisierungsbereich zwischen W3C und OGC (vgl. Tabelle 2) sollen in näherer Zukunft überwunden werden (Savage & Sonnet 2003 und Sonnet 2004), womit ein weiterer Schritt in Richtung Interoperabilität geschehen wird.

Tab. 2: Beispielhafte Darstellung von Inkonsistenzen zwischen W3C und OGC Standards (verändert nach AUMANN ET AL. 2003, S. 18)

Definition Webservice	W3C	OGC
Servicebeschreibung	WSDL	Get Capabilities Operation
Nachrichtenformat	SOAP / XML	HTTP GET Key/Value-Pairs, GML
Webservice Veröffentlichung / Suche	UDDI	OGC Service Registry

Die Techniken der Webservices und der Offenen Standards im Bereich des Geodatenmanagements gipfeln im Konzept der Geodateninfrastruktur (GDI). Eine Geodateninfrastruktur „ist dem Sinne nach Vergleichbar zu anderen […] Infrastrukturen wie z. B. dem Verkehrsnetz. Sie besteht aus einem raumbezogenen Rahmenwerk, welches grundlegende […] Geometrien mit fachlichen Thematiken kombiniert, die von allgemeinem Interesse sind[…]“ (Bill et al. 2001, S. 107). Eine GDI bündelt demnach Geoinformationsressourcen; darüber hinaus besteht die Möglichkeit, Methoden für die Verarbeitung und Informationsgewinnung in eine GDI einzuspeisen.

Im Hinblick auf die Schutzfunktionsberechnung sind die Eingangsdaten zunächst über einheitliche Schnittstellen im Internet verfügbar zu machen. Dies geschieht im Falle von Vektordaten (z. B. Faktor Boden) über die Bereitstellung als Web Feature Services und im Falle von Rasterdaten (z. B. Faktor Sickerwasserrate) über die Bereitstellung als Web Coverage Services (WCS). Dabei ist davon auszugehen, dass in einer landes- oder bundesweiten GDI (z. B. www.gdi-nrw.org, www.geomis.bund.de in Deutschland oder beispielsweise www.geoland.at in Österreich) die Datenerzeuger (z. B. Landesvermessungsämter, Staatliche Umweltämter, etc.) ihre Daten der Öffentlichkeit über die Technologie der Webservices zur Verfügung stellen. Da im Rahmen des Projektes diese Infrastruktur noch nicht vorzufinden ist, simulieren die Projektpartner die Bereitstellung der Geodaten über Webservices als projektinterne GDI.

Die Schicht der Datenhaltung (Abb. 2, Data-Tier) kommuniziert über das Standardprotokoll des Internets HTTP mit der sog. Geschäftslogik-Schicht (Abb. 2, Business-Logic). Dabei ist es möglich, die Daten in unterschiedlichen Systemen an unterschiedlichen Orten zu speichern (distributive Datenhaltung). Die Geschäftslogik-Schicht stellt Routinen zur Geodatenverarbeitung (z. B. Geodatenverarbeitungsservice zur Verknüpfung der Eingangsdaten gemäß Hölting- Formel) bereit und erzeugt somit aus Daten die vom Nutzer angefragten Informationen. Diese werden dem Benutzer als kartenähnliche Darstellung (Web Map Service) übermittelt und können mit einem Browser bzw. einem GIS-Client betrachtet werden (Abb. 2, Presentation-Tier). Eine detaillierte Betrachtung der projektintern entwickelten GDI findet sich in Kiehle et al. 2003 und Heier 2004.

Alle drei Schichten der in Abbildung 2 skizzierten Systemarchitektur können an unterschiedlichen Orten implementiert sein; auch die einzelnen Schichten können auf verschiedene Systeme aufgeteilt werden. So kann z. B. der skizzierte Geoverarbeitungsservice an einem anderen Ort implementiert sein, als der Web Map Service. Da alle Schichten und Webservices nach allgemein gültigen Standards entwickelt werden, lassen sie sich problemlos in größere Geodaten- Infrastrukturen (z. B. GDI-NRW) eingliedern bzw. können Daten oder Verarbeitungskomponenten aus anderen Geodaten- Infrastrukturen einbinden. Diese Skalierbarkeit macht das System leicht erweiterbar und an höhere Nutzerzugriffe anpassbar.

Die Beschreibung der innerhalb der GDI vorhandenen Daten und Webservices sowie Restriktionen zur Nutzung und Weiterverarbeitung eben dieser wird über einen Web Catalog Service implementiert. Dieser erlaubt die Recherche in Metadatenbanken, welche Metadaten gemäß ISO 19115 für Geodaten bzw. ISO 19119 für Dienste (vgl. ISO 2003) bereitstellen. Kernelement der GDI ist ein Geodienst (vgl. Abb. 2, Geoprocessing Service), welcher die Daten von verteilt vorliegenden Datenbanken akquiriert und diese weiterverarbeitet.

Alle Komponenten sind unter Verwendung von Open Source Technologie entwickelt worden, was ein hohes Maß an Flexibilität ermöglicht. Gerade vor dem Hintergrund knapper öffentlicher Ressourcen lassen sich mittels Open Source Technologie hochgradig komplexe Informationssysteme implementieren, welche keine zusätzlichen Lizensierungskosten verursachen. Durch den Einsatz der Programmiersprache Java, den Einsatz von XML- Technologie und die konsequente Einhaltung von Standards des W3C, der ISO und des OGC konnte eine offene GDI entwickelt werden, welche in hohem Maße an die Wünsche ihrer potentiellen Benutzer angepasst werden kann.

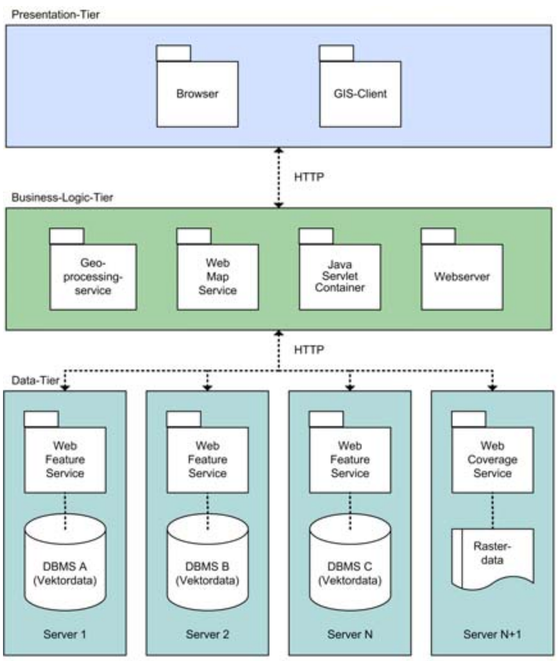


Abb. 2: Vereinfachte Systemarchitektur der projektinternen GDI

6 ANWENDUNGSFALL BERECHNUNG DER SCHUTZFUNKTION DER GRUNDWASSERÜBERDECKUNG

Der Nutzer einer GDI ist in der Regel nicht an technischen Details interessiert. Vielmehr möchte er eine Technologie nutzen, welche es ihm erlaubt, Informationen zu erhalten um bestimmte Aufgabenstellungen zu lösen. Im vorliegenden Projekt wird davon ausgegangen, dass der Nutzer aus dem Umfeld der räumlichen Planung, der Wasserversorgung oder dem Umweltschutz an Informationen bezüglich der Schutzfunktion der Grundwasserüberdeckung interessiert ist. Dieser arbeitet i. d. R. auf Basis einer Gebietsauswahl (z. B. Einzugsgebiet der Inde oder Stadtgebiet Aachen) in Maßstabsbereichen zwischen 1:5.000 und 1:100.000.

Anstatt den Weg über Darstellung und Weiterverarbeitung der Daten in einem (Desktop-)GIS zu wählen bietet ihm das skizzierte System die Möglichkeit, über einen Browser an Hand einer kartenähnlichen Darstellung eine Gebietsauswahl zu treffen. Ausgehend von dieser Gebietsauswahl besteht die Möglichkeit zum einen Basisdaten (prototypisch umgesetzt: Betrachtung der Geologie, Betrachtung des Flurabstandes, Betrachtung des Bodens und Betrachtung der Sickerwasserrate) zu visualisieren und zum anderen die Schutzfunktion der Grundwasserüberdeckung nach Hölting berechnen zu lassen. Dabei akquiriert das System selbständig die notwendigen Daten aus verteilten Datenbeständen, verschneidet die Geometrien und berechnet die Schutzfunktion der Grundwasserüberdeckung.

Damit der Nutzer das Ergebnis besser beurteilen kann werden verschiedene Metadaten, insbesondere über räumliche Auflösung, Datenqualität, Datenaktualität und vieles mehr visualisiert. Abbildung 3 zeigt einige Screenshots der implementierten Geodateninfrastruktur vor dem Hintergrund der untersuchten Einzugsgebiete. Die Geodateninfrastruktur steht bislang nur ausgewählten Nutzern zur Verfügung, jedoch wird in Kürze ein Demo-Zugang für interessierte Nutzer über die Projekthomepage (http://www.distributive-geodaten.de) eingerichtet. Einen Überblick über die umgesetzten Komponenten geben Kappler et al. 2004. Einen Überblick über die prototypische Umsetzung eines Geodienstes zur Visualisierung der Schutzfunktion der Grundwasserüberdeckung geben Azzam et al. 2004.

Die Vorteile für den Nutzer sind vor allem eine effiziente Datenbearbeitung, die automatisierte Generierung von Informationen aus Basisdaten, ein Zugriff auf verteilt vorliegende Datenbestände sowie ein einfache Handhabbarkeit der Applikation. Zur Bedienung der Software sind keine tiefgehenden GIS-Kenntnisse erforderlich. Darüber hinaus funktioniert das System mit jedem Browser der vierten Generation.

7 ZUSAMMENFASSUNG UND AUSBLICK

Der Einsatz von Internettechnologien und offenen Standards im Bereich des Geodatenmanagements führt zu einer verbesserten Nutzbarkeit von Geodaten. Gerade wenn Geoinformationen aus verteilt vorliegenden Geodaten generiert werden sollen oder müssen, ist der Aufbau von Geodaten Infrastrukturen und Geodiensten sinnvoll. Darüber hinaus steigert der Einsatz von Geodaten Infrastrukturen die Wertschöpfung aus bereits erhobenen Geodatenbeständen, da bestehende Daten vernetzt werden und durch interoperable Anwendungen zugriffsfähig gemacht werden können. Dies ermöglicht zum Teil die Nutzung bislang nicht verfügbarer, da nicht bekannter, Datenbestände und trägt somit zur Vermeidung einer „Doppelerhebung“ bereits vorhandener Daten bei.

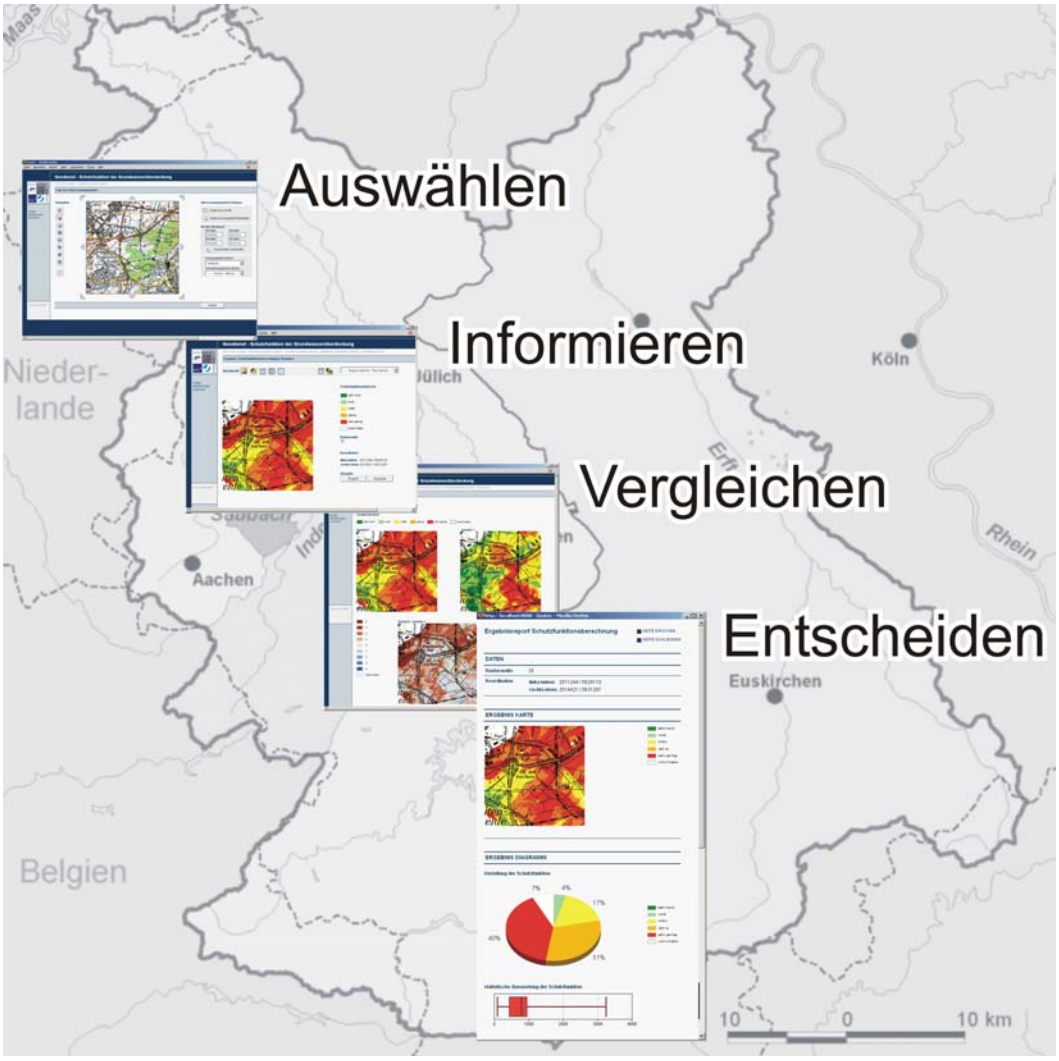


Abb. 3: Untersuchungsgebiet und Screenshots der entwickelten GDI

Im Bereich der Geodatenverarbeitung hat sich seit der Jahrtausendwende eine Vielzahl von Standards herausgebildet, die es schon jetzt ermöglicht, interoperable Internetanwendungen zu implementieren. Vor dem Hintergrund transnationaler Zusammenarbeit im Flussgebietsmanagement (z. B. Europäische Wasserrahmenrichtlinie) ist die im Projekt bearbeitete Fragestellung beispielhaft für Problemstellungen, die im Rahmen der Geodatenverarbeitung (Heterogenität der Daten, distributive Datenhaltung, etc.) auftreten. Das Projekt leistet einen wichtigen Beitrag zur Entwicklung von Verfahren zur Mehrfachnutzung von Geodaten und trägt somit dazu bei, die Wirtschaftlichkeit von Geodaten zu steigern. Besonders hervorzuheben ist der intensive Einsatz von Web Coverage Services. Diese werden im Allgemeinen zur Darstellung von topographischen Informationen oder von Luft-/Satellitenbildern verwendet. Im vorliegenden Projekt wurden WCS jedoch vor allem genutzt, um Informationen in Form von binären Wertearrays zu transportieren; eine oft unterschätzte Möglichkeit der Web Coverage Service Spezifikation. Details zur Informationsgenerierung mittels binärer Wertearrays finden sich in Kiehle 2006.

Durch den Zugriff auf standardisierte Metadaten über Katalogdienste werden Datendokumentationen in einem einheitlichen Format für den Nutzer transparent. Dies ermöglicht auch eine qualitative Abschätzung der Eingangsdaten, welche für die Bewertung der erzeugten Ergebnisse unumgänglich ist.

Das Projekt wurde intensiv im Rahmen von mehreren Workshops mit potenziellen Nutzern aus der Wasserversorgung, der Umweltverwaltung und der räumlichen Planung diskutiert und verbessert.

Im Rahmen eines Interoperability Experiments des Open Geospatial Consortiums wurde an der Entwicklung einer Spezifikation zur standardisierten Informationsgenerierung, der Web Processing Service Spezifikation mitgearbeitet (Heier et al. 2005). Diese erlaubt es, nicht nur die Datendienste in standardisierter Weise zu konfigurieren und bereit zu stellen, sondern vor allem die Dienste zur Informationsgenerierung in einer standardisierten Weise bereitzustellen. Damit ist die Möglichkeit gegeben, auch die Prozesse der Informationsgenerierung in Form von Services bereitzustellen und so einer Wiederverwertung zuzuführen. Dies ist ein wichtiger Schritt in Richtung einer serviceorientierten Geodateninfrastruktur, die auf Prozessen aufbaut und nicht lediglich auf Daten.

Während im Bereich der syntaktischen Interoperabilität gezeigt werden konnte, dass heterogene, verteilte Datenbestände mittels Service-Technologie zu Informationen aufbereitet werden können, so war die Herstellung semantischer Interoperabilität nicht Ziel des Projektes. Um zu einer vollautomatischen Integration von Services in den Prozess der Informationsgenerierung zu gelangen ist eine semantische Beschreibung von Daten und Diensten unabdingbar. In einem parallel zum vorgestellten Projekt laufenden Forschungs- und Entwicklungsvorhaben wurden Methoden zur Herstellung semantischer Interoperabilität mittels Geodiensten (vgl. Bernard et al. 2003 und Bernard et al. 2004a) entwickelt. Es gilt zukünftig, Methoden der syntaktischen und semantischen Interoperabilität zu koppeln, um eine vollautomatische Informationsgenerierung zu erzielen.

Die Erfahrungen aus dem Projekt „distributive Geodaten" lassen sich vor allem auf Anwendungen aus dem Planungs- und Decision-Support-Bereich übertragen. Die entwickelte Methodik erlaubt es, eine große Fülle von verteilten Daten zu erschließen und je nach Fragestellungen „just-in-time" zu Informationen aufzubereiten. Dabei steigt mit der zunehmenden Verfügbarkeit von lokalen, nationalen und globalen Dateninfrastrukturen die Verfügbarkeit von Geodaten aus allen denkbaren Anwendungsbereichen und ermöglicht somit eine umfassende Datenbasis zur Generierung von Informationen. Die Methodik ist unabhängig von der verwendet Datenbasis und ermöglicht die Entwicklung von sustainable solutions for the information society…

8 DANKSAGUNG

Das Projekt „Entwicklung einer Informationsinfrastruktur zur regelbasierten Ableitung von Geoinformationen aus distributiven, heterogenen Geodatenbeständen unterschiedlicher Maßstäbe am Beispiel der Schutzfunktion der Grundwasserüberdeckung" wird unter dem Förderkennzeichen Nr. 03V0638 vom Bundesministerium für Bildung und Forschung (BMBF) und der Deutschen Forschungsgemeinschaft (DFG) im Rahmen des Sonderprogramms Geotechnologien vom 01.10.2002 bis zum 30.09.2005 gefördert. Auf die vorliegende Publikation kann mit der Publikationsnummer GEOTECH-197 verwiesen werden.

Teile der Ergebnisse wurden in Kooperation mit der ahu AG, Aachen sowie mit dem Forschungszentrum Jülich, Programmgruppe Systemforschung und technologische Entwicklung erarbeitet. Diesen Projektpartnern gilt mein besonderer Dank.

Die vorliegende Arbeite wurde vom Autor am Lehrstuhl für Ingenieurgeologie und Hydrogeologie der RWTH Aachen bearbeitet.

9 LITERATUR

Aumann, G.; Donaubauer, A.; Kunkel, T.; Schilcher, M. (2003): OGC Web Services zur interoperablen Nutzung verteilter Geodatenbanken für mobile Anwendungen. GIS 13(6): 17-23.

Azzam, R.; Kappler, W.; Kiehle, C.; Kunkel, R. (2004): Development of a Spatial Data Infrastructure for the Derivation of Geoinformation from Distributive Geodata – Prototyping a Geoservice for Groundwater Vulnerability. Geotechnologien Science Report (4): 10-14.

Berger, M. (2003): Bestimmung der Schutzfunktion der Grundwasserüberdeckung im Raum Aachen unter besonderer Berücksichtigung anthropogener Einflüsse. Diplomarbeit am Lehrstuhl für Ingenieurgeologie und Hydrogeologie der RWTH-Aachen. Unveröffentlicht.

Bernard, L.; Haubrock, S.; Hübner, S.; Kuhn, W.; Lessing, R.; Lutz, M.; Visser, U. (2003): Semantic Interoperability by means of Geoservices - Semantic Problems in three Use Cases and Approaches for Potential Solutions. Geotechnologien Science Report (2): 1-16.

Bernard, L.; Einspanier, U.; Haubrock, S.; Hübner, S.; Klien, E.; Kuhn, W.; Lessing, R.; Lutz, M.; Visser, U. (2004a): Ontology-based Discovery and Retrieval of Geographic Information in Spatial Data. Geotechnologien Science Report (4): 15-29.

Bernard, L.; Fitzke, J.; Wagner, R.M. (2004b): Geodateninfrastruktur. Grundlagen und Anwendungen. Heidelberg (Wichmann).

Bettag, U. (2001): Web-Services. Informatik-Spektrum (24). Berlin (Springer): 302-304.

Bill, R.; Zehner, M. (2001): Lexikon der Geoinformatik. Heidelberg (Wichmann).

Bogena, H.; Kunkel, R.; Leppig, B.; Müller, F.; Wendland, F. (2004): Assessment of Groundwater Vulnerability at Different Scales. Geotechnologien Science Report (4): 30-34.

Diepolder, G. W. (1995): Schutzfunktion der Grundwasserüberdeckung. Grundlagen – Bewertung – Darstellung in Karten. GLA Fachberichte (13). München (Bayerisches Geologisches Landesamt): 5-79.

Heier, C. (2004): Implementierung einer Informationsinfrastruktur zur regelbasierten Ableitung von Geoinformationen aus distributiven Daten auf Basis von OGC- konformen Webservices. Diplomarbeit an der Fakultät für Geowissenschaften – Geographisches Institut – der Ruhr-Universität Bochum. Unveröffentlicht.

Heier, C.; Kiehle, C. (2005): Geodatenverarbeitung im Internet - der OGC Web Processing Service GIS 15, (6): S. 39-43.

Hölting, B., Haertlé, T., Hohberger, K.-H., Nachtigall, K.-H., Villinger, E., Weinzierl, W., Wrobel, J.P. (1995): Konzept zur Ermittlung der Schutzfunktion der Grundwasserüberdeckung. Geologisches Jahrbuch (63). Hannover (Schweizerbart´sche Verlagsbuchhandlung): 7-20.

ISO (2003): ISO/TC 211 Geographic information/Geomatics. http://www.isotc211.org. (Zugriffsdatum: 14.07.2005).

Kappler, W.; Kiehle, C., Kunkel, R.; Meiners, H.-G.; Müller, W.; Betteraey, F. van (2004): Promoting Use Cases to the Geoservice Groundwater Vulnerability. Geotechnologien Science Report (4): 67-69.

Kiehle, C.; Heier, C.; Kappler, W.; Kunkel, R. (2003): Entwicklung einer Informationsinfrastruktur zur regelbasierten Ableitung von Geoinformationen aus distributiven, heterogenen Geodatenbeständen. In: Bernard, L. ;Sliwinski, A. ;Senkler, K. (Hrsg.): Geodaten- und Geodienste- Infrastrukturen - von der Forschung zur praktischen Anwendung. Beiträge zu den Münsteraner GI-Tagen 26./27. Juni 2003 Band 18. , Münster. S. 215-228.

Kiehle, C. (2006): Entwicklung einer Geodateninfrastruktur zur regelbasierten Ableitung von Geoinformationen aus distributiven Datenbeständen. Mitteilungen zur Ingenieurgeologie und Hydrogeologie 92. Dissertation am FB 5 der RWTH Aachen.

Kunkel, R.; Wendland, F. (2002): The GROWA98 model for water-balance analysis in large river basins – the river Elbe case study. J. Hydrol. (259): 152-162.

Nebert, D. D. (Hrsg.) (2001): Developing Spatial Data Infrastructures: The SDI Cookbook. Version 1.1. http://www.gsdi.org/pubs/cookbook/cookbook0515.pdf (Zugriffsdatum: 14.07.2005)

Open GIS Consortium (2001a): OpenGIS Implementation Specification: Grid Coverage (OGC 01-004). http://www.opengis.org/docs/01-004.pdf. (Zugriffsdatum: 15.07.2005).

Open GIS Consortium (2001b): OpenGIS Implementation Specification: Coordinate Transformation Services (OGC 01-009). http://www.opengis.org/docs/01-004.pdf. (Zugriffsdatum: 15.07.2005).

Open GIS Consortium (2002a): Web Map Service Implementation Specification (OGC 01-068r2). http://www.opengis.org/docs/01-068r2.pdf. (Zugriffsdatum: 15.07.2005).

Open GIS Consortium (2002b): OpenGIS Catalog Services Specification (OGC 02-087r3). http://www.opengis.org/docs/02-087r3.pdf. (Zugriffsdatum: 14.04.2005).

Open GIS Consortium (2002c): OpenGIS Web Feature Service Implementation Specification (OGC 02-058) http://www.opengis.org/docs/02-058.pdf. (Zugriffsdatum: 15.07.2005).

Open GIS Consortium (2003): OpenGIS Geography Markup Language (GML) Implementation Specification (OGC 02.023r4). http://www.opengis.org/docs/02-023r4.pdf. (Zugriffsdatum: 15.07.2005).

Rudloff A., Stroink L., Wilken H. (2001): GEOTECHNOLOGIEN – Understanding and Managing the Earth's System. 2001 MARGINS Meeting, Schriftenreihe der Deutschen Geologischen Gesellschaft, Heft 14: 175-176.

Savage, C.; Sonnet, J. (Hrsg.) (2003): OWS 1.2 SOAP Experiment Report. OGC03-013. Online (Zugriff: 15.10.2005): http://www.opengeospatial.org/docs/03-014.pdf

Snell, J.; Tidwell, D.; Kulchenko, P. (2002): Webservice-Programmierung mit SOAP. (Köln): O`Reilly.

Sonnet, J. (Hrsg.) (2004): OWS 2 Common Architecture: WSDL SOAP UDDI. OGC04-060r1. Online (Zugriff: 21.12.2005): https://portal.opengeospatial.org/files/?artifact_id=8348

Stroink L. (2001): GEOTECHNOLOGIEN – Ein geowissenschaftliches Forschungsprogramm gewinnt an Kontur. GMIT Geowissenschaftliche Mitteilungen, Nr. 4: 19-23.

Wimmer, G.; Leppig, B.; Hüsener, D.; Schetelig, K. (2001): Das Hydrologische Kartenwerk Nordrhein-Westfalen auf dem Weg zum Fachinformationssystem Grundwasser. In: Strobl, J.; Blaschke, T.; Griesebner, G. (Hrsg.): Angewandte Geographische Informationsverarbeitung XIII. Beiträge zum AGIT Symposium Salzburg 2001. Heidelberg (Wichmann): 524-533.

W3C (2003): Web Services. http://www.w3.org/2002/ws/. (Zugriffsdatum: 14.07.2005).

Informationsinfrastrukturen und raumbezogene Identität als Ansatzpunkte nachhaltiger Lebensqualität. Empirische Untersuchungen in der Messestadt Riem (München)

Andreas KOCH

(Prof. Dr. Andreas Koch, Sektion Geographie, Department für Geo- und Umweltwissenschaften, Ludwig-Maximilians-Universität München, Luisenstr. 37, 80333 München, AndreasKoch@lmu.de)

1 EINLEITUNG

Die mediale Vermittlung und Verbreitung stadtteilbezogener Informationen ist eine seit langem bekannte und beliebte Möglichkeit, um auf kulturelle, gesellschaftliche und politische Angebote im Stadtquartier aufmerksam zu machen. Insbesondere der Einsatz moderner Informations- und Kommunikations-technologien trägt mit seinen vielfältigen Möglichkeiten der (multimedialen) Präsentation der Angebote, den unterschiedlichen Vertriebswegen (z.B. Infopoints, PC's zu Hause oder am Arbeitsplatz, Mobiltelefonen) und den verschiedenen Interaktionsformen (Information, Kommunikation und Transaktion) zur mannigfaltigen Partizipation der Bewohner bei. Dem Auf- und Ausbau entsprechender Informations-infrastrukturen – unter anderem in Form portalbasierter eGovernment- oder geoGovernment-Angebote – kommt somit ein hoher Stellenwert zu. Ein differenziertes Spektrum gelungener Informations- und Kommunikationsdienste potenziert darüberhinaus Voraussetzungen, sich mit seinem Stadtteil aktiv(er) und bewußt(er) auseinanderzusetzen – sich mit ihm zu identifizieren. Dieses Potenzial weist über seine Funktion der Aktualisierung von Wissen zur alltäglichen Teilhabe am Geschehen im Stadtteil auf eine weitere wichtige identitätsstifende Aufgabe hin, nämlich eine grundlegende Hilfe zur Orientierung für Neubürger zu sein – und diese Funktion ist vor allem dann von besonderer Bedeutung, wenn es sich, wie im vorliegenden Fall der Messestadft Riem, um einen völlig neuen Stadtteil handelt. Allein die quantitativen Dimensionen der sich entwickelnden Messestadt, aber auch der Dynamik von Wohnmobilität in München allgemein, sprechen bereits für sich: bis 2013 werden in der Messestadt 7.000 Wohnungen für 16.000 Einwohner gebaut, hinzu kommen weitere 13.000 Arbeitsplätze. Im Jahr 2003 sind etwa 85.000 Menschen nach München zugezogen, ca. 66.000 von München weggezogen und knapp 100.000 innerhalb Münchens umgezogen (vgl. Wagner 2005: 41)!

Gleichwohl stellen Informations- und Kommunikationsdienste mittelbare und freiwillig in Anspruch nehmbare Instrumente zur lokalen Identifikation dar. Der grundlegende Bezugsgegenstand ist jedoch die Identität und das grundlegende Bezugsobjekt das Individuum. Dieser Blick auf die persönliche Identität, die sich im Zuge der gesellschaftlichen Postmodernisierung – durch Individualisierung und Pluralisierung der Lebensstile – zu einer individuellen Notwendigkeit gewandelt hat – „[o]b man will oder nicht, man muss seinem Leben Sinn verleihen" (Kaufmann 2005: 82) –, ist jedoch um den Blick auf die soziale und räumliche Komponente zu ergänzen. Ein hierfür geeigneter theoretischer Anknüpfungspunkt wird im Rahmen dieses Beitrages in der Systemtheorie Luhmann'scher Prägung gesehen, denn alle drei ‚Welten' lassen sich als operativ geschlossene und strukturell gekoppelte Systeme verstehen, die sich wechselseitig bedingen. Raumbezogene Identität dynamisiert auf diese Weise die Identitätsprozesse des Subjekts gleichermaßen wie dies kollektive Identitätsbezüge tun. Raumbezogene Identität subsumiert dabei zwei Dimensionen von Identifikation – die Identifikation von und die Identifikation mit räumlichen Gegebenheiten und Sachverhalten (vgl. Weichhart 1990: 16ff). Die gebaute Umwelt mit ihren physisch-materiellen Manifestationen sowie ihren subjektiv und sozial konstruierten Symbolgehalten beeinflussen diesen kontinuierlichen Prozess der subjektiven Sinngebung – und werden von diesem beeinflusst. Plakativ hat dies Rau (2003: 3) auf den Punkt gebracht: „Ein Buch kann man zuschlagen und weglegen. Musik kann man abschalten und niemand ist gezwungen ein Bild aufzuhängen, das ihm nicht gefällt. An einem Haus aber oder an einem anderen Gebäude kann man nicht vorbei gehen, ohne es zu sehen. Architektur hat die größte sichtbare gesellschaftliche Wirkung. Gebäude prägen nicht nur Stadtviertel und Städte. Sie prägen unsere Gesellschaft und das kann Konsequenzen haben, die weit reichen".

Diese weitreichenden Konsequenzen im Sinne einer nachhaltigen Lebensqualität in der Messestadt Riem zu gestalten, haben die Stadt München und das Stadtquartier selbst durch das Leitbild der urbanen, kompakten, grünen und sozial durchmischten Stadt sowie darauf aufbauender Planungsinstrumente umzusetzen versucht. Der Begriff der nachhaltigen Lebensqualität wird hier aus der Sicht der Bewohner empirisch vor dem Hintergrund reflektiert, ob und wie sie sich mit ‚ihrer' Messestadt identifizieren (können). Um dieser Frage nachgehen zu können, wird zunächst auf den Begriff der personalen Identität und ihre sozialen wie räumlichen Kontextualisierungen näher eingegangen. Daran schließt sich die Darstellung der Messestadt Riem mit seiner baulichen Gestaltung und seinen bereits realisierten Informationsinfrastrukturen an. Auf der Grundlage einer durch das Bürgerforum der Messestadt initiierten aktivierenden Bürgerbefragung (vgl. Klöver 2005) und von mir betreuten Diplomarbeiten zu ‚Ortsbindung' (vgl. Gräber 2004), ‚Wohnen und Arbeiten' (vgl. Guber 2005) und ‚Planungsevaluierung' (vgl. Birmann 2005) in der Messestadt Riem, erfolgt dann eine Präsentation ausgewählter empirischer Erkenntnisse zum allgemeinen Identifikationspotenzial und der Bedeutung der Informationsinfrastrukturen für Prozesse lokaler Identifikation.

2 IDENTITÄT – ZUM BEGRIFF UND SEINEN KONTEXTEN

Der Begriff ‘raumbezogene Identität' sowie die ihm zugrunde liegende Konzeption haben in der sozialgeographischen Theoriediskussion einen schweren Stand. Allerdings liefern die Argumente, die für und gegen seine Verwendung sprechen, hilfreiche Anhaltspunkte für eine grundlegende Auseinandersetzung mit dem, was Identität bedeutet, auf wen und was sie sich bezieht und wie diese Beziehungen theoriekonform und empirisch überprüfbar in ein Gesamtgefüge eingebettet werden können.

Zu den Einwänden, die gegen eine konzeptionelle Berücksichtigung raumbezogener Identitätsprozesse vorgebracht werden, gehören neben anderen, dass

derartige Prozesse, auf subjektiver wie kollektiver Ebene, für (post)moderne Gesellschaftsstrukturen keine Relevanz mehr besäßen eine Einbeziehung räumlicher Gegebenheiten und Sachverhalte (insbesondere in ihrer physisch-materiellen Dimension) grundsätzlich dazu tendierten, zu wenig und zu viel beweisen zu wollen, sie also trivial und total seien. Mit anderen Worten, dass kognitive und soziale Phänomene ausschließlich psychische und soziale Grundlagen haben

auf der Grundlage einer systemtheoretischen Argumentationslogik soziale Systeme Kommunikationssysteme und damit aräumlich seien; und Kommunikation über räumliche Gegebenheiten und Sachverhalte auf einer semantischen Ebene ablaufe, so dass es auf den sinnvermittelnden Symbolgehalt räumlicher Phänomene ankomme (vgl. Weichhart 1990: 6f).

Auf den ersten Blick scheinen diese Einwände kaum stichhaltig widerlegt werden zu können. Im Folgenden soll es auch nicht um eine völlige Widerlegung, sondern um den Versuch eines differenzierten Verständnisses von Identität gehen, das die Einwände ernst nimmt und sie in eine in sich schlüssige theoretische Einbettung integriert. Eine Schwierigkeit, diesen Einwänden mit Argumenten zu begegnen, die für eine Berücksichtigung raumbezogener Identität plädieren, liegt in einer diffusen Verwendung des Begriffes Identität ganz allgemein – Kaufmann (2005: 10) spricht hier in Anlehnung an Goffman von einem ‚Zuckerwattenbegriff', an dem zuviel kleben bleibt: „Der Begriff war für alles brauchbar und oft wirksam, er war überall. Er war überall und nirgends. Er war genau deshalb nirgends, weil er überall war" (darin scheinen Identität und Raum eine Gemeinsamkeit zu besitzen). Zudem ist es wichtig, den historischen Kontext der Entstehung und Entwicklung des Identitätsbegriffs zu berücksichtigen.

2.1 Individuelle und soziale Identität

Der französische Soziologe Jean-Claude Kaufmann, auf dessen ‚Theorie der Identität' ich mich im Folgenden beziehe, verortet die Identität klar und deutlich beim Individuum, ohne jedoch soziale Gegebenheiten als Kontextualisierung zu leugnen. So ist die Identität das, „[…] wodurch sich das Individuum wahrnimmt und sich zu konstruieren versucht […]. Sie ist eine subjektive Interpretation der sozialen Gegebenheiten des Individuums" (Kaufmann 2005: 102). Subjektivität ist dabei nicht in einem totalen Sinn zu verstehen, entscheidend ist die „[…] vielgestaltige, permanente Fähigkeit, Entscheidungen zu treffen […]. Denn dort liegt das Zentrum des Identitätsprozesses. Nicht in einer reinen Subjektivität, sondern in der Wahl zwischen Möglichkeiten […]. Vom Standpunkt des wählenden Individuums aus zählt nicht die objektive Machbarkeit einer Identität, sondern die Vorstellung, die es sich selbst von dieser Machbarkeit macht. […] Deshalb ist es ein der Analyse extrem abträglicher Fehler, die Identität auf objektive Gegebenheiten zurückzuführen […]" (ebd.). Identität nicht auf objektive Gegebenheiten – wie das ‚Soziale' oder ‚Räumliche' – zurückzuführen, dient somit primär der konzeptionellen Klarheit und Eindeutigkeit. Die Entwicklung und Aufrechterhaltung einer individuellen Persönlichkeit über Identitätsprozesse ist ein selbstreflexiver Prozess, so dass Identität grundlegend dem Subjekt zugeordnet ist. Zur Aufrechterhaltung der Selbstreflexion sind Bezugspunkte, die ausserhalb des Subjekts liegen, allerdings unumgänglich. Das Bemerkenswerte an diesem Zusammenhang ist sein paradoxer Charakter: Identität und Selbstreflexion stehen zum einen in einem antagonistischen Spannungsverhältnis, da das Nachdenken über sich Selbst, das Hinterfragen des eigen Selbst (die Selbstreflexion) die identitäre Konstruktion des Selbst immer wieder aufbricht und destabilisiert (vgl. ebd.: 157ff). Andererseits bedingen sich Identität und Selbstreflexion wechselseitig, da die Vorstellung einer temporären Stabilisierung des Selbst nur dann Sinn macht, wenn sie durch Destabilisierung gefährdet ist (und umgekehrt).

Die Möglichkeit und Fähigkeit zur Stabilisierung der eigenen Persönlichkeit ist somit die zentrale Funktion der Identität. „Die Identität ist eine Umhüllung, die Selbstgewissheit verleiht. Das Individuum kann als kontinuierliche Verbindung von zwei Prozessen angesehen werden: einerseits ein sich überaus häufig wandelnder, widersprüchlicher Bestand an individuell inkorporiertem und auf besondere Weise angelegtem sozialen Gedächtnis, andererseits ein System subjektiver Geschlossenheit, das Sinn verleiht, indem es die Illusion einer augenscheinlichen Ganzheit schafft" (ebd.: 59). An anderer Stelle formuliert Kaufmann (2005: 113), die „[…] Identität ist ein Prozess des Schließens und Festlegens, der sich der Logik der Öffnung und der Bewegung der Reflexivität widersetzt". Mit diesen Zitaten ist zugleich ein wichtiger Hinweis für eine systemtheoretische Einbettung des Gesamtgefüges identitärer Prozesse gegeben, auf die in Kapitel 2.3 näher eingegangen wird. Das Paradox der Identität lässt sich somit als kontinuierlichen dialektischen Prozess der Schließung und Festlegung sowie dem reflexiven Aufbrechen dieser Schließung verstehen. Das reflexive Aufbrechen der Identitätshülle wird zwar ebenfalls – bewusst und unbewusst – vom handelnden Individuum vorgenommen, die Impulse hierfür kommen jedoch weitgehend von ausserhalb. Sozialpsychologisch betrachtet tritt komplementär zur individuellen die soziale bzw. kollektive Identität hinzu, indem die Konstruktion der Selbsterfahrung auch durch Rekonstruktion der Fremderfahrung erfolgt (vgl. Weiss 1993: 26). Individuelle Identität ist somit Bedingung und Produkt sozialer Interaktion. Deutlich wird dies beispielsweise bei der biografischen Identität, da das ‚Schreiben' der eigenen Lebensgeschichte auch die Zugehörigkeit zu sozialen, ethnischen, religiösen oder kulturellen Gruppen impliziert (vgl. Frey & Hausser 1987: 4).

Für diesen gegenwärtigen Blick auf das Phänomen der Ausprägung individueller Identität ist es hilfreich, knapp auf den historischen Kontext dieses Wandels einzugehen. In traditionellen Gesellschaften wurden individuelle Identitäten über Rollen kollektiv zugewiesen, die von den Rollenträgern mehr oder weniger selbstverständlich adaptiert und nicht über autonome Prozesse hinterfragt wurden. „Nach traditioneller Weise ist man, was und wo man ist, und kann sich nicht einmal vorstellen, daß man auch anders und anderswo sein könnte" (Berger & Luckmann 1971: 58; ferner Hecht 2005: 22). Im Zuge der Individualisierung hat sich das Rollenverständnis gewandelt und das Gewicht der Identitätsbildung verschoben, ohne jedoch den sozialen Kontext völlig zum Verschwinden gebracht zu haben. Entscheidend ist, die Verschiebung explizit zu betonen: „Die historische Neuheit liegt nicht im Aufkommen einer Vorstellung von sich selbst, sondern darin, dass diese einen anderen Platz im Prozess der Konstruktion von Realität einnimmt" (Kaufmann 2005: 69f). Und zugleich gilt es die ‚soziale Schwerkraft' als externen Einfluss-, aber nicht als Determinierungsfaktor zu berücksichtigen – denn „[…] Subjektivität bildet sich nicht in einem autonomen Raum aus, der vom Individuum perfekt beherrscht wird" (ebd.: 105). Vor dem Hintergrund dieser Einschätzung wird auch deutlich, dass mit den subjektiven und gesellschaftlichen Veränderungen persönliche Identitätserfordernisse überhaupt erst virulent geworden sind und man mit dem Übergang von vormals kollektiven Rollenzuweisungen zu selbstreflexiven Identitäten daher nicht zwingend die Schlussfolgerung ziehen kann, wir lebten in und mit permanenten Identitätskrisen.

2.2 Raumbezogene Identität

Für das Verständnis und den Stellenwert raumbezogener Identität ist das Strukturgefüge von individueller und sozialer Identität mit seiner Komplementarität und Dialektik der strukturierenden Elemente und ihrer prozessualen Beziehungen erkenntnistheoretisch von grundlegender Bedeutung. Analog zur sozialen Kontextualisierung über inkorporierte Schemata ist eine räumliche Kontextualisierung über ebenfalls inkorporierte Schemata in das Strukturgefüge zu integrieren. Individuelle Identität als Selbstkonzept schließt im Prozess des Wissens um die eigene Existenz neben gesellschaftlichen Assoziationen auch Gegebenheiten und Sachverhalte der physisch-materiellen Umwelt mit ein. So spielen, wie beispielsweise die jüngsten Gewaltausbrüche in französischen Vorstädten deutlich gezeigt haben, für die Selbstachtung der Person auch lokale Identitätseinflüsse eine entscheidende Rolle. Um in der bisher dargestellten Begriffslogik zu bleiben, ist erstens der Begriff Identität um die räumliche Dimension zu erweitern (als räumliche Identität) und zweitens der jeweilige Bezugspunkt begrifflich zu spezifizieren (so u. a. als raumbezogene Identität). Raumbezogene Identität belässt den Identitätsbegriff beim Subjekt, er ist also eine Dimension der individuellen Identität und meint, dass das Subjekt räumliche Gegebenheiten und Sachverhalte in seinen Identitätsprozess mit einbezieht. Die subjektive Fähigkeit zur Einbeziehung räumlicher Gegebenheiten und Sachverhalte – im Sinne einer ‚identification with' (vgl. Graumann 1983) – setzt eine Identifizierbarkeit als ‚identification of' voraus. Damit wird räumlichen Eigenschaften eine Identität zuerkannt: „Mit dem „Identifizieren" als gedanklichem Prozess der Objekterfassung umschreiben wir gleichzeitig die Identität des betreffenden Objekts!" (Weichhart, 1999a: 9). Räumliche Identität ist, wie auch soziale Identität, das notwendig Komplementäre zur raumbezogenen Identität. Abbildung 1 veranschaulicht diesen Zusammenhang. Der (hier abstrahierte) Raum verfügt über eine Eigenständigkeit, die ausserhalb des subjektiven (und sozialen) Einflussbereiches liegt, sozusagen einen eigenen Modus des Schließens und Festlegens besitzt. Zugleich verfügt er über Kopplungsmechanismen, die ihn über raumbezogene Identitätsprozesse erkennbar und veränderbar machen. Somit manifestieren sich dialektische Prozesse sowohl innerhalb der drei Ebenen (Subjekt – Gesellschaft – Raum) als auch zwischen ihnen.

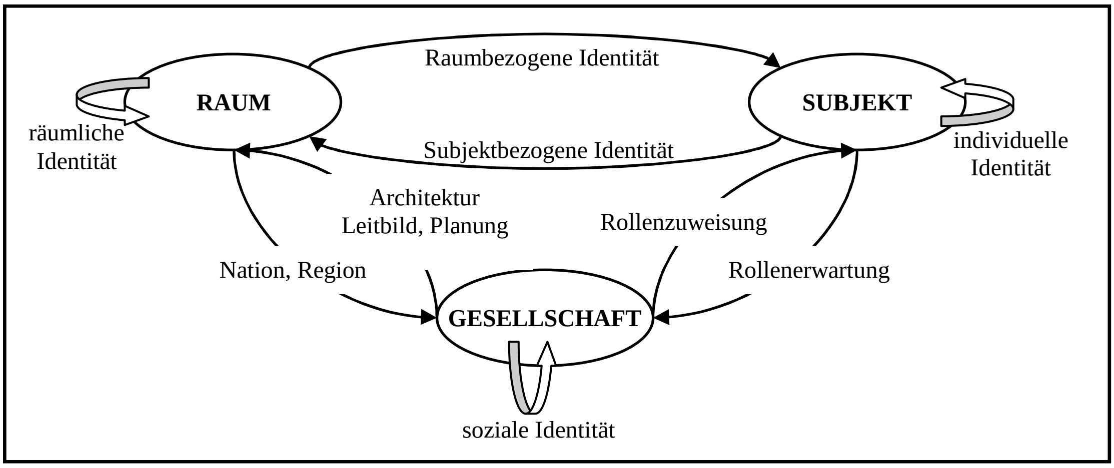


Abbildung 1: Zusammenhänge der Identitäten (eigener Entwurf)

Zwei ergänzende Bemerkungen zu Abbildung 1 sind mir zum Verständnis wichtig. Zum einen ist eine Differenzierung der Beobachterperspektive notwendig. Als Beobachter 1. Ordnung ist das Subjekt Teil des schematisierten Zusammenhangs, indem es für sich selbst eine Subjektidentität generiert. Als Beobachter 2. Ordnung ‚schwebt' es gleichsam über dem schematisierten Zusammenhang und beobachtet andere Subjekte beim Herstellen ihrer Identität. Beide Perspektiven sind dabei für die individuelle Identität bedeutsam. Zum anderen treten neben die dargestellten unmittelbaren Kopplungseffekte auch mittelbare hinzu. So ist zum Beispiel Gentrification ein Prozess, der über raumbezogene Identität und über sozial vermittelte Raumbezüge abläuft.

In Anlehnung an Weichhart (1990: 35ff) lässt sich raumbezogene Identität in vier unterschiedliche Bereiche typisieren. Der erste Bereich umfasst dabei Aspekte der ‚Sicherheit, Vertrautheit und Zugehörigkeit'. Raumbezogene Identität repräsentiert in diesem Fall eine Bedingung zur subjektiven Stabilisierung von Selbstgewissheit. Die lokale Räumlichkeit in ihrer physisch-materiellen und semantischen Ausprägung generiert einen relativ stabilen Rahmen für die identitäre Schließung und Festlegung des Individuums. Zugleich ist dieser Rahmen, durch Prozesse der räumlichen Identitätsveränderung, fragil und auf diese Weise zugleich Ursache für reflexive Hinterfragungen der subjektiven Identität. Ein zweiter Bereich, der mit ‚Stimulation und Aktivität' überschrieben ist, bezieht sich auf Prozesse der individuellen Aneignung von Räumen. Die Fähigkeit zur subjektiven Aneignung räumlicher Phänomene vollzieht sich als kontinuierlicher, aktiver und selektiver Prozess, und setzt damit aber das, was man sich aneignen kann, bereits voraus. Aneignung kann sich dann auch in einer passiven Akzeptanz bzw. Adaption des räumlich Vorhandenen äußern. Diese beiden Modi der Aneignung können dabei im zeitlichen Ablauf variieren und sich überlagern. In der dritten Dimension der ‚sozialen Interaktion und Symbolik' dient der (physische) Raum als Vermittler Sinn generierender Zeichen. Die subjektive und/oder sozial vermittelte Zuweisung symbolischer Bedeutungsgehalte von bestimmten Orten führt dabei nicht nur zu unterschiedlichen Aufenthaltsqualitäten, sondern schafft auch eine ungleiche Verteilung von Orten sozialer Interaktion. Und auch hier gilt, dass die Verteilungsungleichheit sich sowohl aus räumlichen Gegebenheiten als auch aus raumbezogenen Identitätsprozessen heraus erklären lässt. Mit ‚Identifikation und Individualität' ist viertens der Sachverhalt umschrieben, dass Raum als Mittel und Zweck, als Medium und Gegenstand der Identität des Individuums dient. Auf dieser Ebene raumbezogener Identität sind Phänomene der Privilegierung und Stigmatisierung, der Inklusion und Exklusion sowie der emotionalen Entwicklung von Zugehörigkeit subsumiert. „In other words, a sense of self-identity is partially incorporated into an individual's being when anchored to the place in which it was experienced" (Godkin 1980, in: Weichhart 1990: 42). In diesem Zusammenhang kann auch ein Wohnungseinbruch als Beispiel einer schwierigen Auseinandersetzung mit dem Verhältnis von individueller und raumbezogener Identität angesehen werden, wie Weichhart (1990: 43) verdeutlicht: „Das gewaltsame Eindringen in die Wohnung, die Verletzung des physischen Rahmens der Intimsphäre, wird als Verletzung und Schändung der Ich-Identität empfunden. Das Einbruchsopfer, das zum Zeitpunkt der Tat gar nicht anwesend war, fühlt sich durch das gewaltsame Eindringen in die Wohnung im Kern seiner Persönlichkeit beschmutzt, besudelt oder gar vergewaltigt […]“.

Raumbezogene Identität besitzt damit eine in vielfacher Hinsicht wichtige Referenzqualität zur Konstruktion der eigenen Persönlichkeit. Dies setzt wiederum eine räumliche Identität voraus, die sich über die Gestaltqualität der gebauten Umwelt und ihrem Symbolgehalt konstituiert. Ihre Wahrnehmung ist dabei subjektiv spezifiziert, jedoch nicht völlig beliebig. Dies gilt nun offensichtlich auch für einen von Grund auf neu enstandenen und noch im Entstehen begriffenen Stadtteil wie die Messestadt Riem. Das Faktum der Entstehungsdynamik dieses Viertels bedingt gleichwohl eine Relativierung mancher Indikatoren, mit deren Hilfe Identitätsprozesse empirisch untersucht wurden. Mit Bezug auf eine Untersuchung von Schneider (1986) stellt Weichhart (1990: 53) plausibel fest, dass für den Grad raumbezogener Identität „[…] neben der Gebürtigkeit, der Wohndauer und den viertelsbezogenen Sozialkontakten auch die physisch-räumliche Struktur des Viertels und die historische Tiefe seiner baulich-sozialen Entwicklung bedeutsam sind“. All diese Faktoren sind in der Messestadt Riem nicht vorhanden (gewesen) und dennoch, so die Überlegung, muss es auch im Kontext des Neuen Identifikationsmöglichkeiten geben. Die Identifikation der Bewohner mit der Messestadt ist eine bewusste Auseinandersetzung mit ihrer baulichen Gestaltung und Ästhetik, der Aufenthaltsqualität an bestimmten Orten, ihren Potenzialen, kognitive und emotionale Zugehörigkeit entstehen zu lassen, aber auch Nachbarschaftskontakte zu knüpfen, Gleichgesinnte zu treffen oder sich aktiv im Quartier zu engagieren. Mit einem Wort: Selbstzufriedenheit zu erlangen und immer wieder herzustellen. Die Identifikation all dieser Möglichkeiten (im Sinne der Identifikation von) hängt natürlich entscheidend vom Handeln der Bewohner ab – das Quartier zu erkunden, sich mit Nachbarn zu verabreden, etc. Zugleich spielen hier aber auch die vorhandenen Informationsinfrastrukturen, in ihrer Vielfalt und Unterschiedlichkeit, eine entscheidende Rolle, um etwas als etwas identifizieren zu können. Auf sie soll nun im Rahmen der Vorstellung des Untersuchungsgebietes näher eingegangen werden. Abschließend jedoch soll noch ein knapper Überblick zur systemtheoretischen Einbettung der dargestellten Identitätsphänomene gegeben werden (ausführlicher Koch 2005 und 2004; Weichhart 1999b: 4ff und 1990: 33f).

2.3 Systemtheorie und Identität

Die Systemtheorie (nach Luhmann; exemplarisch vgl. Luhmann 1993) versteht Systeme als selbstreferentielle und sich selbst (re)produzierende Gedanken- und Kommunikationssysteme. Damit ist gemeint, dass jedes psychische System (Bewusstseinssystem) und soziale System (differenziert nach Interaktions- Organisations- und funktionalen Gesellschaftsteilsystemen) in der Lage ist, aus sich selbst heraus zu entstehen (Autopoiesis) und sich selbst zu erhalten. Für diese Fähigkeit ist eine operative Schließung der Systeme notwendig. Operativ heißt, dass – im Falle psychischer Systeme – Gedanken und – im Falle sozialer Systeme – Kommunikationen anschlussfähig gehalten werden. Sofern und solange dies gelingt, bleiben Systeme erhalten. Komplementär zur operativen Schließung tritt die strukturelle Kopplung der Systeme. Damit in einem sozialen System Kommunikation stattfinden kann, sind Individuen (psychische Systeme) notwendig. Diese Individuen sind nun aber nicht die Systemelemente des sozialen Systems, sondern stehen ausserhalb – sie sind an das soziale System strukturell gekoppelt. Aus der Sicht der psychischen Systeme gilt dies natürlich auch umgekehrt. In Analogie hierzu lassen sich auch Räume als räumliche Systeme verstehen, die nun mit sozialen und psychischen Systemen ebenfalls strukturell gekoppelt sind. Alle drei Systemtypen weisen damit die Eigenschaft der Eigenständigkeit und der Interdependenz auf (vgl. Koch 2004: 303ff).

Die Grundlage dieses systemtheoretischen Verständnisses beruht auf dem Begriff der Differenz. Im Kontext der Auseinandersetzung mit Identität ist dieser Sachverhalt fundamental: „Differenzen und Differenzwahrnehmung sind die entscheidende Grundlage jeder Identitätsbildung!“ (Weichhart 1999b: 5) bzw. an anderer Stelle: „Wir können also festhalten, dass die Phänomene der raumbezogenen Identität insgesamt einen Beitrag zur Selbsterhaltung personaler und sozialer Systeme leisten. Diese funktionale Leistung bezieht sich auch auf jene Prozesse der Differenzbildung, mit deren Hilfe die Selbstbeschreibungen von Ich-Identität und Gruppenidentität vorgenommen werden“ (ebd.: 6). Aber nicht nur dies, auch die identitäre Schließung und (temporäre) Festlegung auf subjektiv passende Sinnzusammenhänge findet ihre übergeordnete Entsprechung in der operativen Schließung der Systeme. Und die durch selbstreflexive Prozesse induzierte ‚Störung’ der Identität hängt von der strukturellen Kopplung des Individuums mit sozialen und räumlichen Systemen als kontextualisierte Fremderfahrungen ab.

Das Vorhandensein bzw. die Generierung von Differenzen erklärt sich systemtheoretisch aus der Notwendigkeit heraus, Komplexität zu reduzieren, um überhaupt kommunizieren bzw. denken zu können. Die Schließung der Systeme und die damit einhergehende Komplexitätsreduktion garantieren ein ausreichendes Maß an Stabilität, um Autonomie, Selbstachtung, Selbstvertrauen, Selbstgewissheit und Kompetenz zu gewinnen und immer wieder herstellen zu können. Eine sinnstiftende Beziehung zwischen Subjekt-Identität und Ort-Identität über raumbezogene Identität ist auf diese Weise zumindest potenziell möglich (vgl. hierzu auch Kaufmann 2005: 98). „Damit leisten die verschiedenen Aspekte raumbezogener Identität einen Beitrag zur Selbsterhaltung des [psychischen; Anm. A.K.] Systems“ (Weichhart 1990: 35).

Ergänzend zur formalen Differenzenebene ist auch ihre qualitative Betrachtung von Bedeutung. Denn es stellt sich hier unter anderem die Frage, ob und in welchem qualitativen Umfang ein Stadtquartier wie die Messestadt Riem in der Lage ist, Ort-Identität zu vermitteln. Mitentscheidend ist beispielsweise, wo ein heutiger Messestadtbewohner früher gewohnt hat; Jemand, der bislang eine dörfliche Siedlingsstruktur gewohnt war, wird sich unter Umständen in der Messestadt nur bedingt wohlfühlen und sich mit ihr entsprechend identifizieren. Möglicherweise aber dennoch durchaus positiv, dann nämlich, wenn ‚dörfliche Identitätsmuster’ wie hoher Grünflächenanteil und enger nachbarschaftlicher Kontakt gegenüber der hohen Baudichte und urbaner Versorgungsstruktur (z.B. Shopping Center) ein höheres Identifikationsgewicht erhalten. Aufgrund des Fehlens vielfältiger kultureller Angebote mag die Messestadt umgekehrt für einen aus der Innenstadt Münchens (oder Berlins, etc.) Zugezogenen keine urbanen Identifikationspotenziale bereitstellen. Diese Ausführungen machen, bei aller plausiblen theoretischen Fundierung, auf ein grundsätzliches methodisches Problem aufmerksam. Als Beobachter 2. Ordnung (der Forscherperspektive) kann man sich dem

Phänomen der kontinuierlichen Konstruktion der Identität Anderer, selbst mit einem ausgefeilten Methodenmix, nur bis zu einem gewissen (nicht fixen) Grad annähern. Dies nicht nur, weil man nur eine Momentaufnahme dieses Prozesses erhält und man als Beobachter 2. Ordnung immer auch teilweise durch seinen Status als Beobachter 1. Ordnung die empirischen Ergebnisse filtert (selbst dann also, wenn man selbst nicht im Befragungsort wohnt), sondern vor allem auch deshalb, weil es sehr schwierig ist, über einen derart komplexen Sachverhalt wie Identität als Befragter Auskunft zu geben. Die subjektive Spezifizierung wahrgenommener und verinnerlichter ‚allgemeiner' Aspekte verhindert eine Bewertung nach generell gültigen Referenzmustern. Hinzu kommt, dass identitäre Stabilität auch stereotype Muster inkorporiert – positiv als ‚Image' und negativ als ‚Klischee'. Neben der indviduellen raumbezogenen Identität spielt hier Raum als Thema in sozialer Kommunikation eine wichtige Rolle, wobei auch in diesem Falle komplexitätsreduzierende Typisierungen, Vereinfachungen und Kontextualisierungen entscheidend sind.

Bereits aus dieser theoretischen Perspektive sollte deutlich werden, dass die einleitend genannten Kritikpunkte gegen eine Berücksichtigung des (physisch-materiellen) Raumes in Identitätsprozessen entkräftet werden können. Gerade unter postmodernen Gesellschaftsbedingungen mit ihren Anforderungen an Flexibilität und Rationalität in einem globalisierten Kontext, sind Möglichkeiten räumlicher Verankerungen für das Selbstverständniss von hohem Wert. Dies gilt selbst dann, wenn auch die räumlichen Verhältnisse den Globalisierungseinflüssen unterworfen sind und ein Begriff wie ‚Heimat' heute einen anderen Stellenwert besitzt (vgl. Hecht 2005: 22ff). Für beide Begriffe – Raum und Identität – gilt, dass sie in ihrem Beschreibungs- und Erklärungswert inflationär gebraucht werden; dies diskreditiert jedoch nicht ihren theoretischen Wert, sondern macht es notwendig, ihren Einsatz kritisch zu reflektieren. Schließlich ist unbestritten, dass soziale und psychische Systeme aräumliche Systeme sind. Das ist die eine Seite der Differenz. Hinzu kommt jedoch, dass beide an räumliche Systeme strukturell gekoppelt sind, so wie auch psychische Systeme an soziale gekoppelt sind. Beide Seiten gilt es bei der Beurteilung der Raumrelevanz zu berücksichtigen.

3 DIE MESSESTADT RIEM – DAS STADTQUARTIER UND SEINE INFORMATIONSINFRA-STRUKTUREN

Das Leitbild ‚urban – kompakt – grün', das die Stadt München im Rahmen ihrer ‚Perspektive München' auch für die Planungen zur Messestadt Riem eingesetzt hat, versucht einer Vielzahl von Erfordernissen nachhaltiger Stadtentwicklung Rechnung zu tragen, auf die an dieser Stelle nur überblicksmäßig eingegangen werden kann. Ein wichtiger Aspekt dieser Planungsphilosophie ist der hohe Grad an Eigenständigkeit des Quartiers, der sich auf möglichst viele Funktionen – neben Wohnen auf Arbeiten, Versorgung, Freizeitgestaltung, Erholung – und demzufolge der Siedlungsstruktur erstrecken sollte. Um einen möglichst hohen Grad an Identifikation der Bewohner mit ihrem Quartier zu erzielen und nachhaltig zu stärken, werden neben baulich-gestalterischen Maßnahmen vielfältige Informations- und Kommunikations-dienstleistungen angeboten, die die face-to-face-Kontakte um medial vermittelte Möglichkeiten ergänzen.

3.1 Die Messestadt Riem

Drei übergeordnete Planungsziele wurden hierfür definiert, aus denen der soziale und räumliche Identitäts-aspekt explizit hervorgeht:

- „Identität und Stadtgestalt: Das Viertel soll eine eigene Identität und eine charakteristische Stadtgestalt erhalten, die den dort lebenden und arbeitenden Menschen das Gefühl von Heimat vermitteln.
- Ökologische Stadtentwicklung: Die Stadt soll sich nach ökologisch orientierten Zielsetzungen entwickeln, um den Menschen eine hohe Lebensqualität im Einklang mit der Natur zu bieten.
- Vollständige Infrastruktur: Es sollen alle erforderlichen Infrastruktur- und Versorgungseinrichtungen geschaffen werden, die das Zusammenleben der Menschen fördern und ein Miteinander von Wohnen und Arbeiten entstehen lassen" (Gräber 2004: 53f; ferner Birmann 2005: 47).

Die Entstehung der Messestadt Riem verdankt sich dem 1992 erfolgten Umzug des Münchner Flughafens von Riem ins Erdinger Moos (vgl. Abb. 2). Auf der dadurch frei gewordenen 560 ha großen und etwa 7 km vom Stadtzentrum entfernten Fläche hat die Stadt München sich bereits in einem sehr frühen Planungsstadium (Basisplan 1990) neben der Verlagerung der Messe aus der Innenstadt (die dem neuen Stadtteil seinen Namen gibt) für eine so genannte Drittellösung der Flächennutzung entschieden. Ein Drittel der Fläche dient gewerblicher Nutzung, ein Drittel ist der Wohnnutzung vorbehalten und ein Drittel ist Freifläche (vgl. Abb. 3). Im weiteren Planungsverlauf ist der Grün- und Freiflächenanteil allerdings deutlich erhöht worden.

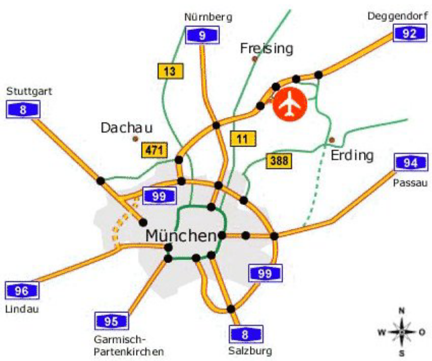


Abbildung 2: Standort des neuen Münchner Flughafens

Diese funktionalen Bereiche sind räumlich deutlich voneinader getrennt. Die Gewerbegebiete schließen sich westlich und östlich an das Messegelände an, im Süden begrenzt durch eine markante Allee, die das daran anschließende Wohnviertel und die Grünflächen von den kommerziell genutzten Bereichen trennt. 1998 wurden die Neue Messe München und das Internationale Kongresszentrum eingeweiht, im Mai 1999 folgte die Verlängerung der U-Bahn bis in die Messestadt. Die Wohnbebauung erfolgt in insgesamt fünf Bauabschnitten, Ende 1998 sind die ersten Menschen in die Messestadt gezogen. Mit dem Beginn der Bundesgartenschau im April 2005 wurde der erst Bauabschnitt abgeschlossen, seitdem leben ca. 4.500 Personen in etwa 2.100 Wohnungen im Quartier. Mit der Fertigstellung des zweiten Bauabschnitts im Jahr 2007 werden 50% der geplanten 7.000 Wohnungen errichtet sein. Mit dem Abschluss des Gesamtprojekts wird bis 2013 gerechnet. Dann werden nicht nur 16.000 Menschen hier leben, sondern auch 13.000 hier arbeiten (vgl. http://www.messestadt-riem.com).

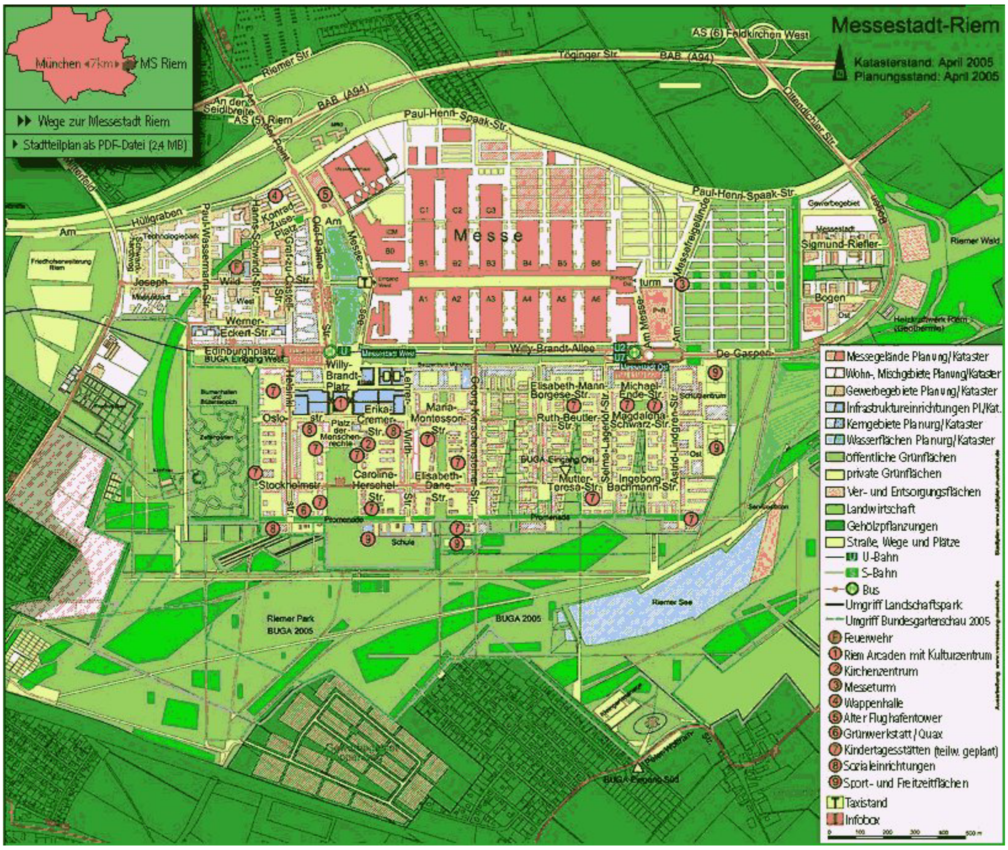


Abbildung 3: Das Gelände der Messestadt Riem

Die Versorgung der Messestadtbewohner wird innerhalb des Quartiers bislang im Wesentlichen durch das 120 Geschäfte (und 55.000 qm Verkaufsfläche) umfassende Einkaufszentrum ‚Riem Arcaden' gewährleistet, das im März 2004 eröffnet hat und über einen Supermarkt verfügt. Daneben existieren nur sehr vereinzelt wohnumfeldnahe Einkaufsmöglichkeiten. Ganz anders ist die Situation im Bereich der öffentlichen und sozialen Dienstleistungen, ein umfangreiches Angebot sorgt hier für vielfältige Möglichkeiten der aktiven Teilnahme am öffentlichen Leben. Neben mehreren Kindergärten und Kindertagesstätten, einer Grundschule und einer ökumenischen Kirche, gibt es unter anderem ein Familienzentrum, mehrere Nachbarschaftstreffs, ein Zentrum für Freizeit und kulturelle Bildung und ein ‚Projekt zur Beteiligung von BürgerInnen und NutzerInnen am Aufbau des neuen Stadtteils', das über Informationsveranstaltungen, Beratungen und Projektinitiierungen die Entstehung und Aufrechterhaltung sozialer Netzwerke unterstützt. Das kulturelle Angebot umfasst vor allem Kunstprojekte, die unter anderem vom Kulturzentrum betreut werden und das rege Interesse – nicht nur seiner Bürger, sondern auch von Nicht-Bewohnern – an der Entwicklung der Messestadt widerspiegeln. Für diese Klientel gibt es mit der Infobox, die mit Ausstellungen zur Planungsphilosophie und -geschichte eine Auseinandersetzung mit dem Stadtteil anregt, ein weiteres Angebot. Im Übrigen richtet es sich vornehmlich an Familien mit Kindern, dem relativ am stärksten vertretenen Haushaltstyp im Quartier; ein Nachtleben mit Bars und Discotheken gibt es praktisch nicht.

Sich selbst bezeichnet die Messestadt Riem als ‚ökologische Stadt' – nahezu die Hälfte der 560 ha nehmen die Grünflächen im Wohnumfeld, ein neu gepflanzter Wald im Nordosten und der Landschaftspark, der mit 200 ha Fläche, einem Badesee und einem Rodelhügel Austragungsort der Bundesgartenschau 2005 war, ein. Zur Gewährleistung der ökologischen Ansprüche, aber auch zur Schaffung eines hohen Freizeit- und Erholungswertes, hat die Stadt München ein differenziertes Bündel an Planungsinstrumenten implementiert, das über die übliche Bauleitplanung hinausgeht und zum Beispiel in der ‚Beratergruppe für Stadtgestalt und Ökologie', einem von Vertretern der Stadt und unabhängigen (Landschafts-)Architekten besetzten Gremium, ihren Niederschlag findet (vgl. Birmann 2005). Für diese im Namen der Nachhaltigkeit die Lebensqualität fördernden Maßnahmen wurden der Messestadt Riem bereits eine Reihe nationaler und internationaler Preise verliehen, so unter anderem vom Bundeswettbewerb ‚Urban 21' oder von ‚Habitat II'.

Die ursprüngliche architektonische Planung orientierte sich an gründerzeitlichen Idealen, mit einer geschlossenen Bebauung und grünen Innenhöfen. Mit den Planungen zum Landschaftspark wurde diese Idee jedoch verworfen. Realisiert hat man schließlich eine Art Kammstruktur, die die Wohnbebauung unmittelbar mit vernetzten Grünzügen verbindet. Von Nord nach Süd nimmt die Bebauungsdichte graduell ab und geht in den Landschaftspark über. „Die Baustruktur ist vom Wechsel geschlossen bebauter

Straßenräume mit locker bebauten, grünen Innenbereichen gekennzeichnet. Ein wichtiger Aspekt stellt damit der öffentliche Raum dar, der als Abfolge von Straßen und Plätzen mit graduellem Übergang in begrünte Straßen, Kinderspielplätze, zusammenhängende Grünhöfe und Park konzipiert ist“ (Gräber 2004: 57). Ein weiteres Element zur Schaffung von Identifikationspotenzialen ist die Differenzierung der Gebäudetypen. Vorherrschend sind zwar drei- und viergeschossige Gebäude, dazwischen (und nach Süden zunehmend) liegen jedoch zweigeschossige Blocks und vereinzelt gibt es auch Reihenhäuser. Diese Mischung erfolgte nicht allein aus gestalterischen Gründen, sondern auch aufgrund des Planungsziels eines sozial gemischten Stadtquartiers. In der Messestadt beträgt – für den ersten Bauabschnitt – der Anteil sozial geförderten Wohnungsbaus 28%. Hinzu kommen 30%, die nach dem so genannten München-Modell für Einheimische mit bestimmten Einkommensgrenzen vorrangig zum Kauf angeboten wurden. Weitere 14% sind für mittlere Einkommensgruppen ohne bisherige Wohn- oder Arbeitsbindung vorgesehen. Somit sind lediglich 28% frei finanzierter Wohnungsbau, ein im Vergleich zu anderen Neubauvorhaben relativ geringer Anteil.

Aus den explorativen Gesprächen, die Gräber (2004) im Rahmen ihrer Untersuchungen zur Ortsbindung mit verantwortlichen Planungsexperten führte, kristallisiert sich eine ambivalente Einschätzung zu den Potenzialen raumbezogener Identät heraus. Positiv hervorgehoben wird der hohe Grad an Zugänglichkeit des umfangreich vorhandenen öffentlichen Raumes, die eine ausreichende Durchlässigkeit innerhalb des Quartiers garantiert. „Alle Höfe und Grünräume sind frei zugänglich und miteinander verbunden. Ebenso ist […] die Durchgangsmöglichkeit durch das Einkaufszentrum gewährleistet, ohne die die beiden öffentlichen Plätze des Viertels voneinander getrennt wären“ (ebd.: 59). Integrationsfördernde Maßnahmen baulich zu planen, hielt ein befragter Experte für ein schwieriges Unterfangen: „Man weiß weder, wer da draußen investieren wird, noch wer dort wohnen wird und wie die überhaupt zu so einem Angebot stehen. Ich glaube nicht, dass man Stadt auf eine gewisse Bevölkerungsgruppe hin entwerfen sollte, es muss schon einen Ausgleich geben können. […] In der Realität kommt es natürlich sofort zur Ghettobildung“ (ebd.). Die Frage, ob durch Bauplanung und -gestaltung soziale Kontakte gefördert werden können, ist ebenfalls nicht eindeutig zu beantworten. „Auch wenn es tendenziell so ist, dass Leute, die in Sichtweite zueinander wohnen, eher Kontakt miteinander aufnehmen, gibt es viele Beispiele, wo sich innerhalb eines Hauses selbst die nächsten Nachbarn nicht kennen. Daher ist es fraglich, inwiefern die Architektur dazu überhaupt einen Beitrag leisten kann. Durch die vielen Wege und die Abkopplung des Verkehrs begegnen sich die Bewohner zumindest häufiger, was möglicherweise eine bessere soziale Integration fördern könnte“ (ebd.). Bemerkenswert ist schließlich, dass der Symbolgehalt des Quartiers über markante Gebäude als gering eingeschätzt wird – es gebe nur wenige Identifikationspunkte, die sich zudem nicht zwingend als identitätsstifende Impulsgeber audrängten. Komplementär zu den Aussagen der am Planungsprozess Beteiligten wird in Kapitel 4 anhand der Ergebnisse von Gräber (2004) und einer aktivierenden Bürgerbefragung die Sicht der Bewohnerinnen und Bewohner schlaglichtartig beschrieben.

3.2 Informationsinfrastrukturen in der Messestadt Riem

Der Begriff ‚Informationsinfrastruktur' wird hier in einem weiten Sinne verstanden, d.h. es werden hierunter nicht nur technologisch vermittelte Informations- und Kommunikationsinfrastrukturen subsumiert, sondern auch durch Printmedien und Institutionen (wie dem Bürgerforum) verbreitete Informationskanäle miteinbezogen. Für die empirische Erfassung raumidentitärer Prozesse spielen – in einem allgemeinen Sinn von Informationsinfrastruktur – natürlich auch die im (physischen) Raum als markant und relevant ausgewiesenen Plätze, Treffpunkte oder mit einer bestimmten Symbolik aufgeladenen Orte eine wichtige Rolle. Der Stellenwert der Informationsstrukturen ist dabei ein doppelter: zum einen, und hier ausschließlich betrachtet, sind sie ein Mittel zum Zweck für raumbezogene Identität. Zum anderen können sie jedoch auch den Status eines Selbstzweckes erlangen und so bis zu einem gewissen Grad als unabhängig von ihrem Nutzungszweck betrachtet werden.

Insgesamt verfügt die Messestadt Riem über ein sehr breites Angebot an Informations- und Kommunikationsdienstleistern (im Folgenden IuK-D abgekürzt). Unter den Institutionen nimmt das Bürgerforum, das seit 2003 als eingetragener Verein firmiert, einen zentralen Stellenwert ein. Räumlich im 2004 eröffneten Kulturzentrum in den Riem Arcaden untergrbracht, informiert das Bürgerforum über Ausstellungen und regelmäßige Mittwochstreffen über alle Belange im Quartier. Darüber hinaus bemüht es sich um eine aktive Teilnahme der Bewohner an kulturellen, sportlichen oder politischen Veranstaltungen und trägt somit wesentlich zum Auf- und Ausbau sozialer Netzwerke bei. Im Auftrag des Bürgerforums wurde zudem die bereits erwähnte aktivierende Bürgerbefragung 2004 mit dem Ziel durchgeführt, Einstellungen der Bewohner zum Quartier zu erheben und sie zur aktiven Mitarbeit an Projekten zu motivieren. Vorläufer des Bürgerforums war das Bürgerbeteiligungsprojekt ‚Messestadt Riem:Dialog', deren Aufgabe es war, „[…] die Entwicklung der sozialen Netze und der Nachbarschaften zu fördern. Für dieses Projekt wurde eine Steuerungsgruppe ins Leben gerufen, die vom Sozialreferat koordiniert wurde und der weitere Mitglieder der Verwaltung und des Stadtrates angehörten“ (Birmann 2005: 50). Weitere Einrichtungen in diesem Kontext sind das erwähnte Beteiligungsprojekt zum Aufbau des neuen Stadtteils, das Familienzentrum Messestadt e.V. (das Eltern-Kind-Gruppen, Beratungstreffen, Vorträge, Kurse und Fortbildungskurse initiiert) und eine Vielzahl an Bewohnertreffs, wie beispielsweise das Bewohnertreff ‚Galeriahaus' (zur Förderung und Begleitung von stabilen Hausgemeinschaften und verträglichen Nachbarschaften), ‚Lehrer-Wirth-Str.' und ‚Widmannstr.' (vgl. http://www.messestadt-riem.de).

Mit der vierteljährlich erscheinenden ‚TakeOff!' gibt es seit 2000 eine Stadtteilzeitung, die als öffentliches Sprachrohr über Entwicklungen im Quartier informiert, kritisiert, problematisiert und versucht, nicht nur möglichst viele Leser zu gewinnen, sondern auch Schreiber zu akquirieren. Das Themenspektrum umfasst Informationen des Bürgerforums, Aktivitäten der Nachbarschaftstreffs (überschrieben mit ‚Häuser voller Leben'!), Hinweise zu Kunst- und Kulturereignissen; aber auch ökologische Projekte, kirchliche Themen, ‚Neues von der Baustelle'!, oder die Belange der Kinder werden behandelt. Ein weiteres Printmedium ist die Begrüßungsmappe für Neubürger, die, durch Ratschläge der Akteure vor Ort mitkonzipiert, als erste Orientierungshilfe dient. Im Bereich der internetgestützten IuK-D sind zum einen das Projekt ‚Privatfernsehen/Internetfernsehen' (vgl. http://messsestadt-tv.com) und zum anderen das Projeket ‚E-neighborhood' (vgl. http://www.messestadt-riem.com/msr/pl_neighbors/fr_neigh.htm) zu nennen. Ersteres verfolgt das Ziel, mit Hilfe von Videoaufnahmen den eigenen Bekanntheitsgrad als Verein, Jugendgruppe, Musikband, etc. zu steigern oder die persönliche Identifikation mit dem eigenen Stadtquartier filmisch aufzuarbeiten (vgl. Abb. 4). Über das Internet werden entsprechende Videoaufnahmen dann publiziert – so beispielsweise die Eröffnung der Riem Arcaden oder der Spatenstich zur Bundesgartenschau. Bemerkenswert ist, dass bislang fast ausschließlich Beiträge des Initiators von ‚messestadt-tv.com' präsentiert werden. Mit dem zweiten Projekt verbindet sich die Idee, Nachbarschaftskontakte über das Internet zu initiieren oder aufrecht zu erhalten. Dieser virtuelle Kontakt- und Marktplatz umfasst Angebote zu Dienstleistungen (z.B. der Lösung von Computerproblemen), zum lokalen Arbeits- und Immobilienmarkt und der Suche nach Gleichgesinnten zur gemeinsamen Freizeitgestaltung (vgl. Abb. 5).

Das folgende Kapitel versucht anhand einer Auswahl empirischer Ergebnisse der Diplomarbeit von Gräber (2004) und der aktivierenden Bürgerbefragung (vgl. Klöver 2005) einen ungefähren Eindruck von den Potenzialen und Realisierungen raumbezogener Identitätsbildungen zu vermitteln.

Abbildung 4: Internetseite von messestadt tv

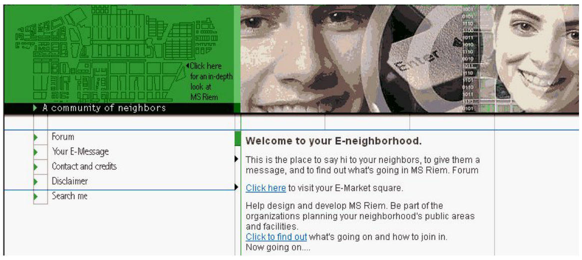


Abbildung 5: Internetseite von E-neighborhood

4 EMPIRISCHE ERGEBNISSE ZU RAUMBEZOGENEN IDENTITÄTEN DER MESSESTADT-BEWOHNER

Aus den empirischen Ergebnissen lassen sich keine umfassenden Schlussfolgerungen zu Identitätsprozessen allgemein ziehen, vielmehr dienen sie zum Erkennen schlüssiger Anhaltspunkte über raumbezogene Identitätsmuster der Bewohner der Messestadt Riem. Auch wurden nicht alle vier oben dargestellten Dimensionen (‚Sicherheit/Vertrautheit/Zugehörigkeit', ‚Stimulation/Aktivität', ‚Symbolik/soziale Inter-aktion' und ‚Identifikation/Individualität') gleichermaßen untersucht. Für die aktivierende Bürgerbefragung gilt, dass sie Einblicke über den Bekanntheitsgrad der Iuk-D gewährt, ohne diese weiter zu vertiefen; hier sind weitere empirische Untersuchungen notwendig.

Interessante Erkenntnisse über raumbezogene Identität liefern mental maps. Sie stellen eine Art Schnittmenge der ‚identification of' und ‚identification with' dar, indem sie (zumindest partiell) enthüllen, was die Probanden wahrnehmen und, durch Positionierung, Größe, Detailgenauigkeit, Weglassung, etc., wie sie das Wahrgenommene gewichten bzw. in ihrer Bedeutung einordnen. Die mental maps, die Gräber (2004: 64ff) ihre Befragten zeichnen ließ, lassen einen Zusammenhang zwischen Aneignungsmodi und täglicher Aufenthaltsdauer näherungsweise erkennen. Jene Bewohner, die sich berufs- und/oder familienbedingt relativ wenig in der Messestadt aufhalten, nehmen vor allem ihr unmittelbares Wohnumfeld genauer wahr. Mit zunehmender Entfernung von der Wohnung, die nahezu ausnahmslos in die Mitte der Zeichnung platziert wurde, nehmen maßstäbliche Genauigkeit und Detailiertheit ab. Der umgekehrte Zusammenhang – man arbeitet in der Messestadt und/oder eignet sich aufgrund der eigenen Kinder bestimmte Orte an, so dass größere Aktionsräume mit entsprechender Genauigkeit wiedergegeben werden – kann allerdings nicht allgemein konstatiert werden, obgleich manche der Befragten diesen Kontext verifizierten. Die Auswahl bestimmter Orte mit subjektiv wahrgenommener hoher Aufenthaltsqualität ergibt sich zum Beispiel für Mütter/Väter mit Kindern aus einem Wechselspiel mehrerer Faktoren: Den von den Kindern wahrgenommenen und für attraktiv empfundenen Plätzen, ebenso jenen der der Mütter und Väter, und auch der Auswahlmöglichkeit zwischen verschiedenen Orten mit ähnlicher funktionaler Bedeutung (zum Beispiel Spielplätze oder Grünflächen). Hinzu kommt aber auch ein Lagekriterium in dem Sinne, dass Spielplätze allein aufgrund ihrer Nähe – und damit Erreichbarkeit und Kontrollierbarkeit – bevorzugt werden. Raumbezogene Identität bleibt damit subjektzentriert, zugleich aber auch raumbeeinflusst.

Vor diesem Hintergrund ist auch die Auswahl bevorzugter Orte als soziale Treffpunkte zu sehen. Ohne Frage spielen für die Beurteilung der Aufenthaltsqualität bestimmter Plätze soziale und räumliche Rahmen-bedingungen eine die persönliche Entscheidung beeinflussende Rolle. Die Entscheidung wird jedoch durch subjektive Empfindungen von der Person getroffen. Daher verwundert es nicht, dass prägnante Orte wie das Einkaufszentrum, das Stadtteilcafé oder der Spielplatz als Treffpunkt unterschiedlich bewertet werden – die Spannweite reicht von deutlicher Ablehnung bis begeisterter Zustimmung (vgl. Gräber 2004: 67). Ein für die Interpretation raumbezogener Identitätsmuster bemerkenswertes Ergebnis erhält man, wenn man die Beurteilung der physiognomisch-ästhetischen Gestaltung mit der Beurteilung der umfassenderen Lebens-qualität im Quartier in Beziehung zueinander setzt, da sich hieran zeigt, dass einige Bewohner mit widersprüchlichen bis gegensätzlichen Auffassungen und Assoziation gut leben können. Raumbezogene Identität manifestiert sich auf diese Weise als komplexer, mehrdimensionaler und in sich verschachtelter Prozess. Eine deutliche Mehrheit der Befragten beurteilte nämlich die architektonische Ästhetik ihres Wohnumfeldes deutlich negativ, Aussagen wie ‚so dicht bebaut', ‚einfallslos', ‚langweilig', ‚trist', ‚irgendwie unecht', ‚leider schon fertig geplant, nichts kann sich von alleine entwickeln' oder ‚das Viertel gleicht einem Ghetto' (vgl. ebd.: 68f) wurden häufiger gemacht (gleichwohl ist das nicht das Urteil aller Befragten). Dem stehen, von denselben Personen, durchweg positive Emotionen hinsichtlich des alltäglichen Lebens in der Messestadt gegenüber. Es ist möglich und sinnvoll, sich mit seinem Wohnumfeld positiv zu identifizieren und gleichzeitig die gebaute Umwelt als wenig ansprechend zu bewerten (sinnvoll deswegen, weil nicht alle

Bewohner ihren neuen Wohnort freiwillig gewählt, sondern als Sozialhilfeempfänger beispielsweise zugewiesen bekommen haben). Diese positive emotionale Zugehörigkeit äußert sich unter anderem auch darin, dass einige der befragten Personen ihren Besuchen gerne das ganze Viertel zeigen.

Eine weitere Ausdrucksform raumbezogener Identität äußert sich eher mittelbar über die Art der Entstehung und Entwicklung sozialer Kontakte. Einige der Befragten hatten über Baugemeinschaften schon vor dem Einzug oder während der Bauphase erste Kontakte zu ihren künftigen Nachbarn. Diesen lebensgeschicht-lichen Einschnitt an einem Ort, der erst im Entstehen begriffen ist, erlebten manche Personen als besonders prägend, so zum Beispiel folgende Bewohnerin: „Also es war … so, dass wir hier … im Moment vom Einzug schon mehr Leute kannten als wie nach zwölf Jahren in der Schellingstraße [eine Straße in der Nähe des Münchner Stadtzentrums; Anm. A.K.] … und dann … alle Leute, die hier zuziehen, suchen eigentlich Kontakt, weil sie alle so bissel entwurzelt sind …“ (Gräber 2004: 74). Diese Erfahrung des sozialen Zusammenhalts wird dann teilweise gerade nicht mit Merkmalen des urbanen Zusammenlebens (was es eigentlich ist), sondern mit Vorstellungen dörflicher Sozialstrukturen assoziiert, wie eine andere Bewohnerin anmerkt: „… vor allem am Anfang wie gesagt, man sieht die Leute immer wieder, man kennt sich vom Sehen und dann ist es wirklich fast wie ein Dorf gewesen, wo man fast jeden kennt und jeden grüßt und mit dem einen oder anderen auch näher ins Gespräch kommt“ (ebd.). Insofern zeigen die empirischen Ergebnisse auch, dass gerade auch völlig neugebaute Stadtteile ein ideales Soziotop für die Kontinuität biografischer Identitäten sein können. „Jeder war durch den Umzug ein Stück weit entwurzelt und suchte daher den Kontakt zu den Menschen, denen es ähnlich ging. Hinzu kam, dass in der Messestadt keine gewachsenen, eingefahrenen Strukturen vorhanden waren, die die Kontaktaufnahme zu ‚Alteingesessenen’ erschweren hätten können“ (Gräber 2004: 76).

Doch nicht nur das Wohnumfeld, auch Institutionen wie das Familienzentrum oder das Bürgerforum sind identitätsunterstützende Formen, wie exemplarisch an den Aussagen eines Bewohners illustriert werden kann: „Die Kontakte haben sich dadurch entwickelt, dass ich immer Informationsangebote gesucht hab und die gab’s in verschiedenen Beteiligungsprojekten hier im Stadtteil und über diese Beteiligungsprojekte … habe ich dann auch so das Bedürfnis gehabt, mich zu engagieren und darüber sind dann Geschichten entstanden wie die Stadtteilzeitung, wie das Bürgerforum … und ja … dann sind über diese Initiativen dann einfach Kontakte entstanden und daraus sind Freundschaften entstanden und das ist das Schöne, was sich hier so entwickelt …“ (Gräber 2004: 85).

Bei subjektiv unterschiedlicher Abwägung der Vorzüge und Nachteile, die das Leben in der Messestadt beeinflussen, können sich, bei vorsichtiger Interpretation der Ergebnisse der qualitativen Interviews, die Bewohner mit ihrem Stadtquartier positiv identifizieren. Zu diesem Ergebnis kommt auch die aktivierende Bürgerbefragung, die im Sommer 2004 durchgeführt wurde und in deren Rahmen 221 Personen befragt wurden. 80% gaben an, gerne in der Messestadt zu wohnen (vgl. Klöver 2005: 9). Zum Zeitpunkt der Befragung waren etwa ein Viertel der Haushalte 1-Personen-Haushalte und die Hälfte Haushalte mit Kindern. Der Ausländeranteil betrug knapp 39%. Im Vergleich zum Durchschnitt der Stadt München insgesamt, liegen die beiden letztgenannten Werte in der Messestadt Riem deutlich über dem Durchschnitt. Befragt wurde auf Spielplätzen, einem Stadtteilcafé, während des einmal jährlich stattfindenden Promenadenfests und an der Haustür.

Der hohe Anteil positiver Identifikation erhält ein zusätzliches Gewicht dadurch, dass 60% angaben, ihren privaten Mittelpunkt im Quartier zu haben. Auch sind Umfang und Intensität der sozialen Kontakte ausgesprochen hoch: „Im Durchschnitt geben die Befragten neun weitere BewohnerInnen, zum Teil sogar ganze Familien, zu den sie einen guten Kontakt haben, das heißt, ein nachbarschaftliches Verhältnis, das über das reine Austauschen von Grüßen und Höflichkeitsfloskeln hinausgeht. Diese Kontakte sind auch recht häufig, 83 Prozent […] gaben an, mindestens wöchentlich intensiveren Kontakt zu den NachbarInnen zu haben“ (ebd.). Diese hohen Werte sind allerdings auch auf die Befragungsorte zurückzuführen, denn in der Stichprobe sind Mütter im Vergleich zur Grundgesamtheit und zu anderen Personengruppen überrepräsentiert. Gerade der in vielen Fällen nocht nicht allzu lange zurückliegende Umzug trägt überdies dazu bei, die Freundschaften am vorherigen Wohnort (meistens im Stadtgebiet von München) aufrecht zu erhalten. Hinzu kommt ferner, dass sich das Leitbild der ‚Stadt der kurzen Wege’ auch in der Messestadt, was die nahräumliche Verknüpfung von Arbeiten und Wohnen betrifft, bislang nicht realisiert hat. Guber (2005: 60) hat im Rahmen seiner empirischen Untersuchungen zu diesem Thema einen Anteil von knapp 5% aller Befragten ermittelt. Ein ausschließlicher Bezug für sämtliche alltägliche Aktivitäten ist daher selten gegeben und konzentriert sich zudem relativ stark auf Mütter mit kleinen Kindern. Hinsichtlich der Wahl der Treffpunkte unterscheiden sich die Ergbnisse dieser Studie kaum von jenen von Gräber (2004), wie Tab. 1 zeigt. Deutlich ist jedoch ein Bezug zur Wohnung erkennbar – sei es die eigene oder die der Nachbarn.

„Wo treffen Sie sich mit Ihren Nachbarn?“	**Mehrfachantworten in % (Werte gerundet)**
Draußen (z.B. Spielplatz)	64
Ich werde zu meinen NachbarInnen eingeladen	57
Nur im Hausflur / vor der Haustür	56
Ich lade sie auch zu mir ein	53
An bestimmten Plätzen (z.B. Kindergarten, Bächer, etc.)	36
Wir treffen uns meistens bei einem/r bestimmten Nachbarn/in	5

Tabelle 1: Beliebte Treffpunkte in der Messestadt (Quelle: Klöver 2005: 10; leicht verändert)

Neben den intensiveren Kontakten zu Nachbarn spielen für ein positives Zugehörigkeitsgefühl auch die informellen Kontakte eine wesentliche Rolle, „[…] die sich aus den Routinen des Alltagshandelns mehr oder weniger zufällig ergeben, aber eine hohe Häufigkeit und räumliche Konzentration aufweisen“ (Weichhart 1990: 64). Damit einhergehende Erwartungshaltungen reichen von gegenseitiger Rücksichtnahme (23%) bis zu Hilfsbereitschaft (75%).

Die Erwartungen der befragten Bewohner an ihr neues Lebensumfeld spiegelt das Spannungsfeld zwischen individueller und räumlicher Identität, das sich über strukturelle Kopplungsmechanismen permanent vollzieht, wider. Der Vollzug räumlicher Aneignung geschieht bei der Mehrheit der befragten Personen im Bewußtsein bereits existenter räumlicher Gegebenheiten, die zwar kritisiert werden (zu hohe Baudichte, wenig ansprechende Architektur, unausgewogene Einzelhandelsstruktur, etc.), mit denen man sich aber zu arrangieren lernt. Demzufolge konzentrieren sich die Erwartungen vorrangig auf die neue Wohnung (55% der Nennungen) und das unmittelbare Wohnumfeld mit seiner Kinderfreundlichkeit (60%) und den vielen Grünflächen (28%). Die Möglichkeit, etwas Neues mitzugestalten, fällt mit 16% demgegenüber deutlich zurück (vgl. Klöver 2005: 15).

Im Rahmen der aktivierenden Bürgerbefragung wurde auch erhoben, welche Informationskanäle und -dienste in Anspruch genommen werden. Aus den bisherigen Darstellungen dürfte die Erkenntnis, dass zu den wichtigsten Informationsquellen im Stadtteil die Nachbarn gehören, wenig überraschen (vgl. Tab. 2). Daneben spielt das Bürgerforum eine wichtige Rolle als vermittelnde Institution für vielfältige IuK-D, so beispielsweise die Organisation der monatlich stattfinden Stadtteilgespräche, des jährlichen Promenaden-fests, bei dem sich unterschiedliche Grupen und Vereine des Quartiers präsentieren können oder die Herausgabe der Stadtteilzeitung TakeOff!. Der Bekanntheitsgrad des Bürgerforums liegt insgesamt bei knapp zwei Drittel aller Befragten, er streut jedoch leicht in Abhängigkeit vom Bezugsjahr (unkorreliert) und etwas stärker in Abhängigkeit von Alter und Geschlecht: Während knapp 70% der Frauen das Bürgerforum kennen, sind es knapp 50% bei den Männern. Mit zunehmendem Alter steigt der Bekanntheitsgrad von 58% bei den unter 34jährigen bis auf 75% bei den über 65jährigen Befragten (vgl. ebd.: 20; Werte gerundet).

Auffallend ist zunächst, dass die Nachfrage nach quartiersbezogenen Informationen allgemein hoch ist (zudem sind nicht alle Möglichkeiten genannt, es fehlt beispielsweise die Infobox). Auf den ersten Blick überraschend scheint die relativ geringe Nutzung des Internet und des lokalen TV. Berücksichtigt man allerdings die fehlende Repräsentativität der Stichprobe (mit einem überrepräsentierten Anteil der Mütter, was nicht heißen soll, dass sie diesen Medien ablehnend oder unfähig gegenüber stehen), ferner die Tatsache, dass die Printmedien-Angebote und die face-to-face Kontakte bereits einen hohen Anteil des Informationsbedürfnisses befriedigen dürften, dann relativieren sich die ‚niedrigen' Werte merklich.

„Wie informieren sich die ‚MessestädterInnen'?"	**Mehrfachantworten in % (Werte gerundet)**
Stadtteilzeitung TakeOff!	72
Kostenloser Stadtteilanzeiger ‚Hallo'	67
Gespräche mit Nachbarn	65
Plakate	51
Presse allgemein	28
Hauskanal (lokales TV)	24
Internet	14
E-Mail Verteiler des Bürgerforums	8
Sonstiges (meist Programme der Einrichtungen im Quartier)	16

Tabelle 2: Informationsquellen der Messestädter (Quelle: Klöver 2005: 18; leicht verändert)

„Interessant an dieser Stelle ist jedoch, dass sich die deutschen und die nicht-deutschen BewohnerInnen bei den Quellen für ihre Informationen unterscheiden. Unter den deutschen BewohnerInnen lesen knapp 80% die Take-off, damit genießt die Zeitschrift wirklich einen sehr hohen Aufmerksamkeitswert. Bei den MigrantInnen sind es etwas weniger, aber doch gut die Hälfte (52%). Die MigrantInnen informieren sich anteilig stärker über die NachbarInnen und die „Hallo", und etwas häufiger als die deutschen BewohnerInnen mittels des Internet und des Hauskanals" (Klöver 2005: 18). Das breit gefächerte Informationsangebot stößt bei den Bewohnern der Messestadt Riem somit auf eine hohe Resonanz.

5 FAZIT

Raumbezogene Identität ist ein komplexer, mehrdimensionaler und kontinuierlicher Vorgang, in dessen Mittelpunkt das Subjekt als Entscheidungsinstanz steht. Dieses Subjekt wird bei seiner persönlichen Sinnsuche von sozialen und räumlichen Gegebenheiten und Sachverhalten beeinflusst, die es nach eigenen Maßstäben inkorporiert. Der physisch-materielle und der subjektiv sowie sozial konstruierte Raum verschaffen jedem Einzelnen einen Rahmen, der Vertrauen, Stabilität, Handeln und Interaktion ermöglicht. Die konkrete Ausgestaltung und Gestaltvielfältigkeit des Rahmens ist vom einzelnen Individuum zwar ebenfalls beeinflussbar, aber nicht in einem grundlegenden, absolut kontingenten Sinne. Strategische Identitätsalternativen bestehen in Form von aktiver Adaption, passiver Resignation oder Wegzug.

Es konnte empirisch gezeigt werden, dass dem Leitbild der urbanen Dichte, trotz gewisser Widerstände, eine berechtigte Realisierungschance zuerkannt werden kann, wenn damit ausreichend alternative Möglichkeiten raumbezogener (und auch rollenspezifischer) Identitätsbildung einhergehen. Mit der erkennbaren räumlich-architektonischen Ausrichtung des Quartiers auf Familien – hoher Grünflächenanteil, viele Spielplätze und soziale Einrichtungen, Maßnahmen zur Verkehrsberuhigung – scheint es der Stadt München mit der Planung der Messestadt Riem gelungen zu sein, dieses Quartier mit positiven Assoziationen zu verbinden. Hierzu tragen auch die vielfältigen Informationsmedien bei, die bei den Bewohnern nicht nur bekannt sind, sondern auch angenommen werden. Zum gegenwärtigen Zeitpunkt und vor dem geschilderten Hintergrund ist es wohl realistisch, den Nutzungsgrad von lokalem TV und des Internet als hoch einzuschätzen. Im Kontext raumbezogener und sozialer Identitätsprozesse spielen unmittelbar sinnlich wahrnehmbare Erfahrungen zweifelsohne (und, so möchte man hinzufügen, zum Glück) eine größere Rolle. Wie in vielen anderen Bereichen auch, substituiert das Internet oder lokale TV bisherige Handlungsmuster nicht, sondern ergänzt sie. In diesem Lichte sind auch die empirischen Ergebnisse der Einstellungen der Messestädter zu interpretieren.

6 LITERATUR

BERGER, P.L. & T. LUCKMANN: Die gesellschaftliche Konstruktion der Wirklichkeit. Eine Theorie der Wissenssoziologie; Stuttgart, 1971

BIRMANN, T.: Evaluierung der in der Messestadt Riem tätigen „Beratergruppe für Stadtgestaltung und Ökologie" (= unveröffentlichte Diplomarbeit am Department für Geo- und Umweltwissenschaften, Sektion Geographie, der LMU München), 2005

FREY, H.-P. & K. HAUSSER: Entwicklungslinien sozialwissenschaftlicher Identitätsforschung; Frey, H.-P. & K. Hausser (Hrsg.): Identität. Entwicklungen psychologischer und soziologischer Forschung, Stuttgart, 1987, S. 3-26

GRÄBER, J.: Die Entwicklung von Ortsbindung in einem neuen Stadtteil – am Beispiel der Messestadt Riem – (= unveröffentlichte Diplomarbeit am Department für Geo- und Umweltwissenschaften, Sektion Geographie, der LMU München), 2004

GRAUMANN, C.F.: On Multiple Identities; International Social Science Journal 35, 1983, S. 309-321

GUBER, Ch.: Wohnen und Arbeiten im Stadtteil der kurzen Wege? Eine empirische Untersuchung zu Anspruch und Wirklichkeit nachhaltigen Lebens in der Messestadt Riem (= unveröffentlichte Diplomarbeit am Department für Geo- und Umweltwissenschaften, Sektion Geographie, der LMU München), 2005

HECHT, M.: Wir Heimat-Vertriebenen; Psychologie Heute, Heft 12/2005, 2005, S. 22-27

KAUFMANN, J.C.: Die Erfindung des Ich. Eine Theorie der Identität; Konstanz, 2005

KLÖVER, B.: Alles klar in der Messestadt?! Eine aktivierende Befragung in der Messestadt Riem; Bürgerforum Messestadt Riem, 2005

KOCH, A.: Autopoietic Spatial Systems. The significance of actor network theory and system theory for the development of a system theoretical approach of space; Social Geography Vol. 1, 2005, pp. 5-14

KOCH, A.: Dynamische Kommunikationsräume. Ein systemtheoretischer Raumentwurf; Münster, 2004

LUHMANN, N.: Soziale Systeme; Frankfurt, 1993

RAU, J.: Redebeitrag von Bundespräsident Johannes Rau; Online: http://www.bmvbw.de/architektur-baukultur/download/Rau.pdf (Stand 22.11.05), 2003

WAGNER, M.: Kenntnisstand und Verkehrsverhalten von Münchner Neubürgern als Grundlage für eine Vermarktung nachhaltiger Mobilität (= unveröffentlichte Diplomarbeit am Department für Geo- und Umweltwissenschaften, Sektion Geographie, der LMU München), 2005

WEICHHART. P.: Raumbezogene Identitäten 1. Intensivkurs, Department of Human Geography Nijmegen; Online: http://www.ru.nl/socgeo/n/colloquium/PlaceId01new.pdf (Stand 22.11.05), 1999a

WEICHHART. P.: Raumbezogene Identitäten 3. Intensivkurs, Department of Human Geography Nijmegen; Online: http://www.ru.nl/socgeo/n/colloquium/PlaceId03new.pdf (Stand 22.11.05), 1999b

WEICHHART, P.: Raumbezogene Identität. Bausteine zu einer Theorie räumlich-sozialer Kognition und Identifikation (= Erdkundliches Wissen Heft 102), Stuttgart, 1990

WEISS, G.: Heimat vor den Toren der Großstadt. Eine sozialgeographische Studie zu raumbezogener Bindung und Bewertung in Randgebieten des Verdichtungsraums am Beispiel des Umlandes von Köln; Köln, 2003

Online-Informationen zur Messestadt Riem unter (Stand 22.11.05):
http://www.messestadt-riem.com/
http://www.messestadt-riem.de/

ÖROK-Atlas online - Atlas Informationssystem Austria (AIS)
Ein interaktives, multimediales Informations- und Analyseinstrument

Markus SEIDL, Karel KRIZ

(Mag. Markus SEIDL, Geschäftsführer Österreichische Raumordnungskonferenz (ÖROK);
Dr. Karel KRIZ, Universität Wien, Institut für Geographie und Regionalforschung (IfGR), Kartographie und Geoinformation
AIS-Konsortium (IfGR UNI-Wien, ÖIR, TU-Wien)

VOM „ATLAS ZUR RÄUMLICHEN ENTWICKLUNG ÖSTERREICHS“ (ÖROK-ATLAS) ZUM ÖROK-ATLAS ONLINE

Seit dem Jahr 1983 werden von der Österreichischen Raumordnungskonferenz jährlich Karten zum „Atlas zur räumlichen Entwicklung Österreichs“ (ÖROK-Atlas) veröffentlicht. Zielsetzung ist, aktuelle Informationen zur räumlichen Entwicklung Österreichs in kartographisch leicht verständlicher und anschaulicher Form darzustellen. Mit dem steigenden Interesse an europäischen Themen seit dem Beitritt Österreichs zur Europäischen Union im Jahr 1995 wurde das Kartenprogramm um Karten für das Gebiet der Europäischen Union und den weiteren österreichischen Grenzraum erweitert.

Diese Darstellungen (z. B. regionale Bevölkerungsprognosen, Bildungsinfrastruktur, regionale Wirtschaftsentwicklung) wurden bisher von der ÖROK als einziger Institution publiziert. Eine Änderung dieser Situation ist insofern nicht zu erwarten, als die ÖROK aufgrund ihrer Zusammensetzung (Bund, Länder, Städte und Gemeinden, Wirtschafts- und Sozialpartner) dazu prädestiniert ist, raumrelevante Informationen, die von verschiedenen Gebietskörperschaften vorgehalten werden, zusammenzuführen, zu analysieren und kartographisch aufzubereiten.

Das Projekt „ÖROK-Atlas online“ wurde ins Leben gerufen, um den Entwicklungen im Bereich der neuen Medien Rechnung zu tragen. Durch den ÖROK-Atlas online soll es auf virtueller Ebene in kartographisch hochwertiger Form zu einer Zusammenführung und Veranschaulichung ausgewählter geographischer und regionalstatistischer Daten kommen und dem Benutzer die Möglichkeit gegeben werden, interaktiv mit dem System zu arbeiten. Die ausgewählten Themen werden sich an jenen bisher im Rahmen der Druckversion des ÖROK-Atlas publizierten orientieren.

DAS KONZEPT

Seit Mai 2003 beschäftigt sich eine Arbeitsgruppe im Rahmen der ÖROK mit dem Projekt ÖROK-Atlas online. Als erstes (Zwischen-)Ergebnis der Beratungen wurde als Grundlage für die Realisierung einer online-Version des ÖROK-Atlasses ein Strategiepapier ausgearbeitet, das die Basis für die Ausschreibung für die Entwicklung eines Prototyps bildete, der die Basis für die Weiterentwicklung bieten sollte.

Den Zuschlag für das Projekt erhielt eine Bietergemeinschaft mit folgenden Partnern: Universität Wien, Institut für Geographie und Regionalforschung (IfGR) Kartographie und Geoinformation – Projektleitung; TU Wien, Institut für Geoinformation und Kartographie (IGK), Forschungsgruppe (FG) Kartographie; ÖIR Informationsdienste GmbH.

Als Anforderungen an den Prototyp für den ÖROK-Atlas online wurden definiert:

- Das <u>Grundsystem</u> soll so angelegt sein, dass der *ÖROK-Atlas online* von jedem PC abrufbar und einfach bedienbar ist, ohne die Notwendigkeit von Zusatzinstallationen.
- Die <u>kartographische Aufbereitung</u> soll jener der des gedruckten ÖROK-Atlas entsprechen. Auch der *ÖROK-Atlas online* soll didaktischen Ansprüchen gerecht werden und sowohl Laien als auch Experten als Informationsmedium dienen. Dabei sollen auch grenzüberschreitende bzw. europäische Zusammenhänge aufbereitet werden.
- <u>Ausgangspunkt des Systems sind vorgefertigte Karten</u>, zu denen Erläuterungsmaterial (Text, Tabellen, Grafiken) zur Verfügung steht. Diese Karten stellen die Schnittstelle zum gedruckten ÖROK-Atlas dar, der – in sehr schlanker Form – weitergeführt werden soll. Der Prototyp wird Karten zu folgenden Themen umfassen: Bevölkerung, Umwelt, Verkehr Wirtschaft.
- Für Expert/innen soll die <u>Möglichkeit</u> bestehen, <u>eigene Karten zu erstellen</u>, zum einen auf Basis der bereits im System vorhandenen Daten (z. B. durch neue Kombination einzelner Themen), zum anderen durch die Integration eigener Daten.
- Alle <u>Karten</u> sollen in verschiedenen Formen <u>ausgegeben</u> werden können – abgespeichert, ausgedruckt, exportiert, einschließlich Erläuterungstexten, Statistiken, Grafiken etc.

Die wirkungsvolle Vermittlung nationaler und europaweiter Information zur räumlichen Entwicklung auf unterschiedlichen administrativen Niveaus stellt enorme Anforderungen an die Datenspeicherung und Datenverwaltung, als auch deren kartographische Visualisierung. Die Partner des *ÖROK Atlas online* Konsortiums stellen sich der Herausforderung, einen Atlas zu entwickeln, der höchsten technischen, grafischen und informativen Ansprüchen gerecht wird.

ÖROK Atlas online ist ein Produkt, das neben den zahlreichen Möglichkeiten der statistischen Bearbeitung der Daten auch raumrelevante Aspekte berücksichtigt und darüber hinaus eine entsprechend hochqualitative kartographische Umsetzung der Ergebnisse gewährleistet. Die Gleichstellung der Bedeutung von Datenexploration und Kartographie soll an dieser Stelle festgehalten werden.

PROJEKTZIELSETZUNG

Moderne Methoden der Computer- und Telekommunikationstechnologie bieten uns vielfältige Möglichkeiten, bestehende Arbeitsabläufe zu erweitern und zu optimieren. In diesem Sinne ist als primäres Ziel dieses Forschungs- und Entwicklungsarbeit die Konzeption und Erstellung eines Prototypen *ÖROK Atlas online* zu sehen, der sowohl die kartographische Visualisierung unterschiedlicher Datensätze, aber auch die Abfrage und Analyse dieser ermöglicht. Dabei werden sowohl geographische als auch thematische Daten integriert und diese über ein interaktives Kommunikationsportal abrufbar gemacht. Die so entstandene Informationsschnittstelle für die Abfrage, Analyse und Darstellung der räumlichen Entwicklung Österreichs gewährleistet eine technologisch zeitgemäße Weiterführung des bestehenden ÖROK-Atlas.

Die Präsentation der räumlichen Entwicklung Gesamtösterreichs und Europas sowie die Darstellung raumordungs- und regionalpolitisch relevanter Sachverhalte unter Berücksichtigung aktuell-politischer Schwerpunktsetzung sind als zentrale Aspekte der inhaltlichen Ausrichtung des Atlas zu sehen. Die von Experten durchgeführte Aufbereitung entsprechender Inhalte und Darstellungen sowie die kartographische Visualisierung aktuell-politischer Aspekte werden durch die Erweiterung des klassischen Mediums der Print-Karte mit Funktionalitäten der Interaktivität aufgewertet.

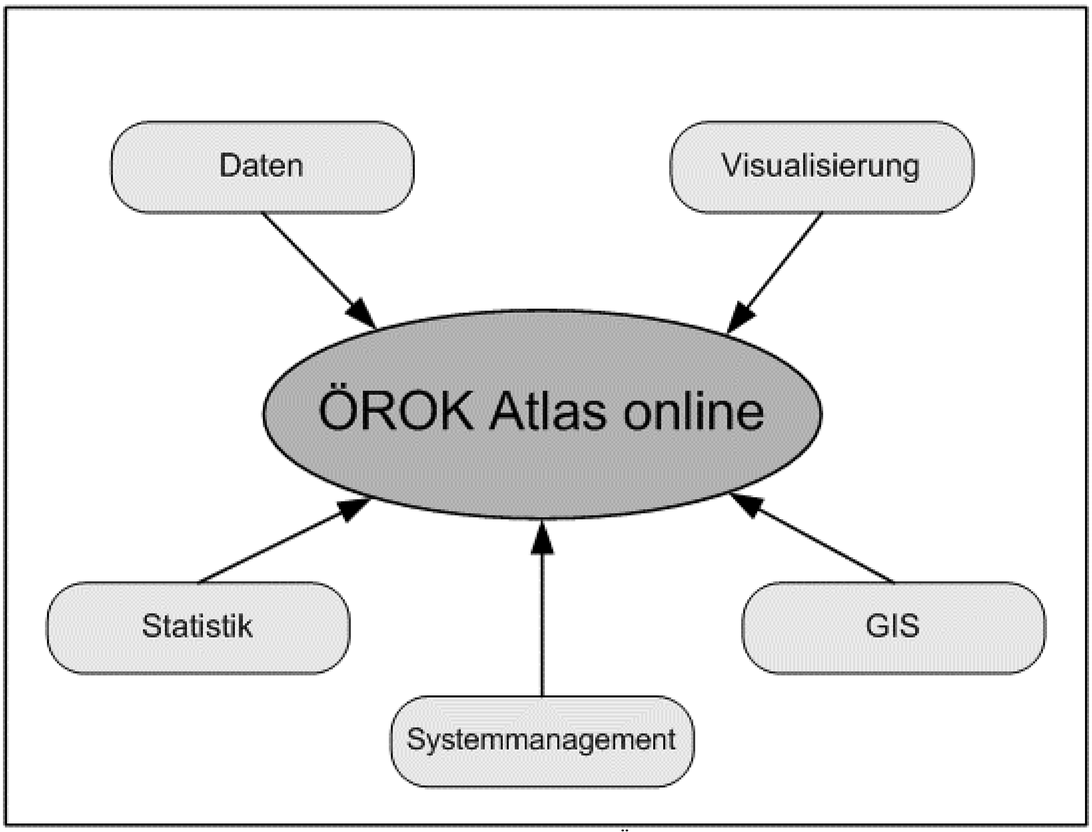


Abbildung 1: Basisarchitektur des ÖROK-Atlas online

In der Folge soll das kartographische Konzept des *ÖROK-Atlas online* erläutert, sowie grundlegende Aspekte der technischen Implementierung des Prototyp dargestellt werden.

KARTOGRAPHISCHES KONZEPT

Die Darstellung thematischer Sachverhalte in Form kartographischer Visualisierungen bedarf konzeptioneller Überlegungen, die zu einer optimalen Präsentation der Basisinformation führen.

Dem breiten und damit inhomogenen Benutzerkreis soll der *ÖROK-Atlas online* als Analyseinstrument, Nachschlagewerk und Lehrmittel zur Verfügung stehen. Das regelbasierte System soll dem Benutzer die größtmögliche Flexibilität in der Erstellung seiner Präsentation anbieten und durch die implementierten system-spezifischen Interaktionsfunktionen zu den primären Basis- und Sachdaten führen.

Der *ÖROK-Atlas online* sieht die Visualisierung für beide Ausgabemedien (Papier und Bildschirm) vor. Dabei bedeutet die systemtechnische Umwandlung in die jeweiligen Ausgabeformate und die Verbindung zu den Ausgabegeräten weniger Aufwand als die benötigte kartographische Modellbildung. Beide Ausgabemedien verlangen eine jeweils angepasste Maßstabsreihe sowie eine entsprechende Auflösung der Kartengraphik.

Die Basis für die Realisierung einer automatisch durchführbaren Sachdatenvisualisierung bilden generelle kartographische Grundlagen (z.B. durch skalenniveauabhängige Symbolwahl). Die Automatisierung erfolgt in mehreren Schritten, wobei vor allem Metadaten und Tabellen, die ein „Wenn-Dann-Schlußfolgerung“ zulassen, von Bedeutung sind.

Zunächst werden die umzusetzenden Daten auf prinzipielle Eigenschaften geprüft (Metaanalyse), danach erfolgt auf einer Extraktion ausgezeichneter Werte eine Ableitung weiterer Größen (Datenanalyse). Nach der Auswahl eines geeigneten Umsetzungsverfahrens und der Bestimmung der spezifischen Eigenschaften des Informationsträgers (Symbol/Signatur) je nach Art der Darstellung

(Datenumsetzung und Festlegung der Ausprägung der graphischen Variable) wird der endgültige graphische Verortungsbezug festgelegt (Verortung) und zugleich eine perzeptive Prüfung durchgeführt, wobei vor allem kritisch betrachtet wird, ob eine Darstellung lesbar ist oder nicht.

Die zur Verfügung stehenden Kartentypen des *ÖROK-Atlas online* sehen neben mono-thematischen Darstellungen auch komplex-analytische thematische Visualisierungen vor. Derartige Karten weisen neben ihrem topographischen Grundgerüst mehrere thematische Ebenen auf. Diese Tatsache führt zu einer Komplexitätssteigerung des gesamten Systems, insbesondere wenn bedacht wird, dass es dem Nutzer möglich sein soll, einzelne Ebenen der Karte gesondert zu manipulieren. Auf Grund dieser Notwendigkeit wird im *ÖROK-Atlas online* ein striktes Karten-Ebenen-Prinzip eingehalten. Über die gängige Möglichkeit hinaus, die Sichtbarkeit einzelner Kartenebenen zu beeinflussen, können diese hiermit sowohl in ihrer geometrischen, wie auch thematischen Komponente isoliert bearbeitet werden.

TECHNISCHE IMPLEMENTIERUNG

Die technische Architektur des *ÖROK-Atlas online* Prototyps folgt einem Mehr-Schichten Modell, das sämtliche Systemkomponenten in einem logischen Modell abbildet. Dieses bedingt, dass alle Workflows in einer konkret definierten und standardisierten Abfolge ablaufen. Es erfolgt somit eine, nicht nur auf Komponenten, sondern auch auf der Ebene der System-internen Befehlsfolge basierenden Unterteilung des Systems.

Die Abfolge GUI – Funktionen – Datenbank - Externe Programme gewährleistet eine saubere Trennung jener Bereich, auf die der Nutzer Zugriff hat von systemkritischen Bereichen.

Eingaben des Nutzers über die Graphische Benutzeroberfläche (GUI) haben keinen direkten Zugriff auf Datenbank und Externe Programme, sonder müssen durch eine Funktions-Schicht laufen. Diese führt nicht nur die internen Befehlsaufrufe aus, sondern gewährleistet mittels umfangreicher Prüfungen auch die Plausibilität und Fehlerfreiheit der Nutzereingabe.

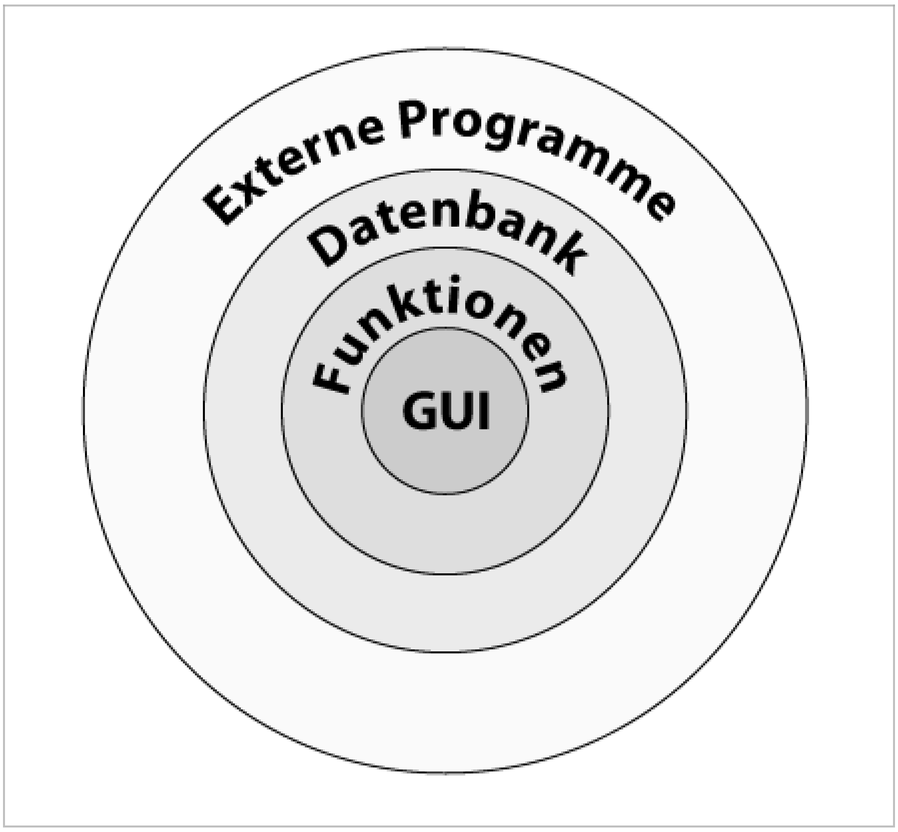


Abbildung 2: Mehr-Schichten Modell der System-Architektur

Sämtliche Funktionen sind in Funktionsbibliotheken ausgelagert, die, je nach Workflow, zur Laufzeit in das System eingebunden werden. Die einzelnen Funktionsbibliotheken sind weitgehend voneinander unabhängig, was die individuelle Weiterentwicklung dieser erleichtert.

Das Herzstück der *ÖROK-Atlas online* Implementierungen stellen die diversen Funktionsbibliotheken dar. Sie beinhalten sämtliche Arbeitsaufgaben, die das System zur Verfügung stellt.

Der Aufruf einzelner Funktionen erfolgt nicht direkt, sondern immer über den Weg der Nutzereingabe über die graphische Benutzeroberfläche.

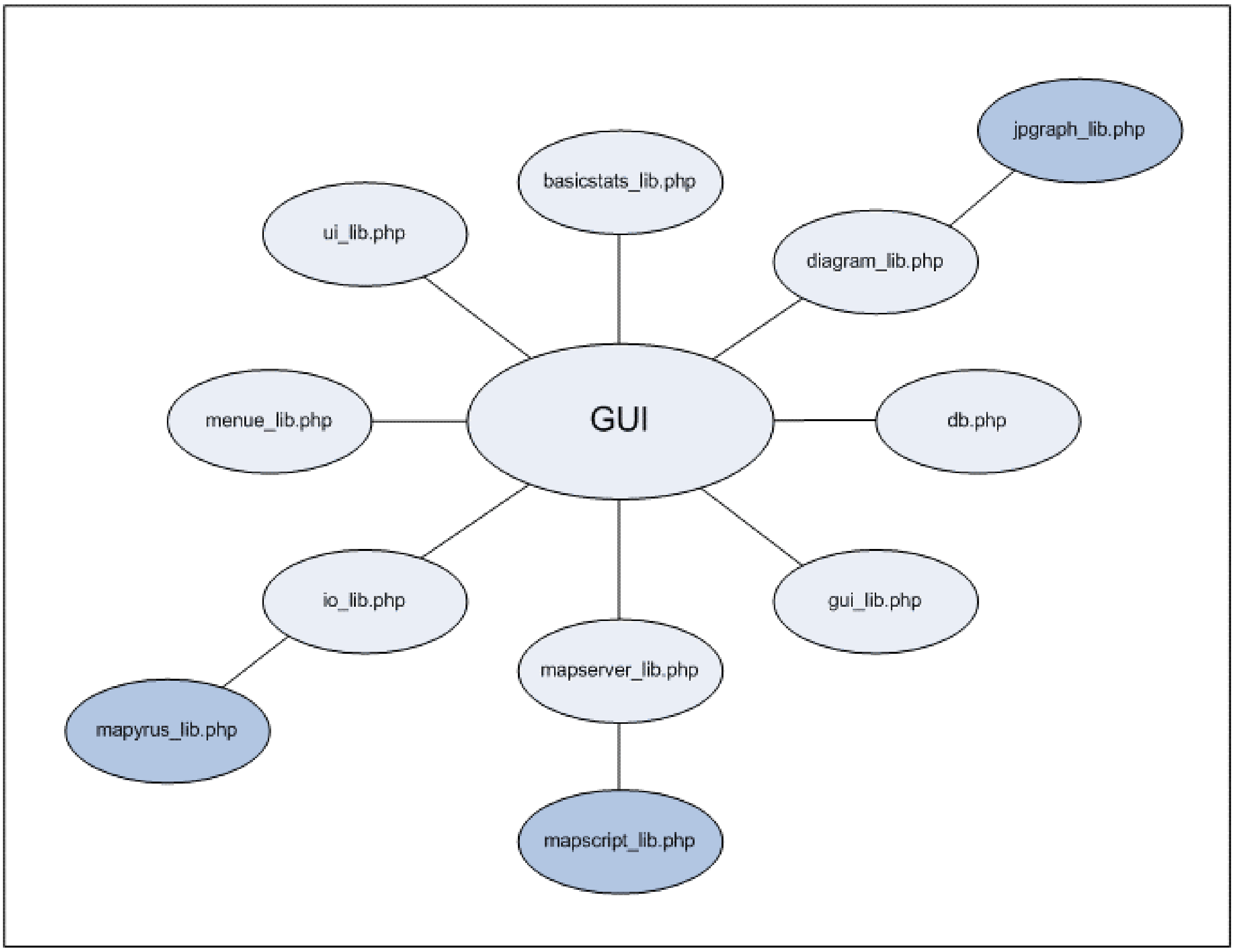


Abbildung 3: ÖROK Atlas Online Funktionsbibliotheken

Der Funktionsbibliothek zur Erstellung der Karten kommt eine entscheidende Rolle zu, ist doch der *ÖROK-Atlas online* ein stark kartenzentriertes System.

Die Kartenerzeugung erfolgt Objekt-orientiert, und ermöglicht somit die hierarchische Untergliederung jeder Karte in mehrere Ebenen, die wiederum aus Objektgruppen bestehen. Diesen Objektgruppen werden generelle, oder für einzelne Objekte individuell erstellte, Darstellungsparameter zugewiesen.

Die vollständige Definition jeder Karte erfolgt im *ÖROK-Atlas online* nicht zwingend in einem vorgeschalteten Prozess des Kartographen, sondern kann zur Laufzeit erfolgen. Vordefinierte Karten werden in Form fertiger Kartendefinitionen in der Datenbank abgelegt, um zur Laufzeit interpretiert und erstellt werden zu können. Die Kartendefinitionen sind während des gesamten Workflows lediglich im Speicherbereich vorhanden und werden nicht physisch erstellt.

REALISIERUNG

Seit Mai 2005 steht der Prototyp für den „ÖROK-Atlas online“ für die Mitglieder der Arbeitsgruppe zum Testen online zur Verfügung.

Der erste Schritt in Richtung der Realisierung des *ÖROK-Atlas online* soll mit der Finalisierung des Prototypen im Februar 2006 abgeschlossen sein. Der Prototyp wird für alle geplanten Anforderungen Basiselemente bieten, u. a. für die Benutzeroberfläche sowie die Funktionalitäten, und Daten zu ausgewählten Themenbereichen umfassen.

Ab März 2006 sollen die Vorbereitungsarbeiten zur Überführung des Prototypen in den Echtbetrieb beginnen, u. a. soll das Gesamtsystem optimiert, die Oberfläche benutzerfreundlich gestaltet sowie die Funktionalitäten und Datengrundlagen erweitert werden. Die Arbeiten sollen weiter durch die ÖROK-Arbeitsgruppe begleitet werden. Gleichzeitig ist die laufende Evaluierung durch einen breiteren Nutzerkreis geplant, u. a. durch VertreterInnen unterschiedlicher Fachbereiche in Bund und Ländern, Planungsbüros, Wissenschaftlern, Lehrern etc.

Es ist geplant, im Spätherbst 2006 mit dem *ÖROK-Atlas online* online zu gehen.

Centrope_MAP – 4 Staaten, 4 Sprachen, 4 Bezugssysteme, eine Region mit grenzüberschreitender Informationsinfrastruktur

Walter POZAREK, Timo VON WIRTH, Manfred SCHRENK

(M.A. Timo von Wirth, Multimediaplan.at KEG, Project Manager, Baumgasse 28, 1030 Wien, tvw@multimediaplan.at)
(DI Manfred Schrenk, Multimediaplan.at KEG, Managing director, Baumgasse 28, 1030 Wien, schrenk@multimediaplan.at)
(D.I Walter Pozarek, Planungsgemeinschaft Ost (PGO), Rockhgasse 6/3, 1010 Wien, walter.pozarek@noel.gv.at.at)

1 HINTERGRUND

Eine hochwertige Geodateninfrastruktur und effiziente Möglichkeiten der räumlichen Analyse mit Hilfe von Informations- und Kommunikationstechnologien sind für eine nachhaltige Regionalentwicklung unentbehrlich und spielen auch im Wettbewerb der Regionen als wesentliche Instrumente der Entscheidungsfindung für Politik und Wirtschaft eine zunehmend größere Rolle. Für die gemeinsame Regionalentwicklung der Europaregion Centrope ist es daher unerlässlich, auf vergleichbare Rauminformationen und Sachdaten über Staatengrenzen hinweg zugreifen zu können.
Die Europaregion Centrope ist durch die politische Willenserklärung von Kittsee, September 2003 sowie das Memorandum von St. Pölten, April 2005 definiert. Dort legten die Landeshauptleute und Komitatspräsidenten der Länder *Wien*, *Niederösterreich*, *Burgenland*, *Südmähren*, *Bratislava*, *Trnava* und *Györ-Moson-Sopron* sowie die Bürgermeister von *Brno*, *Bratislava*, *Trnava*, *Györ*, *Eisenstadt*, *St. Pölten* und *Wien* die politische Basis für eine „Europa Region Mitte“, in der die Chancen und Möglichkeiten für mehr Wohlstand und nachhaltiges Wachstum im zentraleuropäischen Raum gemeinsam gestärkt werden sollen.

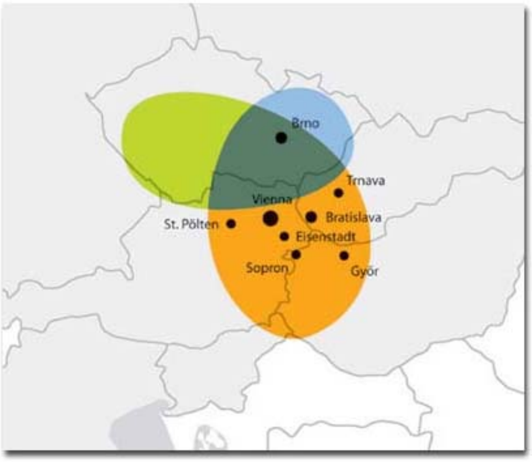


Abbildung 1: Übersicht Centrope Region, Quelle: http://centrope.info/baerdtneu/, 2005

Bereits im Rahmen der ersten Projektphase „Digitale Basiskarte Centrope“ war die Planungsgemeinschaft Ost (PGO) Initiator der Arbeiten. Dabei wurden bewusst auch die Regionen Südböhmen (Jihocesky) und Vysocina (CZ) sowie das Komitat Vas (HU) mitbetrachtet; da eine scharfe räumliche Abgrenzung bzw. Beschränkung auf die „Kernregionen“ aus regionalplanerischer und geodatenpolitischer Sicht nicht sinnvoll erschien. Im Rahmen des EU-Interreg IIIA Projektes BAER – „Building a European Region“ wurde an der weiteren Umsetzung von Centrope_MAP als Pilotprojekt innerhalb des Themenbereiches „Regionalentwicklung und Verkehr“ gearbeitet. In der 3. Phase des Projektes standen wichtige Erweiterungen und neue Funktionalitäten im Mittelpunkt.
Akteure aus den Teilregionen des Centrope Raumes werden für die Umsetzung eingebunden. Die Realisierung einer grenzüberschreitenden Zusammenarbeit auf dem Weg zu einer gemeinsamen Geodateninfrastruktur kann nur über verstärkte Kommunikation und Vernetzung von Stakeholdern aus der Region erfolgen.

Langfristig wird eine standard-basierte, verteilte Datenhaltung bei vollständiger Interoperabilität der Systeme und Datenformate angestrebt. Für ein solches „Idealsystem“, an dessen Komponenten derzeit in ganz Europa im Rahmen zahlreicher Projekte (Informationsinfrastrukturen/ GDI´s) gearbeitet wird, wurden zunächst die technischen Basisstrukturen erarbeitet. Damit kann kontinuierlich an der weiteren Implementierung, ausgerichtet an internationalen Standards (z.B. OGC-Spezifikationen), gearbeitet werden.

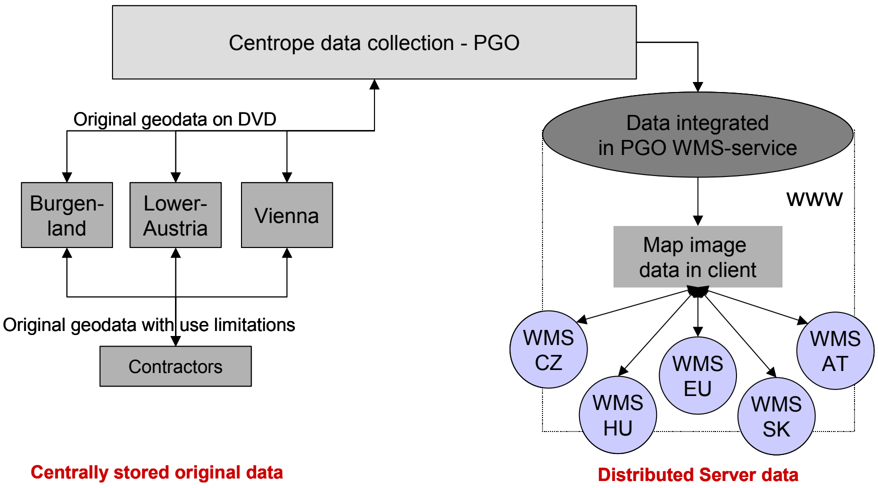


Abbildung 2: Projektansatz: Integration verteilter Geodaten als WMS

2 PROJEKTSCHRITT – AUFBAU WEB MAP SERVER PGO

Bislang wurden die Daten aus CENTROPE_MAP auf Datenträgern zwischen den beteiligten Partnern weitergegeben, um einen einheitlichen, zentralen Datensatz für die Gesamtregion vorzuhalten. Der Austausch von Daten mit Institutionen der Nachbarstaaten hat dabei allerdings rechtliche Probleme der gegenseitigen Datennutzung aufgeworfen. Es ist absehbar, dass im grenzüberschreitenden Informationsaustausch die Bedeutung von direktem Online-Zugriff auf verschiedene Server immer wichtiger wird, einerseits auf Attributdaten, die in Form von Datenbanken online abfragbar sind, im Bereich der Geoinformation als sog. „Web Map Services".

MultimediaPLAN hat daher einen Web Map Server für die PGO aufgebaut, der den aktuellen Datenbestand des Projektes als Web Services bereitstellt. Zusätzlich wurden mit anderen Beteiligten, die Web Map Services betreiben, die Erfordernisse für das gegenseitige Zugreifen auf die Informationen abgestimmt.

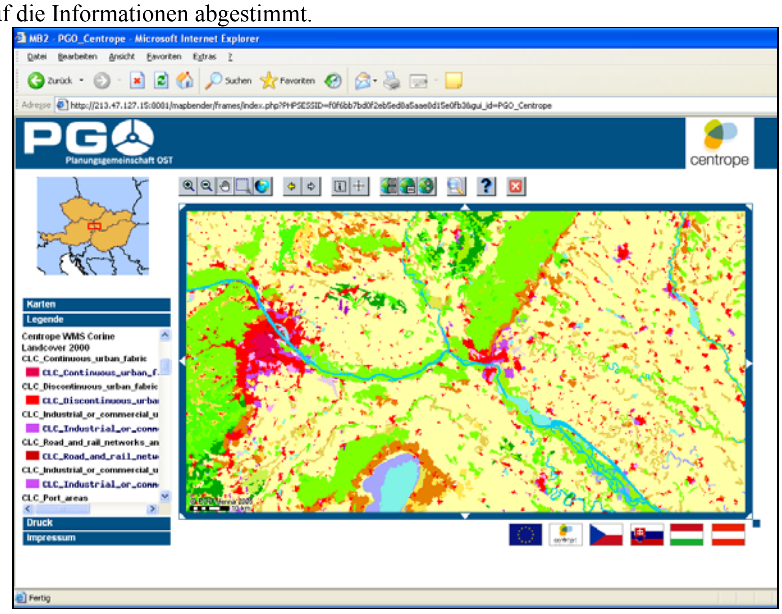


Abbildung 3: PGO Client GUI des Web Map Servers mit CORINE Land Cover Daten 2000

Der technische Aufbau einer Client-Server-Struktur zur webbasierten Darstellung von räumlichen Daten erfolgt in zwei Stufen. Zunächst wird der Web Map Server erstellt, anschließend eine benutzerfreundliche Clientanwendung für das PGO-Projekt eingebunden.

- Web Map Server (UMN)
- Client (Mapbender)

Als Web Map Server wurde der University of Minnesota Mapserver (UMN) ausgewählt. Zur Anwendung kam dabei das Softwarepaket *ms4w* (MapServer for Windows) der Firma DM Solution Group. Dieses beinhaltet unter anderem einen UMN-Server Version 4.6.1 und einen Apache http Server Version 2.0.54.

Entscheidendes Kriterium bei der Einrichtung eines Web-Map-Servers ist die Konformität mit Standards und Spezifikationen des Open Geospatial Consortium (OGC). OGC hat in der *OpenGIS Web Map Server (WMS) Interface Implementation Specification* definiert, welche Voraussetzungen und Funktionalitäten ein WMS zu erfüllen hat, um als OGC-konform zu gelten. OGC-konforme WMS sind interoperabel und können mit anderen Produkten verschiedener Hersteller zusammenarbeiten, sofern diese ebenfalls die OGC-Voraussetzungen erfüllen.

Der UMN mapserver erfüllt die Spezifikationen: WMS (client/server), non-transactional WFS (client/server), WCS (server only), WMC, SLD, GML and Filter Encoding. Zusätzlich ist die Skriptsprache MapScript inkludiert, die über PHP, Perl, Python oder Java Zugriff auf die MapServer C API ermöglicht.

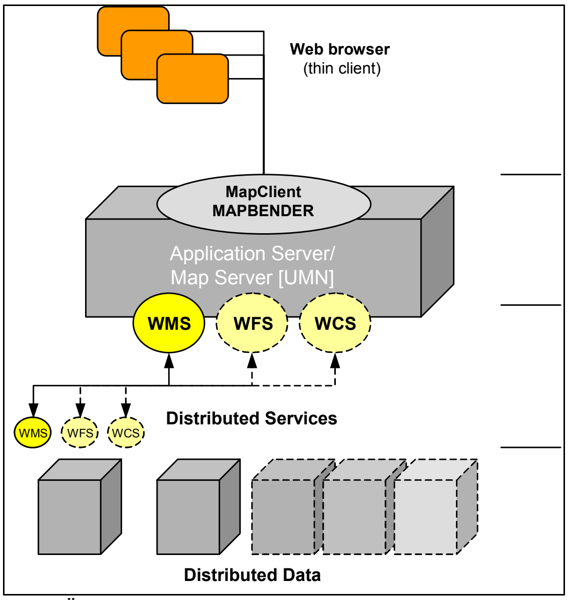


Abbildung 4: Übersicht System Architecture, Centrope MAP WMS, 2005

Ein OGC-konformer WMS besitzt die drei Hauptfunktionen, die von einem Benutzer abgefragt werden können. Bei diesen Funktionen handelt es sich um die „unbedingten" Abfragen *GetCapabilities* und *GetMap*, sowie um die optionale Abfrage *GetFeatureInfo*. Diese Abfragen und in weiterer Folge der Austausch der Informationen erfolgt über das Hypertext Transfer Protocol (HTTP). (vgl. http://www.adlexikon.de/Web_Map_Service.shtml)

Der GetCapabilities-Request fragt für ein bestimmtes Service die verfügbaren Layer sowie deren Eigenschaften ab. Aufgrund der zurückgegebenen Informationen kann ein Anwender das betreffende Service in seinem Client aufrufen und verfügbar machen.

Der GetMap-Request liefert genaue Angaben seitens des Clients, welche Layer für welchen Kartenausschnitt ausgegeben werden sollen. Dieser gewünschte Ausschnitt wird in Form einer Bilddatei zurückgegeben und in einem Client angezeigt, ohne dass dabei die originären, geometrischen Daten mitgesendet werden.

Der UMN verwaltet Geodaten in zwei Formaten. Einerseits befinden sich in der Ordnerstruktur des UMN Mapservers die vorhandenen Geodaten (*.shp files) in einem geschützten und nicht zugänglichen Verzeichnis. Zusätzlich existieren die Projektdateien (.map-Datei) der verfügbaren Services. Die Projektdateien enthalten Angaben zu verfügbaren Layer, Styles, Klassen, Legende, Ausgabeformaten, Ausschnittsgrößen, Scalebar, Projektionen, Skalierungen und weitere.

Als (thick) Client, der die eigentliche Benutzeroberfläche der Map Server Anwendung darstellt, wurde das Open Source Softwareprodukt Mapbender ausgewählt. Mapbender ermöglicht, durch eine Sammlung von javascript und php-Skripten, Benutzeroberflächen zu erstellen und zu verwalten. Zusätzlich können Benutzer(-gruppen) angelegt und mit Rechten für verschiedene Oberflächen versehen werden. Externe Web Map Services können über GetCapabilites Requests in bestehende Oberflächen eingefügt werden. Über einen Link, der neben der Serveradresse auch Informationen zur gewünschten GUI (Guided User Interface), dem User und dessen Passwort enthält, kann ein Projekt in einem Internetbrowser direkt aufgerufen werden.

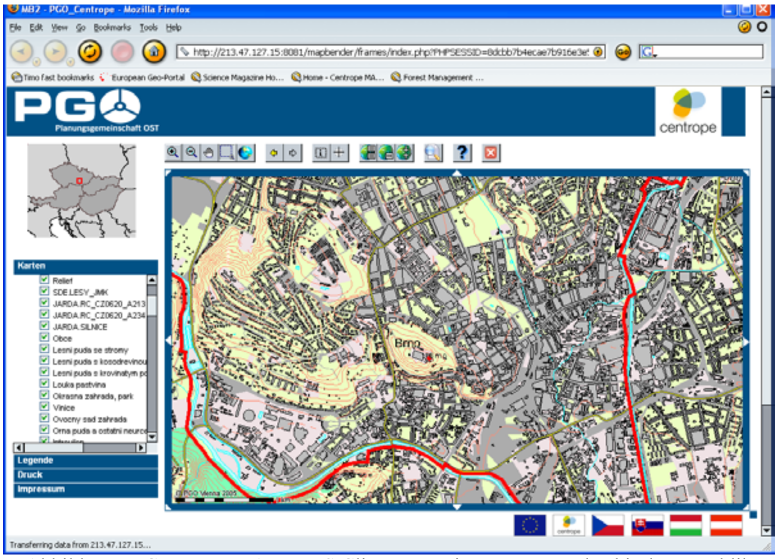


Abbildung 5: Centrope_MAP WMS Client, Integrierte Daten Tschechische Republik

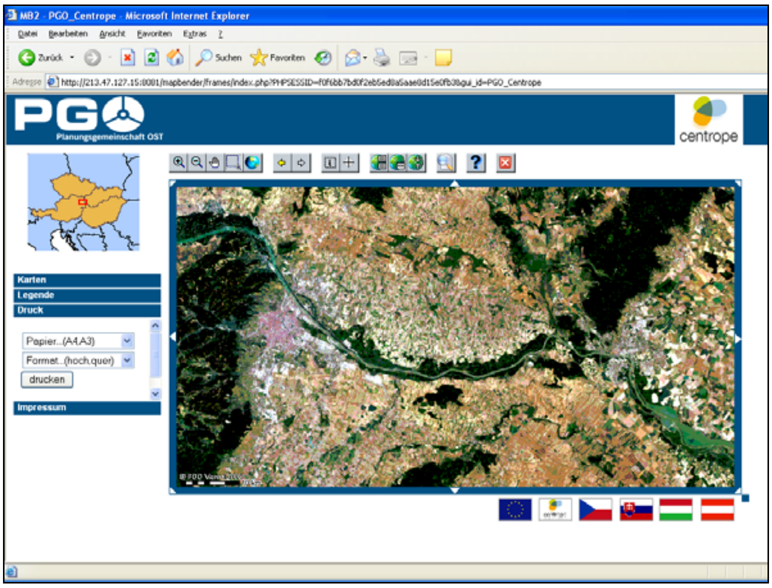


Abbildung 6: Centrope_MAP WMS Client, Satbildszene der Centrope Region als Map Service

3 METADATEN UND VERNETZUNG

Die im System Centrope_MAP vorhandenen Daten sind in einer Metadatensammlung erfasst und dokumentiert. Diese wurde im Rahmen des Projektes erweitert und aktualisiert sowie um eine Katalogfunktion ausgebaut. Die Recherche nach Datensätzen kann online erfolgen, da sämtliche Metainformationen auf der Projekt-Webseite zur Verfügung stehen. Die Metainformationen wurden entsprechend dem ISO-Standard 19115, mit Konzentration auf das ISO19115 Core Datenset, erstellt.

Abbildung 7: Centrope_MAP WMS Client, Satbildszene der Centrope Region als Map Service

Um einen „ersten Überblick“ zur Region Centrope erhalten zu können werden unterschiedliche Karten aus den aktuellen Centrope Geodaten in einem einheitlichen Layout erstellt. Diese digitalen Karten liegen als pdf-Dateien in den Formaten DIN A3 und DIN A0 vor und können von Nutzern direkt geplotet werden.
Eine wesentliche Aufgabe des Projektes ist die weitere Vernetzung der Akteure in der CENTROPE-Region, in diesem Fall der Akteure im Bereich der räumlichen Planung und des Geoinformationswesens. Direkte Kontakte zu den Stake Holdern in der Region und gezielte elektronische Informationsübermittlung haben zu einer weiteren Intensivierung der grenzüberschreitenden Zusammenarbeit beigetragen. Die Vernetzung und Koordination mit anderen Europäischen Initiativen im Bereich der grenzüberschreitenden, regionalen Geodateninfrastruktur wird vorwiegend mittels elektronischer Medien hergestellt, um die CENTROPE_Map-Anliegen zu transportieren, z.B. im Rahmen der Projekte CEGIS_MDB-Meetings, CrossSIS EU-workshop.

4 AUSBLICK

Das Projekt Centrope_MAP sollte als ein fortschreitender Prozess eines laufenden, grenzüberschreitenden Informationsaustausches zum wechselseitigen Nutzen und damit auch als Beitrag zur Schaffung einer Identifikation mit der Centrope Region gesehen werden. Die zusätzliche Integration von Daten, die Erweiterung von Funktionalitäten, die grenzüberschreitende Vereinheitlichung des Kartenlayouts und weitere Aspekte sollten daher im Sinne einer kontinuierlichen Fortführung in einem Folgeprojekt bearbeitet werden.

5 LITERATUR

ANDRAE, S., et al (2004): „Austrian Mini GDI“ – Das Zusammenspiel zweier interoperabler, OGC-konformer Web Mapping Services. In: Strobl, Blaschke, Griesebner (2004): Angewandte Geografische Informationsverarbeitung XVI – Beiträge zum AGIT-Symposium

OGC (2001): WebMapServer (WMS) Interface Implementation Specification. Open Geospatial Consortium

MultimediaPLAN.at (2004): Pilotprojekt Centrope_MAP – Überarbeitetes Anbot

LESSING, Rolf u. MÜLLER, Falko (2003), Ministeriums des Innern des Landes Brandenburg Potsdam, „Mögliche Maßnahmen zur infrastrukturellen Entwicklung des öffentlich-rechtlichen Geoinformationswesens im Land Brandenburg und der Region (GIB – Studie)“, Potsdam, 2003

EBBINGHAUS, Jürgen u. RIEKERT, Wolf-Fritz, „Organisationsübergreifender Austausch von Geodaten, über Weitverkehrsnetze am Beispiel der Stadt Köln“, in: Informatik für den Umweltschutz, 10. Symposium, Tagungsband, Metropolis-Verlag, Marburg, 1996

HILTGARTNER Karin, KANONIER, Arthur u. PROKSCH, Wolfram, TU Wien, Department für Raumentwicklung, Fachbereich Rechtswissenschaften: „ Studie – Rechtsvorschriften für Geodaten in Österreich“, im Auftrag der Österreichischen Raumordnungskonferenz (ÖROK), Wien, 2004

TCHISTIAKOV, A.: „ eEARTH: Bridging the divided national geo-datases via multlingual web application” unter: http://mmp-tk1.kosnet.com/corp/archiv/papers/2005/CORP2005_TCHISTIAKOV.pdf

Erfassung von Siedlungsräumen mit Hilfe von statistischer Rasterdaten am Beispiel Salzburgs

Thomas PRINZ, Franz DOLLINGER und Erich WONKA

(Dr. Erich Wonka, Statistik Austria, Guglgasse 13, 1110 Wien, E-Mail: Erich.Wonka@statistik.gv.at
Mag. Thomas Prinz, ARC Seibersdorf research Gmbh, Research Studios Austria, Studio iSPACE, Leopoldskronstrasse 30, 5020 Salzburg, e-mail: thomas.prinz@researchstudio.at;
Univ.-Doz. Dr. Franz Dollinger, Land Salzburg, Fachreferent Raumforschung und grenzüberschreitende Raumplanung, Postfach 527, 5020 Salzburg, E-Mail: franz.dollinger@salzburg.gv.at)

1 EINLEITUNG

Räumliche Zustände und Entwicklungen zu messen und zu bewerten ist eine bedeutende Aufgabe der Raumforschung. Um Entwicklungen und Trends nachvollziehbar dokumentieren zu können, benötigt man räumliche Daten- und Planungsgrundlagen und daraus entwickelte Messgrößen (Indikatoren). Mit Indikatoren wird der Zustand und die Entwicklung eines Raumes beobachtet und beurteilt. Zielgrößen und Indikatoren sind Orientierungspunkte für die Entwicklung von Programmen und Planungsstrategien. Räumliche Indikatoren zur Messung räumlicher Entwicklungen und Trends stellen daher eine bedeutende Entscheidungsgrundlage für Planung, Politik und Unternehmen dar. Die Berechnung ausgewählter Indikatoren wie u.a. „Einwohnerdichte je km² Dauersiedlungsraum" erfordert eine entsprechende Abgrenzung von Siedlungsräumen vor allem auch in den mittleren und größeren Maßstabsbereichen. Insbesondere auf Ebene der Regional- und Ortsplanung werden jedoch auch räumlich differenzierte Kenngrößen benötigt. Ziel dieses hier dargestellten Ansatzes ist es, Möglichkeiten zur Entwicklung eines in der räumlichen Auflösung „flexiblen" Siedlungsraumes unter Nutzung der geographischen Raster der Statistik Austria sowie weiterer geographischer Merkmale (Landnutzung, Topographie) aufzuzeigen. Eine erheblicher Mehrwert ist durch die Integration regionalstatistischer hochauflösender Informationen zur weiteren Ausdifferenzierung und Verfeinerung (Wohn / Gewerbenutzung) zu erwarten.

2 VON DER KOORDINATENGEBUNDENEN STATISTIK ZU GEOGRAPHISCHEN RASTERN

a. Eine neue Möglichkeit: Statistische Daten auf Grundlage von homogenen Rasterfeldern

Die Statistik Austria stellt die Speicherung der Großzählungsdaten 2001 auf generelle Bindung an Adresskoordinaten um. Anhand eines universellen Datenmodells besteht die Möglichkeit, unabhängig von bereits bestehenden statistischen und administrativen Gebietsgliederungen nahezu beliebige Aggregationseinheiten zu definieren. Damit können adressbezogene statistische Masszahlen flexibel bereitgestellt und in z.B. raumplanerische Prozesse integriert werden. Darauf aufbauend können hochauflösende regionalstatistische Planungsgrundlagen und Indikatoren entwickelt werden. Diese stellen eine bedeutende Grundlage für die Erhöhung der Entscheidungsqualität in raumbezogenen Fragestellungen in verschiednenen Anwendunsgdomänen wie Raumplanung, Geomarketing, Infrastrukturplanung dar (vgl. Strobl, J., Prinz, T. und E. Wonka, 2004).

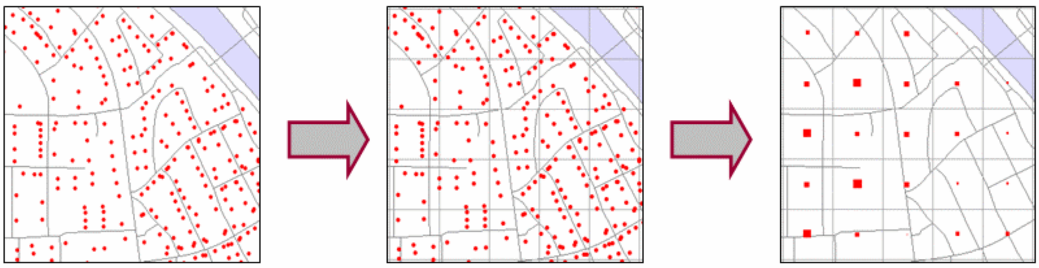


Abb.1: Von der koordinatengebundenen Statistik zu geographische Rastern

Das Monitoring der räumlichen Entwicklung, der Einsatz von Potenzialmodellen und Bilanzierungsmethoden werden durch eine konsequente Anwendung hochauflösender regionalstatistischer Rasterdaten unterstützt. Gerade in sehr heterogen nutzbaren Regionen wie dem Alpenraum ist die erzielbare höhere Auflösung statistischer Grundlagen von besonderem Wert, führte doch die an administrativen bzw. politischen Grenzen orientierte Regionalstatistik hier zu unrealistischen Werten und in weiterer Folge zu einer Unterschätzung dichtebedingter Problemsituationen. Eine dem Ausgabemaßstab angepasste Repräsentation ist in erster Linie unabhängig von den individuellen topographischen Strukturen des Untersuchungsgebiets auf der Basis von variablen geographischen Rasterzellen (Bsp. 125m und 250m) möglich. Da sich bei Rasterzellen die Daten auf gleiche Flächen beziehen, stellen die Absolutwerte zugleich auch die Dichtewerte dar. Dies ist ein klarer Vorteil bei der kartographischen Visualisierung und Interpretation (siehe Abb. 2 und 3).

Die implizierte Betrachtung von statistischen Informationen und z.B. Siedlungsstrukturen ergibt einen signifikanten planerischen Mehrwert. Durch diese Vorgangsweise wird vermieden, dass statistische Kennzahlen auf Flächen bezogen werden (kartographischer Flächeneffekt) die aufgrund der Landnutzung keine einschlägige Relevanz aufweisen und die Ergebnisse verfälschen würden (siehe Abb. 2). Die Nutzung und Inwertsetzung dieses „neutralen" Raumbezugs beginnt sich erst durchzusetzen, obwohl die topographisch unabhängige Betrachtung von statistischer Information und Raumstrukturen wertvolle, räumlich fein ausdifferenzierte Zusatzinformationen bietet und eine bedeutende Grundlage für Erreichbarkeits- und Potenzialmodelle sowie für die Ableitung von räumlichen Indikatoren darstellen.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

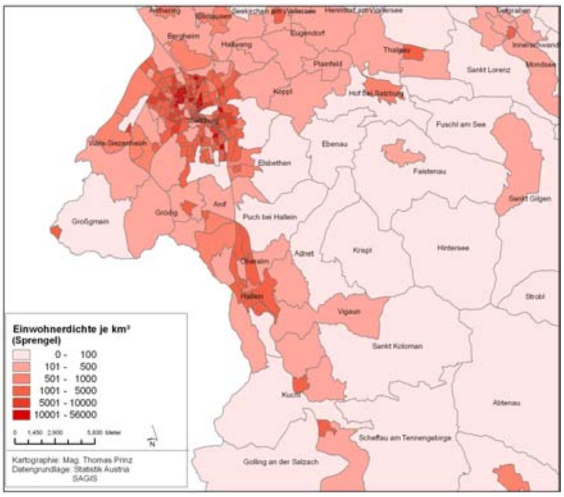


Abb.2: Einwohnerdichte je km² auf Sprengelbasis

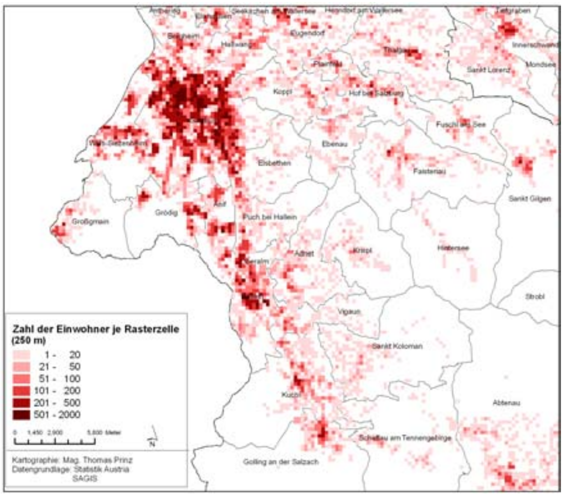


Abb.3: Zahl der Einwohner je Rasterzelle (250 m)

b. Datenangebot Statistik Austria

Der Datenbankbenützer kann relativ leicht über die ISIS-Datenbank von Statistik Austria Daten über die Statistischen Zählsprengel oder Gemeinden bekommen. Benötigt man aber statistische Daten auf der regionalen Bezugsebene von Rastereinheiten, ist eine Sonderauswertung notwendig. Nicht alle, aber ein Großteil der statistischen Daten aus der Großzählung 2001 wird auf der Basis von Rastereinheiten bereitgestellt. Statistik Austria bietet eine Auswahl davon kostengünstig auch als Standardpakete an.

Standardpaket A – Objekte (Fallzahlen): Zahl der Personen mit Hauptwohnsitz, Zahl der Personen mit Zweitwohnsitz, Zahl der Haushalte, Zahl der Gebäude, Zahl der Wohngebäude, Zahl der Wohnungen, Zahl der Arbeitsstätten, Zahl der Beschäftigten.
Standardpaket B - Objekte und Merkmale aus der Volkszählung: Wohnbevölkerung nach Familienstand, Wohnbevölkerung nach Alter und Geschlecht, Wohnbevölkerung nach Bildungsstand, Wohnbevölkerung nach der Staatsangehörigkeit, Wohnbevölkerung nach dem Geburtsland, Wohnbevölkerung nach Lebensunterhalt, Privathaushalte nach Haushaltsgröße.
Standardpaket C - Objekte und Merkmale aus der Gebäude- und Wohnungszählung: Gebäude nach der Gebäudenutzung, Wohnungen nach der Ausstattungskategorie der Wohnung, Wohnungen nach der Wohnsitzangabe, Wohnungen nach der Wohnraumzahl, Wohnungen nach der Nutzfläche der Wohnung, Wohnungen nach dem Energieträger für die Wohnungsbeheizung, durchschnittliche Nutzfläche von Wohnungen mit Hauptwohnsitz, durchschnittliche Wohnräume von Wohnungen mit Hauptwohnsitz pro Bewohner.
Standardpaket D - Objekte und Merkmale aus der Arbeitsstättenzählung: Arbeitsstätten nach Beschäftigtengrößengruppen der unselbständig Beschäftigten, Selbständig und unselbständig Beschäftigte an der Arbeitsstätte nach Wirtschaftssektoren und Geschlecht.

3 ABGRENZUNG VON SIEDLUNGSEINHEITEN

Für eine detailliertere Siedlungsabgrenzungen eignen sich Fernerkundungsdaten, die topographische Situation der Österreichkarte 1:50.000 (ÖK50) und der Einwohner- und Beschäftigtenzahlen auf der Basis von Gebäudekoordinaten.

Das Beispiel in der Abbildung 4 (linke Karte) zeigt die Nutzungskategorie „städtisch geprägte Flächen“ aus dem CORINE-Programm. Kleinräumige Siedlungseinheiten sind teilweise jedoch nicht erfasst. In Österreich erfolgte die Abgrenzung von Siedlungseinheiten mit dem Stand von 1991 auf der Grundlage der in der ÖK50 eingezeichneten Siedlungsgebiete bzw. Gebäude. Diese Siedlungseinheiten sind hier ein zusammenhängend verbautes Gebiet von Wohnhäusern, industriellen, gewerblichen, sonstigen wirtschaftlichen und kulturellen Einrichtungen mit mindestens 500 Einwohnern (siehe mittlere Karte in der Abbildung 4). Unabhängig von den Gemeinden stellen die Siedlungseinheiten zusammenhängende verbaute Gebiete dar. In Österreich wurde auch keine Unterbrechung der Siedlungseinheit angenommen, wenn kurze, unverbaubare Talengen oder Bergriegel eine an sich zusammengehörige Siedlungseinheit unterbrechen.

Die Siedlungseinheiten mit dem Stand von 2001 und zukünftig auch aktuelle Auszüge aus den Registerzählungen wird man nicht nur mehr auf der Grundlage der Siedlungssituation der ÖK 1:50.000, sondern auf der Basis von Gebäudekoordinaten und weiteren statistischen Merkmalen abgrenzen. Eine Möglichkeit dabei ist, dass um die Gebäudekoordinaten ein zu definierender Puffer (z.B. 100m) gezogen wird. Nur größere Gebäudeansammlungen mit einer entsprechenden Einwohner- und Beschäftigtenzahl werden dabei berücksichtigt. Weiters besteht die Möglichkeit, eine nähere Differenzierung des Siedlungsraumes durch Einbeziehung der überwiegenden Nutzung - dominiert die Wohnnutzung? Oder steht eine gewerbliche / industrielle Nutzung im Vordergrund? - durchzuführen.

Eine andere Möglichkeit ist, dass man die Gebäudekoordinaten vorerst einer Rasterzelle mit einer Seitenlänge von 125m zuordnet. Ihre Abgrenzung geschieht so, dass benachbarte Rasterzellen, deren Gesamtbevölkerung (Personen mit Haupt- und Nebenwohnsitz) plus Beschäftigte am Arbeitsort eine bestimmte Mindestdichte aufweist, zusammengefasst (regionalisiert) werden (siehe rechte Karte in der Abb. 4). Welche Rasterzelle zu einer Siedlungseinheit dazugerechnet wird, hängt aber auch von der topographischen Situation ab. So wird man z.B. solche Rasterzellen nicht mehr zu einer Siedlungseinheit hinzufügen, wenn sich dadurch die Siedlungseinheit über Gebirgszüge oder größere Gewässer ausdehnen würde.

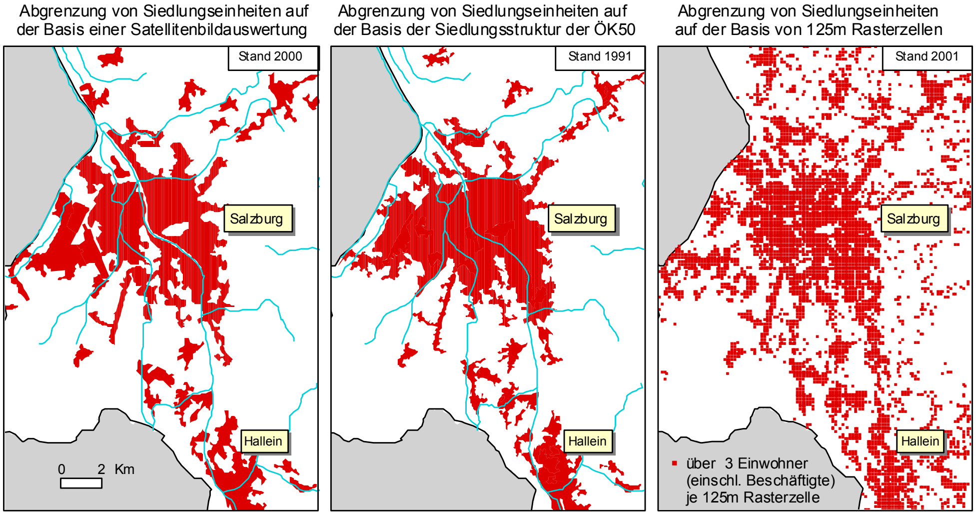


Abbildung 4: Abgrenzung von Siedlungseinheiten (SE) auf der Basis von Fernerkundungsdaten (linke Karte), der Siedlungsgebiete aus der ÖK50 (mittlere Karte) und der Einwohner (einschl. Beschäftigte) nach 125m Rasterzellen (rechte Karte). In der rechten Karte erfolgte noch keine Zusammenfassung der Raster zu einem zusammenhängenden verbauten Gebiet mit einer Mindesteinwohnerzahl.

4 ERFASSUNG VON SIEDLUNGSRÄUMEN MIT HILFE VON GEOGRAPHISCHEN RASTERDATEN

Wohl vermittelt die Literatur (vgl. Lienau, C. 2000, S.140ff) Konzepte zur Definition und Abgrenzung von Siedlungsräumen und deren Unterordnungen (Sub-, An-, Peri-, Ökumene udgl.), scheitert jedoch teils an einer konsequenten methodischen Umsetzung oder der Verfügbarkeit notwendiger Datengrundlagen (vgl. Umweltbundesamt, Hrsg. 2004, S.65). Eine in Österreich weitgehend angenommene Abgrenzung des (Dauer)Siedlungsraum gibt die Statistik Austria (Statistik Austria, Hrsg., 2005; Lexer, W., 2004). So sind die wesentlichen Eigenschaften und Bereiche, die dem Dauersiedlungsraum zugeschrieben werden, die „agrarwirtschaftlich, baulich und verkehrsmäßig genutzte Fläche lt. Kataster mit Stand 2004“. Lienau unterstreicht jedoch die Dynamik von Siedlungsgrenzen, ob ihrer Verflochtenheit mit der sozioökonomischen Gesamtsituation, und somit auch des Dauersiedlungsraums (Linau 2000, S. 144). Der Begriff (Dauer)Siedlungsraum und dessen Variationen wird in der Regel als potentieller Siedlungsraum im Sinne des Raumes einer maximal möglichen Besiedelung verstanden wird. Mit Methoden der Fernerkundung erfolgt eine Abgrenzung von Siedlunsgflächen (vgl. Steinnocher et al 2000; Steinnocher & Tötzer, 2001; Kirstein et al 2002). Neben der Abgrenzung ist auch eine weitere Differenzierung, auch unter Einbeziehung von Zensusdaten, von Bedeutung (Steinnocher & Tötzer, 2001).

Je nachdem, welche Rastergröße man zur Erfassung von Siedlungsräumen verwendet, wird sie mehr oder weniger stark generalisiert. Siedlungsräume, die auf Rasterbasis erstellt werden, können in verschiedenen Maßstabsebenen eingesetzt werden (siehe Abb. 5). Stärker generalisierte Siedlungsräume kann man bei statistischen Kartendarstellungen gut zur Kennzeichnung des Dauersiedlungsraumes verwenden. Die Grenzen sind relativ stabil, da eine geringe Zu- oder Abnahme an Gebäuden weniger ins Gewicht fällt als bei einer Abgrenzung der Siedlungsräume auf der Basis jedes einzelnen Gebäudes.

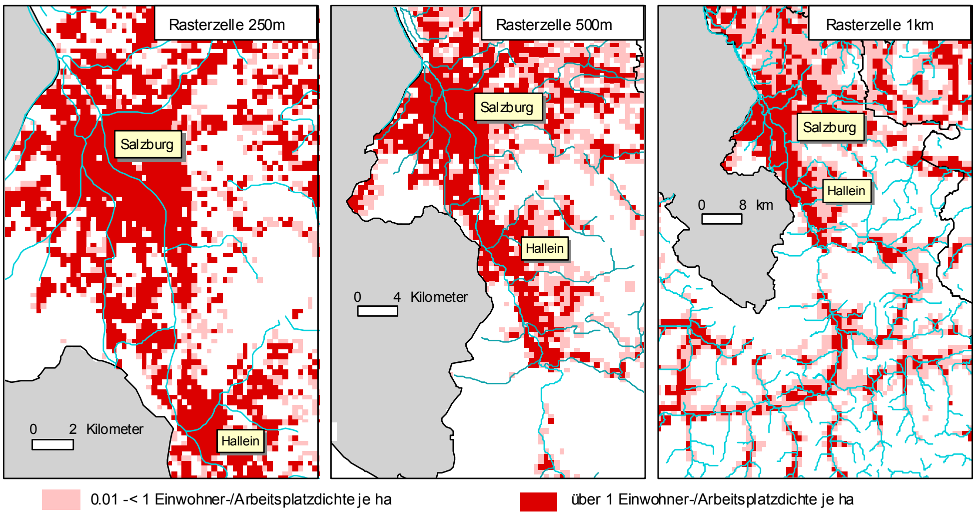


Abbildung 5: Abgrenzung von Siedlungsräumen auf der Basis eines 250m Rasters (linke Karte), eines 500m Rasters (mittlere Karte) und eines 1km Rasters (rechte Karte). Stärker generalisierte Siedlungsräume kann man bei statistischen Kartendarstellungen gut zur Kennzeichnung des Dauersiedlungsraumes verwenden. Das Siedlungsgebiet ist vor allem für die Darstellung von Daten, die sich auf die Gebäude, Wohnungen, Einwohner oder Arbeitsstätten beziehen, von Vorteil.

Die Interpretation einer Karte wird wesentlich erleichtert, wenn man nicht die gesamte Fläche der Verwaltungseinheiten mit einer Flächenfarbe darstellt, sondern nur den Teil innerhalb der Verwaltungseinheit, in dem die statistischen Werte tatsächlich verbreitet sind. Handelt es sich z.B. um die Darstellung von Merkmalen für Wohngebäude, Wohnungen und Einwohner, ist der Verbreitungsraum der Dauersiedlungsraum. Der Anteil der Wohngebäude, die außerhalb des Dauersiedlungsraumes liegen, ist in den meisten Fällen sehr gering.

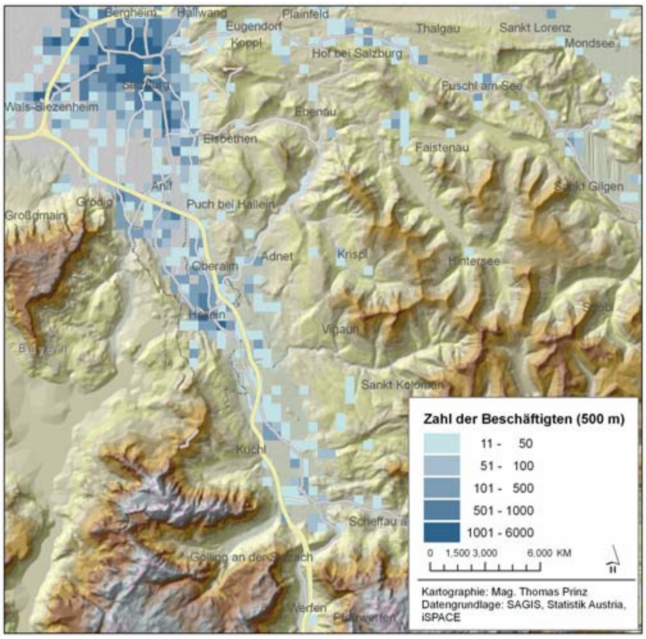


Abb.5: Zahl der Beschäftigten (> 10) auf 500 m Raster

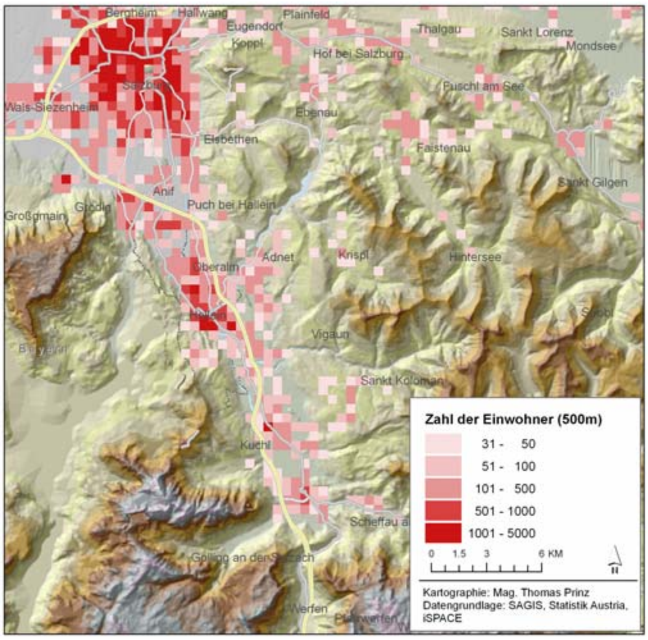


Abb.6: Zahl der Einwohner (> 30) auf 500 m Raster

Zur Erfassung von Siedlungsräumen stellen daher regionalstatistische Kennzahlen wie z.B. Einwohner- und Beschäftigtenzahlen auf der Basis von Rastereinheiten eine wesentliche Bereicherung dar. Eine kombinierte Auswertung der Einwohner- und Beschäftigtenverteilung sowie von Merkmalen aus dem Gebäuderegister ist zielführend. In einem ersten Ansatz wird der Siedlungsgraum ausgehend von jenen Zellen abgregrenzt, die eine dominierende Wohn- (mehr als 30 Einwohner) oder gewerbliche Nutzung (mehr als 10 Beschäftigte) aufweisen.

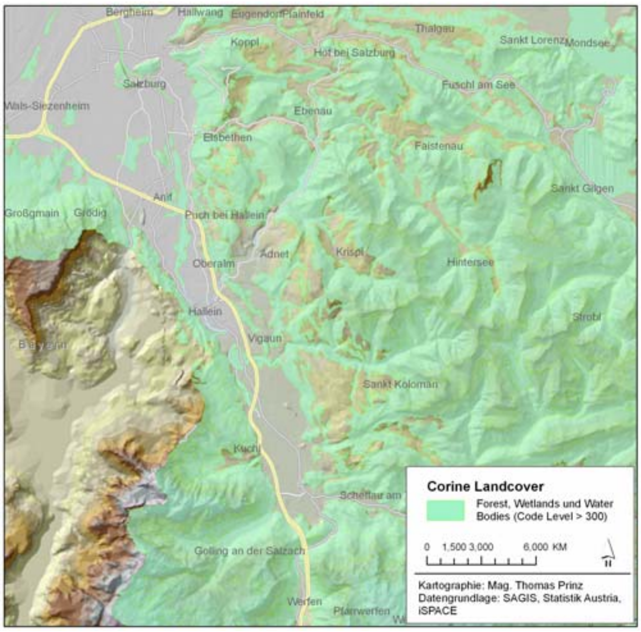


Abb.7: Corine Landcover (Forest, Wetlands, Water bodies)

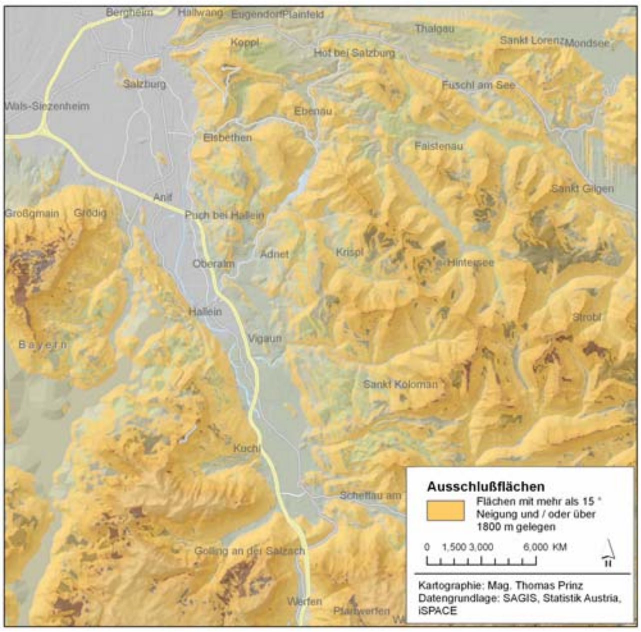


Abb.8: Ausschlußflächen (Neigung / Höhe)

Jene benachbarten Rasterzellen, deren Gesamtbevölkerung (Personen mit Haupt- und Nebenwohnsitz) plus Beschäftigte am Arbeitsort eine bestimmte Mindestdichte aufweisen, werden in weiterer Folge zusammengefasst (regionalisiert). Als eine Art von Regionalisierungsverfahren wird dabei u.a. ein fokaler Operator („moving window") auf die rasterbasierten Zensusdaten angewandt. Diejenigen Zellen werden zusammengefasst, die bestimmte Kriterien erfüllen, wobei eine gleichzeitig glättende und generalisierende Eigenschaft genutzt wird: „Gering" besiedelte Zellen, die in ihrer Umgebung zumindest eine bestimmte Anzahl an ausreichend „besiedelten" Rasterzellen zählen werden letzteren gleichgestellt.

Welche weiteren Rasterzellen einem Siedlungsgebiet dazugerechnet werden, hängt aber auch von einschränkenden Faktoren (Constraints) wie der topographischen Situation (z.B. abgeleitet aus digitalen Höhenmodellen) und der Land- und Bodennutzung (z.B. aus dem Corine-Programm) oder der Flächenwidmung ab. So wird man z.B. solche Rasterzellen nicht mehr zu einer

Siedlungseinheit hinzufügen, wenn sich dadurch die Siedlungseinheit über Gebirgszüge oder größere Gewässer ausdehnen würde. In Abbildung 7 sind jene einschränkenden Faktoren aus dem Datenbestand der Corine Land Cover dargestellt, die nach Definition Auschlußflächen für die Berechnung des Dauersiedlunsgraumes darstellen (Forest, Wetlands und Water bodies). Weiters werden jene Flächen, die höher als 1800m und mehr als 15° geneigt sind, von einer Berechnung ausgeschlossen (Abbildung 8).

5 ANWENDUNG IN DER RAUMPLANUNG

Die Diskussion um nachhaltige Raumentwicklung ist sehr vielschichtig und wird von der Suche nach geeigneten Messgrößen begleitet, da in der Raumplanung quantitative Kenngrößen für die Beobachtung und Kontrolle von Raumentwicklungsprozessen benötigt werden. Viele der vorhandenen Daten sind jedoch nur auf der Basis von Zählsprengeln oder auf Gemeindeebene verfügbar und können die oft nur kleinräumigen Trendentwicklungen nicht darstellen (z.B. die Zersiedelung im Rahmen der Bevölkerungssuburbanisierung). Die räumliche Referenz - der Raumbezug - ist für die Operationalisierung von Planungskonzepten und -strategien zur Raumentwicklung von großer Bedeutung. Das Forschungsstudio iSPACE entwickelt mit Teilaufträgen von Land und Stadt Salzburg innovative räumliche Indikatoren mit Methoden der angewandten Geoinformatik. Mittlerweile liegen erste Ergebnisse vor und es sei beispielhaft darauf hingewiesen, dass im derzeit in Ausarbeitung befindlichen Salzburger Raumordnungsbericht 2005 Kernindikatoren mit Bezug auf den Dauersiedlungsraum bzw. unter Verwendung des neues Datenangebots der Statistik Austria kartographisch aufbereitet werden:

Einwohner 2001 je Quadratkilometer Dauersiedlungsraum
Verbaute Fläche bezogen auf den Dauersiedlungsraum
Demographische Daten bezogen auf homogene Rasterfelder von 250 m bis 2.500 m
Arbeitsmarktdaten bezogen auf homogene Rasterfelder von 250 m bis 2.500 m

Da in der Raumplanung Ziele und Maßnahmen für verschiedene räumliche Ebenen festgelegt werden müssen (Bsp.: Bund - Land - Region - Gemeinde - Gemeindegebiet), sind Datengrundlagen für die verschiedenen Planungsebenen erforderlich. Für Leitbilder und deren Ableitung auf nationaler Ebene reichen im Allgemeinen Indikatoren in kleineren Maßstabsbereichen (Region, Gemeinde, etc.) aus. In den mittleren und größeren Maßstabsbereichen – insbesondere auf Ebene der Regional- und Ortsplanung – werden jedoch auch räumlich differenzierte Kenngrößen benötigt. Je nachdem, welche Rastergröße man der Siedlungseinheit zugrunde legt, bekommt man eine mehr oder weniger stark generalisierte Siedlungseinheit. D.h. Siedlungseinheiten, die auf Rasterbasis erstellt werden, können in verschiedenen Maßstabsebenen eingesetzt werden. Damit können auch stärker generalisierte Siedlungseinheiten als Verbreitungsraum zur Darstellung statistischer Sachverhalte herangezogen werden. Ziel ist eine in der Auflösung flexible - je nach Fragestellung - Planungsgrundlage und besonderer Berücksichtigung der Fortschreibung (Aktualisierung) zu erhalten. Dies ist eine wesentliche Grundlage für laufende Raumbeobachtung auch auf der Ebene der Orts- und Regionalplanung.Genau dafür können auf Grundlage des neuen Datenangebots der Statistik Austria mit den hier vorgestellten Lösungswegen geeignete Indikatoren bereitgestellt werden.

6 QUELLENVERZEICHNIS

Kirstein, W., M. Netzband und L.Linde, 2002, Analyse und Bewertung des Naturraumpotenzials in der suburbanen Kulturlandschaft mit Methoden der Fernerkundung und GIS. - Online: http://www.ufz.de/data/aloe_Endbericht_Naturraumpotenziale1881.pdf, verfügbar am 14.12.2005.

Lexer, W., 2004, Zerschnitten, versiegelt, verbaut? – Flächenverbrauch und Zersiedelung versus nachhaltige Siedlungsentwicklung. - Online: http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/raumplanung/2_flaechenverbrauch/Downloads/Manuskript_Gr_nStadtGrau_Download.pdf, verfügbar am 14.12.2005.

Lienau, C., 2000, Die Siedlungen des ländlichen Raumes. - Braunschweig, (= Das Geographische Seminar).

Österreichische Raumordnungskonferenz (Hrsg.), Österreichisches Raumentwicklungskonzept, Wien 2001.

Prinz, T., Dollinger, F. und E. Wonka: Entwicklung räumlich flexibler Planungs-Indikatoren. Grundlagen für die Umsetzung einer nachhaltigen Regional- und Ortsplanung, In: Strobl, J., T. Blaschke und G. Griesebner (Hrsg.): Angewandte Geographische Informationsverarbeitung XVII, Beiträge zum AGIT-Symposium Salzburg, 2005. S. 118 – 123.

Strobl, J., Prinz, T. und E. Wonka: Flexible Aggregation regionalstatistischer Erhebungen – Neue Produkte der Statistik Austria, In: Strobl, J., T. Blaschke und G. Griesebner (Hrsg.): Angewandte Geographische Informationsverarbeitung XVI, Beiträge zum AGIT-Symposium Salzburg, 2004. S. 556 – 561.

Statistik Austria (Hrsg.), 2005, Statistisches Jahrbuch Österreichs 2005. - Wien.

Steinnocher K. und T. Tötzer, 2001, Analyse von Siedlungsdynamik durch Verknüpfung von Fernerkundungs- und demographischen Daten. In (Umweltbundesamt Hrsg.): Versiegelt Österreich? Der Flächenverbrauch und seine Eignung als Indikator für Umweltbeeinträchtigungen. UBA Conference Papers, CP-030, Wien. S. 39 – 47.

Steinnocher K., F. Kressler und M. Köstl, 2000, Erstellung einer Siedlungsmaske für Österreich aus Fernerkundungsdaten, und Integration zusätzlicher Information aus Zensusdaten. In : J. Strobl und T. Blaschke (Hrsg.), 2000, Angewandte Geographische Informationsverarbeitung XII, Beiträge zum AGIT-Symposium, Salzburg 2000, - Heidelberg. S. 481 – 488.

Umweltbundesamt (Hrsg.), 2004, Die Veränderungen des Lebensraums Alpen dokumentieren. Indikatorensystem und Konzept für einen Alpenzustandsbericht. Abschlussbericht der Arbeitsgruppe „Umweltziele und Indikatoren" der Alpenkonvention. Anhang II. - Berlin. - Online: http://www.umweltbundesamt.de/uba-info-daten/daten/alpen/AnhangII_de.pdf, verfügbar am 14.12.2005.

🏆 reviewed paper

Die Rolle der Post-Suburbia im Globalisierungsprozess: mehr als ein untergeordneter Ergänzungsraum der Kernstadt?

Robert MUSIL

(Dr. Robert Musil, Österreichische Akademie der Wissenschaften, ISR, Postgasse 7/4/2, 1010 Wien, Robert.Musil@oeaw.ac.at)

1 EINE NEUE, GLOBALE ZENRALITÄT DER POST-SUBURBIA?

Die Suburbia ist in die Jahre gekommen, auch in Europa. Nach über drei Jahrzehnten chaotischer und ungeordneter Entwicklungen, die außerhalb der administrativen Stadtgrenzen stattfinden, stellt sich die Frage, ob und wie aus der Zwischenstadt heraus etwas spezifisch Neues entstanden ist – eine Post-Suburbia (Fassmann 2004, 115)? Eng mit dieser Begrifflichkeit ist die Frage der Emanzipation des Umlandes von der Kernstadt verknüpft: die Post-Suburbia übt als Arbeitsplatz-, Versorgungs- und Freizeitzentrum eine eigene „Strahlkraft" auf das weitere Umland aus (Brake 2001, 18). Vor diesem Hintergrund ist zu klären, ob die Post-Suburbia tatsächlich Funktionen ausübt, die bisher der Kernstadt vorbehalten waren (Borsdorf 2004, 17); ob von einer neuen Zentralität gesprochen werden kann, in der das Umland über die Rolle eines wohl wichtigen, aber untergeordneten Ergänzungsraumes hinausgewachsen ist. Kunzmann (2001) spricht in diesem Zusammenhang von einem funktionalen Städtearchipel, in dem die globalen Funktionen in der Kernstadt konzentriert sind, während es die Vorstadträume sind, die lediglich dafür Sorge tragen, „dass die Bühne der Metropole beleuchtet wird, dass sie in vollem Glanz erstrahlen kann. Es sind die funktionalen, glanzlosen Bühnenräume hinter den Kulissen der städtischen Oper, ohne die keine Aufführungen stattfinden können" (Kunzmann 2001, 215-216). Gleichermaßen bildhaft formuliert, lautet die zentrale Frage dieser Arbeit ob das Umland der Kernstadt – vielleicht mit weniger Glanz – nicht selbst zu einer kleinen Bühne der globalen Wirtschaft geworden ist. Präziser formuliert: Welche Rolle nimmt das städtische Umland im globalen Kontext ein?

Der Fokus der Global City-Forschung ist traditionell – insbesondere Sassens richtungweisende Fallstudie (Sassen 1991) – auf die städtischen Zentren, die City beziehungsweise den Central Business District ausgerichtet. Wenngleich festgestellt wird, dass die räumliche Zentralität nicht mehr mit der globalen Zentralität, also mit den Global City-Funktionen, in zwingenden Zusammenhang stehen muss: „In der Vergangenheit und eigentlich noch bis vor kurzem war ‚Zentrum' so gut wie synonym mit City oder CBD. Die räumlichen Korrelate des ‚Zentrums" können jetzt in verschiedener räumlicher Strukturierung auftreten. Es kann dem CBD entsprechen, wie es in New York noch weitgehend der Fall ist, oder es kann sich in einer Stadtlandschaft in der Form eines Netzes von Knoten intensiver Wirtschaftsaktivität präsentieren..." (Sassen 2000, 204-205). Tatsächlich lässt sich – nicht nur in den Edge Cities in den USA, auch im Umland europäischer Metropolen – feststellen, dass neben hochwertigen unternehmensorientierten Dienstleistungsbranchen auch Unternehmenszentralen globaler Konzerne zunehmend im Umland niedergelassen sind (Beauregard und Haila 2000, 28); es scheint, als würde entgegen den Annahmen Kunzmanns eine Emanzipation insofern stattfinden, als sich Kernstadt und Umland hinsichtlich der Einbindung in die globale Weltwirtschaft eher durch unterschiedliche Quantitäten, als durch Qualitäten – also eine regional-funktionale Arbeitsteilung – voneinander unterscheiden: „in fact bring the suburban location the same international business firms, the same professional consulting activities, ..., that the central city has, if on a smaller scale." (Marcuse und van Kempten 2000, 255-256).

2 DAS WIENER UMLAND: EIN STANDORT GLOBALER ZENTRALITÄT?

Die zentrale Forschungsfrage dieser Arbeit zielt darauf ab zu klären, ob und in welchem Umfang das Wiener Umland einen eigenen Beitrag zur globalen Vernetzung, als Standort von international tätigen Unternehmenszentralen für die Stadtregion leistet. Kann von einem Emanzipationsprozess gesprochen werden, der zu einer eigenen – wenn auch schwächer ausgeprägten – globalen Zentralität des Umlandes geführt hat?

2.1 Zur Methodik der Untersuchung

2.1.1 Wo endet die Stadt? Die Frage der geeigneten Abgrenzung des Umlandes der Agglomeration Wien

Die Abgrenzung des städtischen Umlandes ist Gegenstand zahlreicher Untersuchungen, die dahingehend zusammengefasst werden können, dass unterschiedliche Methoden – morphologische, funktionale oder strukturelle – immer zu unterschiedlichen Abgrenzungen führen (Abbildung 1) und damit zu der Aussage verleiten, dass es „die" Abgrenzung der Suburbia garnicht gibt. Internationale Vergleichsstudien (vgl. www.comet.ac.at) zeigen, dass eine standardisierte europaweite Abgrenzungsmethode nicht unbedingt sinnvoll sein muss; nicht zu unrecht schrieb Siebel: „Die europäische Stadt ist Differenz" (Siebel 2004, 12). Zu vielfältig und heterogen sind die Strukturen der europäischen Stadtlandschaft, als das sich diese durch einfache morphologische Klassifikationen, wie etwa die N.U.R.E.C.-Methode (Leichtfried 2001), systematisch erfassen ließen.

Für diese Arbeit wurde eine Abgrenzung auf Basis administrativer Grenzen gewählt, der NUTS-3 Gebietseinheiten Wien Umland-Nord (AT 126) und Wien Umland-Süd (AT 127). Für diese Vorgangsweise sind vor allem zwei Argumente geltend zu machen:

Administrative Abgrenzungen sind in gewisser Weise willkürlich, allerdings im Gegensatz zu funktionalen Abgrenzungen – deren Parameter sich ja verändern (vgl. die Außenzone der Agglomerationsraumabgrenzung der Statistik Austria für die Jahre 1991 und 2001 in Abbildung 1) – zeitlich stabil. Daher ist die Analyse von Zeitreihen mit einer administrativ abgegrenzten Suburbia praktikabler.

Darüber hinaus ist eine großzügige Abgrenzung gegenüber den eher engen, an morphologischen Kriterien orientierten Methoden (vgl. N.U.R.E.C. in Abb. 1) in dieser Arbeit vorzuziehen: Unternehmensansiedelungen finden in zunehmendem Maße – aufgrund ausreichender, günstiger Baulandreserven, bei gleichzeitig günstiger Verkehrsanbindung – im weiteren Umland statt. Eine Beschränkung auf jenen Teil des Umlandes, der nur mehr über sehr geringe bis gar keine Baulandreserven verfügt (wie etwa die

Gemeinde Maria Enzersdorf im Süden Wiens) und deshalb für Betriebsansiedlungen uninteressant ist, macht für den Fokus auf wenig Sinn.

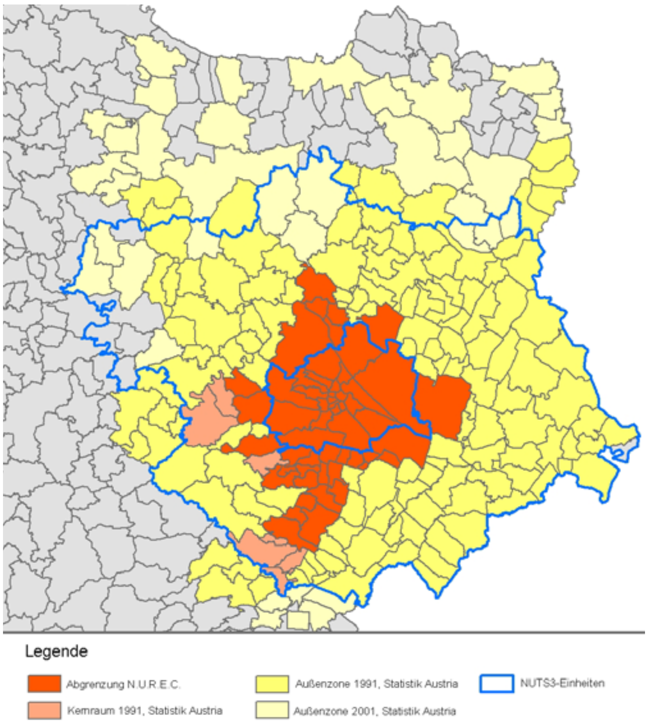


Abb.1: Grenzziehungen für das Umland Wiens (Quelle: Leichtfried 2001, Statistische Nachrichten 1997/2, Statistik Austria 2004)

2.1.2 Indikatoren für die globale Vernetzung einer Stadtregion

Mit welcher Methode soll die globale Vernetzung einer Stadtregion erfasst werden? Eine theoretische Anknüpfung an das Konzept der Global City ist sinnvoll, da dieser einer Ansatz globale Prozesse mit der städtischen Entwicklung in Verbindung gebracht hat (Gerhard 2004, 4). Der Global City-Ansatz betont den netzwerkartigen Charakter der Weltwirtschaft, deren Knotenpunkte eben die global bedeutsamten Städte sind, die durch Flüsse von Informationen, Waren, Dienstleistungen, Menschen und Kapital verbunden sind (Friedmann 1986, 69). Somit ist nicht die Ausstattung eines Standortes, sondern der Umfang und die Art der Einbindung in die globale Ökonomie sind von Relevanz: „Cities are in direct and frequent contact with one another through the various city-to-city flows. … It is our view that the nature of these interrelations (e.g. frequency, strength, importance, sominance/subdominance) undergrids the structure of the world system“ (Smith and Timberlake 1995, 290). Zur Erfassung dieser globalen „Interrelationen“ wurden unterschiedlichste Datengrundlagen herangezogen: internationale Flugstatistiken (Keeling 1995), Unternehmensnetzwerke von global tätigen Unternehmen im Bereich der hochwertigen Dienstleistungen (Taylor 2004) sowie Beziehungen im Bereich Kultur oder Printmedien (Taylor 1997). Wenn auch empirisch kaum untersucht, wird den Kapitalströmen in diesem Netzwerk der globalen Städte eine maßgebliche Rolle für den Aufbau hierarchischer Beziehungen zugesprochen; so meint Sassen: „The international mobility of capital contributes specific forms of articulation among different geographic areas and transformations in the role played by these areas in the world economy“ (Sassen 1991, 169). Und für Friedmann kommt international bedeutenden Städten eine Rolle als Drehscheibe für das globale Kapital zu: „Key cities throughout the world are used by global capital as “basing points” in the spatial organization and articulation of production and markets. The resulting linkages make it possible to arrange world cities into a complex spatial hierarchy” (Friedmann 1986, The World City Hypothesis). Doch mit welcher Form des „global capital” macht es Sinn, die Städtebeziehungen zu erfassen.

An den beträchtlichen globalen Finanzströmen, die zwischen den Global Cities verlaufen, machen ausländische Direktinvestitionen wohl nur einen kleinen und mitunter stagnierenden Teil aus (Bellak 1999, 108); dennoch ist es sinnvoll, diese Form des Kapitaltransfers als Indikator für die globale Vernetzung von Stadtregionen heranzuziehen. Im Vergleich zu Portfolioinvestitionen weisen Direktinvestitionen eine hohe Stabilität auf, wie sich besonders in Wirtschaftskrisen, beispielsweise der Asienkrise in den 1990er Jahren, deutlich gezeigt hat (Bellak 2000, 52; Husa und Wohlschlägl 1999, 222). Diese Einschätzung hängt vor allem von dem Umstand ab, dass ausländische Direktinvestitionen nicht aus spekulativen, sondern aus strategischen und langfristigen Interessen der Investoren getätigt werden; UNCTAD wie auch die österreichische Nationalbank führen das Motiv der „strategischen Kontrolle“ auch als das zentrale Abgrenzungskriterium gegenüber anderen Kapitalströmen an: „Demgemäß versteht man unter ausländischen Direktinvestitionen Kapitalanlagen, die Investoren in der Absicht vornehmen, um mit einem Unternehmen in einem anderen Land eine dauernde Wirtschaftsbeziehung herzustellen und aufrecht zu erhalten, wobei gleichzeitig die Absicht besteht, auf das Management dieser Firma einen spürbaren Einfluss auszuüben“ (OeNB 2004, 6). Es verwundert daher auch nicht, dass ausländische Direktinvestitionen nicht nur als Indikator für die Internationalität einer Volkswirtschaft oder eines Standortes (Altzinger 2000, 16), sondern auch als Manifestation des räumlichen Handelns von globalen Mehrbetriebsunternehmen verstanden werden (Heiduk und Kerlen-Prinz 1999, 54).

Wie ist nun – um zur Ausgangsfrage zurückzukehren – die Bedeutung des Wiener Umlandes für die Vernetzung der Stadtregion Wien einzustufen? In welchem Umfang werden Direktinvestitionen von Unternehmenszentralen, die in der Suburbia niedergelassen sind, durchgeführt? Wie unterscheiden sich die Investitionsflüsse der beiden Teilregionen Kernstadt und Umland in ihrer quantitativen und qualitativen Entwicklung? Lassen sich unterschiedliche räumliche Muster erkennen? Bevor diese Fragen beantwortet werden ist es sinnvoll die Entwicklungen der betrieblichen Suburbanisierung in Wien zu beleuchten. Denn diese bilden den lokalen Rahmen, von dem ausgehend die globalen Invesitionsbeziehungen stattfinden.

2.2 Dynamische Suburbia contra stagnierende Kernstadt? Allgemeine Entwicklungen der Betriebssuburbanisierung in der Stadtregion Wien

Das Wiener Umland war in den vergangenen Jahrzehnten durch ein andauerndes Wachstum der Wohnbevölkerung gekennzeichnet, das ab den frühen 1980er Jahren eine – im internationalen Kontext betrachtet verspätete – Beschleunigung erfahren hatte. Im Jahr 1961 zählte die Agglomeration Wien 2,05 Mio. Einwohner, wobei die Relation Kernstadt zu Umland in etwa bei 20 : 80 Prozent lag. Bis 2004 stieg die Bevölkerungszahl – vor allem seit den 1980er Jahren – auf 2,21 Mio. Einwohner, wobei sich die Relation zwischen den beiden Teilräumen der Agglomeration auf 27 : 73 Prozent verschob. Der Nettoanstieg in diesem Zeitraum betrug somit 165.000 Einwohner und ist ausschließlich dem Umland hinzuzurechnen.

Die betriebliche Suburbanisierung der Agglomeration Wien hinkt dieser Entwicklung hinterher: 1991 lag weniger als ein Fünftel (19 Prozent) der Arbeitsplätze im Umland Wiens, wobei der Anteil bis zum Jahr 2001 nur gering anstieg. Somit lag in diesem Jahr das Verhältnis zwischen den beiden Teilräumen, zwischen Umland und Kernstadt bei 21 : 79. Während sich das Bevölkerungswachstum bis 2001 ausschließlich auf das Umland konzentrierte, lag der Anteil der Kernstadt an der gesamten Beschäftigtenzunahme bei etwa zwei Drittel (66 Prozent von insgesamt 116.000). Trotz der Verlagerung von Industriebetrieben aus der Kernstadt in das Umland, die im Falle Wiens seit den 1980er Jahren als nicht unbeträchtlich eingeschätzt werden können (Mayerhofer und Palme 1996, 68), erreicht die Betriebsurbanisierung (in Arbeitsplätzen am Arbeitsort gemessen) bei weitem nicht das Niveau der Bevölkerungssuburbanisierung. Unternehmensbefragungen haben überdies gezeigt, dass im Gegensatz zur Industrie die Verlagerungstendenzen im tertiären Sektor nur eine geringe Rolle spielen; wenn es zu Standortverlagerungen kommt, dann ziehen es die befragten Unternehmen vor, im jeweiligen Teilraum – also in der Kernstadt oder im Umland – nach einer neuen Niederlassung zu suchen (Bachmann 2003, 86-87).

Das geringe Niveau der Betriebssuburbanisierung spiegelt sich auch in der asymmetrischen Pendlerverflechtung dieser beiden Räume wieder: 1991 pendelten rund 87.000 Bewohner der Suburbia in die Kernstadt, zehn Jahre später waren es bereits 99.700. Dagegen stieg die Zahl der Arbeitnehmer aus der Kernstadt mit einem Arbeitsplatz im Umland von 34.000 auf 44.000, womit die negative Bilanz der Pendlerverflechtung für das Umland in absoluten Zahlen auf -56.000 anwuchs. Die tendenziell steigende Attraktivität des Wiener Umlandes lässt sich allerdings daran ermessen, dass die Zahl der Pendler von Wien in Richtung Suburbia mit 29 Prozent doppelt so rasch anstieg wie umgekehrt, also vom Umland nach Wien (15 Prozent). Dabei dürfen die Bedeutungsunterschiede der beiden Teilräume nicht aus den Augen verloren werden: Gemessen an der Gesamtzahl der Beschäftigten am Arbeitsort sind es gerade einmal 5,3 Prozent der in Wien Beschäftigten, die in das Umland pendeln, wenn auch bei steigender Tendenz (1991: 4,5%). Umgekehrt liegt der Anteil der Wienpendler, gemessen an den verfügbaren Arbeitsplätzen bei knapp unter 50 Prozent (1991: 49,5%, 2001: 46,5%). Von einer Emanzipation des Umlandes von der Kernstadt kann zumindest aus der Sicht der Arbeitplatzverfügbarkeit keine Rede sein.

	Wien		Umland		Umland an Stadtregion (%)	
Abteilungen	1991	2001	1991	2001	1991	2001
Kreditwesen <65>	28.693	27.837	2.702	3.075	8,6	9,9
Versicherungswesen <66>	12.727	11.418	696	883	5,2	7,2
Mit K. und V. verbundene Tätigkeiten <67>	2.294	4.329	186	701	7,5	13,9
Realitätenwesen <70>	6.774	13.098	498	1.558	6,8	10,6
Vermietung bewegl. Sachen o. Bedienungsp. <71>	2.237	3.051	483	950	17,8	23,7
Datenverarbeitung und Datenbanken <72>	7.513	23.686	555	2.761	6,9	10,4
Forschung und Entwicklung <73>	1.906	4.627	682	931	26,4	16,8
Erbringung von u.-bez. Dienstleistungen <74>	51.503	86.111	6.095	12.205	10,6	12,4
Beschäftigte an der Arbeitsstätte <J> und <K>	**113.647**	**174.157**	**11.897**	**23.064**	**9,5**	**11,7**
Beschäftigte an der Arbeitsstätte gesamt	**744.449**	**821.458**	**175.371**	**214.503**	**19,1**	**20,7**

Tab.1: Beschäftigte an der Arbeitsstätte in ausgewählten ÖNACE-Wirtschaftsabschnitten für Wien und Umland Wien, 1991 und 2001 (Quelle: Statistik Austria 2005)

Allerdings scheinen die Dienstleistungsbetriebe des Wiener Umlandes in der Beschäftigung eine wesentlich stärkeres Wachstum aufweisen als die Unternehmen in der Kernstadt; was wohl auch durch den überproportional hohen Anteil von „start ups", jungen Dienstleistungsunternehmen, im Umland erklärt werden kann (Bachmann 2003, 50-51 und 65). Verfügt das Wiener Umland mit seinen überdurchschnittlich jungen und stark wachsenden Dienstleistungsunternehmen auch über jene hochwertigen Branchen, die für das Management der Globalisierung (Taylor 2004, 34) so bedeutend sind oder handelt es sich doch nur um die „Shoppingmall" Wiens, also ein Handels- und Konsumentendienstleistungszentrum am Rande der Großstadt? Während wie bereits ausgeführt der Anteil des Umlandes an der Gesamtbeschäftigung der Agglomeration im Jahr 2001 bei rund 21 Prozent lag, sind die hochwertigen Dienstleistungsbranchen1 mit einem Anteilswert von 11,7 Prozent deutlich unterrepräsentiert. In beinahe allen Wirtschaftsabteilungen der hochwertigen Branchen (vgl. Tabelle 1) wiederholt sich dieses Verhältnis. Allerdings sind die Zuwachsraten im Umland beträchtlich, liegen in den beiden Wirtschaftsabschnitten bei ca. 100 Prozent: während die Kernstadt

[1] Unter dem Begriff „hochwertige Dienstleistungen werden folgende ÖNACE-Abschnitte zusammengefasst: „Kredit- und Versicherungswesen" (J) sowie „Realitätenwesen, Vermietung beweglicher Sachen, Erbringung von unternehmensbezogenen Dienstleistungen" (K).

jahrzehntelang – nicht ausschließlich, aber doch in hohem Maße – den öffentlichen Sektor als Arbeitsplatzmotor beanspruchen konnte (Schmee und Weigl 1999, 76), sind es im Umland vermehrt die hochwertigen Dienstleistungen[2], die das Beschäftigungswachstum ankurbeln.

Das Wirtschaftskraft der Agglomeration Wien hat sich in der zweiten Hälfte der 1990er Jahre – gemessen am Bruttoregionalprodukt (BRP) – im Umland dynamischer entwickelt; wenn das regionale Wirtschaftswachstum im Umland auch starken Schwankungen unterlag (vgl. Abbildung 2), so stieg es zwischen 1995 und 2002 immerhin um 31,8 Prozent auf 14,4 Mrd. Euro. In der Kernstadt erfolgte ebenso starkes Wachstum, lag aber mit 23,9 Prozent deutlich zurück. Das Verhältnis dieser beiden Teilräume hat sich dadurch geringfügig zum Umland verschoben, die Relation stieg von 18,1 : 81,9 im Jahr 1995 auf 19,1 : 80,9 im Jahr 2001 zugunsten des Umlandes. Damit liegt die Wirtschaftskraft ungefähr bei jener 20 Prozent-Marke, die auch schon für die Beschäftigtenzahlen des Umlandes festgestellt wurden.

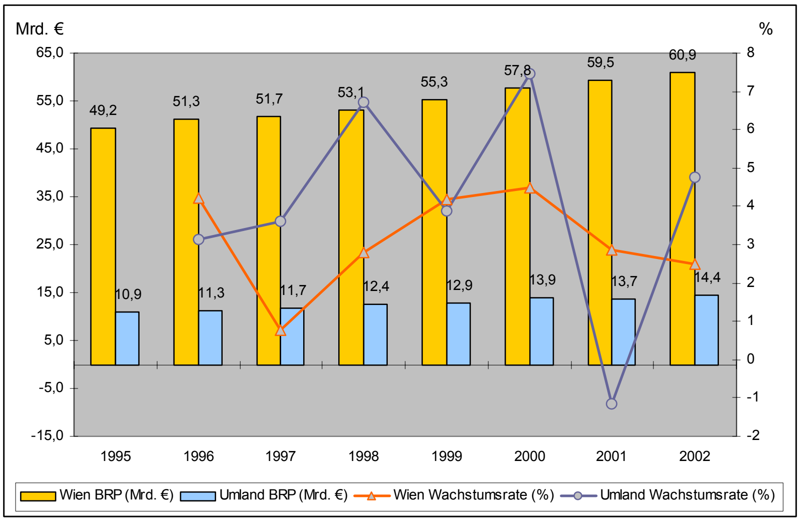


Abb.2: Bruttoregionalprodukt für Wien und Umland Wien, 1995 bis 2002 (Quelle: Statistik Austria 2005)

Die Entwicklungen der Betriebssuburbanisierung der Agglomeration Wien können in folgende Punkte zusammengefasst werden:

Erstens hinkt die Betriebssuburbanisierung der Wohnsuburbanisierung deutlich hinterher; während jeder vierte Bewohner der Agglomeration im Umland lebt, findet sich dort nur jeder fünfte seinen Arbeitsplatz.

Das Ungleichgewicht zwischen Kernstadt und Umland ist in den hochwertigen Dienstleistungsbranchen noch stärker ausgeprägt; nur knappe 11 Prozent der Arbeitsplätze in den Wirtschaftsbranchen „Bank- und Kreditwesen“ und „unternehmensbezogene Dienstleistungen“ liegen in der Suburbia.

Die Entwicklung unterschiedlicher Indikatoren der Bevölkerungs- und Betriebssuburbanisierung zeigt allerdings deutlich, dass die Dynamik des Umlandes zwar von einem niederen Niveau ausgeht, allerdings eine wesentlich ausgeprägtere Wachstumsdynamik als die Kernstadt aufweist.

2.3 Das Wiener Umland als Ursprung und Ziel internationaler Direktinvestitionsströme

2.3.1 Unternehmenszentralen in Kernstadt und Umland

Die Anzahl der Großunternehmen der Agglomeration Wien beträgt laut Steuerstatistik[3] des Jahres 2000 12.554, wovon ein knappes Fünftel (18,8 Prozent) im Umland angesiedelt ist. Für das gleiche Jahr wurden von der Österreichischen Nationalbank in der Agglomeration 1.117 international tätige Mehrbetriebsunternehmen – Konzerne – erfasst, die durch ausländische Diretkinvestitionen internationale Beteiligungen unterhalten. Die Investitionsverflechtungen dieser international tätigen Unternehmen, also der österreichischen Konzernzentralen, stellen naturgemäß einen Bruchteil der Betriebe der Agglomeration Wien: es handelt sich dabei um 8,9 Prozent der Unternehmen nach der Körperschaftssteuerstatistik (also Großbetriebe), aber etwa nur um 1 Prozent aller 115.000 Arbeitsstätten (inklusive Klein- und Mittelbetriebe). Die Aktivitäten dieser 1.117 österreichischen Konzernzentralen stehen im Mittelpunkt der folgenden Analysen.

Der starke Anstieg der international tätigen Unternehmenszentralen in der Agglomeration Wien (Abbildung 3) steht in enger Verbindung zu den geänderten Rahmenbedingungen der österreichischen Volkswirtschaft: die Integration in den Binnenmarkt der Europäischen Union und die Transformation der mittel-osteuropäischen Nachbarländer hat zu einer Öffnung der sehr stark binnenorientierten Volkswirtschaft geführt (Schmee und Weigl 1999 sowie Mayerhofer und Palme 1996). Wie stark die österreichische Ostregion von diesen Entwicklungen erfasst wurde lässt sich an dem Umstand ermessen, dass die Agglomeration Wien in den 13 Erhebungsjahren einen Zuwachs an Unternehmen, die über Auslandsbeteiligungen verfügen, von über 200 Prozent verzeichnete; wobei das Wachstum der Kernstadt etwas unterdurchschnittlich (192,9 Prozent), des Umlandes überdurchschnittlich

[2] Der Terminus „hochwertige Dienstleistungen“ ist allerdings zu hinterfragen. Denn diese Wirtschaftsabteilungen umfassen nicht nur hochwertige Berufsfelder wie „Rechts-, Steuer- und Unternehmensberatung“ oder „Architektur- und Ingenieurbüros“, sondern ebenso „Reinigungsgewerbe“ oder „Detekteien- und Schutzdienste“. Für das Bundesland Wien beträgt der Anteil der tatsächlich hochwertigen Dienste in der Abteilung „unternehmensbezogene Dienstleistungen“ etwa 60 Prozent.

[3] Damit werden die steuerpflichtigen Fälle der Körperschaftssteuer dargestellt.

(272,9 Prozent) ausfiel. Damit ist es in der Kernstadt zu einer Verdreifachung, im Umland beinahe zu einer Verfierfachung der international tätigen Unternehmen (in weiterer Folge auch „Konzernmütter" genannt) gekommen. Aufgrund der beträchtlichen quantitativen Unterschiede zwischen den Teilräumen findet nur eine langsame Verschiebung der Relationen zwischen den beiden Teilräumen statt: der Anteil des Umlandes an den Konzernmüttern der Agglomeration lag 1991 bei 12,5 Prozent, im Jahr 2001 bei 15,4 Prozent. Somit bleibt das Wiener Umland als Standort für Unternehmenszentralen trotz eines spektakulär anmutenden Wachstums hinter seinem ökonomischen Potential – gemessen an Arbeitskräften oder Bruttoregionalprodukt – zurück. Allerdings sagt die Anzahl der Unternehmen nichts darüber aus, wie viel Investitionskapital von den erfassten Konzernmüttern an ausländische Standorte geflossen ist.

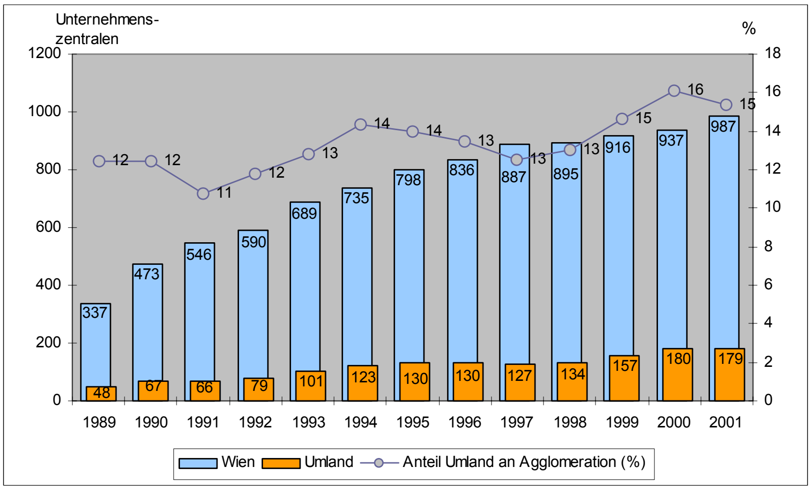


Abb.3: Österreichische Konzernzentralen in der Agglomeration Wien (Kernstadt und Umland sowie Anteil des Umlandes) 1991 bis 2001 (Quelle: OeNB, eigene Datenverarbeitung)

2.3.2 Investitions- und Beteiligungsstruktur der Unternehmenszentralen

Die Anzahl der international tätigen Konzernmütter erhöhte sich im Untersuchungszeitraum beträchtlich. Doch aufgrund der Investitionsvolumina, die im Laufe der 1990er Jahren von der Agglomeration Wien aus weltweit in Unternehmensbeteiligungen investiert wurden, ist es zulässig hier von einer regelrechten Boom-Phase zu sprechen: Lag der Bestand der Investitionsvolumina4 1989 bei 1,3 Mrd. Euro, so stieg dieser bis 2001 auf 17,9 Mrd. Euro an. Der Indexwert – ein Indikator für die Wachstumsdynamik – stieg im Falle der Kernstadt von 100 auf 1.387, jener des Umlandes hingegen auf 2.373 (Abbildung 4). Damit wies das Umland im Vergleich der beiden Teilräume eine durchwegs höhere Wachstumsdynamik als die Kernstadt auf, blieb allerdings rein quantitativ gesehen unbedeutend; der Anteil des Umlandes lag im langjährigen Mittel bei 6,2 Prozent der gesamten Investitionen, wobei beträchtliche jährliche Schwankungen festzustellen sind; diese sind auf die Tatsache zurückzuführen, dass aufgrund der relativ geringen Zahl an Unternehmenszentralen in diesem Teilraum schon wenige große Übernahmen die Statistik maßgeblich beeinflussen können (Abbildung 4). Bis 1997 nahm die Bedeutung des Umlandes anteilmäßig etwas zu (1997: 8,2 Prozent), fiel aber seither wieder deutlich zurück und lag 2001 bei 5,6 Prozent – die Kernstadt hat also in den späten 1990er Jahren wieder an Dynamik gegenüber dem Umland aufgeholt. Das starke Auslangsengagement der Wiener Banken in Osteuropa scheint an dieser Entwicklung entscheidenden Anteil zu haben. Von den 17,9 Mrd. Euro, die 2001 von Konzernmüttern aus der Agglomeration Wien investiert wurden, stammten gerade 1,0 Mrd. aus dem Umland.

Das durchschnittliche Investitionsvolumen je Unternehmenszentrale differiert zwischen den Teilräumen beträchtlich: wurden aus der Agglomeration insgesamt 7,6 Mio. Euro pro Konzernmutter an ausländischen Standorten investiert, so waren es im Umland gerade 3,4 Mio. Euro (vgl. Tabelle 2). Misst man die Beteiligungsgröße allerdings nicht nach dem Investitionsvolumen (Eigenkapital) sondern nach der Anzahl der durchschnittlichen Angestellten in den ausländischen Tochterunternehmen, zeigt sich ein umgekehrtes Bild: rund 98 Beschäftigte werden im Schnitt in den ausländischen Niederlassungen der Umland-Zentralen angestellt, hingegen nur 77 in jenen der Kernstadt. Wenn diese Werte auch durch Beteiligungsgesellschaften (Holdings) verzerrt werden dürften, die eher in der Kernstadt angesiedelt sind, so kann doch festgestellt werden, dass die Unternehmenszentralen des Umlandes über eine deutlich geringere Kapitalintensität5 als jene der Kernstadt verfügen. Interessanter weise sagt die geringe Kapitalintensität auch nichts über die Rentabilität6 der Beteiligungen aus: denn diese lag mit 6,3 Prozent im langjährigen Durchschnitt deutlich über dem Wert der Kernstadt (4,9 Prozent). Damit weist die internationale Verflechtung des Wiener Umlandes nicht nur ein höheres Wachstumsniveau aus die Kernstadt auf; sie sind auch erfolgreicher – wenn man die Rentabilität auf Basis ausgewiesener Gewinne als Ausdruck einer erfolgreichen Internationalisierungsstrategie gelten lässt.

[4] Als Indikator für das Beteiligungsvolumen wird das investitierte Eigenkapital gemessen. Laut Erhebung der Österreichischen Nationalbank wird das Eigenkapital wie folgt definiert: „Dieses setzt sich aus dem Nominalkapital, den Ru‹cklagen und dem Saldo aus Gewinn- und Verlustvortrag zusammen. Einer Empfehlung der EZB folgend ist seit 1999 auch der Gewinn/Verlust des laufenden Jahres im Eigenkapital enthalten. Begründet wird diese Empfehlung mit der Tatsache, dass der Gewinn dem Unternehmen bis zu seiner allfa‹lligen Auszahlung zur Verfügung steht" (OeNB 2004/6, 9).

[5] Kapitalintensität wird am investierten Eigenkapital pro Beschäftigtem bei dem ausländischen Tochterunternehmen gemessen.

[6] Der Gewinnanteil ergibt sich aus dem Anteil der ausgewiesenen Gewinne am investierten Eigenkapital.

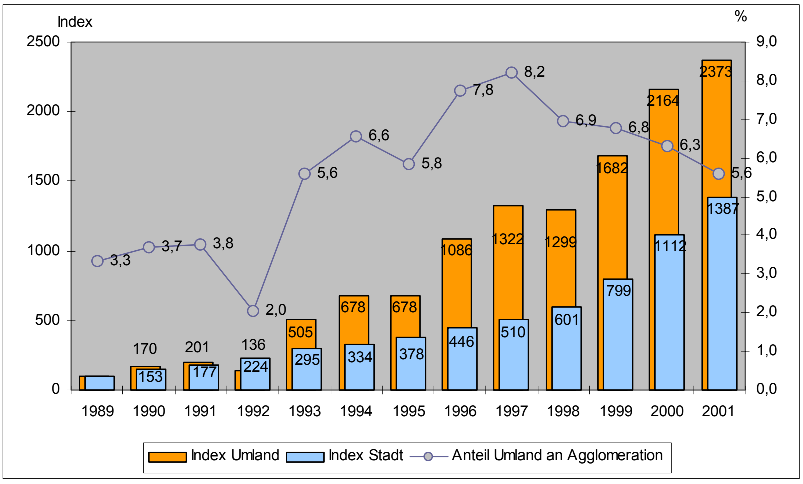


Abbildung 4: Wachstumsdynamik der Investitionsvolumina (Index (1989=100) für Kernstadt und Umland) sowie Anteil des Umlandes 1991 bis 2001. Quelle: OeNB, eigene Datenverarbeitung.

Der schon festgestellte geringe Anteil des Umlandes an Arbeitsstätten in den hochwertigen Dienstleistungsbranchen (vgl. Tabelle 1 in Kapitel 2.2) setzt sich auch bei den international tätigen Unternehmenszentralen fort. Von den in Tabelle 2 über den gesamten Untersuchungszeitraum akkumulierten Unternehmenszentralen entfällt im Umland der höchste Anteil (608 Unternehmen oder 40 Prozent) auf einfache Dienstleistungen (vor allem Handel) und ist darin im Vergleich zur Agglomeration insgesamt überrepräsentiert. Hingegen sind jene Unternehmenszentralen, die in der Kernstadt niedergelassen sind, in hohem Maße den hochwertigen Dienstleistungsbranchen hinzuzuzählen. Mit 3.870 Unternehmen sind die hochwertigen Dienste dominierend. Sie umfassen rund 40 Prozent aller Konzernmütter der Kernstadt.

	Agglomeration	Kernstadt	Umland	Anteil Umland an Agglomeration (%)
Unternehmenszentralen	**11.147**	**9.626**	**1.521**	***13,6***
davon Industrie	3.461	2.953	508	*14,7*
davon Diensleistung	3.411	2.803	608	*17,8*
davon Dienstleistung (hochwertig)	4.275	3.870	405	*9,5*
Investitionsvolumen (EK in Mio. Euro)	**84.822,6**	**79.597,4**	**5.225,2**	***6,2***
Gewinne (in Mio. Euro)	4.214,6	3.883,7	330,9	*7,9*
Rentabilität (Gewinnanteil an EK, in %)	*5,0*	*4,9*	*6,3*	-
Beschäftigte in Tochterunternehmen	**894.692**	**745.002**	**149.690**	***16,7***
Kapitalintensität (EK in 1.000 Euro pro Mitarb.)	94,8	106,8	34,9	-
Beteiligungsgröße je HQ				
Investitionsvolumen (in Mio. Euro pro HQ)	7,6	8,3	3,4	-
Beschäftigte bei Tochter pro HQ	80,3	77,4	98,4	-
ÖNACE-Abschnitte J und K				
Beschäftigte bei Tochterunternehmen	213.838	212.132	1.705	*0,8*
Gesamtwert (in Mio. Euro)	58.441	56.190	2.252	*3,9*

Tabelle 2: Strukturindikatoren der Investitionsflüsse (Akkumulierte Werte für 1989 bis 2001; EK=Eigenkapital); (Quelle: OeNB, eigene Datenverarbeitung)

Das Unternehmen aus der Kernstadt und dem Umland über unterschiedliche Internationalisierungsstrategien verfügen wird bei der Entwicklung der branchenspezifischen Beschäftigtenstruktur in den Tochterbetrieben deutlich: aus den Unternehmenszentralen des Umlandes sind mehr als die Hälfte der Angestellten bei den Tochterbetrieben in der Industrie tätigt, wobei der Anteil von 48,7 Prozent im Jahr 1991 auf 54,2 Prozent im Jahr 2001 gestiegen ist (vgl. Tabelle 3). Industrie und Handel zusammen dominieren mit einem Anteil von 92,9 Prozent die Beschäftigung in den Tochterbetrieben des Umlandes. In der Kernstadt sind zwar im Jahr 2001 mehr als die Hälfte der Beschäftigten der Tochterunternehmen Industrie und Handel zuzurechnen, allerdings weist der Trend eindeutig auf eine Verlagerung zu hochwertigen Dienstleistungen (Banken, F&E, unternehmensorientierte Dienstleistungen). Die branchenspezifischen Investitionsvolumina (gemessen am Gesamtwert7 der Investitionen) erklären auch die Unterschiede der Kapitalintensität; diese resultiert im Wesentlichen aus der Konzentration der Kernstadt-Unternehmenszentralen auf die kapitalintensiven Dienstleistungsbranchen der Zielregionen.

[7] Die Österreichische Nationalbank definiert den Gesamtwert wie folgt: „Summe aus Eigenkapital und dem Saldo aus Kreditforderungen minus Kreditverbindlichkeiten (aktivseitig) bzw. Kreditverbindlichkeiten minus Kreditforderungen (passivseitig).

	Kernstadt Beschäftigte		Kernstadt Gesamtwert		Umland Beschäftigte		Umland Gesamtwert	
	1991	**2001**	**1991**	**2001**	**1991**	**2001**	**1991**	**2001**
Produktion <45>	51,9	39,3	30,8	23,0	48,7	54,2	55,7	48,4
Handel <50>	23,7	12,1	6,5	8,6	35,9	38,7	22,7	24,1
Bank & Kredit <65,66,67,70>	7,4	8,9	12,0	4,7	0,0	1,7	0,0	16,7
Daten u. F&E <72,73>	0,1	0,5	0,0	0,2	0,0	0,0	0,0	0,0
uDL<74>	1,0	10,7	20,6	29,8	2,0	0,2	17,4	6,8
sonstige Dienstleistungen	15,9	28,5	30,1	33,6	13,4	5,2	4,3	4,0
Gesamt	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Tabelle 3: Branchenstruktur für Beschäftigung und investierten Gesamtwert für Kernstadt und Umland nach den ÖNACE-Sektoren (1991 und 2001; Angaben in %) (Quelle: OeNB, eigene Datenverarbeitung)

2.3.3 Räumliche Muster der Investitionsbeziehungen

Die Unterschiede von Unternehmenszentralen aus Kernstadt und Umland bleiben nicht auf die bisher behandelten betriebswirtschaftlichen Strukturmerkmale wie Rentabilität, Branchenzugehörigkeit, Kapitalintensität und Beteiligungsgröße beschränkt. Das räumliche Muster der Investitionsaktivitäten der Unternehmenszentralen in der Agglomeration Wien ist stark von der Transformation in den mittelosteuropäischen Staaten geprägt: flossen 1989 noch immerhin 81 Prozent aller Investitionen nach Westeuropa8, so waren es 2001 – wenn auch bei stark steigenden absoluten Investitionsvolumina – nur mehr 42,6 Prozent; im Gegenzug erhöhte sich der Anteil osteurpäischer9 Zielstandorte von 5,7 auf 40 Prozent; außereuropäische Standorte stiegen leicht, von 13,3 auf 17,4 Prozent. Zwischen den beiden Teilräumen der Agglomeration lassen sich allerdings beträchtliche Unterschiede in der Gewichtung der Zielregionen feststellen.

Das Wiener Umland zeigt eine deutliche Abweichung von dem regionalen Muster der Agglomeration: während für die Kernstadt osteuropäische Standorte eine weniger dominierende Rolle gespielt haben, flossen bereits im Jahr 1989 rund ein Drittel der Beteiligungen aus dem Umland nach Osteurpa, während Westeuropa mit „nur" 52 Prozent der Investitionen im Vergleich zur Kernstadt unterrepräsentiert war (vgl. Abbildung 5). Die Bedeutung Osteuropas als Zielregion für Investitionen aus dem Umland hat im Laufe der 1990er Jahren noch weiter zugenommen: im Jahr 2001 flossen bereits drei Viertel der Umland-Investitionen in diese Region, während der entsprechende Anteilswert der Kernstadt auf 38 Prozent zurückging. Außereuropäische Standorte sind mit gerade 4 Prozent als Zielregion für Beteiligungen aus dem Umland eine vernachlässigbare Größe. Dies legt es nahe, von einem Ausdruck stark ausgeprägten Eurozentrismus, vielleicht auch von einer geringeren globalen Reichweite zu sprechen. Die deutlichen abweichende regionale Orientierung von Unternehmen aus den beiden Raumeinheiten der Agglomeration Wien zeigt, dass die „Neuorientierung" des Wirtschaftsstandortes Wien auf die osteuropäischen Märkte vom Umland wesentlich stärker vollzogen wurde als von der Kernstadt.

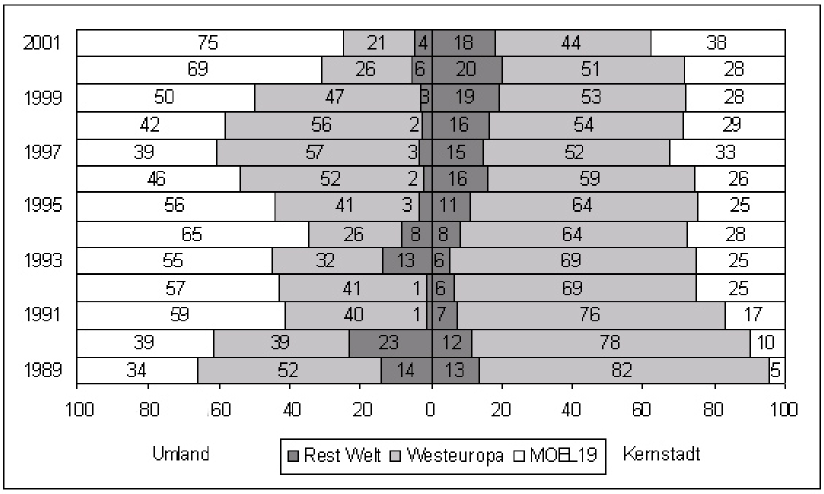


Abbildung 5: Regionale Verteilung der Investitionen (Anteil am Gesamtwert, 1991 bis 2001). Quelle: OeNB, eigene Datenverarbeitung.

Auf Ebene der einzelnen Standorte lassen sich differenziertere Aussagen über die räumlichen Verteilungsmuster der Investitionen von Kernstadt und Umland machen. So zeigt – wie kaum anders zu erwarten – die Kernstadt einen breiteren ökonomischen Aktionsraum (gemessen an der Zahl der Standorte) als das Umland. Denn während die Unternehmenszentralen der Kernstadt Investitionsbeziehungen zu 120 ausländischen Standorten unterhalten, sind es im Falle des Umlandes nur 70 Standorte. Jedoch lässt die Verteilung der Standorte (siehe Abbildung 6) darauf schließen, dass das Umland, aber ebenso auch die Kernstadt, von einem ausgesprochen ausgeprägten Eurozentrismus charakterisiert ist: denn nur 12 von 120 Standorten liegen außerhalb Europas. Und selbst innerhalb Europas zeigt sich ein Schwerpunkt auf die unmittelbaren Nachbarländer, vor allem die Schweiz, Deutschland, Italien sowie Ungarn, Slowenien, Tschechien und die Slowakei. In Abbildung 7 (obere Karten) ist an der Verschiebung des

[8] Westeuropa: EFTA und EU15

[9] Osteuropa (MOEL-19): Albanien, Bosnien und Herzegowina, Bulgarien, BR Jugoslawien, Estland, Kroatien, Lettland, Litauen, Republik Moldau, Mazedonien, Polen, Rumänien, Russland, Slowakische Republik, Slowenien, Tschechische Republik, Ukraine, Ungarn, Weissrussland.

räumlichen Investitionsmittelpunktes sehr deutlich die West-Ost-Neuorientierung festzustellen, die das Umland noch stärker als die Kernstadt betroffen hat.

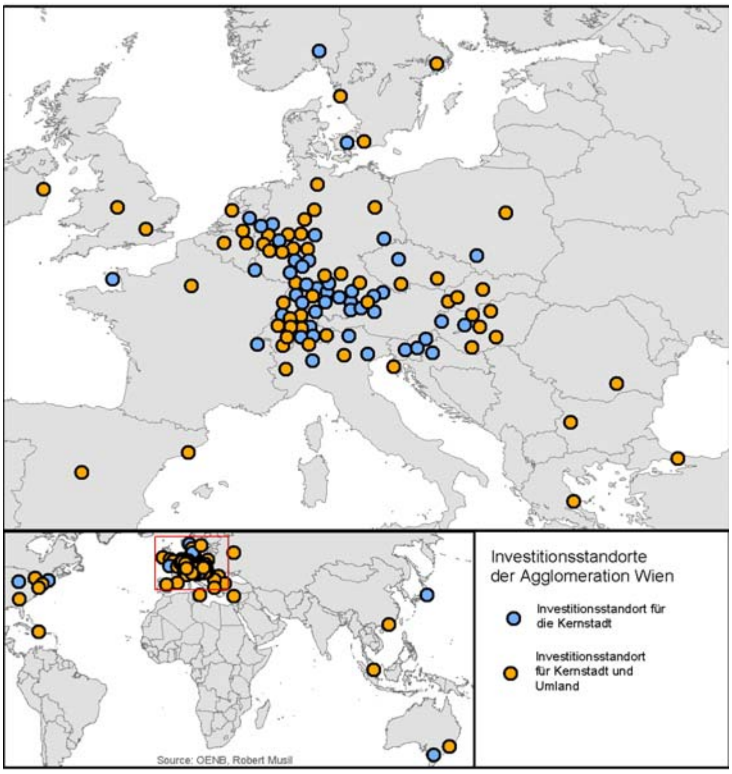


Abbildung 6: Standorte der Investitionsbeziehungen, aufgegliedert nach Kernstadt und Umland (Quelle: OeNB, eigene Datenverarbeitung)

Zur Bewertung der Einbindung der beiden Teilräume in das globale Städtesystem ist es sinnvoll die Zielstandorte nach ihrem Status im Global City-Netzwerk zu klassifizieren. Dazu kann auf die Arbeiten der Forschergruppe um Peter Taylor[10] zurückgegriffen werden, die mittels Netzwerkanalyse die „Global-Cityness“, also die Intensität der Einbindung einer Stadt in das Global-City-Netzwerk erfasst und Städte danach klassifizierten (vgl. Taylor 2004). Der Übersichtlichkeit halber werden die Zielstandorte in drei Klassen eingeteilt (starke Einbindung in das Global City Netzwerk: „hochrangige Global Cities“, schwache Einbindung „niederrangige Global Cities“ und jene Standorte, die über keinen Global City-Status verfügen „keine Global Cities“), wobei die offshore-Zentren der Kanalinseln, Zypern und Malta aufgrund der Verzerrung aus dem Sample der 120 Zielstandorte entfernt wurden. Somit wurden die restlichen 117 Standorte klassifiziert, wobei rund die Hälfte keine Global City (61 Standorte oder 52 Prozent) und je ungefähr ein Viertel hoch- (29 Standorte oder 25 Prozent) bzw. niederrangige Global City (27 Standorte oder 23 Prozent) ist. Die Verteilung des Investitionskapitals nach diesem Global City-Status relativiert den festgestellten Eurozentrismus dahingehend, dass dieser nicht mit einer schwachen Einbindung in die globalen Märkte gleichgesetzt werden darf. Denn immerhin ein knappes Drittel der Investitionen aus dem Umland fließt in hochrangige Global Cities (32,8 Prozent), im Falle der Kernstadt sind es sogar 54,6 Prozent. Umgekehrt spielen die Standorte ohne Global City-Status eine unbedeutende Rolle: nur 6,2 Prozent der Investitionen aus der Kernstadt und 10,5 Prozent der Investitionen aus dem Umland fließen in diese Städte. Für die Kernstadt lässt sich ein signifikanter Zusammenhang dahingehend feststellen, dass an Standorten mit hohem Global City-Status tendenziell hohe Beteiligungssummen investiert werden. Die Abhängigkeit der beiden Variablen (Global City-Status und Investitionsvolumen) konnte mittels CHI²-Test nach Pearson[11] bestätigt werden.

Welche standortspezifischen Muster weisen die Investitionen auf? Welche Rolle spielt die räumliche Distanz? Gemessen an der Luftliniendistanz der Investitionsstandorte[12] kann die Bedeutung der Raumüberwindung für das Investitionsverhalten der Unternehmenszentralen eingeschätzt werden[13]: Bei dem Investitionsvolumen (gemessen am Eigenkapital) wie auch bei der Anzahl der Beteiligungen kann für das Umland eine zwar schwache, aber signifikant negative Korrelation festgestellt werden. Dies bedeutet, dass mit zunehmender räumlicher Distanz die Zahl der Beteiligungen sowie das Investitionsvolumen abnimmt. Für die Kernstadt zeigt sich kein signifikanter Wert. Damit kann zumindest die Vermutung geäußert werden, dass die Raumüberwindung für die Unternehmenszentralen der Kernstadt ein geringeres Hemmnis darstellt als jene aus dem Umland. Für die Beschäftigung bei den

10 Nähere Informationen unter: http://www.lboro.ac.uk/gawc/.

11 CHI²-Test nach Pearson: Prüfgröße 17,579 bei df 4; Signifikanz: 0,001.

12 Für die Korrelationsanalyse wurden nur jene Standorte berücksichtigt, auf die folgende Eigenschaften zutreffen: Erstens Standorte innerhalb der EU-25 sowie der EFTA zuzuglich Rumänien und Bulgarien. Zweitens Standorte, die sowohl von Investitionen aus der Kernstadt als auch aus dem Umland betroffen sind. Drittens keinen (offensichtlichen) off-shore-Finanzzentren wie die Kanalinseln, Zypern oder Malta.

13 Korrelation mit der Luftliniendistanz nach Kendall-Tau-b: Eigenkapital Umland: -0,201*. Beteiligungen Umland: -0,257**. Beschäftigung Kernstadt: -0,201*. Beschäftigung Umland: -0,323**. Korrelation nach Spearman-Rho: Eigenkapital Umland: -0,278*. Beteiligungen Umland: -0,359**. Beschäftigung Kernstadt: -0,292*. Beschäftigung Umland: -0,464**.

ausländischen Tochterunternehmen ergibt sich hingegen für beide Teilräume der Agglomeration Wien eine negative Korrelation: Beteiligungen mit hohen Beschäftigtenzahlen finden sich tendenziell eher an Standorten im nahen Umfeld. Die Beschäftigtenzahl fällt also mit der Distanz ab, wobei die negative Korrelation für das Umland stärker ausgeprägt ist als für die Kernstadt. Angesichts der geringen Korrelationen muss jedoch festgehalten werden, dass es sich nur um Tendenzen handelt; unternehmerisches Standortverhalten kann nicht durch eine einzelne Variable, die Luftliniendistanz, erklärt werden. Es handelt sich nur um (vorsichtig formuliert) schwache Trends.

Die Europakarte in Abbildung 7 weist für die Standorte (Auswahl der Korrelationsanalyse) das Investitionsvolumen und die Beschäftigtenzahl auf. Darin wird nochmals der eingeschränktere ökonomische Aktionsraum der Wiener Suburbia, sowie deren erhebliche Konzentration auf wenige Standorte betont: Budapest, Prag, Hannover, Strassburg und die niederländische Region Eindhoven umfassen immerhin mehr als die Hälfte (54,2 Prozent) aller Investitionen an den europäischen Standorten. Die Investitionen der Kernstadt sind wie schon festgestellt durch ein diversifizierteres Standortmuster gekennzeichnet, jedoch herrschen auch hier erhebliche Konzentrationstendenzen vor: in die Top-5 Standorte (München, Budapest, Amsterdam-Randstadt, Prag, Basel) fließt knapp die Hälfte (48 Prozent) aller europäischen Investitionen. Dieses Muster verstärkt sich bei der Verteilung der Beschäftigtenzahlen: eindeutig (wenn auch nicht überraschend) ist vor allem für das Umland, für die Kernstadt in geringerem Maße, die Ausrichtung auf Standorte in Osteuropa. Angesichts der niedrigen Kapitalintensität und der Dominanz des sekundären Sektors (vgl. die entsprechenden Werte in Tabelle 2 und Tabelle 3) scheint sich die Vermutung bestätigt zu werden, dass Unternehmenszentralen des Umlandes in hohem Maße (verglichen zur Kernstadt) die osteuropäischen Standorte als „verlängerte Werkbank" nützen.

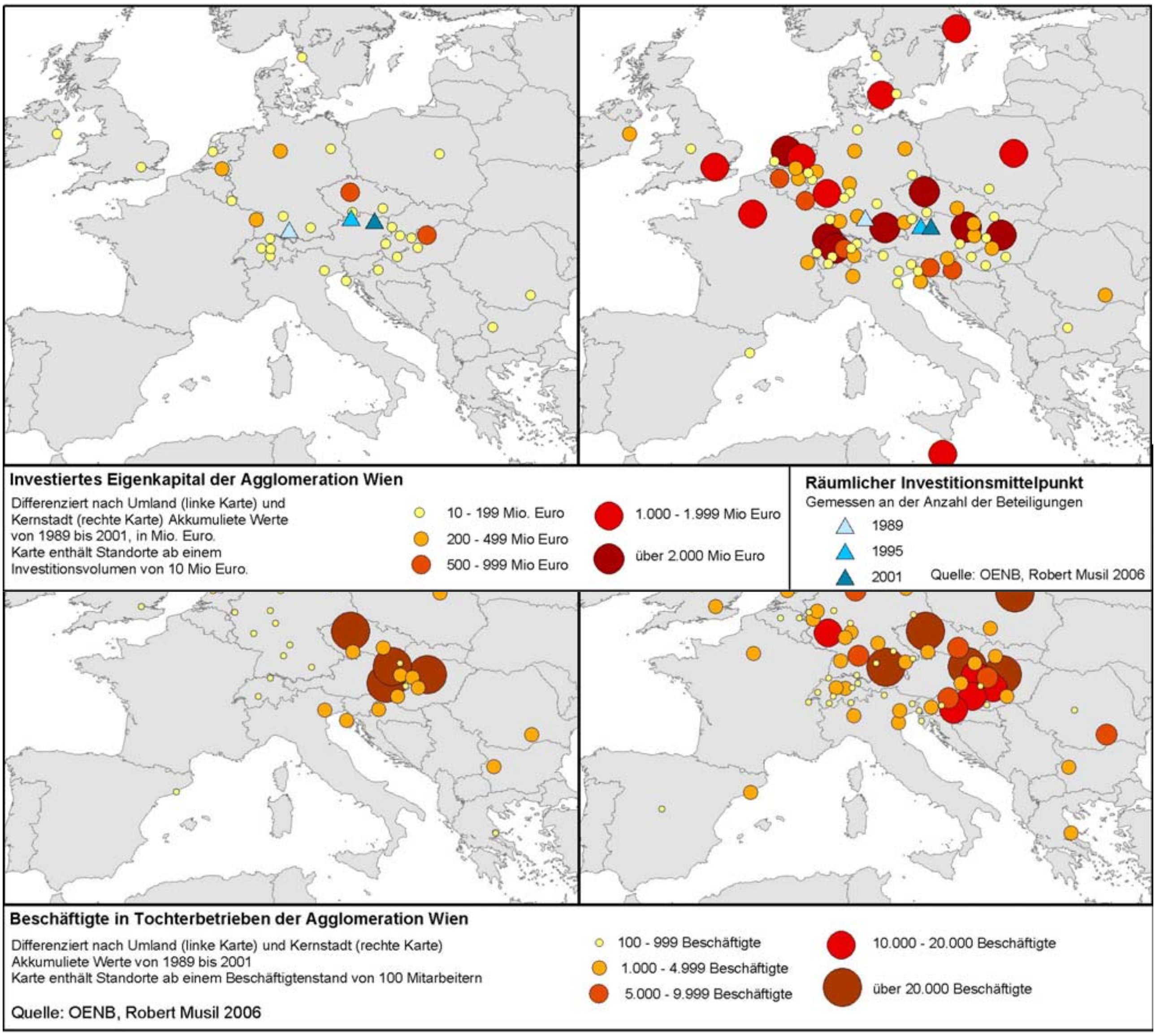


Abbildung 7: Umfang der Zielstandorte gemessen am Eigenkapital (siehe obere Karten) und an der Beschäftigtenzahl (siehe untere Karte), aufgegliedert nach Umland (links) und Kernstadt (rechts) (Quelle: OeNB, eigene Datenverarbeitung)

3 FAZIT: POSTSUBURBANISIERUNG, GLOBALE?

Welche Bedeutung kommt der Suburbia für die globale Vernetzung der Agglomeration Wien zu? Es konnte gezeigt werden, dass – gemessen an der demographischen Bedeutung – die ökonomische Suburbanisierung, rein quantitativ gesehen, eine untergeordnete Rolle spielt: Ein Viertel der Bevölkerung der Agglomeration lebt in der Suburbia. Jedoch liegt nur ein Fünftel der Arbeitsplätze im

Umland, sogar nur ein Zehntel der hochwertigen Dienstleistungsunternehmen. Der Beitrag zur globalen Vernetzung der Agglomeration ist noch stärker unterrepräsentiert: im Jahr 2001 waren 15 Prozent der global tätigen Unternehmenszentralen im Umland niedergelassen, doch lag deren Anteil am Investitionsvolumen unter 6 Prozent.

Die Beteiligungen der beiden Teilräume lassen auf strukturelle Unterschiede schließen: Während die Investitionen der Kernstadt auf hochwertige Dienstleistungen und kapitalintensive Beteiligungen abzielen, scheinen die Unternehmenszentralen des Umlandes eine andere Internationalisierungsstrategie umzusetzen: es dominieren Beteiligungen in den Branchen Industrie und Handel, diese sind daher weniger kapitalintensiv als jene der Kernstadt. Jedoch: die Suburbia wächst – rascher als die Kernstadt. Die Unternehmenszentralen des Umlandes sind zwar kleiner, allerdings durch ein wesentlich dynamischeres Wachstums gekennzeichnet und weisen überdies eine erfolgreichere Unternehmensperformance auf.

Das räumliche Muster der Investitionen belegt die überproportional starke Orientierung des Umlandes auf osteuropäische Standorte, wobei die enge Focussierung auf den (internationalen) Nahbereich nicht mit einer schwachen globalen Vernetzung gleichgesetzt werden darf: die Beteiligungen finden in hohem Ausmaß an solchen Standorten statt, die einen hohen Global City-Status aufweisen. Auch für das Umland kann (wenn auch in geringerm Maße) eine Einbindung in die globale Ökonomie festgestellt werden.

Insgesamt muss die Frage nach der globalen Eigenständigkeit der Post-Suburbia zumindest am Fallbeispiel Wien hinterfragt werden. Denn eine Abkoppelung, eine Emanzipation, die zu einer eigenständigen, globalen Zentralität führt, lässt sich aus den vorliegenden Untersuchungen kaum ableiten. Wohl nimmt das Umland einen steigenden Anteil an den internationalen Verflechtungen der Agglomeration ein, jedoch lassen die strukturellen Unterschiede eher den Schluss zu, dass es sich hier um eine ergänzende Funktion im Sinne der „verlängerten Werkbank Mittelosteuropa“ handelt, die nicht losgelöst von den Entwicklungen der Kernstadt betrachtet werden darf. So gesehen scheint die globale Zentralität Wiens durchaus (noch) mit dem vom CBD ausgehenden zentral-periheren Gradienten übereinzustimmen.

4 LITERATUR

Altzinger W.: Österreichs Direktinvestitionen in den MOEL und der Intra-Firmenhandel, in: Mayerhofer P. und Palme G. (Hg.), Strukturpolitik und Raumplanung in den Regionen den der mitteleuropäischen EU-Außengrenze zur Vorbereitung auf die EU-Osterweiterung. Preparity-Teilprojekt 5: Transnationale Direktinvestitionen und Kooperationen, 2000, S. 15-86.

Bachmann M.: Enquirity of Enterprises, Comet, 2003.

Beauregard R. A. und Haila A.: The Unavoidable Continuities of the City, in: Marcuse P. und van Kempten R. (Hg.), Globalizing Cities. A new spatial order? Blackwell, 2000, S. 22-36.

Bellak Chr.: Kritische Einschätzung der empirischen Erfassung und Verwendung von Direktinvestitionsdaten, in: Heiduk R. und Döhrn G. (Hg.), Theorie und Empirie der Direktinvestitionen, Duncker&Humblot, 1999, S. 103-128.

Bellak, Chr.: Ausländische Direktinvestitionen - die nachhaltige Variante? in: ÖFSE - Österreichische Forschungsstiftung für Entwicklungshilfe (Hg.), Private Kapitalflüsse - Weg aus der Krise? Südwind-Verlag, 2000, S. 47-68.

Borsdorf, A.: Wenn Städte „geformter Geist“ sind, wofür steht dann Postsuburbia? – Spurenlesen im ruralen Raum, in: Borsdorf A.und Mayer V. (Hg.): Konvergenz und Divergenz der Kulturen in den Randzonen der Städte. Beiträge der Sektion 3.7 Internationale Konferenz „Das Verbindende der Kulturen“, ISR-Eigenverlag, 2004, S. 17-26.

Brake K.: Neue Akzente der Suburbanisierung. Suburbaner Raum und Kernstadt: eigene Profile und neuer Verbund, in: Dangschat J. S. und Herfer G. (Hg.): Suburbanisierung in Deutschland. Aktuelle Tendenzen, Leske&Budrich, 2001, S. 15-16.

Fassmann, H.: Stadtgeographie I: Allgemeine Stadtgeographie, Westerman, 2004.

Friedmann J.: The world city hypothesis, in: Development and Change, 1986/17, S. 69-83.

Gerhard U.: Global Cities - Anmerkungen zu einem aktuellen Forschungsfeld, in: Geographische Rundschau, 2004/4, S. 4-11.

Heiduk G. und Kerlen-Prinz J.: Direktinvestitionen in der Außenwirtschaftstheorie, in: Heiduk R. und Döhrn G. (Hg.), Theorie und Empirie der Direktinvestitionen, Duncker&Humblot, 1999, S. 23-54.

Husa K. und Wohlschlägl H.: Vom „Emerging Market“ zum „Emergency Market“: Thailands Wirtschaftsentwicklung in der „Asienkrise“, in: Parnreiter Chr., Novy A. und Fischer K. (Hg.): Globalisierung und Peripherie. Umstrukturierung in Lateinamerika, Afrika und Asien, Brandes&Apsel-Südwind-Verlag, HSK14, 1999, S. 209-236.

Keeling D. J.: Transport and the world city paradigm, in: Knox P. L. (Hg.), World cities in a worldsystem, Cambridge Univ. Press, 1995, S. 115-131.

Kunzmann K. R. und Wegener M.: The Pattern of Urbanisation in Western Europe, Dortmund, 1991.

Leichtfried S.: Siedlungsabgrenzung durch Datenkombination. Eine Machbarkeitsstudie, Institut für Geographie und Regionalforschung der Universität Wien, Diplomarbeit, 2001.

Marcuse P. und van Kempten R.: Introduction, in: Marcuse P. und van Kempten R. (Hg.): Globalizing Cities. A new spatial order? Blackwell, 2000, S. 1-21.

OeNB: Österreichische Investitionen im Ausland und ausländische Investitionen in Österreich. Stand per Ende 2002, Statistisches Monatsheft 6/2004, Wien, Österreichische Nationalbank, 2004.

Sassen S.: The Global City: London, New York, Tokyo, Oxford, Princeton Univ. Press1991.

Sassen S.: The Global City: Strategic Site/New Frontier, in: Borsdorf A. und Parnreiter Chr. (Hg.), International Research on Metropolises. Milestones and Frontiers, Verlag-ÖAW, ISR-Forschungsbericht 29, 2003, S. 13-28.

Schmee J. und Weigl A.: Von der Vollbeschäftigung in die Krise - der Wiener Arbeitsmarkt seit 1945, in: Weigl J. und Schmee A. (Hg.), Wiener Wirtschaft 1945-1998, Verlag Peter Lang, 1999, S. 71-96.

Siebel W.: Einleitung: Die europäische Stadt, in: Siebel W. (Hg.): Die europäische Stadt, Suhrkamp, 2004, S. 11-47.

Smith D. A. und Timberlake M.: Conceptualising and Mapping the Structure of the World System´s City System, Urban Studies 32, 1995, S. 287-302.

Statistische Nachrichten: Stadtregionen 1991 – Das Konzept, in: Statistik Austria (Hg.), Statistische Nachrichten 2/1997, S. 76-83.

Taylor P. J.: Hierarchical Tendencies amongst World Cities: A Global Research Proposal, Cities, 1997-14/6, S. 323-332.

Taylor P. J.: World city network. A global urban analysis, Routledge, 2004.

Unterstützung nachhaltiger Planung durch 3- und 4D Visualisierung mit World Construction Set und Visual Nature Studio

Boris STEMMER & Jochen MÜLDER

(Universität Kassel, Fachbereich Architektur, Stadt- und Landschaftsplanung, Fachgebiet Naturschutz / Landschaftsplanung; boris.stemmer@virtuallandscape.de; jochen.muelder@virtuallandscape.de)

1 EINFÜHRUNG

Räumliche Planung hat sich mit den politisch-gesellschaftlichen Rahmenbedingungen stetig verändert. Die Anforderungen haben an Komplexität gewonnen, nicht zuletzt, weil der Mensch im Zusammenhang mit seiner Umwelt ins Zentrum der Betrachtung gerückt ist. Die Bedeutung von „Nachhaltigkeit" und „Beteiligung" sind heute Grundsätze der Planung (vgl. v. Haaren 2004), die EU-rechtlich verankert (z.B. Aarhus-Konvention) und allgemein anerkannt sind. Um eine bestmögliche Umsetzung und Annahme von Planungen bei Entscheidungsträgern und Bürgern zu erreichen, sollte die Planung transparent sein und ihre Inhalte verständlich aufbereitet werden (ebd.). Gerade die Forderung nach einer visuell verständlichen Aufbereitung von Inhalten, die sich aus der Funktionsweise der menschlichen Wahrnehmung ableitet, wird vielfach zu Recht erhoben (vgl. LANGE; BISHOP 2005).

Im Beitrag werden, anhand der Landschaftsplanung in Deutschland, konkrete Möglichkeiten einer Unterstützung von Planungsprozessen durch digitale 3- und 4D Visualisierungstechniken untersucht. Dabei wird zunächst grundsätzlich betrachtet, zu welchem Zeitpunkt einer Planung 3- und 4D Visualisierungen sinnvollerweise eingesetzt werden können. Anschließend werden Praxisbeispiele vorgestellt und diskutiert. Ausgangspunkt für die Untersuchung ist die Beobachtung der Verfasser, dass die Bedeutung von 3- und 4D Visualisierungen in der Fachliteratur meistens hoch eingeschätzt wird, ihr Einsatz aber in der deutschen Planungs-Praxis selten ist.

Begriffsbestimmung: Unter dem Begriff Visualisierung werden in diesem Aufsatz jene computergenerierten Darstellungen verstanden, die 3 oder 4 Dimensionen umfassen und auf der Grundlage eines digitalen Modells erstellt werden. Landschaftsplanung beschränkt sich im Sinne dieses Aufsatzes nicht auf den Auftrag des § 14 Bundesnaturschutzgesetz (BNATSCHG), sondern umfasst auch Umweltprüfinstrumente und andere Umwelt- und Naturschutzplanungen.

Mit VNS (Visual Nature Studio) und WCS (World Construction Set) bietet der Softwarehersteller 3D-Nature LLC seit einigen Jahren zwei Softwarepakete für die (photo)realistische Landschaftsvisualisierung an. WCS, das schon seit etwa zehn Jahren auf dem Markt ist, liegt mittlerweile in der 6. Version vor. Das Hauptunterscheidungsmerkmal der beiden Pakete ist eine äußerst umfangreiche GIS-Schnittstelle, die mit der Einführung von VNS, ein auf WCS basierendes Programm, bereitgestellt wurde. Dadurch wurde die Nutzung von GIS-Daten wesentlich vereinfacht, so dass VNS problemlos mit GI-Systemen (z.B. ESRI-ArcGIS) zusammenarbeiten kann. Die höheren Anschaffungskosten für VNS rechtfertigen sich durch die Bereitstellung wichtiger Funktionen, wie z.B. das beschleunigte Generieren von Geländemodellen oder die Möglichkeit Attribute der Shapefiles für die Visualisierung zu nutzen. Die Abbildungsqualität der beiden Pakete ist identisch.

2 EINSATZBEREICHE VON VISUALISIERUNGEN IN DER LANDSCHAFTSPLANUNG

2.1 Planungsablauf

Räumliche Planung folgt trotz einer großen Menge an zur Verfügung stehenden Instrumente einem immer gleichen Ablaufschema. Ein solches Schema stellen BRUNS et al. (2005) für die Landschaftsplanung vor (Tab.1).

Wird dieser allgemeine Ablauf betrachtet, findet sich in einigen Planungsphasen die Möglichkeit der Einbeziehung von Visualisierungen. Bei den dargestellten Möglichkeiten handelt es sich lediglich um grundsätzliche Vorschläge. Ob es sich lohnt, eine Visualisierung anzufertigen, muss im Einzelfall entschieden werden. Wichtige Faktoren sind der Projektumfang, der Umfang von Beteiligungsverfahren, das Budget und die weitere Nutzbarkeit des erzeugten Modells (s. Kap. 2.3 Sekundäre Einsatzmöglichkeiten).

Unter Umständen bieten sich Visualisierungen in einem Projekt nicht für alle Planungsphasen an. Tab.1 zeigt, in welchen Planungsphasen die im Kapitel „Praxisbeispiele" genauer erläuterten Projekte visualisiert wurden.

Auf den ersten Blick sind Visualisierungen vor allem für die Planungsphasen 5 und 6, in denen konkrete Maßnahmen dargestellt werden, geeignet. Hier kann zunächst gezeigt werden, was geplant wird. So kann Klarheit darüber geschaffen werden, wie eine Maßnahme sich zukünftig entwickeln wird. Um jedoch die Maßnahmen und ihre Auswirkungen zu beurteilen, ist ein Vergleich mit dem derzeitigen Zustand nötig. Dazu kann sowohl der Ist-Zustand als auch die Landschaftsprognose visualisiert werden (Tab 1. Phase 2). Der Ist-Zustand kann mit geringem Mehraufwand visualisiert werden, da dieser in der Regel als Basis für die Darstellung von Maßnahmen dient. Darüber hinaus erhöht die Visualisierung eines Ist-Zustandes, gegenüber einem Foto, die Vergleichbarkeit zur Visualisieung der Planung (Vorher-Nachher-Vergleich).

In den Phasen 3 und 4 sind ebenfalls Visualisierungen einsetzbar, um Leitbilder und Ziele zu verdeutlichen. Es gilt dabei zu bedenken, dass Planungen in diesem Stadium in der Regel keine flächenscharfen Aussagen treffen. Diese werden jedoch für Visualisierungen grundsätzlich benötigt. Deswegen sollte bei der Verwendung von Visualisierungen in dieser Planungsphase immer darauf hingewiesen werden, dass es sich um Szenarien oder übergeordnete Zielvorstellungen handelt, die so nicht zur Umsetzung kommen werden. Dennoch gilt es, Visualisierungen in diesen Planungsphasen besonders bewusst einzusetzen.

Die Diskussion um einen verantwortungsvollen Umgang mit Visualisierungen (Perspektivenwahl, Manipulation, Wissenschaftlichkeit, etc.) führen u.a. SHEPPARD (1999) und LANGE; BISHOP (2005).

2.2 Kommunikation

Ist die Entscheidung für das Erstellen eines 3D-Modells getroffen, ergeben sich weitere Fragen:

In welcher Planungsphase sollen Visualisierungen eingesetzt werden?

Für welche Zielgruppe sollen Visualisierungen erstellt werden?

In welcher Beteiligungsform sollen Visualisierungen eingesetzt werden?

Die angebotenen Darstellungen müssen auf diese Fragen hin abgestimmt werden. Sollen beispielsweise Handzettel verteilt werden, können nur einige wenige Darstellungen verwendet werden. In einer Präsentation vor einer Bürgerversammlung hingegen können Bilder, aber auch kurze Filme sowie Animationen und interaktive Modelle gezeigt werden. Tabelle 2 liefert einen Überblick über die verschiedenen Beteiligungsformen und die Einsatzmöglichkeiten von Visualisierungen.

	Planungsschritt (allgemein) (nach BRUNS et al. 2005)	**Beteiligungsschritt / Kommunikationsprozesse (nach BRUNS et al. 2005)**	**Einsatzmöglichkeiten von Visualisierungen im Allgemeinen**	**Praxisbeispiele (Kap. 3)**			
				3.1	**3.2**	**3.3**	**3.4**
1	Klären der Aufgabenstellung Ermitteln des Leistungsumfangs	Information über Verfahren und Beteiligungsmöglichkeiten; Beteiligung wichtiger Akteure an Screening und Scoping	keine				
2	Landschaftserfassung, Landschaftsprognose	Öffentliche Information; Beteiligung interessierter Stellen und Personen (auch in die eigentliche Erhebungsarbeit)	Darstellung des Ist-Zustandes Verdeutlichung von Konfliktpotential				
			Darstellung der zu erwartenden Landschaftsentwicklung (0-Variante)				
3	Leitbild und Zielentwicklung, ggf. Einsatz von Szenarien	Diskussion von Zielszenarien und Planungsoptionen mit relevanten Akteuren	Visualisierung von Szenarien / Szenarienkombinationen				
4	Fachliche Landschaftsbewertung, Auswirkungen geplanter Nutzungsänderungen, ggf. Einsatz von Szenarien	Öffentliche Information; Einbeziehen regionaler bzw. lokaler Akteure und Adressaten					
5	Vertiefte raumkonkrete Zieldiskussion Zielkonzept	Umfassende Öffentlichkeitsarbeit: Diskussion von Ziel- und Maßnahmen-Alternativen, einzelnen Zielen und Maßnahmen, Umsetzungsmöglichkeiten	Darstellung von flächenkonkreten oder beispielhaften Maßnahmen				
6	Entwicklung von Maßnahmenvorschlägen Maßnahmenkonzept						
7	Vorbereitung des Instrumenteneinsatzes	Nur durch die Einbeziehung regionaler bzw. lokaler Akteure und Adressaten möglich	keine				

Praxisbeispiele:

3.1 Untersuchung der Veränderungen des Landschaftscharakters durch Hochwasserschutzmaßnahmen
3.2 Unterstützung der Variantenentwicklung für einen Polder
3.3 Visualisierung von Entwicklungsszenarien in Günsterode
3.4 Visualisierung der Funktionsweisen von Lebensraumkorridoren

Tab. 1: Einsatzbereiche von Visualisierungen in den unterschiedlichen Planungsphasen

Innerhalb einer Veranstaltung zur Beteiligung können Visualisierungen zu unterschiedlichen Zwecken eingesetzt werden. WISSEN et al (2005) gliedern eine Veranstaltung in vier Abschnitte.
Motivation: Interesse wecken, motivieren
Situating: die Planung in einen Gesamtzusammenhang stellen
Demonstration: Herausstellen einzelner Maßnahmen und Teilaspekte eines Gesamtkonzeptes
Supporting Construction of complex mental models: räumlich-funktionale Beziehungen zwischen einzelnen Maßnahmen herstellen
Grundsätzlich lassen sich Visualisierungen für alle vier Abschnitte einsetzen, wenngleich der Einsatzschwerpunkt auf „Situating" und „Demonstration" liegt. Für das „Situating" hat sich die Verwendung von 2D-Kartenmaterial als nützlich erwiesen.

Ziel	Kommunikationsform	Zielgruppe	Funktion	Format
Information	Ortsbegehung, Bürgerversammlung, Ausstellung, Internet, Postwurfsendungen, Flyer, Zeitungsartikel, Broschüren	überwiegend fachliche Laien	Darstellung der Gesamtplanung bzw. der Teilergebnisse (Bestand, Analyse, Planung) in Einzelaspekten und Gesamtzusammenhang	Generell: Bilder Bei intensiverer Information, z.B. Bürgerversammlung: Animationen, Filme, virtuelle Modelle
Konsultation	Vorstellung in politischen Gremien, Diskussionen	Fachleute, Laien mit fachlichem Grundwissen	Wie oben, ggf. Beschränkung auf Teilaspekte	Bilder, Animationen, Filme, virtuelle Modelle
aktive Mitarbeit	Arbeitskreis, Projektwerkstatt, Workshops	Fachleute	Veranschaulichung von Problemstellungen	Bilder, Animationen, Filme, virtuelle Modelle

Tab. 2: Zielgruppenspezifische Einsatzmöglichkeiten von Visualisierungen in verschiedenen Beteiligungsverfahren (verändert nach V. HAAREN 2004 UND IEMA 2002)

Ohnehin gilt es zu bedenken, dass, obwohl die Verwendung von Visualisierungen von den Beteiligten meist sehr positiv aufgenommen wird, 2D-Übersichtspläne aber häufig eine bessere Orientierung im Planungsraum ermöglichen. Daher sind (photo)realistische Visualisierungen eine sehr nützliche Ergänzung zu herkömmlichen Visualisierungsmethoden. Jedoch können sie diese nicht vollständig ersetzen. Grundsätzliche Voraussetzung für den effektiven Einsatz von Visualisierungen ist eine allgemein verständliche Erläuterung der angebotenen Visualisierungen (WARREN-KRETZSCHMAR et al 2005).

2.3 Sekundäre Einsatzmöglichkeiten

Über den eigentlichen Planungsablauf hinaus ergeben sich für das erzeugte Modell verschiedene sekundäre Einsatzmöglichkeiten, z.B. zur Unterstützung der Öffentlichkeitsarbeit (Werbung), für den Tourismus oder zur Umweltbildung. Oftmals kann der Ist-Zustand der Landschaft, der für Planungen meistens visualisiert wird, als Darstellungsgrundlage für weitere Informationen und Inhalte genutzt werden. Abb. 1 zeigt eine imaginäre Wanderroute sowie Beschilderungen (Ortsnamen und Sehenswürdigkeiten) in Günsterode. Die Anpassung und Ergänzung des Modells hat in diesem Fall nur wenige Stunden gedauert und lässt sich nun verschiedentlich präsentieren, z.B. als virtuelles Modell auf einer Web-Seite.
Die Stärken von digitalen Visualisierungstechniken werden auch im Bereich der Umweltbildung immer häufiger eingesetzt. Ähnlich wie in der Planung unterstützt die realistische und räumliche Dartstellung das Verständnis und erhöht die Freude und Bereitschaft am Lernen (vgl. LAUTENBACH et al. 2003).

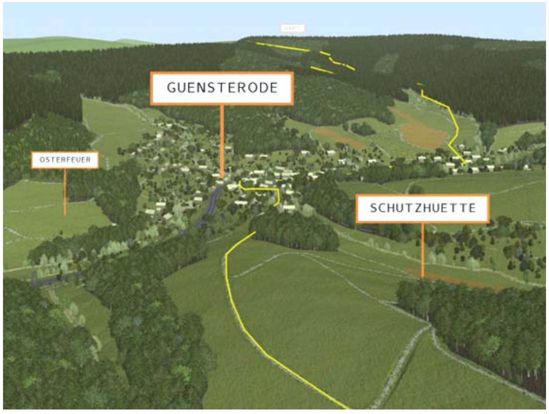


Abb. 1: Dreidimensionale Wanderkarte als sekundäre Nutzung eines 3D-Modells

3 PRAXISBEISPIELE VON VISUALISIERUNGEN IN DER LANDSCHAFTSPLANUNG

3.1 Untersuchung der Veränderungen des Landschaftscharakters durch Hochwasserschutzmaßnahmen (WCS)

In Nordhessen kam es in den letzten Jahren häufig zu einigen kleineren bis mittleren Überschwemmungen. Wenngleich die Schäden nicht so groß waren, wie in anderen, stärker von Überschwemmungen betroffenen Gebieten, hat insbesondere das Hochwasser der Fulda von 1995 das Bewusstsein für die Hochwassergefahr gestärkt. Seit 2003 beschäftigt sich das Forschungsprojekt "Umweltverträglicher Hochwasserschutz für die Einzugsgebiete von Fulda und Diemel"[1] mit der Entwicklung eines Hochwasserschutzkonzeptes für Nordhessen. In diesem kleinmaßstäblichen Konzept werden verschiedene Entwicklungsstrategien für den zukünftigen Hochwasserschutz entwickelt. Parallel dazu erfolgt eine Strategische Umweltprüfung (SUP).

[1] Finanziert durch die EU (INTERREG IIIB Nord-West Europa) und das Hessische Ministerium für Umwelt, ländlichen Raum und Verbraucherschutz. Teil des internationalen Forschungsvorhaben „Creating new Landscapes for Flood Risk Management" („Floodscape" www.floodscape.net) Projektleitung: FG Wasserbau/Wasserwirtschaft der Universität Kassel. Weitere Projektpartner: TU Braunschweig (Leichtweiß Institut für Wasserbau), TU Darmstadt (Institut IWAR - FG Umwelt- und Raumplanung), FG Landschaftsplanung/Naturschutz der Universität Kassel, Wissenschaftliches Zentrum für Umweltforschung - WZ III Abteilung für integriertes Gewässermanagement

Um zu verdeutlichen, wie sich unterschiedliche Hochwasserschutzmaßnahmen auf den Landschaftscharakter auswirken, wurden in einem Teilgebiet Maßnahmenvorschläge räumlich konkretisiert. In einem Talabschnitt der Fulda, zwischen Rotenburg und Melsungen, wurden die Maßnahmen „Vorlandwall“, „Auewaldpflanzung“ und „Nebengerinne“ vorgeschlagen.

Die Visualisierungen der Maßnahmen sind so aufbereitet, dass sie sich für eine Bürgerbeteiligung bzw. eine Öffentlichkeitsbeteiligung verwenden lassen. Ziel ist es, die Änderungen des Landschaftscharakters durch Hochwasserschutzmaßnahmen allgemeinverständlich darzustellen. Dabei gilt es besonders, den langen Entwicklungszeitraum der Maßnahmen „Nebengerinne“ und „Auewaldpflanzung“ zu berücksichtigen. Um diesen Prozess darzustellen, wurden neben statischen Bildern auch Animationen erstellt.

VNS/WCS bieten die Möglichkeit, das Wachstum von Pflanzen zu simulieren, aber auch die Entwicklung eines gesamten Lebensraumes zu animieren. Wichtige Bestandteile der in Abb. 2 gezeigten Animation sind die Verlandung und Verkrautung des Nebengerinnes und die Entwicklung des Waldes mit den entsprechenden Wuchshöhen und Artenzusammensetzungen.

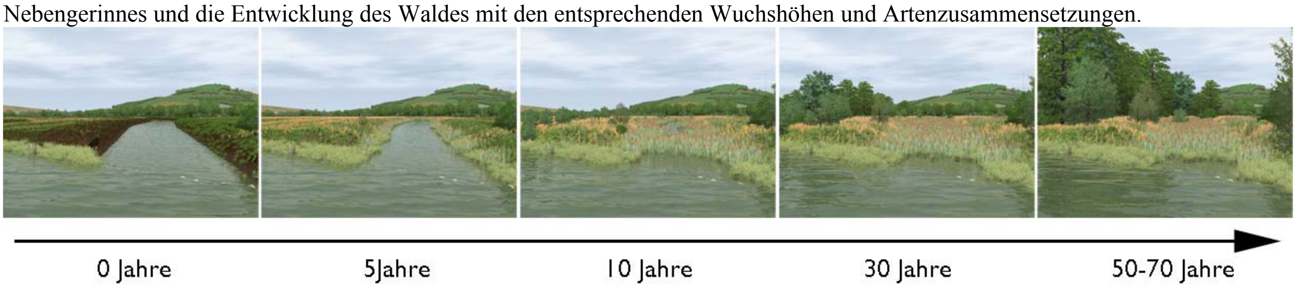


Abb.2: Ausschnitte einer Animation der Maßnahmen „Nebengerinne“ und „Auewaldpflanzung“ (STEMMER 2005)

Hauptsächlich wurde aber mit statischen Vorher-Nachher-Vergleichen gearbeitet (Abb. 3). Bei gleich bleibender Kameraposition wird der aktuelle Zustand mit zukünftigen Landschaften verglichen, indem die Maßnahmen in der derzeitigen Landschaft dargestellt werden. Dabei werden keine Aussagen über die Entwicklung der Landschaftsteile gemacht, die nicht von Maßnahmen betroffen sind. Es wird eine Vorab-Beurteilung des voraussichtlichen Landschaftscharakters und eine Vergleichbarkeit der Maßnahmen untereinander ermöglicht.

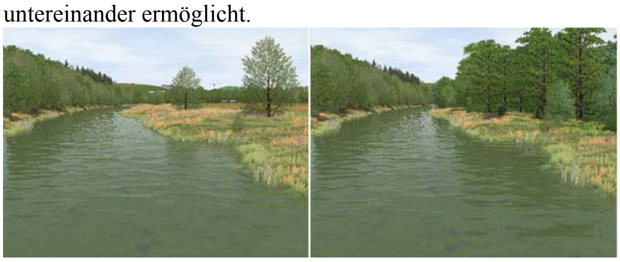


Abb. 3 : Vorher-Nachher-Vergleich: Ist-Zustand (l.) und die gleiche Szene Jahre nach der Anlage eines „Auwaldes“ (r.) aus der Sicht eines Kanufahrers (STEMMER 2005)

Abb. 4: Visualisierung des Szenarien „Renaturierung aller Fließgewässer“ (l.) und „Potentiell natürlicher Zustand“ (r.) (STEMMER 2005)

Die Visualisierungen richten sich an die breite Öffentlichkeit. Sie sollen es den Beteiligten und Interessierten ermöglichen, die Maßnahmen in ihrer Gestalt und Dimension zu verstehen. Sie zeigen auf, wie sich Entwicklungsszenarien, hier technischer Hochwasserschutz und naturnaher Hochwasserschutz, auf den Landschaftscharakter auswirken. Auf Grundlage der Darstellungen kann anschließend über die Maßnahmen mit der Öffentlichkeit diskutiert werden.

Darüberhinaus wurden weitere extreme Landschaftsszenarien visualisiert (Abb. 4). Diese sollten das Verständnis des Begriffs „Naturnähe“ erleichtern. Das Szenario „potentiell natürlicher Zustand“ zeigt eine Landschaft ohne anthropogene Einflüsse, während das Szenario „Renaturierung aller Fließgewässer“ die minimalen Anforderungen an „naturnahe“ Gewässer anhand eines 10m breiten Uferbereichs aufzeigt (§8 und §12 HWG 2005). Die Visualisierung von Szenarien trägt in der Planung auch zur Leitbild- und Zielentwicklung bei (vgl. V. HAAREN 2004). Abstrakte Zielstellungen, wie z.B. 10m breite Uferbereiche an allen Gewässern, können so bildlich dargestellt, und mit Hilfe dieser Darstellungen diskutiert werden.

Visualisierungen dienen in diesem Projekt vor allem dem Zweck der Bürgerbeteiligung und -information. Sie stellen die Diskussionsgrundlage für einen kommunikativen Prozess zwischen Planern und Öffentlichkeit dar. Dazu ermöglichen sie eine Vorab-Beurteilung von Änderungen des Landschaftscharakters, durch einzelne Maßnahmen und damit einhergehender Entwicklungsprozesse. Außerdem helfen sie bei der Entwicklung und Darstellung von Leitbildern und Zielen.

Schließlich können die Visualisierungen auch für das Monitoring bzw. die Erfolgskontrolle der Maßnahmen eingesetzt werden .

3.2 Variantenentwicklungen für einen Polder (VNS)

Das Forschungsprojekt "Umweltverträglicher Hochwasserschutz für die Einzugsgebiete von Fulda und Diemel" bearbeitet neben den in Kapitel 3.1 vorgestellten, weitere Maßnahmen zum Hochwasserschutz. Dazu gehört auch die Eindeichung von ehemaligen Auskiesungsflächen zur Nutzung als Polder.

Betrachtet wurden einige Auskiesungen an der Eder. Zur Unterstützung der Kommunikation des interdisziplinären Teams aus Bauingeneuren und Landschaftsplanern wurde eine Visualisierung angefertigt, die als Diskussionsgrundlage zwischen den Fachdisziplinen Landschaftsplanung und Wasserbau / Wasserwirtschaft genutzt werden konnte. Zunächst wurden Darstellungen angefertigt, die den aktuellen Zustand und eine erste Abgrenzung der Staufläche als 2m hohen Damm zeigt (Abb. 5 links und Mitte).

Aufgrund der Visualisierung (Abb. 5 Mitte), erwies sich die geplante Dammhöhe von lediglich 2m, als zu gering, um das Stauziel auf der gesamten Fläche zu erreichen. Die fachliche Bewertung der Veränderung des Landschaftscharakters, die ebenfalls anhand der Visualisierung erfolgte, stellte eine unzureichende Eingliederung des Polders in die Landschaft fest.

Abb. 5: Ist-Zustand (links) und erste Variante des Polders (Mitte). Rechts: Aktuelle Planung mit abgerundetem und höherem Damm. Die Visualisierung wurde für die Kommunikation innerhalb des Planungsteams genutzt.

Daraufhin wurden neue Varianten ausgearbeitet, in denen sowohl die Anforderungen des Hochwasserschutzes, als auch die landschaftliche Einbindung besser berücksichtigt wurden. (Abb. 5 rechts) Dabei wurde die räumliche Vorstellungskraft der Planer durch die Visualisierung unterstützt.

Dass Visualisierungen die Kommunikation zwischen Planern und Laien verbessert, ist mittlerweile anerkannt (s. Einführung). Das vorgestellte Beispiel zeigt gut, wie die Visualisierungen auch zwischen den Planungs-Disziplinen genutzt werden können, um ein gemeinsames Verständnis von Planungsaussagen herzustellen. Diskussionen und Missverständnisse, aufgrund nicht analog verwendeter Begrifflichkeiten, lassen sich so umgehen. Schließlich konnte so auch das Planungsergebnis verbessert werden. Auch die zu erwartende Änderung des Landschaftscharakters kann mit Hilfe der Visualisierung beurteilt werden.

3.3 Großräumige Landschaftsveränderungen der Gemeinde Günsterode (VNS)

Die Nordhessische Mittelgebirgslandschaft befindet sich im Wandel. Durch den Rückgang der landwirtschaftlichen Nutzung fallen mehr und mehr Flächen brach. Für den Ort Günsterode (Stadt Melsungen) wurden im Rahmen einer Projekarbeit an der Universität Kassel Entwicklungs- und Landschaftsszenarien erarbeitet. Diese Szenarien sind die inhaltliche Grundlage der Visualisierungen.

Visualisierungen wurden erstellt, um sich ein realistisches Bild zukünftiger Landschaften zu machen. Dabei stehen, zum einen die Unterstützung lokaler Entscheidungen und zum anderen die Auswirkungen politisch-gesellschaftlicher Zielsetzungen und Handlungen auf die Landschaft im Vordergrund. So sollen die Menschen vor Ort einen Eindruck der Entwicklungsmöglichkeiten „ihrer“ Landschaft bekommen. Es wird unter Bürgern und Entscheidungsträgern eine Diskussion eingeleitet, die, das „Bild“ vor Augen, zu bewussten und fundierten Entscheidungen führen sollte.

Als Grundlage für die Beurteilung der Szenarien wurde die Landschaft in ihrer jeweiligen Ausprägung in den Jahren 1953 und 2004 visualisiert (Abb. 6). Beim Vergleich der beiden Darstellungen, sieht man deutlich die vorherrschende Tendenz der Landschaftsentwicklung. Im Jahr 2004 gibt es deutlich weniger Ackerland, wogegen der Grünlandanteil stark zugenommen hat, auch wenn einzelne Flächen verbuschen und damit die ersten Sukzessionsstadien einleiten. Die Siedlungsflächen haben seit 1953 ebenfalls deutlich zugenommen.

Abb. 6: Visualisierungen der Landschaftszustände von 1953 (links) und 2004 (rechts).

Die Visualisierungen zeigen die Szenarien „Sukzession“ (ungesteuerte Entwicklung), „Weidelandschaft“ (mit Galloway-Rindern), „Nachwachsende Rohstoffe“ (Raps-Ackerbau und Pappel-Plantagen) sowie „Standortgerechte Forstwirtschaft“ (Buchenwald). Die Funktion dieser großräumigen Visualisierungen besteht darin, frühzeitig über verschiedene räumliche Entwicklungsmöglichkeiten, zu informieren. Darauf aufbauende Planungen und Visualisierungen könnten zielgerichtet Szenarien auswählen, und diese in einem höheren Detaillierungsgrad, z.B. durch genaue Flächenabgrenzungen, ausarbeiten und darstellen. Die Ergebnisse werden im Januar 2006 den Bürgern vor Ort in einer interaktiven Präsentation vorgestellt. Diese Art der Präsentation ermöglicht es dem Betrachter, die verschiedenen Szenarien untereinander, aber auch die Entwicklungsstadien miteinander, zu vergleichen. Eben dieser Vergleich verschiedener Zustände ermöglicht es, befürwortete und eher unerwünschte Entwicklungen vorab zu erkennen.

Abb. 7: Visualisierungen der Szenarien (v.l.n.r.) „Weideland", „Sukzession", „Raps-Ackerbau" sowie „Pappel-Plantagen" mit einjährigem und vierjährigem Aufwuchs

Es wird deutlich, dass die Visualisierungen zum Szenario „nachwachsende Rohstoffe", die intensiven Raps-Ackerbau und Pappel-Plantagen zeigen, kontroverse Diskussionen anregen. Sie zeigen Energie-Landschaften, wie sie vielerorts Wirklichkeit werden könnten, wenn das politische Ziel von einem Anteil von 20% Erneuerbarer Energien bis zum Jahr 2020 (§1 Abs. 2 EEG), tatsächlich in der Landschaft umgesetzt werden würde.

Gerade Kurzumtriebs-Plantagen, meist Pappeln oder Weiden, können, insbesondere aufgrund ihrer Wuchshöhe von bis zu 7m im vierten Jahr, erhebliche Veränderungen des Landschaftcharakters mit sich bringen (Rode 2005: 410). Die Auswirkungen lassen sich jedoch nicht pauschal prognostizieren, sondern müssen in der jeweiligen Landschaft untersucht werden, wobei sich die entsprechenden Visualsierungen zu den Szenarien als hilfreich erwiesen haben.

Visualisierungen wurden dazu eingesetzt, dem Betrachter die möglichen Auswirkungen verschiedener Handlungen, wie z.B. die Vergabe von Fördermitteln oder politische Zielsetzungen, auf die Landschaft zu vermitteln. Entscheidungsprozesse dürften auf diese Weise qualifiziert werden.

3.4 Visualisierungen der Funktionsweisen von Lebensraumkorridoren (VNS)

Was bedeutet Biotopverbund? Nichtfachleuten wird die Antwort auf diese Frage recht schwer fallen. Ein Zeichen für das Vermittlungsproblem des Naturschutzes in Deutschland, handelt es sich doch beim Biotopverbund um eines der wichtigsten politischen Ziele des Naturschutzes, dem im Bundesnaturschutzgesetz (§ 3 Abs. 1 BNATSCHG) sogar ein Flächenanspruch von 10% der Gesamtfläche Deutschlands zugeordnet wird.

Unter Biotopverbund im herkömmlichen Sinne wurden bisher oft lineare Verbindungenelemente oder Korridore (z.B. Hecken) zwischen Biotopen verstanden. Lineare Elemente sind jedoch nur bedingt dazu geeignet, verbleibende „Resthabitate" in der Landschaft funktionsfähig zu verbinden. Das Projekt „Lebensraumkorridore für Mensch und Natur"[2], das im Fachgebiet Landschaftsökologie/Bodenkunde an der Universität Kassel in Kooperation mit anderen Institutionen bearbeitet wurde, vertieft dagegen den neuen Ansatz der Lebensraumkorridore im Biotopverbund.

Lebensraumkorridore bestehen in Anlehnung an das Pan-European Ecological Network (PEEN) aus einer Kombination von Kerngebieten (Core Areas), Landschaftskorridoren (Landscape Corridors), Trittstein-Korridoren (Stepping Stone Corridors) und zusätzlichen schmalen Verbundelementen (Linear Corridors) an technischen Barrieren, wie z.B. Straßen (Abb. 8). Sie dienen der Stabilisierung, Wiederausbreitung bzw. Arealsicherung schutzbedürftiger Arten, sind aber auch für die naturbezogene Erholung offen (RECK et al. 2004).

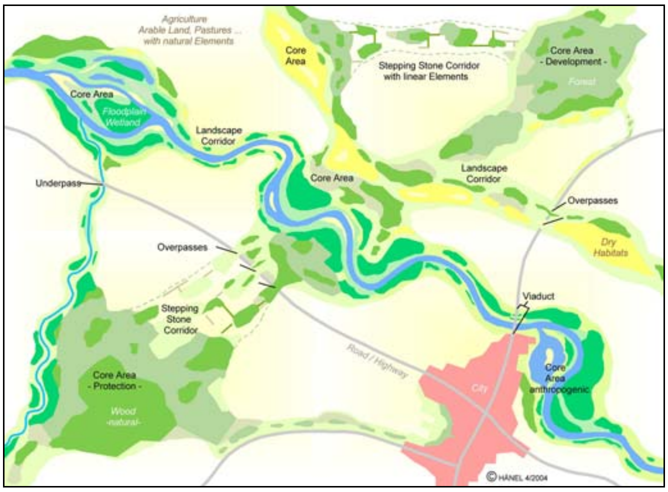


Abb. 8: Skizze eines Netzes aus Lebensraumkorridoren in Anlehung an das PEEN (nach Klijn 2003 aus Böttcher et al. 2005)

[2] Lebensraumkorridore für Mensch und Natur – Initiativskizze (Grobkonzept) zur Entwicklung eines Netzes bundesweit bedeutsamer Lebensraumkorridore. Gefördert: Bundesamt für Naturschutz mit Mitteln des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit im Auftrag des Deutschen Jagdschutzverbandes e.V. Laufzeit: 11/2003–4/2004. Universität-Kassel Fachgebiet Landschaftsökologie / Bodenkunde Dipl.-Ing. Kersten Hänel Dipl.-Ing. Jens Jeßberger (www.uni-kassel.de/fb6/fgloebo/biotopverbund.html). Weitere Projektpartner: Dr. H. Reck (Fachabteilung Landschaftsökologie des Ökologie-Zentrums der Universität Kiel), M. Strein, U. Müller, Dr. R. Suchant (Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg (FVA), Abt. Landespflege, Freiburg).

Für die Funktionalität von Lebensraumkorridoren sind größere Tiere wie Rinder, Pferde, Schafe und Ziegen, aber auch Rothirsche, Elche oder Wisente wichtig, weil sie halboffene Landschaften erhalten und entwickeln (Habitatbildner). Diese strukturreichen Landschaften sind bekannt für ihren Artenreichtum und dienen der Ausbreitung und Wanderung auch vieler kleiner Arten (vgl. z.B. Finck et al. 2004).

Das eigentliche Ziel ist die Generierung eines kurzen Films, der als Basisinformation und zur Atzeptanzförderung auf Veranstaltungen zum Thema Biotopverbund gezeigt werden könnte. Das Gesamtkonzept der Lebensraumkorridore mit Verbundkorridoren der Feucht- und Trockenlebensräume, wie in Abb. 8 dargestellt, wurde visualisiert. Zu sehen ist der angestrebte Charakter der Lebensraumkorridore, eine halboffene, durch große pflanzenfressende Säugetiere (Großherbivore) gestaltete Landschaft, die auch der naturbezogenen Erholung dient. Neben dem Gesamtkonzept werden auch einzelne wichtige Elemente, wie Trittsteine, Grünbrücken, Viadukte, u.a. vorgestellt. Der Film wird durch Erläuterungen ergänzt und kann vom Redner jederzeit angehalten werden.

Aus dem generierten Modell können aber auch Standbilder zu einzelnen Aspekten oder eine Übersicht des Gesamtraumes, zur Verdeutlichung räumlich-funktionaler Beziehungen, erstellt werden (Abb. 9). Diese Darstellungen können auch in anderen Medien, wie z.B. Plakaten oder in Berichten, verwendet werden und sind ein Nebenprodukt, das mit geringem Mehraufwand aus dem Modell erzeugt werden kann.

In den Visualisierungen wird keine konkrete Planung sondern Leitbilder und Ziele dargestellt, die auf eine fiktive Landschaft übertragen wurden. Da die Visualisierung keinen direkten Raumbezug hat und keine konkrete Flächeninanspruchnahme zeigt, können Diskussionen zum Thema „Biotopverbund" auf die Sachebene gelenkt werden.

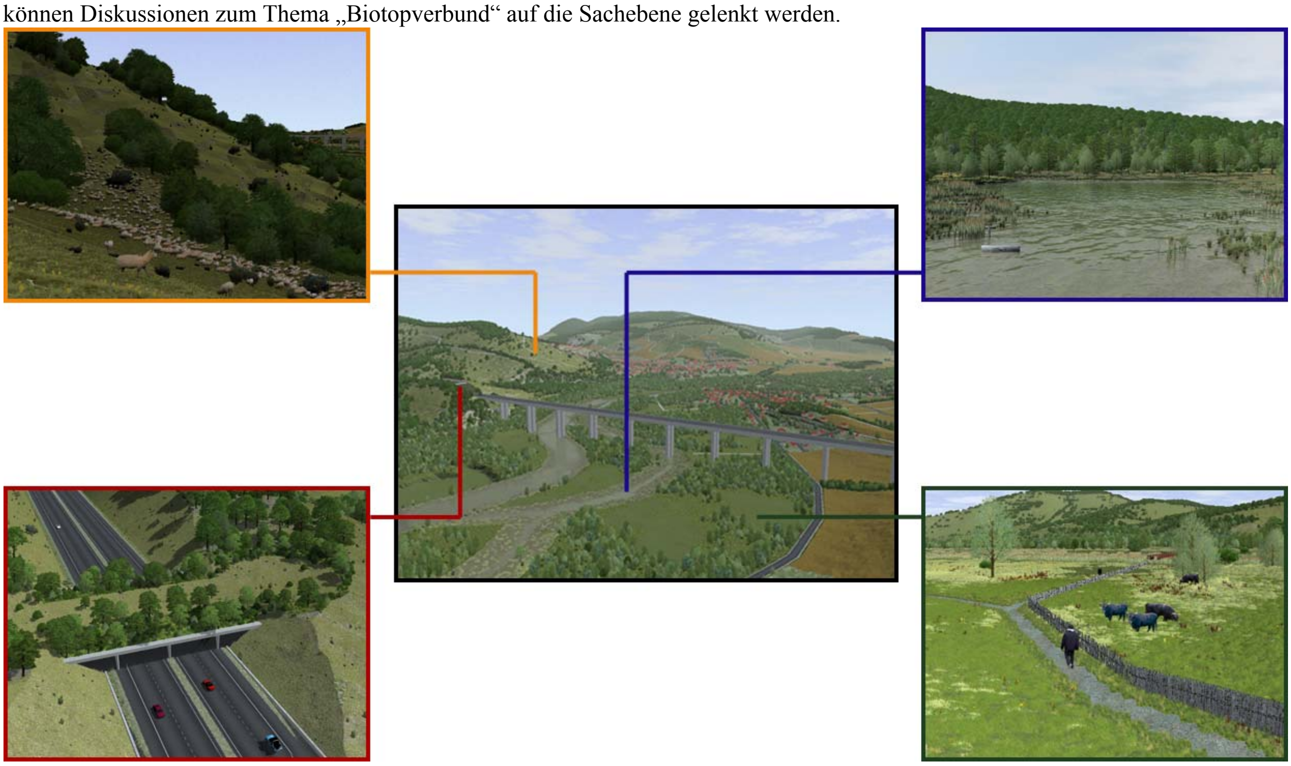


Abb. 9: Verdeutlichung räumlich-funktionaler Beziehungen durch Einblenden von Detailausschnitten mit Einzelaspekten der Planung

4 FAZIT

WCS und vor allem VNS sind Softwarepakete, die es mit vertretbarem Aufwand ermöglichen, (photo)realistische Landschaftsvisualisierungen zu erstellen. Es wird im wesentlichen auf die ohnehin für die Planung notwendigen Daten zurückgegriffen. Alle vorgestellten Projekte sind GIS-basiert, so dass Daten ohne Probleme in VNS importiert und genutzt werden konnten. Obwohl die Qualität der Darstellungen mit WCS und VNS identisch ist, eignet sich VNS aufgrund der GIS-Schnittstelle besser für die Planung.

Die Praxisbeispiele zeigen die vielfältigen Einsatzmöglichkeiten dieser Visualisierungen für die Landschaftsplanung. Dabei ist ihr Nutzen nicht auf die Beteiligung und Information von Bürgern beschränkt. Auch dem Planer selbst und für die Kommunikation in interdisziplinären Teams können sie zusätzlich nützlich sein.

Darüber hinaus machen sie deutlich, dass sich Visualisierungen sowohl für die Darstellung von konkreten Maßnahmen, aber auch für die Darstellung nicht räumlich konkretisierter Planungsziele, eignen. So ist es möglich, Visualisierungen auch in Planungsphasen mit weniger starkem Raumbezug einzusetzen, wie z.B. der Leitbild- und Zielentwicklung (vgl. Tab.1 Phasen 3 & 4). Nicht weniger wichtig ist die Möglichkeit räumlich-funktionale Beziehungen aufzuzeigen. Dies kann insbesondere bei der Bestandsaufnahme und Konfliktermittlung von Bedeutung sein.

Die Darstellungsqualität von Visualisierungen ist den meisten anderen Methoden überlegen. Insbesondere bei der Darstellung von Entwicklungsprozessen stand bisher kein vergleichbares Visualisierungswerkzeug zur Verfügung. Diese können in beliebig langen Animationsequenzen gezeigt werden. Aber auch bei den unbewegten Bildern gibt es kein Werkzeug, das gleichzeitig so präzise (präziser als Montagen, Handzeichnungen, Vergleichsfotos) und flexibel ist (aus einem fertigen Modell kann jede beliebige Ansicht gezeigt werden).

Die genannten Eigenschaften führen schließlich zu einer transparenten und präzisen Darstellung von Planung, die so an Verständlichkeit gewinnt. Dies gilt in besonderem Maße für die Öffentlichkeitsbeteiligung aber auch für interdisziplinäre Kommunikation.

Werden Visualisierungen als Instrument zur Darstellung von Planungsinhalten verstanden, so können wissenschaftlich korrekt (siehe SHEPPARD 1999) erstellte Visualisierungen für das Monitoring bzw. Erfolgskontrollen herangezogen werden. Ob der Zustand der Landschaft im Detail den Visualsierungen entspricht, hängt demnach vor allem von der Qualität der Planung ab. Darüberhinaus verbieten sich Schönfärbereien grundsätzlich, um Enttäuschungen und Verdruss bei allen Beteiligten zu verhindern. Es darf nur das visualisiert werden, was wirklich vorhanden ist bzw. mit fachlicher Begründung vorhanden sein könnte.

Visualisierungen sind geeignet, Planungsergebnisse und die Umsetzung von Plänen deutlich zu verbessern, zum einen durch die Aufwertung des Planungsergebnisses und zum anderen durch bessere Umsetzungschancen aufgrund einer verständlicheren Öffentlichkeitsarbeit. Schliesslich besteht die Chance, dass auf diesem Weg das Vermittlungsproblem von Planung abeschwächt werden kann.

5 QUELLENVERZEICHNIS

Böttcher, M., Reck, H., Hänel, K., Winter, A.: Lebensraumkorridore für Mensch und Natur in Deutschland. In GAIA 14/2 (2005), S. 163 – 166.

Bruns D.; Mengel A.; Weingarten E.: Beiträge der flächendeckenden Landschaftsplanung zur Reduzierung der Flächeninanspruchnahme. F+E Vorhaben, FKZ 803 82 030. Bundesamt für Naturschutz (BfN). 2005.

Finck, P., Härdtle, W., Redecker, B. & Riecken, U. (Bearb.): Weidelandschaften und Wildnisgebiete - Vom Experiment zur Praxis. Schr. R. f. Landschaftspfl. u. Natursch. 78, p. 540. 2004.

IEMA (Institute of Environmental Management and Assessment) (Eds.): Guidelines for Landscape and Visual Impact Assessment. Second edition. Spoon Press. London. 2002.

Klijn, J.A., Opstal, A.J.F.M. Van, Bouwma, I.M.: Indicative Map of Pan-European Ecological Network for Central and Eastern Europe. ECNC, Tilburg, The Netherlands / Budapest, Hungary. 2003.

Lange, E.; Bishop, I. D.: Communication, Perception and Visualization. In: Lange, E.; Bishop, I. D. (Eds.) Visualization in Landscape and Environmental Planning, Technology and Applications.Taylor and Francis. London, New York. (2005).

Lautenbach, S.; Berlekamp, J.; Matthies, M.: Einsatz von GIS und Geländevisualisierungssoftware in der Umweltbildung – Visualisierung der Deponie Piesberg. In: Strobl; Blaschke; Griesebner (Hrsg.) Angewandte Geographische Informationsverarbeitung XV – Beiträge zum AGIT-Symposium Salzburg. 2003.

Reck, H.; Hänel, K.; Böttcher, M.; Winter, A.: Lebensraumkorridore für Mensch und Natur – Abschlussbericht zur Erstellung eines bundesweit kohärenten Grobkonzeptes (Initiativskizze). Stand: Mai 2004. http://www.uni-kassel.de/fb6/fgloebo/lebensraumkorridore.html [Zugriff: 05.01.06]

Rode, M: Energetische Nutzung von Biomasse und der Naturschutz, In: Natur und Landschaft, 2005 (9/10). S. 403-412.

Sheppard, S.: Visual Landscapes – Regeln für die Nutzung der digitalen Kristallkugel. In: Garten und Landschaft, 1999 (11). S. 28-32.

Stemmer B.: 3D-Visualisierung von Landschaften mit WCS 6 – Visualisierung von Hochwasserschutzmaßnahmen als Beispiel für Einsatzmöglichkeiten von World Construction Set (3D Nature LLC) in der Öffentlichkeitsbeteiligung. Diplomarbeit an der Universität Kassel FB 06 Architektur, Stadt- und Landschaftsplanung. 2005. unveröffentlicht.

v. Haaren C.: Landschaftsplanung. Ulmer Verlag Stuttgart. 2004.

Warren-Kretzschmar B.; Neumann A.; Meiforth J.: Interactive Landscape-Planing - Rsesults of a pilot study in Koenigslutter am Elm, Germany. In: M. Schrenk (Eds.), CORP 2005 – Geo-Multimedia – Tagungsband. pp. 171-176. Wien. 2005.

Wissen U.; Lange E.; Schmid W.-A.: Optimizing the Visualization of 3D-Informationfor Participative Planing of Landscape Development Concepts. In E. Buhmann, P. Paar, I. Bishop und E. Lange (Eds.), Trends in Real-Time Landscape Visualization and Participation. Pp 237-245. Heidelberg, Herbert Wichmann Verlag. 2005.

BNatSchG: Gesetz über Naturschutz und Landschaftspflege (Bundesnaturschutzgesetz - BNatSchG) vom 25. März 2002 (BGBI . I S. 1193).

EEG: Gesetz zur Neuregelung des Rechts der Erneuerbaren Energien im Strombereich. Vom 21.7.2004, BGBl Teil 1 2004 Nr.40 vom 31.7.2004.

HWG: Hessisches Wassergesetz vom 6. Mai 2005 GVBl. I S. 305 Verkündet am 12. Mai 2005

"Cross Media" gerechte Kartengraphik in einem AIS

Mirjanka LECHTHALER, Alexandra STADLER

(Dr. Mirjanka Lechthaler & Dipl. Ing. Alexandra Stadler, Technische Universität Wien ▪ Institut für Geoinformation und Kartographie ▪ Forschungsgruppe Kartographie, Erzherzog Johann Platz 1, A 1040 Wien, lechthaler@tuwien.ac.at & alex_stadler@gmx.at)

1 KURZFASSUNG

Wirft man einen genaueren Blick auf die technischen Restriktionen und Signaturierungsregeln der Ausgabemedien Papier und Bildschirm, eröffnen sich interessante Details. Aufbauend auf den gewonnenen Erkenntnissen haben die Autoren einen Weg zur effizienten Gestaltung eines hybriden AtlasInformationsSystems gefunden. Anhand der beispielhaften Umsetzung zweier korrespondierender Karten für die beiden Medien wird das Potenzial der auf den ersten Blick banalen, aber doch hintergründigen Idee aufgezeigt.

2 EINLEITUNG

Das Informationsmedium Internet gewinnt für die Kartographie und kartographischen Anwendungen immer mehr an Bedeutung. Es bietet eine unvorstellbare Vielzahl an Möglichkeiten zur Visualisierung von Geobasisdaten (Geometrie- und Sachdaten) und der darauf basierenden Vermittlung raumbezogener Informationen. Ein wichtiges kartographisches Einsatzgebiet sind regionale, nationale und globale webbasierte Informationssysteme in Form von multimedialen und interaktiven AtlasInformationsSystemen (AIS).

Bei der Redaktion eines entsprechenden Kartenwerkes ist darauf zu achten, dass, wie Cartwright et al. [1999] behaupten, Multimedialität eine neue Ausdrucksform ist, deren rasante Entwicklung dazu führt, dass ständig eigene Regeln und Grammatik durchbrochen werden. Durch das Informations-, Präsentations- und Funktionalitätenportal des Systems sollen verschiedenen Benutzergruppen sinnvolle kartographische Visualisierungen (Karten, Graphiken, Tabellen, Texte) der aktuellen Geobasisdaten in Echtzeit angeboten werden.

Die Karte dient als graphische Benutzeroberfläche und Benutzerschnittstelle im AIS. Über einzelne Elemente der Kartengraphik werden mittels eingebauter interaktiver Systemfunktionalitäten Zugriffe auf die Geobasisdaten ermöglicht. Darüber hinaus werden dem Benutzer System-, Analyse-, Monitoring- und Visualisierungswerkzeuge zur Verfügung gestellt, die ihn bei der themenspezifischen Erstellung von mono- / polyvariablen Datenbankabfragen, -verknüpfungen und -analysen sowie der individuellen Gestaltung „seiner" Karten unterstützen sollen. Besonders wichtig ist dabei, seitens des Systems nur sinnvolle Interaktionen zuzulassen, dies jedoch unsichtbar zu tun, auf dass sich der Benutzer nicht eingeschränkt fühlt. Diese Form der Systemnavigation kann als „restriktiv-flexibel" [Gartner et al. 2005] bezeichnet werden.

Voraussetzung für die breite Akzeptanz des Systems und die möglichen interaktiven Systemzugriffe über die Karte ist die Anwendung einer klaren, lesbaren, dem Maßstab und den technischen Anforderungen des Ausgabemediums angepassten Kartengraphik. Bei der Festlegung von Zeichenschlüsseldefinitionen für Papierkarten kann man auf eine langjährige Erfahrung zurückgreifen.

Beim Ausgabemedium Bildschirm ist die Erfahrung nicht so groß. Die ersten elektronischen Atlanten waren - vor allem was die Lesbarkeit der dargestellten Geoinformation betrifft - noch nicht ausgereift. Die implementierten Karten waren oft nur eingescannte (digital transformierte) konventionelle Atlaskarten, die durch die geringere Auflösung des Bildschirms nur noch erschwert lesbar waren. Die hohe graphische Qualität, die man in gedruckten Atlaskarten durch den Einsatz geeigneter Technologien der Reprotechnik gewohnt war, konnte auf diesem Weg nicht erreicht werden. Grund dafür waren die technischen Restriktionen des Bildschirms, die zu Deformationen der graphischen Grundelemente führen.

Abhilfe schafft die Verwendung einer angepassten Kartengraphik. Dabei müssen folgende Punkte überlegt werden:

Definition der graphischen Mindestdimensionen (Größe / Strichstärke und Abstand) von Kartengraphik und Schrift in Abhängigkeit von Ausrichtung und Form,

Wahl der Grundelemente der graphischen Darstellung (Punkt, Linie, Fläche, Signatur, Schrift) und

Wahl / Kombination der graphischen Variablen (Größe, Form, Farbe, Orientierung, Helligkeit und Muster).

Diese Aufzählung ist speziell auf thematische Karten ausgelegt, hat aber auch für topographische Daten, auf deren Visualisierung sich die Autoren im weiteren Verlauf konzentrieren möchten, durchaus Berechtigung.

Die Anwendung der bildschirmgerechten Kartengraphik nimmt mehr Kartenraum in Anspruch. Somit hat sie Auswirkungen auf den visualisierten Informationsinhalt der Atlaskarte. Durch den Einbau von Interaktionsmöglichkeiten wird dem Benutzer allerdings keine Information mehr vorenthalten – im Gegenteil: er findet ein komplettes System vor, das er in all seiner Tiefe erforschen darf.

Parallel dazu soll das System dem Benutzer ermöglichen, seine zweckorientierten, personalisierten Kartenergebnisse auch analog in höchster Qualität auszugeben. Dieser Dualmodus erfordert eine „Cross Media" gerechte Kartengraphik, welche den eigentlichen Anlass zur Verfassung dieses Artikels gegeben hat.

3 VOM TRADITIONELLEN PAPIERATLAS ZU MULTIMEDIALEN, INTERAKTIVEN AIS

Der Begriff „Atlas“[1] wurde zum ersten Mal von Gerhard Kremer (1512-1594, besser bekannt unter dem Pseudonym Mercator) für eine Kartensammlung verwendet. Es handelte sich um den 1585 erschienenen „Atlas sive Cosmographicae Mediationes de Fabrica Mundi et Fabricati Figura” (Titelblatt siehe Abb. 1), der aus 74 Karten bestand.

Laut Definition des Lexikons für Kartographie und Geomatik [Bollmann et al. 2002] verfolgt ein Atlas das Ziel einer zweckorientierten, systematischen Zusammenstellung von Karten in Buchform, als lose Folge von Einzelblättern oder als Datei für die elektronische Präsentation am Bildschirm (in dieser Form auch als AIS bezeichnet). Ein Atlas mit seinem lokalen, regionalen oder globalen Charakter bietet neben den essentiellen Karten sowohl statische Informationen wie Texte, Tabellen, Bilder und Graphiken sowie computerunterstützt auch dynamische Elemente wie Sprache, Ton, Animation und Video an (Multimedialität).

Die Strukturierung dieser Information erfolgt unter Berücksichtigung vorgegebener Zielsetzungen [Kraak et al. 1996]. Vordergründiges Ziel ist es, räumliche Objekte bzw. ganze Regionen darzustellen und den Zusammenhang mit einem weiten Spektrum an thematischer Zusatzinformation aufzuzeigen. Besonders wichtig ist die Vermittlung räumlicher Strukturen im Bereich physischer, temporaler, sozioökonomischer und humaner Umwelt.

Atlanten gehören zu den ersten kartographischen Produkten, mit denen man in Berührung kommt, da sie wesentlicher Bestandteil des Geographieunterrichtes in der Schule sind. Laut Kraak [2001] handelt es sich um eines der meist verbreitetsten und typischsten kartographischen Produkte.

Abbildung 1: Titelblatt zum „Atlas sive Cosmographicae Mediationes de Fabrica Mundi et Fabricati Figura” [URL1]

Nach Ormeling [2001] ist ein Atlas immer:

ein überlegenes Speichermedium, unabhängig vom momentanen Technologiestand (Papier-/digitale Atlanten),

eine bewusste Kombination von Karten, welche durch die Reihenfolge der abgebildeten Gebiete und die Themenauswahl räumliche Zusammenhänge, Vergleiche und zeitabhängige Szenarien ermöglicht und

ein Explorationsmedium, welches Erkenntnisse über eine weit entfernte Wirklichkeit vermittelt.

3.1 Einteilung von Atlanten

Gerade ein so weit verbreitetes Produkt lässt Einteilungen nach vielen formalen Kriterien zu:

Ausgabemedium / Präsentationsform: Papier-, taktile, digitale und Multimedia-Atlanten

Inhalt / Zweck: topographisch-, komplex-thematische Atlanten[2], Fachatlanten (wie historische, zoologische, botanische Atlanten etc.), Bildatlanten

Ausgabeformat / Umfang des Inhalts: Welt-, Buch-, Hand-, Taschenatlanten

Benutzergruppenanpassung: prominentestes Beispiel: Schulatlanten, aber auch für spezielle Interessensgruppen wie Wanderer, Radfahrer etc.

Ramos et al. [2005] identifizieren in diesem Zusammenhang Charakteristika der jeweils angepassten Atlanten: Bildung, Navigation, Raumplanung, Verwaltung, Beobachtung.

Darstellungsgebiet: Stadt-, Regional-, National-, Welt-, Mond-, Universum-Atlanten

In direktem Zusammenhang mit dem darzustellenden Gebiet steht auch der Maßstab des Atlasses (bezogen auf das jeweilige Ausgabeformat). Das Wort „Atlas“ wird normalerweise mit einem sehr kleinen Maßstab in Verbindung gebracht [Keates 1989, Hake et al. 2002], wie man an der Liste der möglichen Darstellungsgebiete aber sehen kann, sind auch durchaus großmaßstäbige Atlanten auf dem Markt (Stadtatlas).

Neben dieser traditionellen Einteilung von Atlanten gibt es natürlich auch wesentlich spezifischere. Ein Beispiel dafür ist die Unterteilung von digitalen Atlanten nach ihrem Interaktivitätsgrad und analytischen Potenzial [Elzakker 1993, Kraak et al. 1996, Ramos et al. 2005]:

Statische Atlanten: statische Karten ohne Interaktivität und Dynamik

Interaktive Atlanten, die auf Abruf individuell gestaltete Karten generieren: Interaktion mit dem Datensatz, Eingriff in statistische Klassifizierungsmethoden wie Wechsel von Farbschemata, Klassifikationsmethode und Klassenanzahl etc.

Analytische Atlanten basierend auf GIS-Funktionalitäten: Datenbankabfragen wobei die Karte als Benutzerschnittstelle zu den Primärdaten dienen kann, Erstellung, Analyse und Visualisierung von neuen Datensätzen etc.

3.2 Statische Atlanten versus interaktive / analytische Atlanten

Traditionelle Papieratlanten, ob in Buchform oder als Loseblattatlas, weisen eine fixe lineare Struktur auf. Fix im Bezug auf das vorgegebene Format und den daher je nach Darstellungsgebiet eingeschränkten Maßstab, linear was den Themenaufbau betrifft. Die Karten haben dabei einen zweifachen Nutzen: die enthaltene Information wird einerseits gespeichert und andererseits kommuniziert. Den Daten werden teilweise erläuternde Texte samt Statistiken, Diagrammen und Abbildungen beigelegt. Um verschiedene Karten

[1] Die ursprüngliche Bedeutung des Wortes „Atlas“ geht auf die griechische Mythologie zurück. Atlas gehörte zur Göttergruppe der Titanen, die einen erfolglosen Krieg gegen Zeus und die anderen olympischen Götter führten. Als Strafe dafür wurde Atlas von Zeus gezwungen, für immer das Himmelsgewölbe auf seinen Schultern zu tragen [WBE 1993].

[2] Topographisch-, komplex-thematische Atlanten werden im Volksmund oft als geographische Atlanten bezeichnet, Diese Bezeichnung ist allerdings etwas irreführend, da man mit dem Begriff „geographisch“ nicht unbedingt thematische Inhalte assoziiert.

oder Themen jedoch genau erforschen und miteinander vergleichen zu können, sind Hilfsmittel wie Marker, Sticker u.ä. fast unumgänglich.
In Tab. 1 sind nach Ormeling [1996] die wichtigsten Charakteristika von statischen und interaktiven / analytischen Atlanten zusammengefasst und gegenübergestellt. Bezüglich ihrer Funktionalität sind statische Atlanten mit einigen Nachteilen behaftet[3].

Statische Atlanten	Interaktive / analytische Atlanten
statisch	dynamisch
passiv	interaktiv
limitierte Auswahl	komplett
fixe Kartenrahmen	Wahl des Ausschnitts und Maßstabes
allgemein gehalten	benutzerorientiert
Karten sind das fertige Produkt	Karten dienen als Interface

Tabelle 1: Unterschiede zwischen statischen und interaktiven / analytischen Atlanten (nach Ormeling [1996]).

Die digitale Technologie[4] versucht, die Kartographie von diesen Limitierungen zu befreien. Mit dem Fortschritt digitaler Technologie ist auch die interaktive Karte allgegenwärtig geworden. Es ist zu erwarten, dass in naher Zukunft die Barrieren statischer Kartographie durch die standardisierte Einführung von AIS aufgehoben [Ormeling 1996, Asche 2001] und dadurch ein sehr viel freierer Zugang zu geographischen Daten ermöglicht wird.
Nach anfänglichen Schwierigkeiten durch Hardware- (limitierter Speicherplatz) und Softwarebeschränkungen (Mangel an Autorensystemen zur Entwicklung interaktiver Applikationen) entstand 1981 der erste digitale Atlas: „Electronic Atlas of Canada“ [Siekierska et al. 1996]. Dieses Pionierwerk bereitete den Weg für eine breit angelegte Forschungsaktivität auf dem Gebiet [ICA 2005]. Beteiligt daran waren nicht nur Universitäten, sondern auch Regierung und Privatwirtschaft.
Angelangt im 21. Jahrhundert, stehen wir vor dem Internet als idealer Plattform zur Übermittlung geographischer Informationen. Aber genau dadurch ist Vorsicht geboten: Die neuen Webtechnologien und die geringen Beschaffungskosten notwendiger Software bieten beinahe jedermann die Chance, eigene Geoinformationsvisualisierungen zu veröffentlichen – auch jenen ohne kartographische Vorkenntnisse. Es ist daher wichtiger denn je, sich abzuheben, indem man das Verständnis für den Prozess und die Methoden der kartographischen Modellgenerierung in den Vordergrund stellt. Ein moderner Kartograph sollte also zwei Aufgaben erfüllen:
die Umsetzung neuer Präsentationsformen zur interaktiven, analytischen, multimedialen Informationswiedergabe und
ein tiefes Verständnis für den kartographischen Kommunikationsprozess (von der Datenakquirierung bis zur adäquaten Datenübermittlung).
Betrachtet man die neuen Präsentationsformen, fällt auf, dass die Karte nicht mehr als Endprodukt, sondern meist als Benutzerschnittstelle fungiert. Mittels interaktiver Funktionen findet so eine dynamische Exploration der Geoinformation statt. Abhängig von ihren Zielen und Erfahrungen definieren die Benutzer selbst ihre individuelle Form von Geo-Kommunikation [Lechthaler 2004b]. Grundlage dafür ist eine optimal aufbereitete Kartengraphik, die mit entsprechenden Geobasisdaten (Primärdaten) verknüpft ist und so benutzerspezifische Datenbankabfragen und darauf aufbauende Datenvisualisierungen zulässt [Lechthaler 2004a, Persson et al. 2005, Stadler 2004].

3.3 Die Karte als graphische Benutzeroberfläche und Benutzerschnittstelle im AIS

Glaubt man Goodchild [2000], so stellt die Kartographie einen unerlässlichen Bestandteil für die Zukunft der Geographie im Allgemeinen und Geographischer Informationswissenschaften im Speziellen dar. Die Einführung digitaler Karten und deren täglicher Gebrauch führt zu einer stetig wachsenden Nachfrage an guten kartographischen Produkten als Basis für Kartographische und Geographische Informationssysteme (KIS, GIS) vorwiegend zum Zweck der visuellen Kommunikation. Gerade in einem AIS als Spezialfall eines KIS stellt die Karte das zentrale Element dar. Sie dient als multimedialer, interaktiver und dynamischer Informationsträger und ist dadurch ein Lehrmittel, das der Benutzer entlang vordefinierter oder selbst gewählter Pfade erforscht und so sein Wissen über räumliche Phänomene und Prozesse vertieft. Ormeling [2001] verwendet sehr passend die Metapher eines „geographischen Schaltbretts“.
Durch mögliche Zugriffe auf Primärdaten soll das Manko in der Informationsübertragung, verursacht durch die bildschirmgerechte und somit gröbere Kartengraphik, behoben werden. Dadurch sind dem System effektiv keine Kapazitätsgrenzen bezüglich der Informationserschließung mehr gesetzt.

4 BILDSCHIRMGERECHTE KARTOGRAPHISCHE VISUALISIERUNG

Die Gestaltung bildschirmgerechter Atlaskarten stellt eine große Herausfoderung für den Kartographen dar. In seinen Entwurfs- und redaktionellen Arbeiten ist er nicht nur „Kartenmacher“, sondern auch „Systemdesigner“. Neben seiner Aufgabe, den Generalisierungsgrad, die graphische Dichte der Karte sowie die Kartengraphik den Ansprüchen des jeweiligen Maßstabes anzupassen, muss er sich auch bewusst sein, dass er den Bildschirm (mit allen seinen Restriktionen) als Informationsträger und das Internet als Transportmedium optimal auszunützen hat.
Solange die Bildschirmvisualisierung nur als Teil des digitalen Herstellungsprozesses einer zu druckenden Karte dient, ist die reduzierte Qualität und die relativ kleine Anzeigefläche nicht störend. Nachdem aber bei einer Ausgabe am Bildschirm die Karte als interaktive Benutzeroberfläche im Vordergrund der Anwendung steht, muss besonderes Augenmerk auf die Gestaltung der Kartengraphik gelegt werden.
Eine gute Kartengraphik [Spiess et al. 2002, Hake et al. 2002]:
muss die raumbezogenen Informationen gut vermitteln können,
beschränkt sich auf das Wesentliche der darzustellenden Information,

[3] Eines muss man sich stets vor Augen halten: Erfolgt die Ausgabe auf Papier, so haben statische Atlanten den entscheidenden Vorteil der wesentlich feineren Auflösung.

[4] Die digitale Technologie stellt eine der sechs Haupttechnologieformen dar, welche die Kartographie im Laufe der Zeit revolutionierten: manuelle, magnetische, mechanische, optische, photo-chemische und elektronische / digitale Technologie [Robinson et al. 1995].

entlastet das Kartenbild von Überflüssigem,
gewährleistet die verlangte Lagegenauigkeit,
verwendet eine Symbolik, die spontan richtige Assoziationen hervorruft,
ist in der Aussage eindeutig,
hält sich an die vereinbarten kartographischen Richtlinien und
ist gut lesbar.
Die Visualisierung der Karten mit dem Zeichenschlüssel für die Printausgabe führt zu einer, durch die „grobe" Auflösung des Bildschirmes, nicht vernachlässigbaren Deformation des Kartenbildes. Darstellungen hoher graphischer Dichte sind nur noch teilweise lesbar. Somit muss der Zeichenschlüssel für die Visualisierung am Bildschirm dem Ausgabemedium angepasst werden. Dabei spielen die, im Vergleich zu den Minimaldimensionen für die Printausgabe größeren, graphischen Minimaldimensionen eine entscheidende Rolle. Die Definition der bildschirmgerechten Minimaldimensionen der Kartengraphik hängt eng mit der am Bildschirm erzielbaren Auflösung zusammen.

4.1 Technische Restriktionen des Bildschirms als Ausgabemedium für kartographische Anwendungen

Wird eine Karte am Bildschirm dargestellt, müssen die geräteunabhängigen Bildpunkte (Pixel), aus denen die Graphik intern aufgebaut ist, in mittels Loch-, Streifen- oder Schlitzmaske erzeugbare Bildelemente (Ausgabepixel) umgewandelt werden. Die Anzahl dieser Bildelemente variiert zwischen verschiedenen Bildschirmen und stellt die eigentliche Restriktion dieses Mediums dar. Des weiteren sind Bildelementform, Farbtiefe, Bildstörung und Bildwiederholrate von Bedeutung. Im Folgenden werden die aufgezählten technischen Restriktionen (teilweise anhand der noch weit verbreiteten Kathodenstrahl-Bildschirme) genauer erläutert.

4.1.1 Bildpunkt, Bildelement, Größe und Auflösung des Mediums

Ein Bildpunkt (Pixel) ist das Elementarelement einer digitalen Matrix (Bildpunktmatrix), welche für jeden Bildpunkt einen Intensitätswert speichert, der erst durch die Ausgabe auf einem dafür vorgesehenen Gerät (Bildschirm, Drucker) sichtbar wird. Für die Darstellung müssen die Bildpunkte in tatsächlich erzeugbare Bildelemente umgewandelt werden (Abb. 2), deren Anzahl von der Größe und Auflösung des verwendeten Ausgabegerätes abhängt.
Die Größe der Bildelemente hängt direkt mit der Auflösung des Ausgabemediums (Anzahl der Zeilen und Spalten) und der Größe der Ausgabefläche zusammen:

Größe der Bildelemente = Größe der Ausgabefläche / Auflösung des Ausgabemediums

Geht man von einer durchschnittlichen Größe der Bildelemente zwischen 0,20 mm x 0,20 mm und 0,40 mm x 0,40 mm und einer durchschnittlichen Druckauflösung von 0,10 mm aus, so ergibt sich eine 2 bis 4 mal so grobe Auflösung des Mediums Bildschirm im Vergleich zum Medium Papier. Hätte man einen Bildschirm mit der Auflösung einer analogen Karte vor sich, könnte man für die digitale Präsentation die Mindestdimensionen konventioneller Zeichenschlüssel verwenden.
Für die weiteren Untersuchungen wurde nach einem durchschnittlichen Wert für die Größe eines Bildelementes gesucht. Dieser soll folglich als Umrechnungsfaktor zwischen der Anzahl an Bildelementen und der am Bildschirm eingenommenen Fläche dienen. Um schlechter aufgelöste Bildschirme nicht zu benachteiligen, wurde ein größerer Wert innerhalb des Intervalls gewählt, der allgemein gebräuchlich ist: 1 pt (typographischer Punkt[5]) = 0,375 mm [Bollmann et al. 2002].

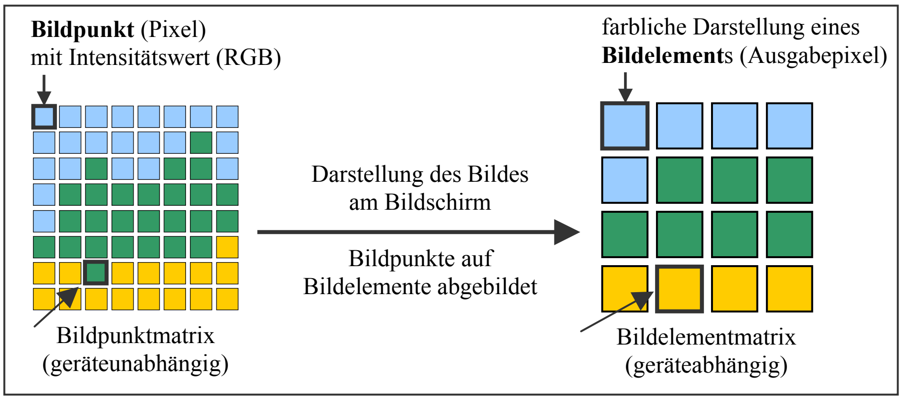


Abbildung 2: Vom geräteunabhängigen Bildpunkt zum geräteabhängigen Bildelement

4.1.3 Form der Bildelemente

Aus der Form der Bildelemente, welche abhängig vom Bildschirmtyp sind, können Unterschiede im Erscheinungsbild der Kartengraphik entstehen. Diese werden im weiteren Verlauf zwar nicht eigens betrachtet, sollen aber der Vollständigkeit halber hier beispielhaft für die drei Arten von Kathodenstrahl-Bildschirmen aufgeführt werden [Malić 1998][6]:
Bei Streifen- und Schlitzmasken-Bildschirmen sind die Bildelemente rechteckig oder quadratisch. Die Breite ist konstant, die Höhe ist abhängig von der vertikalen Auflösung. Bei einer Bildschirmauflösung von 1024 x 768 Bildelementen und einer Bildschirmdiagonale von 20" beträgt die Größe der Bildelemente beispielsweise 0,30 mm x 0,34 mm.

[5] Der „typographische Punkt" wird allgemein zur Größenangabe von Buchdruckschriften verwendet.

[6] Bei LCD(Flüssigkristall)-Bildschirmen sind die Bildelemente ganz ähnlich wie bei Streifen- und Schlitzmasken-Bildschirmen angeordnet. Die Form ist daher auch rechteckig oder quadratisch, die Breite schwankt zwischen 0,21 und 0,30 mm [Neudeck 2001].

Bei Lochmasken-Bildschirmen sind die Bildelemente dreieckig (sechseckig). Die Form ist unabhängig von der Bildschirmgröße bzw. -auflösung. Die Größe der Bildelemente beträgt durchwegs 0,30 mm x 0,30 mm.

4.1.4 Anzahl darstellbarer Farben (Farbtiefe)

Die Graphikkarte enthält die Elektronik zur Steuerung des Bildschirmes. Sie übermittelt digitale Daten vom Prozessor über den Systembus und wandelt sie in Videosignale um, die am Bildschirm dargestellt werden. Wichtige Teile zur Steuerung sind der Video- oder Graphik-Chip, der Bildspeicher und der Digital-Analog-Wandler, der die, in der Bildpunktmatrix abgelegten, Intensitätswerte in analoge Signale umwandelt und dadurch die Visualisierung am Bildschirm ermöglicht. Die farbliche Darstellung jedes Bildelementes hängt von der Farbtiefe ab und umfasst in der Regel mehrere Bits pro Bildelement. Der Speicherbedarf der Graphikkarte ergibt sich aus dem Produkt der Bildschirmauflösung und der Farbtiefe. In der graphischen Datenverarbeitung sollten mindestens 8 MB vorgesehen werden [Neudeck 2001].
Je kleiner die Bildelemente sind, desto höher ist die Auflösung des Bildschirms und desto umfangreicher sind dadurch die Bildinformationen für den Bildaufbau. Da die Kapazität der Graphikkarte und der Transfer der bildaufbauenden Informationen das eigentliche Hindernis darstellt, würde eine höhere Auflösung des Bildschirms gar keinen Sinn ergeben.

4.1.5 Bildstörung

Wie schon beschrieben, wird die Lesbarkeit der Kartengraphik durch die bildschirmbedingte Deformation der Kartengraphik beeinträchtigt. Diese Bildstörung wird verursacht durch [Malić 1998, Neudeck 2001]:
Treppeneffekt (Aliasingeffekt),
Unschärfe durch Antialiasing-Verfahren,
Intensitätsschwankungen der Linienstärken (abhängig vom verwendeten Algorithmus zur Umwandlung in Bildelemente),
Formveränderungen nicht horizontal bzw. vertikal gelagerter Signaturen und Schrift sowie
Deformation der Signaturen abhängig von ihrer Positionierung in der Bildpunktmatrix.

4.1.6 Bildwiederholrate zur Simulation eines flimmerfreien Bildschirms

Der Bildaufbau bei Kathodenstrahl-Bildschirmen basiert auf einer zeilenweisen Abtastung der Bildschirminnenseite. Um den Eindruck eines stabilen Bildes zu bekommen, sollte die Bildwiederholfrequenz höher als die Flimmerverschmelzungsfrequenz des Auges, also zwischen 75 Hz und 100 Hz sein. Die Bildwiederholfrequenz hängt von der Geschwindigkeit des Elektronenstrahls und der Bildschirmgröße ab. Da Bildschirme mit unterschiedlichen Auflösungen arbeiten können, bezieht sich die Bildwiederholrate jeweils nur auf eine bestimmte Auflösung [Malić 1998].

4.2 Einhaltung der Grundregeln bildschirmgerechter Visualisierung

Wie im letzten Punkt beschrieben, werden durch die technischen Restriktionen des Bildschirms Bildstörungen hervorgerufen, welche durch eine entsprechende bildschirmgerechte Kartengraphik gering gehalten werden können. Dadurch wird ein attraktives Kartenbild geschaffen und damit der Qualitätsgrad und die Akzeptanz bei den Benutzern erheblich gesteigert. Für die Attraktivität entscheidend ist, dass:

- die durch die Kartengraphik übertragenen Karteninformationen eine Bilddichte ergeben, welche gut wahrnehmbar bzw. lesbar ist,
- die Darstellungen mit möglichst feiner graphischer Auflösung aufgebaut sind, die dem Ausgabemedium angepasst ist,
- die Signaturen gut differenzierbar sind,
- eine harmonische Farbgebung verwendet wird und
- die Darstellungen ein gutes, überzeugendes Layout aufweisen.

Um die Einhaltung dieser Kriterien zu garantieren, ist es notwendig, graphische Mindestdimensionen für die Darstellung am Bildschirm einzuführen und darüber hinaus Vorschläge für eine angepasste Signaturierung im Hinblick auf Farb- und Schriftwahl sowie die Verwendung von Formen und Mustern zu geben [Lechthaler 2005].

4.2.1 Mindestdimensionen

Mit kleiner werdendem Maßstab nimmt auch die Darstellungsgröße jeder maßstäblichen Objektwiedergabe ab, bis schließlich ihre Lesbarkeit in Frage gestellt ist. Daher spielt die Mindestgröße eines gerade noch lesbaren Zeichens eine große Rolle [Stadler 2004].
Als graphische Mindestdimensionen bezeichnet man Mindestwerte zur Wahrnehmung (Auffassbarkeit, Lesbarkeit) eines Kartenzeichens bzw. eines graphischen Elements im Bezug auf seine Größe und seinen Abstand von einem anderen Kartenzeichen unter normalen Wahrnehmungsbedingungen [Bollmann et al. 2002].
Sie hängen von zwei Faktoren ab:
dem Auflösungsvermögen des menschlichen Auges und
den Beschränkungen des verwendeten Ausgabemediums bzw. der Leistungsfähigkeit des kartentechnischen Verfahrens.
Die Distanz, bei der zwei Punkte gerade noch getrennt wahrgenommen werden, wird als Auflösungsvermögen des menschlichen Auges bezeichnet. Es ist abhängig vom Leseabstand, von der Wellenlänge des Umgebungslichts und vom Sehvermögen des Betrachtenden. Bei normalem Tageslicht ergeben sich folgende Werte für das Auflösungsvermögen in Abhängigkeit vom Leseabstand (Tab. 2):

Leseabstand	Auflösungsvermögen
30 cm (Papier)	0,05 mm
60 cm (Bildschirm)	0,10 mm[7]

Tabelle 2: Auflösungsvermögen in Abhängigkeit vom Leseabstand (nach Neudeck [2001])

Bei der Definition von graphischen Mindestdimensionen sollte man sich deutlich oberhalb der Grenzen visueller Wahrnehmung bewegen, um eine Diskriminierung weniger „scharf" sehender Menschen zu vermeiden. Betrachtet man die Limitierungen der Printausgabe von etwa 100 Linien/cm, entspricht das einer minimalen Linienstärke von 0,1 mm. Nachdem als Leseabstand für Papierkarten meist 30 cm angenommen werden, ist dieser Wert eindeutig größer als das Auflösungsvermögen des menschlichen Auges für diesen Abstand und daher bestens als Minimaldimension geeignet. Diese und auch weitere wichtige Minimaldimensionen sind in Tab. 3 aufgeführt.

Bei der Kartengestaltung für die Darstellung am Bildschirm sind deutlich höhere Mindestdimensionen einzuhalten, auch wenn dadurch die gewohnte graphische Feinheit nicht mehr erreicht werden kann. Grund dafür sind die technischen Restriktionen des Bildschirms.

	Printtechnische Mindestdimensionen		Bildschirmbedingte Mindestdimensionen		
Strichstärke	0,1 mm		1 pt	0,4 mm	
Linienabstand	0,2 mm		2 pt	0,8 mm	
Quadrat, voll	0,3 mm		3 pt	1,1 mm	
Kreisscheibe, voll	0,4 mm		4 pt	1,5 mm	
Rechteck, voll	0,3 mm x 0,6 mm		3 pt x 6 pt	1,1 mm x 2,3 mm	
Schrift horizontal, Versalienhöhe	5 pt = 1,9 mm	Schrift	10 pt	3,8 mm	Verdana
Schrift gebogen, Versalienhöhe	7 pt = 2,6 mm	Schrift	14 pt	5,3 mm	Verdana

Tabelle 3: Graphische Mindestdimensionen für Papier und Bildschirm (nach Malić [1998], Neudeck [2001])

Die in Tab. 3 enthaltenen Angaben für graphische Mindestdimensionen beziehen sich auf die Betrachtung stark kontrastierter Graphikelemente (beispielsweise schwarze Linien auf weißem Grund) bei normalen Lichtverhältnissen. Bei geringerem Tonwert- bzw. Farbgewichtsunterschied sowie schlechteren Lichtverhältnissen müssen größere Mindestdimensionen eingehalten werden.

Abb. 2 zeigt Bildschirmdarstellungen von Wien mit unterschiedlicher Kartengraphik: Links ist die Geometrie einer analogen Karten mit den Minimaldimensionen für den Druck versehen, rechts wurde die Geometrie den Ansprüchen des Bildschirms entsprechend generalisiert und anschließend bildschirmgerecht signaturiert.

Abbildung 2: Wien mit nicht bildschirmgerechter (0,1 mm, 0,2 mm, 0,3 mm) und bildschirmgerechter Kartengraphik (0,4 mm, 0,8 mm, 1,1 mm).

4.2.2 Bildschirmgerechte Signaturierung

Um die Bildstörung möglichst gering zu halten ist es neben der Einhaltung der Mindestdimensionen auch wesentlich bei der Signaturierung auf die geeignete Farb-, Form-, Richtungs-, Muster- und Schriftwahl zu achten

Bei der Farbwahl für Darstellungen am Bildschirm bestehen keine technischen Einschränkungen, es sei denn, die Ausgabe erfolgtt mittels Stiftplotter[8]. Abhängig von der Farbtiefe des Bildschirms bzw. der Graphikkarte kann eine Vielzahl von Farben im additiven RGB-Farbraum erzeugt werden. Relativiert wird diese Aussage lediglich durch die nötige Differenzierbarkeit dargestellter Farben. Diese bedingt Intensitätsunterschiede von 20 % in den Grundfarben (bei dunklen Farben sogar 40 %). Um eine gewisse Standardisierung zu erreichen, wurden „indizierte Webfarben" eingeführt, deren RGB-Werte sich an die im hellen Bereich

[7] Aus dem Wert 0,10 mm für das Auflösungsvermögen aus 60 cm Entfernung erkennt man auf den ersten Blick den Grund dafür, dass einzelne Bildelemente, deren Größe zwischen 0,20 mm x 0,20 mm und 0,40 mm x 0,40 mm schwankt, noch eindeutig wahrgenommen werden können.

[8] Bei Stiftplottern besteht eine begrenzte Auswahl an Farben, da jede zu druckende Farbe als eigener Stift im Stiftekarussell vorhanden sein muss.

geforderten 20 % Intensitätsunterschied halten. Daneben sind natürlich auch die traditionell üblichen Konventionen bezüglich der Verwendung assoziativer Farben und einer deutlichen Unterscheidbarkeit von Vorder- und Hintergrund zu beachten.
Bei der Form-, Richtungs- und Musterwahl für Darstellungen am Bildschirm wäre die Einhaltung folgender Punkte optimal:
Verwendung von rechteckigen und quadratischen anstelle von kreisfömigen, dreieckigen oder sonstigen Punktsignaturen,
Ausrichtung nach der Bildpunktmatrix (Vermeidung schräger Punktsignaturen und Linien),
Vermeidung von Linienmustern (strichlierte Linien, Doppellinien etc.),
Verwendung von Flächenfarben anstelle von Flächenmustern und
geringer Einsatz von linearen Graphikelementen (keine Umrandungen von Flächen etc.).
Bei der Schriftwahl für Darstellungen am Bildschirm sollte man sich auf serifenlose Schriften beschränken und diese möglichst nur horizontal verlaufen lassen. Die Beschriftung ist bei konventionellen Karten von großer Bedeutung. Bei der Darstellung am Bildschirm beeinträchtigen die Deformationen durch die Bildstörung die Lesbarkeit, sodass es sinnvoll ist, eine alternative Form der Schriftdarstellung zu wählen. Abhilfe schaffen Interaktionsmöglichkeiten wie ToolTips, die temporär zur Anzeige beliebiger Attribute verwendet werden können.

5 VORSCHLÄGE FÜR DIE „CROSS MEDIA" GERECHTE KARTENGRAPHIK IN EINEM AIS

Bei der Definition von Vorschlägen für die Kartengraphik in einem AIS wird ein dualer Charakter die Ausgabemedien betreffend vorausgesetzt. Das System soll sowohl die bildschirmgerechte Darstellung als auch eine qualitativ hochwertige Printausgabe[9] gewährleisten. Wie bereits beschrieben, handelt es sich bei Papier und Bildschirm um zwei technisch und auch kapazitätsmäßig grundsätzlich unterschiedliche Ausgabemedien. Jedes für sich muss, um dem Anspruch der Lesbarkeit zu genügen, eine dem Medium gerechte Kartengraphik verwenden.
Dabei bedeutet die systemtechnische Umwandlung in die jeweiligen Ausgabeformate und die Verbindung zu den Ausgabegeräten weniger Aufwand als die nötige kartographische Modellbildung (maßstabsabhängige Generalisierung und Harmonisierung). Durch die noch nicht gelöste Problematik der vollautomatischen kartographischen Modellbildung ist es derzeit nicht möglich, on-the-fly beliebige, maßstabsabhängige Datenvisualisierungen bereitzustellen. Dies würde bald zu unleserlichen und damit sinnlosen Bildschirmpräsentationen der topographischen Verortungsgrundlage sowie der Sachdaten führen.
Daher ist es ratsam, für beide Ausgabemedien Maßstabsreihen zu definieren und durch die Anpassung der Kartengraphik kartographisch vorgefertigte und inhaltlich harmonisierte Maßstabsebenen zu schaffen. Diese repräsentieren die Realwelt in anderen räumlichen Auflösungen. Die Rückkoppelung ist nur durch Zugriffe zu den Geobasisdaten (Primärdaten) möglich. Um die Deformationen der Kartengraphik durch die Bildstörung möglichst gering zu halten, sollten nur beschränkte Zoombereiche innerhalb der Maßstabsebenen zugelassen werden.

5.1 Signaturierung einer bildschirmgerechten Basiskarte

Wegen der unterschiedlichen bildschirmeigenen Parameter ist die Festlegung von Mindestdimensionen am Bildschirm sehr komplex. In Tab. 3 wurden Mindestdimensionen für Linien, Linienabstände, minimale Grundformengrößen (im Hinblick auf Formerkennbarkeit) und Schrift angegeben. Wesentlich sind auch die Einschränkungen im Bezug auf Farb-, Form- und Schriftwahl.
Unter Berücksichtigung der Grundregeln bildschirmgerechter Visualisierung wurde von den Autoren ein Signaturierungsvorschlag für die Basiskarte (größte Maßstabsebene) eines AIS entwickelt. Ziel ist es, für die topographischen Inhaltselemente eine maßstabsangepasste, kartographisch aufbereitete Darstellung am Bildschirm zu gewährleisten.
Die Angaben bezüglich Stil, Dimension und Farbe können Tab. 4 entnommen werden. Die Reihenfolge der Inhaltsebenen entspricht ihrer Hierarchie in der Karte. Je höher die Elemente in der Tabelle angeführt sind, desto höher liegen sie auch in der Karte und desto weniger verdeckt werden sie daher von Elementen anderer Ebenen.
Die Farbwahl beruht auf der Palette indizierter Webfarben, die Intensitätswerte für die additiven Grundfarben Rot, Grün und Blau (RGB) sind jeweils in Hexadezimal- und Dezimalcode aufgeführt. Um eine bessere Vorstellung von der Signaturierung zu bekommen, sind die entsprechenden Werte bzw. Tabellenfelder (wenn möglich) farblich kodiert.

Inhaltsebenen (Reihenfolge nach Hierarchie)	Stil, Dimensionen (1 pt = 0,375 mm)	RGB - Farben (Hexadezimal- / Dezimalcode)
Städte - Signaturen:		
<10.000	Quadrat 5 pt – 1,9 mm	#000000 – 0, 0, 0
10.000 – unter 50.000	Quadrat 9 pt – 3,4 mm	#000000 – 0, 0, 0
50.000 – unter 150.000	Quadrat 14 pt – 5,3 mm	#000000 – 0, 0, 0
150.000 – unter 1.000.000	Quadrat 20 pt – 7,5 mm	#000000 – 0, 0, 0
>1.000.000	Quadrat 27 pt – 10,1 mm	#000000 – 0, 0, 0
Städte – Schrift:		
Allgemein	Verdana, 10 pt, fett	**#000000 – 0, 0, 0**
Landeshauptstädte	Verdana, 12 pt, fett, unterstrichen	**#000000 – 0, 0, 0**
Bundeshauptstädte	Verdana, 12 pt, fett, unterstrichen, Großbuchstaben	**#000000 – 0, 0, 0**
Straßen:		
Autobahn	Mittellinie: 4,5 pt – 1,7 mm Band: 9 pt – 3,4 mm	**#FFFF00 – 255, 255, 0** **#FF3333 – 255, 51, 51**
Bundesstraße	4 pt – 1,5 mm	**#009900 – 0, 153, 0**
Schnellstraße	2 pt – 0,8 mm	**#FF3333 – 255, 51, 51**
Eisenbahn:	punktiert 4 pt – 1,5 mm	**#000000 – 0, 0, 0**

[9] Das Angebot einer qualitativ hochwertigen Printausgabe wird in den meisten webbasierten AIS leider noch sehr rudimentär behandelt.

Gewässer:		
Flüsse	1,5-4 pt – 0,6-1,5 mm	**#3366FF – 51, 102, 255**
Flächenfüllung (ohne Randlinie)		#6699FF – 102, 153, 255
Grenzen:		
Staaten	Mittellinie: 2 pt – 0,8 mm Band: 14 pt – 5,3 mm	**#666666 – 102, 102, 102** **#CCCCCC – 204, 204, 204**
Bundesländer	Mittellinie: 2 pt – 0,8 mm Band: 9 pt – 3,4 mm	**#666666 – 102, 102, 102** **#CCCCCC – 204, 204, 204**
Bezirke	Mittellinie: 2 pt – 0,8 mm Band: 5 pt – 1,9 mm	**#666666 – 102, 102, 102** **#CCCCCC – 204, 204, 204**
Gemeinden	2 pt – 0,8 mm	**#CCCCCC – 204, 204, 204**
Dauersiedlungsraum:	Flächenfüllung (ohne Randlinie)	#FFCC99 – 255, 204, 153
Österreich:		
Staatsfläche (Österreich)	Flächenfüllung	#FFFFCC – 255, 255, 204
ToolTips:		
administrative Einheiten (jeweils die kleinste)	Verdana, 10 pt, fett	**#000000 – 0, 0, 0**
Gewässer (Flüsse, Seen)	Verdana, 10 pt, fett	**#3366FF – 51, 102, 255**
Nachbarländer	Verdana, 10 pt, fett, Großbuchstaben	**#000000 – 0, 0, 0**

Tabelle 4: Signaturierungsvorschlag für die Kartengraphik der Basiskarte im Maßstab 1 : 250k.

Die Dimensionsangaben in Tab. 3 und 4 erfolgen sowohl in Bildelementen als auch metrisch. Die metrische Angabe stellt lediglich eine durchschnittliche Größe dar, da die tatsächliche Größe der Bildelemente von Bildschirm zu Bildschirm und von Auflösung zu Auflösung variiert. Als Umrechnungsfaktor dient der typographische Punkt. Für die Signaturierung sollten jeweils die Bildelementangaben eingehalten werden. Dies lässt sich leicht umsetzen, indem man der Graphik die Auflösung des zur Ausgabe vorgesehenen Bildschirms zuweist und man somit bildschirmgerechte Größen der Signaturen erzielen kann.
Abb. 3 stellt das Ergebnis der vorgeschlagenen Signaturierung dar.

Abbildung 3: Ausschnitt aus der bildschirmgerechten Karte 1 : 250k (100 dpi)

5.2 Adaption bildschirmgerechter Signaturierung für hochwertige Printkarten

Bei der Kartengestaltung für die Darstellung am Bildschirm müssen wegen der niedrigeren Auflösung deutlich höhere Mindestdimensionen als bei Printkarten beachtet werden. Geht man (sicherheitshalber) von der relativ großen Bildelementgröße 0,375 mm (1 pt) und einer durchschnittlichen Druckauflösung von 0,1 mm aus, so ergibt sich eine ca. 4 mal gröbere Auflösung des Mediums Bildschirm. Das bedeutet, dass man konventionelle Kartengraphiken für Printkarten 4-fach vergrößern müsste, um eine akzeptable Darstellung am Bildschirm zu erreichen. Akzeptabel, weil die Minimaldimensionen zwar eingehalten, die Grundregeln

für die Signaturierung aber nicht beachtet werden. Dieses Manko könnte man beseitigen, indem man neben der Vergrößerung eine bildschirmgerechte Signaturierung durchführt. So erhält man eine bildschirmgerechte Karte mit 4 mal größerem Maßstab, aber der gleichen Informationsdichte wie die korrespondierende Printkarte.
Nachdem es kaum Gründe gibt, die gegen die Verwendung bildschirmgerechter Graphik auch für den Druck sprechen, entstand die Idee, eine bildschirmgerechte Karte zu erzeugen und diese in 4 facher Verkleinerung als Printkarte wiederzuverwenden. Eine Ausnahme stellt allerdings die Schrift dar, da sie nicht um denselben Faktor verkleinert werden kann und durch die nicht vorhandenen ToolTips in der Printkarte gegebenenfalls mehr Schriftzüge enthalten sein müssten.
In Abb. 3 ist ein Ausschnitt der printfertigen Karte 1 : 250k zu sehen. Die Kartengraphik ist mit Ausnahme der Schrift durch reine Verkleinerung der in Abb. 4 dargestellten bildschirmgerechten Karte 1 : 1 Mio entstanden. Die 4 fache Verkleinerung ergibt automatisch den 4 fach kleineren Maßstab, die interne Auflösung ist 4 mal so groß (400 dpi) und den technischen Anforderungen des Prints (oder auch des möglichen Offsetdrucks) angepasst.

Abbildung 4: Ausschnitt aus der druckfertigen Karte 1 : 1 Mio (400 dpi)

6 RESÜMEE

Man spricht heute von einer neuen Generation der Karte – der Bildschirmkarte, die in einem interaktiven AtlasInformationsSystem (AIS) als graphische Benutzeroberfläche und Benutzerschnittstelle dient. Über die Elemente der Kartengraphik werden durch interaktive Systemfunktionalitäten Zugriffe zu den primären Daten (Geobasisdaten: Geometrie- und Sachdaten) gestattet. Voraussetzung dafür ist die Anwendung einer klaren, lesbaren, maßstabsabhängigen und den technischen Anforderungen des Ausgabemediums Bildschirm angepassten Kartengraphik.
Um die technischen Restriktionen des Ausgabemediums Bildschirm zu überwinden, müssen beim Aufbau des AIS genaue Richtlinien für die Gestaltung der Kartengraphik sowie die Definition der Systemfunktionalitäten zur Informationserschließung festgelegt werden.
Die meisten Benutzer erwarten heutzutage neben der Darstellung am Bildschirm auch eine analoge Ausgabe. Die Autoren haben gezeigt, dass unter Beibehaltung der Prinzipien maßstabsabhängiger, kartographischer Datenaufbereitung auf einfache Art und Weise ein AIS mit „Cross-Media“ gerechter Kartengraphik erstellt werden kann.
Weitere Forschungsanstrengungen sollten in die Lösung der Schriftbehandlung gesteckt werden. Wie oben beschrieben, ist beim Ausgabemedium Papier einerseits der Platzbedarf für konfliktfreie Schriftzüge (relativ zur Ausgabe am Bildschirm betrachtet) höher und andererseits hat die Schrift innerhalb der Papierkarte einen höheren Stellenwert, da die Möglichkeit der interaktiven Informatiopnserschließung wegfällt.

7 LITERATUR

ASCHE, H. (2001): Kartographische Informationsverarbeitung in Datennetzen – Prinzipien, Produkte, Perspektiven. In: Herrmann, Ch. und H. Asche (Hrsg.): Web.Mapping 1. Heidelberg, Wichmann. 3-18.

BOLLMANN, J. & W. G. KOCH (2002): Lexikon der Kartographie und Geomatik. Heidelberg, Spektrum.

CARTWRIGHT, W. &. M.P. PETERSON (1999): Multimedia Cartography. In: Cartwright, W., M.P. Peterson &. G. Gartner (Hrsg.): Multimedia Cartography. Springer, Berlin. 1-10.

ELZAKKER C. V. (1993): The use of electronic atlases. In: Klinghammer, I., L. Zentai & F. Ormeling (Hrsg.): Seminar on Electronic Atlases. Cartographic Institute of Eötvös Lorand University, Visegrad, Hungary. 145-155.

GARTNER, G., K. Kriz, Ch. Spanring & A. Pucher (2005): The Concept of "Restrictive Flexibility" in the “ÖROK Atlas Online”. In: International Cartographic Association (Ed): Proceedings of International Cartographic Conference 2005, La Coruna/Spain (CD).

GOODCHILD, M.-F. (2000): Cartographic Future on a Digital Earth. In: Cartographic Perspectives, 36, 3-11.

HAKE, G., GRÜNREICH, D. & MENG, L. (2002): Kartographie. 8. Aufl. Berlin, De Gruyter.

ICA (2005): Internet-based cartographic teaching and learning: Atlases, map use and visual analytics. Proceedimgs of Joint ICA Commissions Seminar. International Cartographic Association, Universidad Polytecnica de Madrid.

KEATES, J.S. (1989): Cartographic Design and Production, 2. Aufl. Longman Scientific & Technical, Essex.

KRAAK, J.-M. & F. ORMELING (1996): Cartography: visualization of geospatial data. Longman Scientific & Technical, Essex.

KRAAK, M.-J. (2001): Web Maps and Atlases. In: Kraak, M.-J. & A. Brown (Hrsg.): Web Cartography, Taylor and Francis, London. 135-140.

LECHTHALER, M. (2004a): Cartographic Models as a Basis for Geo-Communication. In: Kereković, D. (Hrsg.): Geographical Information Systems in Research&Practice. International Conference on GIS. GIS Forum - Hrvatski Informatički Zbor, Zagreb, Croatia. 19-32.

LECHTHALER, M. (2004b): The relevance of cartographic scale in interactive and multimedia cartographic information systems. In: Lapaine, M. (Hrsg.): Kartografija i geoinformacije. Scientific and Professional Information Journal of the Croatian Cartographic Society. 6-20.

LECHTHALER, M. (2005): Bildschirmgerechte kartographische Visualisierung der Geobasisdaten in digitalen Atlas Informationssystemen. In: Strobl, J., G. Griesebner (Hrsg.): Angewandte Geoinformatik 2005, Beiträge zum 17. AGIT-Symposium, Salzburg. 402-412.

MALIĆ B. (1998): Physiologische und technische Aspekte kartographischer Bildschirmvisualisierung. Dissertation, Rheinische Friedrich-Wilhelms-Universität zu Bonn. Druck- und Werbegesellschaft m. b. H., Bonn.

NEUDECK S.(2001): Zur Gestaltung topografischer Karten für die Bildschirmvisualisierung. Dissertation, Universität der Bundeswehr München, Heft 74.

ORMELING, F. (1996): Functionality of Electronic School Atlases. In: Köbben, B., F. Ormeling & T. Trainor (Hrsg.): Seminar on Electronic Atlases II, ICA Proceedings on National and Regional Atlases. Prague. 33-39.

ORMELING, F. (2001): Das Bändigen von Multimedia-Konzepten für den Online-Atlas der Niederlande. In: Herrmann, Ch. & H. Asche (Hrsg.): Web.Mapping 1 – Raumbezogene Information und Kommunikation im Internet, Wichmann, Heidelberg. 178 – 189.

PERSSON, D., G. GARTNER & M. BUCHROITHNER (2005): Towards Typology of Interactivity Functions for Visual Map Exploration. In: Stefanikis, E., M.-P. Peterson, C. Armecanis & V. Delis (Hrsg.): Geo-Hypermedia’05, Proceedings of the 1. International Workshop on Geographic Hypermedia, Denver, Colorado, U.S.A.

RAMOS, C.-DA S., & W. CARTWRIGHT (2005): Atlases from paper to digital medium. In: Stefanikis, E., M.-P. Peterson, C. Armecanis & V. Delis (Hrsg.): Geo-Hypermedia’05, Proceedings of the 1. International Workshop on Geographic Hypermedia, Denver, Colorado, U.S.A.

ROBINSON , A.H., MORRISON, J.L., MUEHRCHE, P.C. KIMERLING, A.J. & GUPTIL, S.C. (1995): Elements of Cartography, 6.Aufl. JohnWiley&Sons, New York.

SPIESS, E., U. BAUMGARTNER, S. ARN u. C. VEZ(2002): Topographsiche Karten, Kartengraphik und Generalisierung. Schweizerische Gesellschaft für Kartographie (Hrsg). Kartographische Publikationsreihe Nr.16.

SIEKIERSKA, E. & D. WILLIAMS (1996): National Atlas of Canada on the Internet and School-Net. In: Köbben, B., F. Ormeling & T. Trainor (Hrsg.): Seminar on Electronic Atlases II, ICA Commission on National and Regional Atlases, Prague. 19-23

STADLER, A. (2004): Verknüpfung korrespondierender Kartenelemente im Hinblick auf automatisierte Fortführung. Diplomarbeit, Institut für Geoinformation und Kartographie, TU Wien.

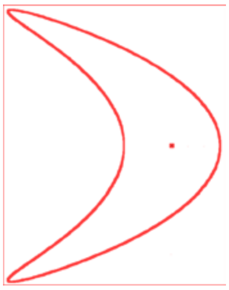
WBE (1993): World Book Encyclopedia, Vol. 1, World Book, 868-869.

[URL1] http://de.wikipedia.org/wiki/Bild:Mercator_-_Atlas_-_1595.png (zuletzt besucht am 20. November 2005)

IKone - Computergestützte Auswertung von Konversionsflächen mithilfe von Voronoi Diagrammen

H. HAGEN, G. STEINEBACH, I. SCHELER, M. RUBY

(Prof. Dr. H. Hagen, TU Kaiserslautern, AG Computergraphik und Computergeometrie, Postfach 3049, Kaiserslautern, hagen@informatik.uni-kl.de)
(Prof. Dr.-Ing. G. Steinebach, TU Kaiserslautern, Lehrstuhl Stadtplanung, Postfach 3049, Kaiserslautern, steineb@rhrk.uni-kl.de)
(Dipl.-Ing. I. Scheler, TU Kaiserslautern, AG Computergraphik und Computergeometrie, Postfach 3049, Kaiserslautern, scheler@rhrk.uni-kl.de)
(Dipl.-Inform. M. Ruby, TU Kaiserslautern, AG Computergraphik und Computergeometrie, Postfach 3049, Kaiserslautern, ruby@rhrk.uni-kl.de)



1 ABSTRACT

In this paper we present our computer based tool **IKone** tailor-made to support the process of redevelopment of military conversion areas. The need of re-planning conversion areas for different utilizations is expected. The main actors in this special planning process are the county, the investor and the vendor. Our work is focused on the profiles of different sites and their analysis based on the need of the decision makers. We identify and describe all the determining indicators. Afterwards we arrange the multiple parameters according to the different views fixed by the actors. We define the different views by an individual weighting of hard and soft location factors. Our great conclusion is the absolutely required independence of the defining parameters. Combining a clustering-process with a selective visualization technique provides a powerful tool for interpretation. Our goal is to superpose the clustering and visualization process with the geographic position of the conversion area. The tool is part of the data management and visualization system DaMaViS which we presented at last years CORP.

2 EINFÜHRUNG

Die Konversion freiwerdender militärischer Flächen wird in den nächsten Jahren in Europa weiterhin eine wichtige Rolle im Rahmen der Stadt-, Raum- und Umweltplanung einnehmen. Diese Situation ist bedingt durch zahlreiche Umstrukturierungen der in Europa stationierten Streitkräfte zur Anpassung an die veränderten Sicherheitsbedürfnisse europa- und weltweit. Im deutschen Bundesland Rheinland-Pfalz stellt die Konversion ein großes Problem dar. Der Abzug der französischen Truppen sowie der Teilabzug der amerikanischen Streitkräfte bedingte ein Freiwerden zum Teil großer Flächen sowohl in guter Innenstadtlage als auch in Randlagen. Es wird vermehrt notwendig sein, freiwerdende Liegenschaften auch im Bereich der zivilen Konversion (freiwerdende Bahn- und Postflächen) zu überplanen und in die städtebaulichen und raumplanerischen Rahmenbedingungen einzupassen. Die Lösung der damit verbundenen Probleme erfolgt zurzeit noch fast vollständig ohne Computerunterstützung und geeignete Programme. Grundlage für die Bearbeitung dieser Konversionsflächen sind bisher statistische Erhebungen und weiterführende Bestandsaufnahmen.

Abbildung 1: Konversion in Kaiserslautern [17]

Mit der hier vorgestellten computergestützten Entscheidungshilfe schaffen wir eine Möglichkeit, die im Umnutzungsprozess der Konversionsflächen Involvierten schneller und zielorientiert zu einer Entscheidungsfindung zu führen. Das entwickelte Tool sammelt die im Laufe der Bestandsaufnahme anfallenden Informationen und wertet diese sichtweisenbezogen für die einzelnen Akteure aus. Sie erhalten somit eine direkte Rückkopplung, welche Gebietseinteilungen für sie von besonderem Vorteil sind.
Im folgenden Abschnitt 3 wird die wissenschaftliche Einbettung der computergestützen Entscheidungshilfe dargestellt. Kernstück unserer Arbeit ist der Prozess des Information Clustering, mit dem sich Abschnitt 4 beschäftigt. Ausgangspunkt des Information Clustering ist eine Bestandsaufnahme der Konversionsdaten sowie die Definition der Konversionsfläche durch Parameter. Mit Hilfe der Parameter wird eine Zielfunktion aufgebaut, die den Clusterprozess charakterisiert. Die Konversionsdaten fließen in die Zielfunktion ein und werden durch sie in n-dimensionale Objekte gruppiert. Das Clustering liefert somit eine Neuordnung der

Parameter und bildet die Basis für die Interpretation der Konversionsdaten. Als Methode für das Clusteringverfahren verwenden wir verallgemeinerte Voronoi Diagramme. Durch die Wahl dieses Verfahrens ist es uns möglich, die zahlreichen Parameter der Zielfunktion zuzuführen. Eine weitere nützliche Option der verallgemeinerten Voronoi Diagramme bietet die Integration von Gewichten in das Clusteringverfahren. Mit Hilfe der Gewichte ist es uns möglich die verschiedenen Sichten der Akteure auf die Konversionsfläche zu verwalten. Wir erweitern den Ansatz der Voronoi Diagramme mit Metriken durch die Verwendung von topologieerhaltenden Distanzfunktionen. Im Anschluss an das Clustering erfolgt eine Visualisierung der Objekte mittels Techniken aus dem Gebiet der Informationsvisualisierung. Unser Tool zur computergestützten Auswertung von Konversionsflächen ist in das Datenmanagementsystem DaMaViS (**Da**ten**Ma**nagement**Vi**sualisierungs**S**ystem) [1] integriert. In Abschnitt 5 werden die Resultate unserer Arbeit vorgestellt, Abschnitt 6 fasst diese Arbeit zusammen und in Abschnitt 7 schließlich wird ein Ausblick auf zukünftige Arbeiten gegeben.

3 GRUNDLAGEN

Im Bereich der Raum- und Umweltplanung werden zurzeit verstärkt den Planungsprozess unterstützende Systeme (planning support system) entwickelt. Diese Systeme haben zum Ziel, spezielle Sachverhalte im Planungsbereich leicht verständlich darzustellen. Der Planungsprozess ist so gegliedert, dass zunächst eine Analyse der Fragestellung basierend auf statistischen Informationen durchgeführt wird. Anschließend wird eine systematische Analyse der verschiedenen Möglichkeiten durchgeführt. Die bisher in der Planung zum Einsatz kommenden computergestützten Systeme kombinieren überwiegend statische Daten verschiedener Datenbanken miteinander und stellen diese visuell zwei- oder dreidimensional dar. Durch diese visuelle Hilfe sollen die in den Planungsprozess involvierten Personen schneller zu einer Entscheidungsfindung gelangen. Beispielsweise werden Statistiken und Karten zwei- oder dreidimensional dargestellt. Normalerweise erfolgt keine Interpretation der Daten, die Visualisierung wird lediglich eingesetzt, um einen rein optischen Überblick zu geben. Es liegen bereits einige Ansätze vor, die existierende GIS-Systeme mit zusätzlichen Informationen kombinieren. Hopkins [2] beschreibt beispielsweise die Struktur eines Systems, welches statische Elemente der Planung mit dynamischen Prozessen, bspw. das Wachstum von Pflanzen oder Luftzirkulationen, vereint. Andere Systeme verknüpfen die Darstellung von 3D Stadtmodellen mit weiteren Informationen, wie z.B. Lärm [3]. In dem Paper von K. Kanzler und N. de Lange [4] wird eine Übersicht über den Einsatz von GIS-Systemen in der Regionalplanung gegeben.

Ein interessanter Ansatz GIS-Systeme mit der Clusteranalyse zu verknüpfen, wurde im Anwendungsfeld Bodenkunde durch M. Fecht [6] erstellt. Eine kürzliche Arbeit von Keith Andrews [10] ist das InfoSky System. InfoSky ist ein Such- und Navigations-Visualisierungssystem, welches Anwendern die effiziente Erforschung großer, hierachisch strukturierter Dokumentenablagesysteme ermöglicht. Hierbei wird die Geometrie der Voronoi Diagramme zum Clustern eingesetzt. Die hierachische Struktur wird durch eine rekursive Voronoi-Unterteilung des zur Verfügung stehenden Raumes erreicht.

Die Interpretation der Ergebnisse der Clusteranalyse erfolgt am sinnvollsten unterstützt durch eine aussagekräftige Visualisierung. In den letzten Jahren wurden im Gebiet der multidimensionalen und multivariaten Informationsvisualisierung verschiedenste Techniken entwickelt [7], die sich für den Einsatz im Rahmen der Konversion eignen. Wir haben die Techniken untersucht und auf ihre Eignung für den Einsatz im Bereich der Konversion geprüft. Die sogenannten stick figures von Pickett und Grinstein [8] eignen sich sehr gut, räumliche Daten darzustellen und lassen sich effektiv mit einer Karte kombinieren. Der Nachteil ist, dass sie auf eine geringe Anzahl von Dimensionen beschränkt sind. Eine Erweiterung dieser Techniken stellt aber einen vielversprechenden Ansatz für die Konversion von Flächen dar. Der Ansatz von Kleiberg, van de Wetering und van Wijk [9] im Bereich der botanischen Informationvisualisierung bildet eine gute Grundlage, eine optische Überlappung der Visualisierung mit der zweidimensionalen Karte zu vermeiden.

Das von uns entwickelte Datenmanagementsystem DaMaViS (DatenManagementVisualisierungsSystem) [1] vereinigt verschiedene Insellösungen in einem System für die Anwendung in der Stadtplanung. DaMaViS benutzt generische Datenstrukturen, wodurch es in der Lage ist, Daten aus den unterschiedlichsten Anwendungsdomänen zu verarbeiten. Beispielsweise kann es eingesetzt werden, die Daten eines Geographischen Informationssystems zu verwalten und zu visualisieren [16]. Um mit dem System eine interpretierende Visualisierung vornehmen zu können, haben wir für DaMaViS die hier vorgestellte computergestützte Entscheidungshilfe **IKone** (**I**nterpretation von **Kon**versionsflächen) entwickelt.

Die Konversion ist ein komplexer Teilbereich des Planungsprozess, der sich mit der Umnutzung ehemals militärischer Liegenschaften befasst. Die in Frage kommenden Flächen sind durch die jahrelange einseitige Nutzung vollkommen von der Entwicklung der Umgebung abgekoppelt und müssen nun wiedereingegliedert werden. Die Studie vom Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

[5] vermittelt einen Überblick über die generelle Struktur des Planungsprozesses im Bereich der Konversion. Mit unserer Entscheidungshilfe schaffen wir die Möglichkeit, die im Umnutzungsprozess der Konversionsflächen Involvierten schneller und zielorientiert zu einer Entscheidungsfindung zu führen. Das vorgestellte Tool **IKone** sammelt die im Laufe der Bestandsaufnahme anfallenden Informationen und wertet diese mittels eines Information Clustering Verfahrens sichtweisenbezogen für die Akteure aus. Dazu wird zunächst ein Clusteringprozess durchgeführt, der die vielfältigen Informationen gruppiert und in Abhängigkeit der Akteure gewichtet. An diesen Clusteringprozess schließt sich eine Visualisierung mit Verfahren aus dem Bereich der Informationsvisualisierung an, die schließlich die Interpretation der Konversionsdaten ermöglicht.

4 INFORMATION CLUSTERING

Der Prozess des Information Clustering gliedert sich in zwei Hauptschritte, das Clustering und die Visualisierung. Voraussetzung für das Clustering ist eine Bestandsaufnahme der Konversionsfläche sowie deren Definition durch die bestimmenden Parameter. Bei der Auswahl der bestimmenden Parameter ist vor allem die Unabhängigkeit der Parameter untereinander von Bedeutung. Nach der Bestandsaufnahme der Konversionsfläche fließen diese in die Zielfunktion ein. Die Zielfunktion ist der zentrale Punkt des Information Clustering. Für dessen Aufbau orientieren wir uns an der bewährten Methode der Voronoi Diagramme und untersuchen dieses auf die topologischen Eigenschaften. Durch das Clustering werden die Daten neu geordnet und somit mehrdimensionale Objekte identifiziert. Den zweiten Schritt des Information Clustering stellt die Visualisierung der Ergebnisse dar. Der Grundgedanke hierfür ist die Zuordnung der Objekte mittels deren geographischer Position zu den Flächen. Die Visualisierung erfolgt mit Techniken aus dem Bereich der Informationsvisualisierung, die sich für eine Interpretation der abstrakten Objekte besonders eignet.

Im folgenden Abschnitt 4.1 werden zunächst die Parameter bestimmt, die die Fläche definieren. In Abschnitt 4.2 wird das Clusterverfahren beschrieben, mittels dem die n-dimensionalen Objekte berechnet werden. Der anschließende Visualisierungsprozess wird in Abschnitt 4.3 vorgestellt. Abschnitt 4.4 beschreibt die Einbettung von **IKone** in das System DaMaViS.

4.1 Parameterauswahl

Der Planungsprozess für die Umnutzung einer freigewordenen Fläche gliedert sich in verschiedene Schritte. Unsere Arbeit konzentriert sich hierbei auf die Profilerstellung der Konversionsflächen gefolgt von einer Analyse basierend auf den Ansprüchen der Entscheidungsträger. Der Hauptaugenmerk liegt bei der Profilerstellung auf der Auswahl und Kombination der einflussnehmenden Parameter. Die Entscheidungsträger, die den Umnutzungsprozess in Rheinland-Pfalz charakterisieren, sind die drei Akteure Investor, Kommune und Eigentümer.

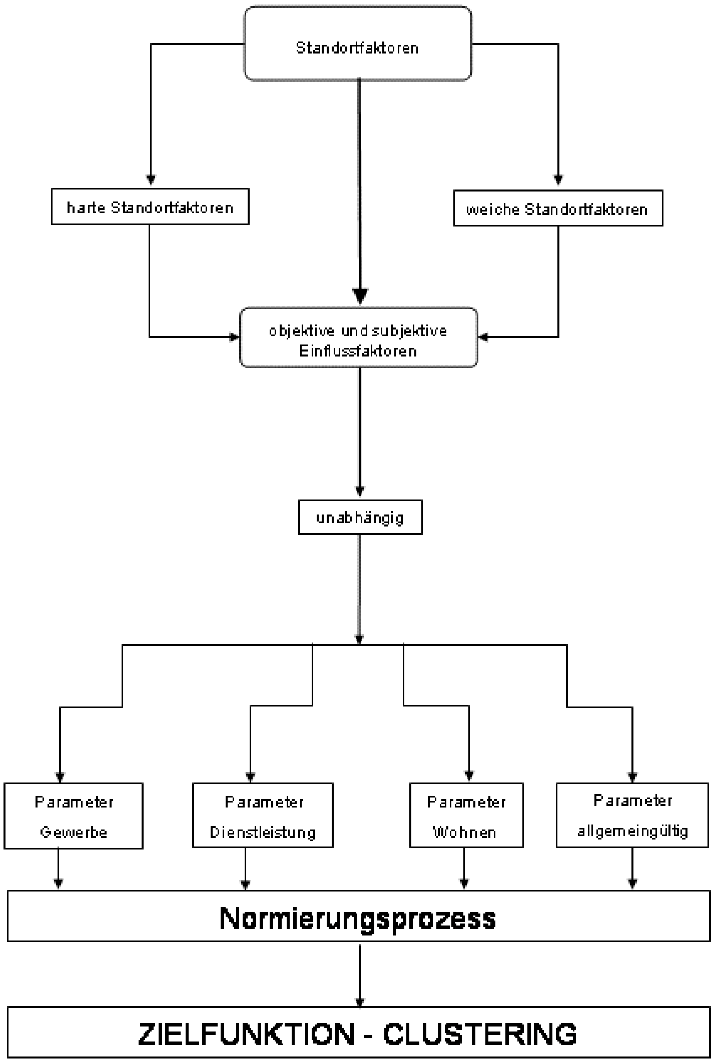


Abbildung 2: Prozess zur Parameteridentifikation

Die Grundlage für das von uns gewählte Clusteringverfahren bildet eine Analyse des Konversionsgebietes. Die Analyse beginnt mit der Bestimmung der Standortfaktoren gefolgt von der Datenerhebung. Abbildung 2 beschreibt den Prozess der Analyse der Standortfaktoren hin zur Parameteridentifikation. Aus den ermittelten Standortfaktoren ergeben sich eine Vielzahl objektiver und subjektiver Einflussfaktoren, die die weitere Nutzung der Fläche bestimmen. Die Standortfaktoren werden von uns gegliedert nach Faktoren, die für alle Nutzungsarten von Interesse sind und solche, die lediglich in den drei Nutzungsarten Wohnen, Dienstleistung und Gewerbe benötigt werden.

Objektive Einflussfaktoren sind alle harten Standortfaktoren. Sie umfassen hauptsächlich natürlich-technische und von Menschen geschaffene Faktoren. Hierzu zählen beispielsweise die Verfügbarkeit von Naherholungs- und Freizeiteinrichtungen, Erreichbarkeit von Arbeitsplätzen, Aufbau des Bodens, das Arbeitskräftepotential, das Bildungsangebot und die Nähe zu einem Flughafen. Bei diesen quantifizierbaren Daten der Flächen handelt es sich sowohl um statistische Daten wie auch um Messdaten, die gezielt an bestimmten Punkten vor Ort oder durch statistische Umfragen erhoben werden.

Darüber hinaus untersuchen wir die subjektiven Einflussfaktoren. Hierzu zählen die weichen Standortfaktoren, die als qualitative Faktoren in die weitere Berwertung eingehen. Als Beispiel für subjektive Einflussfaktoren können die Lebensqualität, das Stadt- und Regionsimage, das Image des Betriebsstandortes etc. gesehen werden. Diese Parameter sind nicht direkt quantifizierbar, sondern werden im Zuge unserer Bestandsaufnahme ermittelt.

Die Gesamtheit der Einflussfaktoren ergibt eine Fülle voneinander abhängiger und unabhängiger Parameter. Für die Klassifizierung der Flächen ergibt sich die unbedingte Forderung nach der Unabhängigkeit der Parameter. Unabhängigkeit wird in diesem Kontext so

definiert, dass ein Parameter nicht durch einen anderen beschrieben werden kann. Alle abhängigen Parameter werden durch einen übergeordneten unabhängigen Paramter ausgedrückt.
Da die Parameter in verschiedenen Einheiten und Dimensionen vorliegen, fügen wir einen Normierungsprozess an. Hierdurch garantieren wir die Vergleichbarkeit der Parameter als Eingangsgrößen der Zielfunktion. Die unabhängigen Parameter werden der Zielfunktion zugeführt.

4.2 Clusteringprozess

Zentraler Punkt des Clusterverfahrens ist die Konstruktion der Zielfunktion. Eingangsparamter der Zielfunktion sind die in Abschnitt 4.1 beschriebenen Parameter der Konversionsfläche. Für die Berechnung verwenden wir verallgemeinerte Voronoi Diagramme [11]. Voronoi Diagramme sind ein bewährtes Verfahren, das in den unterschiedlichsten Anwendungsbereichen mit Erfolg eingesetzt wird. Der Vorteil der Nutzung dieser generellen Struktur ist zum einen deren natürliche Nähe zu Abstandsbeschreibungen und zum anderen die Möglichkeit eine große Menge Parameter berücksichtigen zu können. Um die Sichten der einzelnen Akteure in die Zielfunktion integrieren zu können, erweitern wir den einfachen Ansatz der Voronoi Diagramme durch die Hinzunahme von Gewichten [12]. Hierbei müssen die topologischen Eigenschaften der Zielfunktion berücksichtigt werden, da beispielsweise der Zusammenhang der Unterteilung eine besondere Anforderung bei der Konversion darstellt. Löcher in der Struktur sind spezielle Artefakte, die entweder unterdrückt werden müssen, oder aber toleriert werden können. Auf Grund dessen verwenden wir eine topologieerhaltende Distanzfunktion, mit der wir die Gewichte additiv und multiplikativ verknüpfen.
Zunächst führen wir kurz in die Notation der Voronoi Diagramme ein und beschreiben dann deren topologischen Eigenschaften bei der Verwendung der unterschiedlichen Gewichtungen. Anschließend erläutern wir den Vorteil einer generellen Distanzfunktion gegenüber dem Einsatz von Metriken.

4.2.1 Voronoi Tesselation

Wir betrachten eine Menge P von unterschiedlichen Punkten in R^2, $P = \{p_1, \dots, p_n\} \subset R^2$ mit $2 \le n < \infty$ und $p_i \ne p_j$. Die Voronoi Region $V(p_i)$ ist der Ort derjenigen Punkte, deren Abstand zum korrespondierenden Referenzpunkt p_i näher ist, als zu jedem anderen Punkt p_j, $p_j \in P \backslash \{p_i\}$ in der Ebene. Jede Voronoi Region wird somit durch einen Referenzpunkt erzeugt und erfüllt folgenden Ausdruck:

$$V(p_i) = \bigcap_{p_j \in P \setminus \{p_i\}} H(p_i, p_j) \tag{1}$$

$H(p_i, p_j)$ ist die Halbebene, die alle Punkte im R^2 enthält, die näher zu p_i als zu jedem anderen Punkt p_j liegen. Basis dieser Betrachtung ist eine Distanzfunktion, so dass die Voronoi Region mit einer gegebenen Distanzfunktion d alternativ auch folgendermaßen definiert werden kann:

$$V(p_i) = \{p \mid d(p, p_i) < d(p, p_j), j \ne i\} \tag{2}$$

4.2.2 Gewichtete Distanzfunktionen

Bei den einfachen Voronoi Diagrammen, wie sie in Abschnitt 4.2.1 eingeführt wurden, besitzen die Referenzpunkte keine Attribute. Demnach sind alle diese Punkte gleichwertig beziehungsweise haben alle das gleiche Gewicht. Um Attribute an den Referenzpunkten berücksichtigen zu können, benutzen wir gewichtete Voronoi Diagramme. Dabei dienen die Attribute als Gewichte w_i der Distanzfunktion. Die Sichten der einzelnen Akteure auf die Konversionsfläche können somit durch die Gewichte w_i ausgedrückt werden.

Für den Ansatz in der Konversion unterscheiden wir zwei allgemeine Gewichtsfunktionen:

(i) Additiv gewichtete Distanzfunktion
Das additiv gewichtete Voronoi Diagramm wird definiert als:

$$d_{aw}(p, p_i) = \|p - p_i\| - w_i \tag{3}$$

Die additive Gewichtung einzelner Parameter kann durch den Vergleich mit Gewichtskreisen veranschaulicht werden. Diese sind um die Referenzpunkte orientiert und haben einen Radius, der genau den Gewichten w_i entspricht. In Abbildung 3 wird das zugehörige Voronoi Diagramm dargestellt.

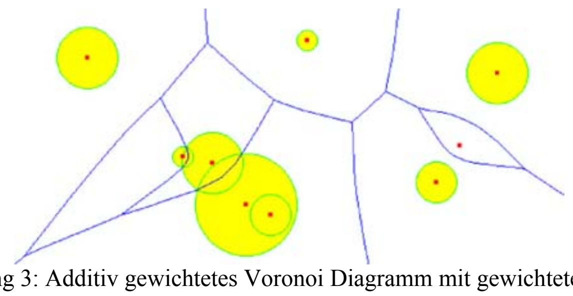


Abbildung 3: Additiv gewichtetes Voronoi Diagramm mit gewichteten Kreisen [14]

Das additiv gewichtete Voronoi Diagram hat im wesentlichen drei Eigenschaften, die für den Einsatz im Bereich der Konversion von Bedeutung sind:

1. Die additiv gewichtete Voronoi Zelle mit dem Gewichtskreis σ neben n anderen Gewichtskreisen $\{\sigma_i, 0 \le i < n\}$ ist leer, genau dann, wenn ein i existiert mit $0 \le i < n$, so dass der Gewichtskreis um σ vollständig im Inneren einer anderen Voronoi Zelle V_i liegt.

   Mit anderen Worten bedeutet dies, sobald die Gewichtung umliegender Referenzpunkte einen Schwellwert übersteigt, trägt die verhältnismäßig schwache Gewichtung im Inneren nichts mehr zum Voronoi Diagramm bei und die Zelle bleibt leer.
2. Die additiv gewichtete Voronoi Zelle ist nicht zwingend konvex, aber sternförmig. Wenn die Konturlinie der zugehörigen Distanzfunktion konvex ist, resultieren daraus immer topologisch zusammenhängende Voronoi Gebiete.
3. Der Bisektor zweier Referenzpunkte ist
   (a) leer, falls Eigenschaft 1 erfüllt ist,
   (b) eine Halblinie, falls der kleinere Gewichtskreis im Inneren des größeren liegt und die Kreislinien sich berühren,
   (c) eine Gerade bei gleichen Punktgewichten,
   (d) in allen anderen Fällen ein Teilstück einer Hyperbel, gekrümmt um den kleineren Gewichtskreis.

Durch diese Eigenschaften wird deutlich, dass additive Gewichtung als solches immer topologieerhaltend ist. Lediglich die Wahl einer nicht konvexen Distanzfunktion kann diesen Zusammenhang zerstören. Bleibt man also –zunächst- bei der euklidischen Metrik und integriert die Parameter mittels einer additiven Gewichtung in die Zielfunktion, so liefert der Clusteringprozess eine zusammenhängende Tesselierung.
Die Beweise zu den genannten Eigenschaften können bei Møller [13] nachgelesen werden.
(ii) Multiplikativ gewichtete Distanzfunktion
Naturwissenschaftliche Wachstumsprozesse, beispielsweise das Kolonienwachstum von Bakterienkulturen oder Kristallisierungsprozesse in Mineralien, zeichnen sich oft durch unterschiedlich schnelles Wachstum in den einzelnen Keimpunkten aus. Eine Simulation dieser Phänomene bietet das Appolonius-Model [11]. Dabei wachsen die Gebiete, ausgehend von den Referenzpunkten, radial, aber mit unterschiedlicher Geschwindigkeit. Dies entspricht einem Voronoi Diagramm, basierend auf einer Distanzfunktion, welche zusätzlich zum Abstandsmaß noch das Gewicht des Referenzpunktes multiplikativ verknüpft.
Die multiplikativ Gewichtete Distanzfunktion wird also definiert durch:

$$d_{mw}(p, p_i) = \frac{1}{w_i}\|p - p_i\|, \qquad w_i > 0 \tag{4}$$

Das multiplikativ gewichtete Voronoi Diagramm hat fünf wichtige Eigenschaften:
1. Eine multiplikativ gewichtete Voronoi Region ist nicht leer und nicht notwendigerweise konvex oder zusammenhängend. Dadurch können Löcher im Voronoi Diagramm entstehen, dass heißt Teilregionen, die von ihrer Referenzregion topologisch getrennt sind.
2. Eine Voronoi Region ist genau dann konvex, wenn alle Gewichte der umliegenden Regionen größer oder gleich dem aktuellen Gewicht sind.
3. Eine Voronoi Region ist unbegrenzt, wenn ihr Gewicht gleich dem Maximalgewicht aller Referenzpunkte ist.
4. Zwei Voronoi Regionen können sich unverbundene Kanten teilen.
5. Der Bisektor beschreibt
   (a) einen Kreisbogen genau dann, wenn unterschiedliche Gewichte an den entsprechenden Referenzpunkten vorliegen und
   (b) eine Halbgerade, wenn die beiden Gewichte gleich sind.

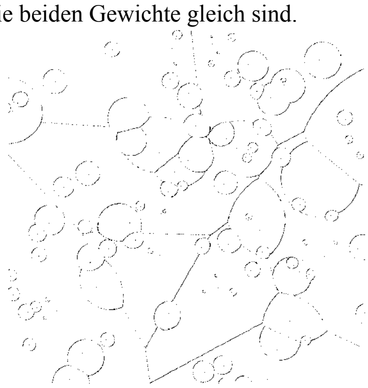


Abbildung 4: Multiplikativ gewichtetes Voronoi Diagramm [15]
Durch die Eigenschaften dieser Gewichtung wird deutlich, dass die multiplikative Gewichtung nicht immer topologieerhaltend ist. Dennoch stellt diese Gewichtung eine fundamentale Form dar, welche verschiedenste Prozesse sehr gut simuliert. Für den Einsatz in der Konversion muss sie als kritisch angesehen werden, kann jedoch durchaus ihren Sinn haben.
Die Beweise zu den genannten Eigenschaften können bei [11] nachgelesen werden.

4.2.3 Generelle Distanzfunktionen

Für die Anwendung des Clusteringverfahrens ist zunächst eine geeignete Modellierung der Ähnlichkeit zwischen den Datenobjekten erforderlich. Dies erfolgt durch eine Distanzfunktion, die für Paare von Objekten definiert ist. Zur Definition der Distanz zwischen den Objekten werden direkte oder abgeleitete Eigenschaften der Objekte verwendet. Typische Beispiele für Distanzfunktionen mit numerischen Attributswerten sind die Minkowski-Metriken [11]. Ein Nachteil bei der Verwendung dieser Metriken ist, dass die Bisektoren Flächen aufspannen können und somit nicht mehr eindeutig zu definieren sind.
Durch die Verwendung von konvexen Distanzfunktionen verhindern wir diese Problematik. Hierfür betrachten wir eine kompakte, konvexe Menge C in der Ebene, die den Nullpunkt im Inneren enthält. Um den Abstand von p nach q bezüglich C zu definieren, wird C um den Vektor p verschoben. Der Strahl von p durch q schneidet den Rand von C in genau einem Punkt q'.

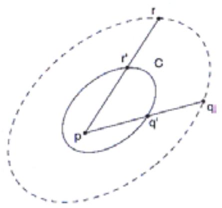


Abbildung 5: Konstruktion einer konvexen Distanzfunktion

Wir definieren die konvexe Distanzfunktion d_c folgendermaßen:

$$d_c(p,q) = \frac{|pq|}{|pq'|} \tag{5}$$

Sollte der ausgehende Strahl einen nicht-konvexen Teil von C schneiden, liefert die Distanzfunktion d_c das gleiche Resultat für unterschiedliche Punkte q_i. Beispielsweise ist in Abbildung 6

$$d_C(p,q_1) = d_C(p,q_2) = d_C(p,q_3) \tag{6}$$

Das bedeutet, dass die wichtige Eigenschaft der Dreieckungleichung der Metrik Definition nicht eingehalten wird. Für unseren Ansatz ist es jedoch nur von Bedeutung, dass d_c die positive Definitheit erfüllt. Dieses wird direkt durch die Definition von d_c garantiert.

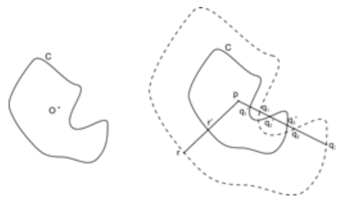


Abbildung 6: Konstruktion einer generellen Distanzfunktion

Die konvexe Distanzfunktion ist symmetrisch sofern C symmetrisch zum Ursprung ist. Zusätzlich erfüllt d_c folgende Eigenschaften:

C ist der Einheitskreis von d_c, d.h. $\{x \mid d_c(x,0) = 1\}$

d_c ist translation invariant

Mit diesem sehr allgemeinen Ansatz ist es möglich jede geschlossene Kurve als Konturlinie einer allgemeinen Distanzfunktion zu interpretieren.

4.3 Visualisierungsprozess

Nachdem der Clusterprozess abgeschlossen ist, liegen die neu geordneten Daten in Form von mehrdimensionalen Objekte vor. Eine Interpretation der Ergebnisse an dieser Stelle ist jedoch mühsam und verwirrend, da die Objekte zu viele Informationen enthalten. Auf Grund dessen schließen wir eine Visualisierung an, für die wir Techniken aus dem Bereich der Informationsvisualisierung verwenden, die sich für eine Interpretation der abstrakten Objekte besonders eignen. Die Grundidee hierbei ist, die zugrundeliegende Karte der Konversionsfläche mit der Visualisierung zu überlagern und somit einen direkten Bezug zwischen diesen Informationen herzustellen. Die einzelnen Parameter müssen hierbei durch die Visualisierung besonders repräsentiert werden.

Um diesen Anforderungen gerecht zu werden, haben wir zunächst zwei Visualisierungsmethoden getestet, eine Icon-basierte und eine hierachische Methode. Die Icon-basierte Methode hat den Vorteil, dass die Resultate graphisch auf den Flächen dargestellt werden können. Somit läßt sie sich sehr leicht mit den Karten kombinieren, indem einfach verschiedene Layer übereinander gelegt werden. Mit den beiden Standardtechniken stick-figure icon und velco-icon [8] ist es jedoch nicht möglich eine größere Zahl von Parametern darzustellen, so dass wir den Ansatz erweitert und das Picklock-Icon entwickelt haben.

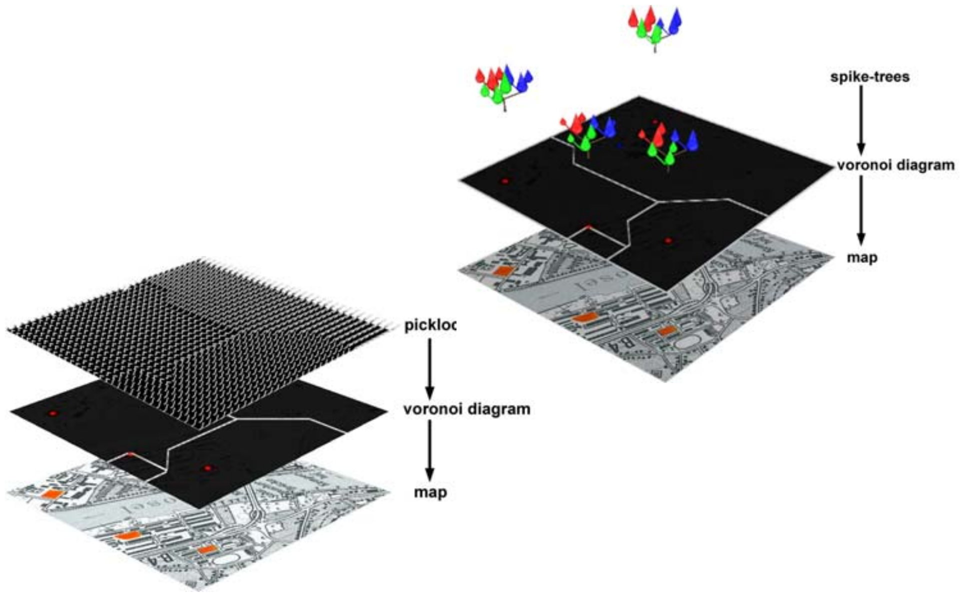


Abbildung 7: Picklock-Icon und Spike-Tree Visualisierung

Zusätzlich haben wir eine hierachische Visualisierungstechnik entwickelt. Der Vorteil dieser Methode ist, dass die Visualisierung nicht die Karte überdeckt. Der von uns entwickelte Spike-Tree gehört zur Botanischen Informationsvisualisierung und ist punktorientiert. Der Spike-Tree ist eine Weiterentwicklung der Ansätze von Kleiberg, van de Wetering und van Wijk [9].

Zwei Beispiele dieser Visualisierungstechniken sind in Abbildung 7 zu sehen. Basis ist die zugrunde liegende Karte, darüber wird das Clusterergebnis gelegt, auf das die Visualisierung aufgesetzt wird.

4.4 System DaMaViS

In der heutigen Zeit produziert fast jede Anwendungsdomäne sehr große, heterogene Datenmengen. Für den Bereich der Stadtplanung eröffnet sich daraus ein immer breiteres Themenfeld, in dem zukünftig rechnerunterstützte Entscheidungshilfen Anwendung finden. Als Beispiel hierfür kann ein virtueller Rundgang genannt werden, der eingesetzt werden kann, Entscheidungen in der Stadtentwicklungspolitik zu einem Ziel zu führen, da die visuelle Aufbereitung der Plandaten die Vorstellungskraft der Entscheidungsträger stärkt. Viele Auswertungen in der Stadtplanung werden noch von Hand erledigt, da für Rechneranwendungen keine geeigneten Module auf dem Markt angeboten werden. Die auf dem Markt befindlichen Module sind vielfach Insellösungen, die in getrennten Arbeitsschritten, nacheinander ausgeführt, zu einer Problemlösung führen.

Mit Hilfe von Datenmanagementsystemen wird in den einzelnen Fachdisziplinen der Komplexität der Daten begegnet. Meistens sind die existierenden Systeme jedoch auf ausgewählte Anwendungsbereiche spezialisiert und relativ statisch konzipiert. Im Anwendungsfeld Raum- und Umweltplanung existieren diverse spezialisierte Informationssysteme wie beispielsweise Landinformationssysteme, Rauminformationssysteme, Umweltinformationssysteme. Diese Systeme bieten spezifische Auswertungen einzelner Anwendungsbereiche an.

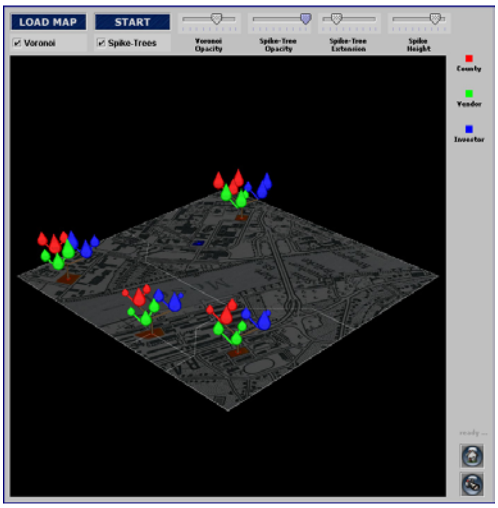


Abbildung 8: DaMaViS mit einer Spike-Tree-Visualisierung

Das von uns entwickelte Datenmanagementsystem DaMaViS vereinigt verschiedene Insellösungen in einem System für die Anwendung in der Stadtplanung. DaMaViS benutzt generische Datenstrukturen, wodurch es in der Lage ist, Daten aus den unterschiedlichsten Anwendungsdomänen zu verarbeiten. Beispielsweise kann es eingesetzt werden, die Daten eines Geographischen Informationssystems (GIS) zu verwalten und zu visualisieren. Ein weiteres Anwendungsfeld ist die Erstellung eines virtuellen Walkthrough durch eine Stadt oder kleinere Teilräume. Das System verknüpft eine große Zahl heterogener Datenbanken miteinander und ermöglicht eine gezielte Auswertung der gesammelten Daten im Bereich der nachhaltigen Stadtteilentwicklung (z.B. Bahnhofsumgebung Kaiserslautern) und der Konversion im weiteren Sinne. Die Basis bilden verschiedenste Datenbanken mit Statistiken, Texten und Bildern sowie Graphiken. Insgesamt erfolgt eine Visualisierung der Ergebnisse mittels geeigneter Techniken

aus dem Bereich der Informationsvisualisierung. Neben den vorab genannten spezifischen Anwendungsmöglichkeiten bietet das System grundlegende Möglichkeiten Texte zu bearbeiten und einzelne Textpassagen in einen Report zu integrieren. Detaillierte Informationen zu unserem DaMaViS System sind in [1] zu finden.
Wir haben die in Abschnitt 4 beschriebene Entscheidungshilfe **IKone** in DaMaVis integriert. Es besteht die Möglichkeit im Clusteringprozess das Verfahren der additiven oder multiplikativen Gewichtung auszuwählen und anschließend eine Visualisierung der Ergebnisse vorzunehmen.

5 ZUSAMMENFASSUNG

In diesem Paper wurde das Tool **Ikone** als Erweiterung des von uns entwickelten Datenmanagementsystems DaMaViS (DatenManagementVisualisierungsSystem) vorgestellt. **IKone** wurde entwickelt, um mit dem System DaMaViS eine interpretierende Visualisierung vornehmen zu können. Mit dieser Entscheidungshilfe schaffen wir die Möglichkeit, die im Umnutzungsprozess der Konversionsflächen Involvierten schneller und zielorientiert zu einer Entscheidungsfindung zu führen. Das vorgestellte Tool **IKone** wertet hierbei die im Laufe des Planungsprozess anfallenden Daten mittels eines Information Clustering Verfahrens sichtweisenbezogen für die in den Umnutzungsprozess involvierten Akteure aus. Dazu wird zunächst ein Clusteringprozess durchgeführt. Dieser ist unterteilt in eine Bestandsaufnahme der Fläche, gefolgt von der Auswahl der Parameter und dem Erstellen der Zielfunktion. Diese bildet den zentralen Punkt des Information Clustering Prozesses. Die topologischen Eigenschaften der Zielfunktion müssen genau betrachtet werden, da beispielsweise der Zusammenhang der Unterteilung eine besondere Anforderung im Kontext der Konversion darstellt. Hierbei sind Löcher in der Struktur spezielle Artefakte. Durch das Clustering werden die Daten neu geordnet und somit mehrdimensionale Objekte identifiziert. An diesen Clusteringprozess schließt sich eine Visualisierung mit Verfahren aus dem Bereich der Informationsvisualisierung an, die schließlich die Interpretation der Konversionsdaten ermöglicht. Unser Grundgedanke hierfür ist die Zuordnung der Objekte mittels deren geographischer Position zu den Flächen. Die Visualisierung erfolgt mit Techniken aus dem Bereich der Informationsvisualisierung, da diese sich für eine Interpretation der abstrakten Objekte besonders eignen.

6 ZUKÜNFTIGE ARBEITEN

Als Ausblick auf die zukünftigen Arbeiten können folgende Punkte angesehen werden:

- Evaluaierung der Ergebnisse anhand realer Konversionprojekte.
- Evaluierung der Visualisierungstechniken durch die Akteure des Umnutzungsprozesses.
- Weiterentwicklung der Visualisierungstechniken.
- Erweiterung des Tools auf den Bereich der sogenannten „zivilen Konversion“. Hierfür muss die Parameterauswahl den spezifischen Bedürfnissen dieses Sachverhaltes angepasst werden.

7 REFERENZEN

[1] Hagen, H., Steinebach, G., Münchhofen, M., Ruby, M., Scheler, I., Wadlé, M., Michel, F.: Datenmanagementsystem für die Stadtplanung; CORP2005, Wien 2005.

[2] Hopkins, L.: Structure of a planning support system for urban development; In Planning Support Systems, Integrating geographic information systems, models and visualization tools, ESRI Press, Redlands, California, pp 81-98, 2001.

[3] Pfäfflin, F., Diegmann, V.: IVU Umwelt GmbH, LimArc - Lärmmodellierung in ArcGIS; 17. AGIT-Symposium, AGIT-EXPO Forum, Salzburg 2005.

[4] Kanzler, K., de Lange, N.: Entscheidungsunterstützung in der Regionalplanung; Bewertung von Ansiedlungsvorhaben des großflächigen Einzelhandels. 17. AGIT-Symposium, Salzburg 2005, pp 309-314.

[5] Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: Studie "Nachnutzung vormals militärisch genutzter Flächen"; Bonn, November 1997.

[6] Fecht, M., Geitner, C., Heller, A., and Stötter, J.: Ermittlung der räumlichen Verteilung von Bodeneigenschaften – eine Kombination von GIS, Clusteranalyse und Geländearbeit; 17. AGIT-Symposium, Salzburg 2005, pp 155-164.

[7] Keim, D.: Visual Techniques for Exploring Databases; Martin-Luther Universität Halle-Wittenberg, 1997.

[8] Pickett, R. M., Grinstein, G. G.: Iconographic Displays for Visualization Multidimensional Data; IEEE Conference on Systems, Man and Cybernetics, pp 514-519, 1988.

[9] Kleiberg, E., van de Wetering, H., and van Wijk, J.J.: Botanical visualization of huge hierarchies; In Proceedings IEEE Symposium on Information Visualization (InfoVis 2001), IEEE Computer Society Press, pages 87–94, 2001.

[10] Kappe, F., Droschl, G., Kienreich, W., Sabol, V., Becker, J., Andrews, K., Granitzer, M., Tochtermann, K., and Auer, P.; InfoSky: Visual Exploration of Large Hierarchical Document Repositories; Proc. of HCI International 2003, Crete, Greece, Volume 3, pages 1268-1272. Lawrence Erlbaum Associates, June 2003.

[11] Okabe, A., Boots, B., Sugihara, K., Chiu, S.: Spatial Tesselations; Whiley, 2nd Edition, 2000.

[12] Aurenhammer, F., Edelsbrunner, H.: Voronoi diagrams: A survey of a fundamental geometric data structure; ACM Computing Surveys, 23(3):345-405, September 1991.

[13] Møller, J.: Random Johnson-Mehl tessellations; Advances in Applied Probability, 24:814-844, 1992.

[14] Leißing, F. und Müller-Molinet, P.: Verallgemeinerte Voronoi Diagramme; Projektarbeit TU Kaiserslautern, 2003.

[15] Schneider, M.: Toplogieerhaltende Voronoi-Algorithmen; Diplomarbeit TU Kaiserslautern, 2004.

[16] Hagen, H., Ruby, M., Scheler, I.: Information Clustering in the context of Urban Planning; International Symposium on Generalization of Information, Berlin 2005.

[17] http://www.pre-park.de/redesign/web/htm/frameset/index_news.htm.

Ein Jahr „GenderAlp! Raumentwicklung für Frauen und Männer“ – ein Werkstattbericht

Heidrun WANKIEWICZ

(Mag.a Heidrun Wankiewicz[1], Projektbüro GenderAlp! c/o Land Salzburg, Büro für Frauenfragen und Chancengleichheit, Michael Pacherstraße 28) 5020 Salzburg, www.genderalp@salzburg.gv.at und wankiewicz@utanet.at

1.0. GENDERALP! DATEN UND FAKTEN

1.1 Vorgeschichte, PartnerInnen, Zielgruppen und Budget

Nach 18-monatiger Projektentwicklung seitens des Landes Salzburg (Büro für Frauenfragen und Chancengleichheit – Leitung Romana Rotschopf - gemeinsam mit Raumplanungsabteilung, Christine Itzlinger und Fritz Mair) und dem Aufbau eines PartnerInnenetzwerks aus insgesamt 12 Verwaltungsabteilungen aus den Regionen der Alpenländer Frankreich (Belfort und Rhône-Alpes), Italien (Genua und Piemont), Slowenien, Deutschland (Freiburg i.Br. und München) sowie Österreich (Länder Niederösterreich, Oberösterreich und Salzburg, Bildungseinrichtungen - Verwaltungsakademie Salzburg und Universität für Bodenkultur, Wien) wurde das Projekt GenderAlp! im November 2004 im Rahmen der Gemeinschaftsinitiative INTERREG IIIB – Alpenraum bewilligt[2] . Die Entwicklung der Partnerschaft hat sich als langwierig erwiesen, da die Bedingung für die Mitwirkung war, dass es sich um Verwaltungsstellen von Ländern, Städten und Regionen handelt, die bereits Erfahrung haben mit abteilungsübergreifender Umsetzung von Gender Mainstreaming in Raumentwicklung, Orts- und Regionalplanung, Regionalentwicklung oder in der geschlechtersensiblen Mittelverwendung in der Projektförderung oder in der öffentlichen Haushaltsplanung.

Im Zentrum steht die Frage, was kann die Verwaltung zur Gleichstellung in den Alpenraumregionen im Sinne des Top-down-Ansatzes beitragen. Die **Zielgruppen** im GenderAlp! Projekt sind daher EntscheidungsträgerInnen und SachbearbeiterInnen in Verwaltungen auf lokaler, reginoaler, nationaler und transnationaler (EU-) Ebene, die sich i.w.S. mit Raumentwicklung und oder Gleichstellung beschäftigen: Raumordnung und Landesplanung, Wirtschaftsförderung und Wirtschaftspolitik, EU-Förderabwicklungsstellen, Budget- und Finanzabteilungen, Regionalentwicklungsagenturen und –managements, statistische Ämter, beschäftigungs- und arbeitsmarktpolitische öffentliche Stellen sowie selbstredend die Gleichstellungsstellen.

Das **Projektbudge**t umfasst 2,3 Mio. Euro aufgeteilt auf 12 PartnerInnen und 3 Jahre Laufzeit (2005 bis 2007); die Mittel werden zur Hälfte von den PartnerInnen, zur anderen Hälfte von der EU (EFRE-Mittel) aufgebracht. Die Projektverantwortung trägt ein **Leadpartnerconsortium des Landes Salzburg**: Federführung hat das Büro für Frauenfragen und Chancengleichheit; dazu kommen die Abteilungen Landesplanung und Wirtschaft und Tourismus.

> **ZUR ERINNERUNG:**
> **Gender-Mainstreaming** bedeutet, dass in allen Phasen des politischen Prozesses – Planung, Durchführung, Monitoring und Evaluation – der Geschlechterperspektive Rechnung getragen wird. Ziel ist die Förderung der Gleichstellung von Frauen und Männern. Nach dem Gender-Mainstreaming-Konzept sind politische Maßnahmen stets daraufhin zu prüfen, wie sie sich auf die Lebenssituation von Frauen und Männern auswirken, und gegebenenfalls neu zu überdenken. Nur so kann Geschlechtergleichstellung zu einer Realität im Leben von Frauen und Männern werden.
> Tab. 1: Definition Gender Mainstremaing der europäischen Komission - DG Soziales http://europa.eu.int/comm/employment_social/gender_equality/gender_mainstreaming/general_overview_de.html Dezember 2005

1.2 Themenschwerpunkte und Projektziele

Ausgangspunkt des Projekts ist die Erfahrung, dass Gleichstellungsorientierung zwar in Bereichen, die auf Humanressourcen spezialisiert sind, nämlich in sämtlichen beschäftigungs- und arbeitsmarktpolitischen Maßnahmen (meist ESF-gefördert), gut verankert ist; hingegen auf der Ebene der technischen Disziplinen wie. zB. Raumplanung, Hoch- und Tiefbau und auf der Ebene der öffentlichen Finanzen (Finanz- und Budgetabteilungen inkl. Wirtschafts- une Regionsförderung) jedoch wenig Erfahrung besteht und in der Regel kein Interesse bzw. keine Verantwortlichkeit für die Gender- und Gleichstellungsfrage festzustellen ist.

Es braucht wohl nicht extra hervorgehoben werden, dass in den Alpenraumländern – sieht man von einigen meist großstädtischen VorreiterInnen ab – die Gleichstellung als Thema und noch viel mehr als erreichtes Ziel noch einen weiten Weg vor sich hat und ein Projekt wie GenderAlp! not tut: äußerst geringe bis gar keine Partizipation von Frauen an Entscheidungsprozessen („viel zu wenige BürgermeisterInnen und Stadt- und GemeinderätInnen, viel zu wenige Führungspositionen in Verwaltung und Wirtschaft), die äußerst niedrige Rate von Väterkarenz, nämlich die Option das soziale Geschlecht anders zu definieren und der hohe soziale und ökonomische Preis, den Frauen immer noch in ihrer sozialen Rolle als Betreuende (für Kinder, Kranke, pflegebedürftige SeniorInnen und Ehegatten etc.) aufgrund der räumlichen Strukturen und Arbeitsmarktangebote dafür zahlen, und zwar sowohl in Geld (Lebenseinkommen) als auch in (Frei-)Zeit. Die Debatte um das Gleichstellungsthema erinnert etwas an die Verkehrspolitik: Seit Jahren wird die Verlagerung des Verkehrs auf die Schiene wie die Aufhebung von Ungleichheit in Einkommen und Aufgaben zwischen den Geschlechtern gepredigt, die aktuellen Trends und Entwicklungen sprechen jedoch eine ganz andere Sprache.

Andererseits ist nicht erst durch die Nachhaltigkeitsdebatte und Nachhaltigkeitsstrategie (besonders systematisch in der Schweiz, aber auch in Deutschland und Österreich auf gesamtstaatlicher Ebene) sondern auch durch die jüngeren EU-Strategien (zB. Lissabon) und die Diskussion in den Raumplanungs- und Wirtschaftsressorts um die Wettbewerbsfähigkeit von Regionen und Standorten die enorme Bedeutung der Humanressourcen und deren Mobilisierung für die Entwicklung einer Gesellschaft und eines Wirtschaftsraums auf der Agenda, wenn auch mit z.T. anderen Schwerpunkten, als es bei den Gleichstellungszielen der Fall ist.

Zentrale Fragestellungen im GenderAlp! Projekt sind daher:

Wie kann durch die Strategie des Gender Mainstreamings die Wirtschafts- und Regionalentwicklung im Alpenraum optimiert werden?

Welche wirksamen Instrumente und Erfahrungen in der bedürfnis- und zielgruppenorientierten Raumentwicklung für Frauen und Männer gibt es ?

---

[1] Die Autorin ist als selbständige Raumplanerin mit Sitz in Salzburg tätig; sie ist für die dreijährige Projektlaufzeit von GenderAlp! mit der Geschäftsführung für den Leadpartner Land Salzburg beauftragt.

[2] Vorgeschichte und Projektstand 2004 s. corp-Band 2004, Beitrag Wankiewicz – Itzlinger – Rotschopf,

Welchen Beitrag können die öffentlichen Verwaltungen auf allen räumlichen Maßstabsebenen durch Gesetze, Verordnungen, Strategien und Arbeitsprogramme und durch Anreize in Form von Förderungen für die Umsetzung dieser Ziele auf kommunaler, regionaler, nationaler und internationaler Ebene leisten?

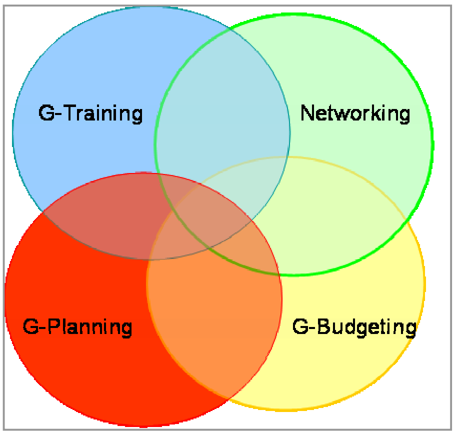
Bedarfsgerechte Planung, zielgruppengenauer und damit effizienter Mitteleinsatz, die Neupositionierung der Rolle der Verwaltungen in der postindustriellen Gesellschaft (Stichworte wie „new public management“ und „good governance“) und damit eine Neudefinition der Methoden und Werkzeuge für Interventionen dieser Verwaltung angesichts massiv schrumpfender Budgetrahmen sind das schwierige Umfeld, in welchem GenderAlp! Innovationen und praxisgerechte Methoden und Prozesse entwickeln wird.

2.0. UMSETZUNGSPROJEKTE DES GENDERALP! PARTNERINNEN-NETZWERKS

2.1 Hauptthemenfelder und Aktionsfelder der Umsetzungsprojekte

Bereits bei der Projektentwicklung war ein wesentliches Kriterium für die Auswahl der Partnerinnen die Erfahrung der jeweiligen Institutionen mit den Projektthemen und die Bereitschaft, ein konkretes Projekt während der GenderAlp! Laufzeit durchzuführen.

Während der 3 Jahre werden von den beteiligten PartnerInnen im Rahmen ihrer jeweiligen Zielgruppen insgesamt 34 Implementierungsprojekte in und mit jeweils unterschiedlichen Verwaltungsabteilungen durchgeführt. Alle Projekte verfolgen das Ziel, einen neuen Standard für künftiges Verwaltungshandeln zu entwickeln, der dann für alle Alpenraum-Regionen anwendbar sein soll, mit der notwendigen Adaptierungen auf die jeweiligen Verwaltungskulturen der beteiligten Länder Slowenien, Italien, Frankreich, Deutschland und Österreich. Alle Umsetzungsprojekte bewegen sich in mehreren GenderAlp! Arbeitsfeldern, haben ihren Fokus jedoch auf eines dieser Felder (s. nebenstehende Abbildung; Details auf www.genderalp.com.).



Gender-Training und Sensibilisierung hat sich als ein Schlüsselfeld für alle Projekte herauskristallisiert: D.h. alle Projekte bauen auf bereits laufenden oder abgeschlossenen Gender Mainstreaming-Implementierungsprozessen in der jeweiligen Institution/ Verwaltungseniheit auf oder initieren durch das Projekt einen solchen Prozess. Wirksame Umsetzug kann erst passieren, wenn die Frauen und Männer in den Verwaltungen für das Themenfeld sensibilisiert und bereit für die Anwendung der Tools und Methoden sind.

Gleichzeitig ist evident, dass Planungsprojekte nur erfolgreich sind, wenn auch öffentliche Budgetmittel für die Umsetzung von festgelegten Strategien oder zB. für den Bau der „gendergerechteren“ Variante einer Stadt- und Regionalbahn bereitgestellt werden. Umgekehrt ist ja gerade die Budgeterstellung „in Geld gegossene Politik“ und für die Standortqualität und Standortentwicklung von entscheidender Bedeutung, d.h. sie greift sehr wirksam in die Raumplanung ein (in unterstützender, wie in konterkarierender Weise).

2.2 Umsetzungsprojekte im Handlungsfeld Gender Planning[3]: Stadt Freiburg i. Breisgau, Urban Planning Institute of the Republic of Slovenia (UPIRS), Land Salzburg, Land Niederösterreich, Land Oberösterreich, Universität für Bodenkultur

Von der **Stadt Freiburg im Breisgau ist das Tiefbauamt** Projektpartner. Die baden-würtembergische Stadt hat bereits langjährige Erfahrung in frauengerechter und in nachhaltiger Stadtplanung und -entwicklung[4]. Dazu kommt ein vorbildlicher Prozess in der Gender Mainstreaming-Implementierung in die Stadtverwaltung auf der Ebene der Organisations- und Personalentwicklung, welcher nun durch Schwerpunkte in den technischen Breichen wieder wichtige Innovationen leistet. Herzstück des Freiburger Projekts ist die Entwurfsplanung zu einer Stadtbahnverlängerung mit begleitender zielgruppendifferenzierter und gendersensibler Bürgerbeteiligung[5]. Aus diesem Projekt sollen Standards für künftige Beteiligungsprozesse in ähnlicher Qualität, wie sie für die technischen Bereiche bereits vorliegen, entwickelt werden. Der corp-Beitrag von Juliane Krause, welche im Auftrag der Stadt Freiburg dieses Projekt begleitet, wird auf die Erfahrungen und Erkenntnisse dieses Projekts näher eingehen[6].

Der **slowenische Projektpartner UPIRS**[7] ist als Planungsgesellschaft im gesamten Raum des ehemaligen Jugoslawien tätig. UPIRS hat sich in diesem jungen Beitrittsland zur Aufgabe gemacht, für die ExpertInnen auf staatlicher Ebene und im Städtebund („sog. Municipalities“) die Relevanz der „Genderfrage“ auf der Ebene des planerischen und legistischen Handelns aufzubereiten und konkrete Instrumente für die Praxis bereitzustellen. Die statistische Analyse wird im ersten Quartal 2006 fertiggestellt, das Informationsangebot in einer slowenischen Webpage soll in der 2. Hälfte 2006 bereit stehen.

Der erste Teil des **Salzburg-Projekts** „Wohnen und Arbeiten in Salzburg“ unter Leitung der Landesplanung, nämlich die systematische Aufbereitung von guter Praxis in der Raumplanung und die Einbringung dieses Wissens in den laufenden Überarbeitungsprozess zum Wohn- und Betriebsstandortekonzept im Salzburger Zentralraum ist zum Großteil abgeschlossen[8]. 2006/07 wird im Zeichen der Instrumente-Entwicklung, der Standardisierung, Verbreitung, Aus- und Weiterbildung liegen.

Spannend wird der Dialog mit dem **Projektpartner Land Niederösterreich**, wo Qualitätsstandards für eine gendersensible Betriebsstandortentwicklung und Standortmanagement am Beispiel von zwei großen Industriezonen, nämlich dem IZ-Niederösterreich Süd (ca. 200 ha, überwiegend bebaut) und dem Wirtschaftspark Wolkersdorf (ca 60 ha) in Bearbeitung sind. Nicht nur in

---

3 alle Umsetzungsprojekte sind auf www.genderalp.com in Englisch, ab März 2006 auf www.genderalp.at auch in Deutsch abrufbar.

4 S. zu den vorbildlichen Stadtteilentwicklungen im Stadterweiterungsgebiet Rieselfeld und in der Konversionsfläche des Quartiers Vauban neben einer umfassenden Zukunftsstrategie Flächennutzungsplan 2020 http://www.freiburg.de/1/1/111/index.php

5 Siehe die Informationen zum Stadtbahnprojekt Zähringen die Homepage der Stadt Freiburg http://www.freiburg.de/1/109/10928/index.php

6 S. Beitrag J. Krause

7 S. http://www.urbinstitut.si/index.asp?jezik=GB Englische webpage.

8 S. Beitrag C. Itzlinger: Gender Mainstreaming und Standortentwicklung im diesjährigen corp-Tagungsband 2006, externe Studie s. Zibell 2005.

Niederösterreich erweist sich die Diskussion mit den beteiligten Stellen (z.B. ECO-Plus, der Betriebsansiedlungsagentur, den Gemeinden, der Dorf- und Stadterneuerung und der Raumplanung sowie mit den Standortmanagern) als wesentliche Schlüsselaufgabe des Projekts.

Das **Land Oberösterreich** (Partnerin ist hier die Raumordnungsabteilung) wiederum bringt in diesem Bereich die Instrumente und die Sichtweise der Regionalentwicklungsagenturen ein. Hier werden die Erfahrungen der oberösterreichischen Regionen mit jenen der Arbeitsgruppe Gender Mainstreaming des Landes und den PartnerInnen in Salzburg, Freiburg und in Frankreich systematisch ausgetauscht und für die Praxis nutzbar gemacht. Im Jänner 2006 wurden die Ergebnisse der ExpertInneninterviews präsentiert, im Herbst 2006 soll eine Exkursion zu den PartnerInnen in Deutschland und Frankreich den Erfahrungsaustausch in zielgruppengenauer und geschlechtergerechter Regionalentwicklung und –planung intensivieren.

Fast abgeschlossen ist ein Teilprojekt der **Universität für Bodenkultur** (Boku)[9], welches im Rahmen eines studentischen Seminars des Sommersemesters 2005 in der gemischt-strukturierten oberösterreichischen Gemeinde Lengau (Innviertel, OÖ) die Alltagssituation von Frauen und Männern als Jugendliche, als Erwachserne und als SeniorInnen im Detail analysierte und mögliche Handlungsfelder aufzeigte. Diese Arbeiten wurden den LengauerInnen bereits vorgestellt und 2006 sollen im Rahmen von 2 Workshops aus der Fülle der Ergebnisse 2 Bereiche konkret in die Umsetzung gehen. Auffallend postitiv war und ist das Interesse und die Sensibilität auf der Ebene der Gemeinde. Hier gelingt es am besten, die „Standardvorbehalte“ gegen das Gender Thema durch die konrekten Bezüge auf die Situation in einer Gemeinde aufzulösen. GemeindepolitikerInnen sind es gewöhnt, sich für alle Bereiche in einer Gemeinde verantwortlich zu fühlen!

2006 plant die Boku aufbauend auf den Erfahrungen dieses und anderere Gender-Projekte[10] die Entwicklung von Fortbildungsmodulen für Gemeinden und PlanerInnen in Zusammenarbeit mit Landesverwaltungen und 2007 die Durchführung von mehreren Fortbildungsveranstaltungen voraussichtlich in Kärnten, Niederösterreich, Oberösterreich und Salzburg.

2.3 Umsetzungsprojekte im Handlungsfeld Gender Budgeting: Provincia di Genova, Langhe Monferrato Roero (Region Piemont) Landeshauptstadt München, Land Salzburg, Land Oberösterreich

In der EU und in der Fachdiskussion ist die Frage einer geschlechtergerechten Haushaltsplanung – nämlich Gender Budgeting – deutlich stärker verankert, als die Planungsfrage. Besonders lange - beginnend mit Pilotprojekten in der Kleinstadt Sestri Levante (2001-02) und der Großstadt Genua (2003-04) - beschäftigt sich die **Provinz Genua** (Abteilung Arbeitsmarktpolitik) mit diesem Thema und hat bereits ein italienisches Städtenetzwerk von Gender Budgeting Initiativen aufgebaut (www.genderbudget.it). Ziel im Rahmen von GenderAlp! ist es, eine breit anwendbare Methode für die Alpenraumländer (Programmgebiet von GenderAlp!) und darüber hinaus (europäische Erweiterungsgebiete) zu entwickeln, bekannt zu machen und zu fördern. Die Expertise von Genua wird auch für die **Bergregion Langhe Monferrato Roero** in Piemont für die Stadt Cuneo (ca. 60.000 Einwohner) gemeinsam mit dem zweiten Projektpartner zur Anwendung gebracht.

Der Beitrag der **Landeshauptstadt München** (Federführung durch das Referat für Arbeit und Wirtschaft gemeinsam mit der Gleichstellungsstelle) im Bereich Gender Budgeting ist auf drei Felder in Kooperation mit den jeweiligen Abteilungen der Stadt aufgeteilt: In einem ersten Schritt wird eine Wirksamkeitsanalyse der öffentlichen Ausgaben einmal im Bereich Förderungen für GründerInnen, einmal im Bereich Förderungen für beschäftigungspolitische Maßnahmen, einmal im Bereich Tourismus (Vergabe von Stellplätzen des Christkindlmarktes) durchgeführt. In einem zweiten Schritt soll darauf aufbauend eine Empfehlung für die Modifikation künftiger Förderungen durch die Ausarbeitung von Indikatoren für eine geschlechtergerechte Mittelverwendung erarbeitet werden und in einem Handbuch als Standard festgelegt werden. München bringt auch seine Erfahrungen in langjähriger Gender Mainstreaming-Implementierung in die Stadtverwaltung und in der Frauenförderung mit ein.

Das **Land Oberösterreich** nimmt sich 3 Bereiche des Landeshaushaltes vor, nämlich die Bereiche Gesundheit, Sport und Bildung. Zum Zeitpunkt der corp wird bereits ein erster Zwischenbericht zur Budgetanalyse einschließlich eines Interviews mit PoltikerInnen und leitenden BeamtInnen des Landes Oberösterreich vorliegen. Neben dem Umgang mit sehr heiklen Budgetzahlen tun sich bei dieser Analyse auch Fragen, wie der Umgang mit Ehrenamt und unbezahlter Arbeit (Wer leistet sie?`Wie wird sie bewertet?) und eine Fülle von Wissenslücken auf[11] .

Synergien mit München und Oberöstereich erwartet sich auch das **zweite Salzburger Projekt** „Bedarfsgerechte Förderungkriterien für Frauen und Männer“, welches die Praxis der Ziel-2 Förderungen in der vergangenen Programmplanungs Periode anhand der Salzburger Regionen Pinzgau-Pongau (Teilgebiete) und Lungau im Hinblick auf die beabsichtigte und nicht beabsichtigte Wirkung auf Frauen und Männer analysiert. Darauf aufbauend sollen Vorschläge für künftige Projekt- und Programmförderungen entwickelt werden und auch die Frage der Messbarkeit und Umsetzbarkeit der „Geschlechtergerechtigkeit“ durch entsprechende Indikatorensets praxisgerechte Lösungen anbieten. Dieses zweite Salzburger Projekt wird ausführlich von A. Lamprechter im Rahmen eines eigenen Beitrags zur corp 2006 beschrieben[12].

2.4 Umsetzungsprojekte Genderkompetenz, Training und Weiterbildung: Projekt in Rhône-Alpes, Genua, Langhe-Monferrato-Roero, München , Universität für Bodenkultur und Salzburg (Land Salzburg und Verwaltungsakademie des Landes Salzburg)

Auf die zentrale Bedeutung dieses Bereiches für die Akzeptanz und die Umsetzung von genderrelevanten Fragestellungen bei den Projektzielgruppen hat die Autorin bereits unter 3.1 hingewiesen.

Die Verantwortung für die Systematisierung dieses Themenbereichs liegt in Händen der Region **Rhône-Alpes,** jedoch sind alle PartnerInnen mit der zielgruppenkonformen Vermittlung, Verbreitung, Sensibilisierung und Weiterbildung ihrer jeweiligen Zielgruppen befasst (s. mein Hinweis in Abschnitt 2.1). Der Projektstart des Rhône-Alpes Beitrags wird erst mit 2006 erfolgen;

---

9 S. die Projektergebnisse unter http://www.rali.boku.ac.at/6016.html

10 S. Damyanovic im corp Band 2006 zur Mobilität im ländlichen Raum am Beispiel des Gailtales.

11 S. Land Oberösterreich http://www.land-oberoesterreich.gv.at/cps/rde/xchg/SID-3DCFCFC3-CDE0C1D0/ooe/hs.xsl/36701_DEU_HTML.htm

12 S. A. Lamprechter corp 2006 „Bedarfsgerechte Förderkriterien für Frauen und Männer“

geplant ist die Erarbeitung eines Aus- und Weiterbildungs-Inventars, die Durchführung von 2 Regionalanalysen in der Stadtregion Grenoble und in der ländlichen Region „Vallée de la Drôme" sowie die Ausarbeitung eines Pflichtenheftes für Aus- und Weiterbildung für unterschiedliche Zielgruppen mit unterschiedlichem Vorwissen.
Durch die Reduktion des Beitrags des Partners Rhône-Alpes wird mit Beginn 2006 ein Teil der Gelder zugunsten des Aufbaus eines Genderkompetenz-Netzwerks verwendet. Ziel ist es, die Partnerschaft von GenderAlp! auch nach der Projektlaufzeit fortzuführen um das Know-How der Institutionen und deren Netzwerke dauerhaft für die Entwicklung der Regionen und Gemeinden nutzbar zu machen.

3.0. ZWISCHENBILANZ NACH DEM ERSTEN JAHR (1/3 DER PROJEKTLAUFZEIT)

Die quantitative Zwischenbilanz des ersten Jahres ist beeindruckend: Insgesamt wurden von allen ProjektpartnerInnen 58 zielgruppenorientierte Workshops und Diskussions-Veranstaltungen durchgeführt. Damit konnten rund 600 TeilnehmerInnen aus den GenderAlp! Zielgruppen mit den Fragestellungen des Projekts gezielt befasst werden.
Qualitativ lässt sich feststellen: Die Widerstände gegen das Gender-Thema sind mancherorts größer, als wir erwartet haben; und dies gilt gleichermaßen für Männer wie auch für Frauen. Gekoppelt ist dieser Widerstand damit, dass die Verantwortung für die Umsetzung auf die Gleichstellungsstellen und/oder Frauenbüros geschoben wird und angesichts steigender Anforderungen an SachbearbeiterInnen in den Verwaltungen der eigentliche Ansatz, nämlich im jeweils eigenen Ressort und Aufgabenbereich die Umsetzung von Gender Mainstreaming zu entwickeln und zu überwachen, auf der Strecke bleibt.
Dazu kommt, dass derzeit weder die Verwaltung als Top-down lenkende Kraft mit Gestaltungswillen, noch die Raumordnung per se im Zeitalter von Rezession und Postindustrialisierung „Konjunktur" hat: die ordnende Hand, die auch nein sagen muss zu einer Standortwahl von InvestorInnen, ist derzeit weder politisch noch in der Presse opportun. Beides gemeinsam, nämlich das Thema „Geschlechtergerechtigkeit" und „Raumplanung" ist somit ein schweres Handicap. Da GenderAlp! mit dem Aus- und Weiterbildungsthema und mit der Effizienz des Verwaltungshandelns auch noch mitten in der „Verwaltungsreform-Diskussion" ist, scheinen die geplanten Ziele manchmal in weiter Ferne und unlösbar.
Klar ist jedenfalls, dass im Rahmen von GenderAlp! nur erste Schritte gemacht werden können.

3.1 Gender Mainstreaming Stragegie nutzen, um Raumordnungsstrategien, planerisches Handeln und wirkungsvolle Raumentwicklung neu zu denken

Gender Mainstreaming in der Raumentwicklung heißt nicht, die bisherigen Konzepte und Methoden über Bord zu werfen, sondern sie im Hinblick auf ihre Wirksamkeit auf Frauen und Männer zu überprüfen.
Die Strategie bietet somit die Möglichkeit, die Raumplanungsmethoden und planerisches Handeln neu zu denken.
Im Hinblick auf die Gender-Frage ergeben sich u.a. für unterschiedliche Gruppen (zB. Personen mit Betreuungspflichten und Personen ohne Betreuungspflichten unterschiedliche Anforderungen an Wohnung und Wohnumfeld, an Wohnstandorte und Erreichbarkeiten
Wohnen umfasst somit zwei Perspektiven (nach B. Zibell 2005)

- Ruhe, Muße und Erholung – Perspektive der außer Haus Erwerbstätigen: **entsorgter Alltag**
- Arbeit und Verpflichtung – Perspektive der Hausarbeit Leistenden: **versorgender Alltag**

Gender Mainstreaming in der Raumentwicklung und Raumplanung geht daher vom Wohnen aus, denn immerhin 80 – 90 % aller Gebäude sind Wohngebäude!
So zeichnet sich eine Renaissance des Konzepts der Stadt / der Gemeinde / der Region der kurzen Wege ab, die ja nicht neu ist, aber mit wenig Durchschlagskraft in die Umsetzung gelangt ist. Weiters rückt die NutzerInnenperspektive wieder in den Mittelpunkt und die Notwendigkeit, die Wirkung von Planungs- und Budgetmaßnahmen detaillierter zu berücksichtigen.
Das „Gewusst-Wie" ist sowohl für die Raumordnung im allgemeinen, als auch für eine bedarfs- und geschlechtergerechte Raumordnung gut bekannt. So ist auch gleichzeitig festzustellen, dass die Raumordnung auf der Ebene der Gesetze und Verordnungen (der materiellen Ebene) – nicht nur in Österreich – schon weitgehend bedürfnisgerecht und geschlechtergerecht orientiert ist.
Die große Lücke klafft in der Umsetzung (Stichwort „Prozess"), nämlich bei den Entscheidungsprozessen, bei der ressort- und institutionensübergreifenden und abgestimmten Zusammenarbeit. Und das das gilt wieder gleichermaßen für Gender Planning und Gender Budgeting, wie für die Raumplanung im Allgemeinen: Ich erinnere an die Diskussion um die fehlende Übereinstimmung der politischen Entscheidungskompetenzen mit den aktuellen räumlichen Verflechtungen und Rahmenbedingungen.
Und hier schließt sich der Kreis: Ohne (Gender-)kompetenz, keine Umsetzung: Um Prozesse effizienter und wirkungsvoller zu machen, braucht es die Bereitschaft und die Kompetenz der beteiligten Frauen und Männer in den Institutionen und in der Bürgerschaft, diese auch entsprechend zu gestalten. Womit wir wieder beim Thema Sensibilisierung, Aufbau von Gender-Kompetenz - ja eigentlich beim heißesten Thema, nämlich der Verwaltungsreform sind.

3.2 Gender Mainstreaming im größeren Rahmen der Nachhaltigkeitsdebatte positionieren?

Trotz aktueller Strömungen bin ich als Planerin nach wie vor überzeugt, dass gerade angesichts der knappen Ressourcen eine Optimierung des Einsatzes der öffentlichen Mittel und eine optimale Raumnutzung dringend erforderlichsind. Aber: Wie sie verkaufen? Die Reaktion auf das Thema „Gender in der Raumentwicklung" ist meist die, als wäre es ein „ExotInnenthema" oder ein ausschließlich feministisches und /oder Frauenthema.
Derzeit geprüft wird die Frage, ob die Einbettung des Gender-Themas in einen größeren Rahmen Sinn macht Ein möglicher Ansatz für die Integration in die Debatte um Nachhaltigkeit und Globalisierung und damit um die Fragen, wie kann man den Fortschritt von Regionen, Städten und Gesellschaften messen und welche Wirkungen von Planungen sind gesellschaftliche erwünscht. Spätestens mit dem Thema der Nachhaltigkeit und dem regionalen Benchmarking, zu welchem die Schweiz es zur Meisterschaft gebracht hat, ist die Frage der Gleichstellung und die Gender Frage auf dem Tisch: soziale Nachhaltigkeit beinhaltet genau auch diese Frage – neben vielen anderen.

Ein Beispiel aus dem schweizerischen Projekt Monet soll diesen auch nicht mehr ganz neuen umfassenden Fortschrittsbegriff und die entsprechenden Messgrößen dazu aufzeigen. Nachhaltige Entwicklung verlangt, dass die heute lebenden Menschen ihre Bedürfnisse decken können, ohne den in Zukunft lebenden Menschen die Möglichkeit zu nehmen, ihre eigenen Bedürfnisse decken zu können (nach Brundland 1987, zitiert nach Projekt Monet 2005). Im Zentrum dieser Bedürfnisdeckung und dann der entsprechenden Definition der Messindikatoren stehen vier Fragen:

Bedürfnisdeckung – wie gut leben wir heute?

Gerechtigkeit – wie sind die Ressourcen verteilt?

Kapitalerhaltung – was hinterlassen wir unseren Kindern?

Entkoppelung – wie effizient nutzen wir die Ressourcen?

Gemessen wird die Erreichung dieser Ziele anhand von drei Zieldimensionen, nämlich

1) gesellschaftlicher Solidarität,
2) wirtschaftliche Leistungsfähigkeit
3) ökologische Verantwortung

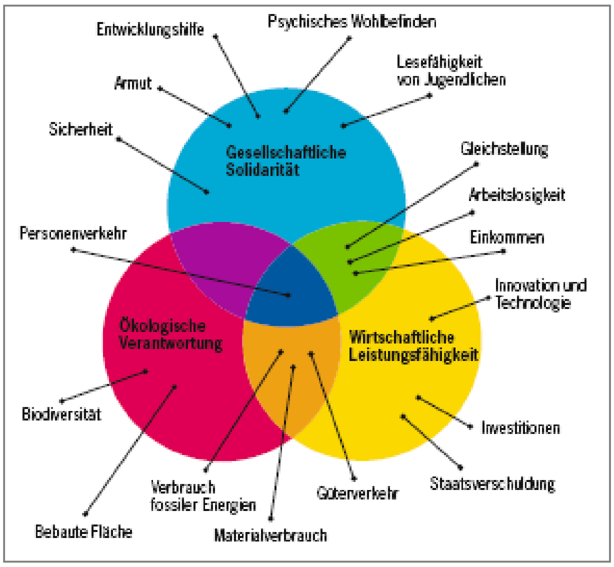


Abb.1: Nachhaltigkeitsindikatoren für regionales Benchmarking in der Schweiz „Projekt Monet“ (ARE / BFS/BUWAL 2005)

Nachhaltigkeit und Geschlechtergerechtigkeit können einander unterstützen, aber in vielem auch kontraproduktiv wirken, wie die deutsche GENANET-Gruppe eindrucksvoll an vielen Themen der Nachhaltigkeitsdebatte des Bundes aufzeigt (s. GENANET). Es wird sich weisen, ob eine Verknüpfung dieser beiden komplexen Bereiche nutzbringend oder eher hinderlich ist. Für Rückmeldungen und Diskussionsbeiträge aus der Fachwelt sind wir jederzeit dankbar.

4.0. HERAUSFORDERUNGEN 2006-07/AUSBLICK

2006 steht im Zeichen der Verarbeitung der ersten Teilergebnisse und des intensiven Austausches mit den jeweiligen Zielgruppen sowie zwischen den GenderAlp! PartnerInnen und deren NetzwerkpartnerInnen. Gleichzeitig muss die breite Umsetzbarkeit, nämlich der europäische Mehrwert für die unterschiedlichen beteiligten Ländern überprüft und sichergestellt werden. Besonders schwierig erweist sich in diesem Zusammenhang auch die Frage der Sprachkompetenz in einem an Konnotationen so reichen Themenfeld, wie es nun einmal die Geschlechterfrage in Verbindung mit den regionalen Verwaltungskulturen sind. Trotz hoher Sprachkompetenz aller Beteiligten ist die vereinbarte Projektsprache Englisch oft nur ein Vehikel, welche eine intensive Fachdiskussion um gesellschaftlch dahinter stehende Konzepte eher verschleiert als erhellt. Dies gilt auch für die internationale Homepage in englischer Sprache, welche für die jeweiligen Zielgruppen der PartnerInnen nur bedingt einsetzbar ist; daher richten fast alle PartnerInnen eine eigene „muttersprachliche“ Schiene für ihre Zielgruppen ein oder haben sie bereits eingerichtet.

Ein noch stärkeres Gewicht und eine Sytematisierung soll der Genderkompetenz und dem Aufbau von Aus- und Weiterbildungs- und Sensibilisierungsmodulen für die GenderAlp! Themen gewidmet werden. Vermittlung und Fachdiskussion wie Methodendiskussion, durch die die Durchführung von Trainings und Fortbildungen un die Präsentation von Teilergebnissen vor Fachpublikum – nicht zuletzt die breite Teilnahme an der corp mit insgesamt 7 Beiträgen aus dem GenderAlp! Umfeld[13].

Zusammenstellung einer Wissensdatenbank zu Qualitätsmanagement und Zielgruppenorientierung in der Raumentwicklung und in den öffentlichen Haushalten unter Berücksichtigung der Gender Mainstreaming Strategie

Erfahrungsaustausch und Wissenstransfer der Ergebnisse der Umsetzungsprojekte, welche aus der Verwaltungspraxis zu den Bereichen der Raumentwicklung unter Integration von Gender Mainstreaming, Gender Planning und Gender Budgeting durchgeführt werden.

Erarbeitung von konkreten Werkzeugen für EntscheidungsträgerInnen in Verwaltung und Politik

Kommunikation und Vermittlung der Ergebnisse durch Schulung, Training, Aus- und Weiterbildung und durch Praxisbeispiele; letztlich Aufbau von Gender-Kompetenz in den Organisationen der öffentlichen Verwaltung

Last but not least: Bewusstsein schaffen in den Bereichen geschlechtergerechter Raumplanung (Gender Planning) und Gender Budgeting zur Umsetzung von Gender Mainstreaming und zur Qualitätssicherung in der Raumentwicklung

Übrigens: 2006 ist das „Europäische Jahr der Chancengleichheit“. Wir sind schon gespannt, was es uns für das GenderAlp! Projekt in der Vermittlung der Teilergebnisse bringt.

5.0. QUELLEN UND LITERATUR

ARE – Amt für Raumentwicklung, BFS - Bundesamt für Statistik und BUWAL – Bundesamt für Umwelt, Wald und Landschaft 2005: Nachhaltigkeit in Kürze. 17 Schlüsselindikatoren zeigen den Fortschritt. Neuchâtel. Web: http://www.bfs.admin.ch/bfs/portal/de/index/themen/nachhaltige_entwicklung/uebersicht.html

Aufhauser E et.al.. 2003: Grundlagen für eine gleichtsllungsorientierte Regionalentwicklung. Stdie im Auftrag des Bundeskanzleramts, Abteilung IV/4. Wien. Siehe auch web: http://www.bka.gv.at/DesktopDefault.aspx?TabID=3500&Alias=BKA

Aufhauser E. et al. 2005: Gleichstellung von Frauen und Männern in regionalen Innovationszentren und im regionalen Innovationsmanagement. Handbuch im Rhamen von GINNOVA – Gender in Innovation in Styria SE. Wien.

Bundesamt für Bauwesen und Raumordnung 2005: Gender Mainstreaming im Städtebau. Experimenteller wohn- und Städtebau (ExWOST) - Informationen laufende Nummern und homepage dazu www.bbr.bund.de/exwost

Färber C, Spitzner M. et. Al. 2001: Umsetzung von Gender Mainstreaming in der Städtebaupolitik des Bundes. Expertise im Auftrag des Bundesamts für Bauwesen und Raumordnung. Webpublikation: IV-Teile mit umfangreichstem Literaturverzeichnis. http://www.bbr.bund.de/exwost/forschungsfelder/ff_index.html?/exwost/forschungsfelder/029_publikationen_expertise.html

13 siehe die Beiträge von C. Itzlinger, A. Lamprechter, J. Krause, J. Gannard (2 Beiträge) und D. Damyanovic (zwar kein GenderAlp! Projekt, aber ProjektpartnerIn und thematischer Input für unser Team).

Genanet –Leitstelle Geschlechtergerechtigkeit und Nachhaltigkeit Deutschland: im Web: Themen Gender und Energie , Gender und Biodiversität, Gender und Klimaschutz, Gender und Lärm, Gender und Mobilität,
im Speziellen zum Thema Gender und Nachhaltigkeit im web: http://www.genanet.de/nachhaltigkeit.html
Grasenick K. et al. 2004: Regionale Kulturen und Gender Mainstreaming Analyse im Rahmen des Projekts EQUAL-JustGem – Endbericht. Joanneum Research Graz.
Itzlinger C., Rotschopf R. Wankiewicz H. 2004: GenderAlp! Qualitätsssicherung in der Raumplanung. Umsetzung von bedarfs- und geschlechtergerechter Planung im Alpenraum www.corp.at/2004 . IN: corp 2004 – Tagungsband 2004 (Manfred Schenk HG) Wien
Knoll Szalai 2005: Bildung und nachhaltige Entwicklung. Im auftrag des Lebensministeriums. Wien.
Landeshauptstatt München – Gleichstellungsstelle (HG) 2004: Planen für Frauen und für Männer in der Stadt. Umsetzung der Gender Mainstreaming Strategie in der räumlichen Planung. München.
Land Salzburg GenderAlp! Leadpartnerteam 2005: Präsentationen und Berichtsentwurf von B. Zibell zur Schlussveranstaltung zur externen Studie „Gender Practice in der Raumplanung“ und „Qualitätsziele und Qualitätskriterien in der Raumordnung“ in Salazburg. S. www.genderalp.com/News/Press
Land Niederösterreich 2004-05: GESIR – Gendersensible Regionalentwicklung. Verschiedene Instrumente aus einem EQUAL-Projekt. im Web verfügbar unter www.bab.at/gesir
Lebensministerium (HG) 2005. Sozioökonomische Dimension der Alpenkonvention unter besonderer Berücksichtigung der Städte.
Provincia di Genova 2003 ff: www.genderbudget.it: Italienisches Netzwerk von Städten und Gemeinden zur geschlehctersensiblen und –gereichten öffentlichen haushaltsplanung mit englischsprachigem Bereich. Die Webpage wird von PP Genua betreut.
SRL – Vereinigung der Stadt- Regional- und Landesplaner 2004: Materialsammlung zur SRL-Jahrestagung „Der andere Blick. Praxis von Gender Mainstreaming in der räumlichen Planung“ vom 5. – 7. November 2004 in Hannover.
Siehe auch web: http://www.srl.de/fg/frauen/aktuelles/nachricht.php4?id=221
SRL – 2004: Planerin Heft 3_04– Fachzeitschrift für Stadt-, Regional- und Landesplanung: Der andere Blick – Gender Mainstreaming in der Planung.
Stadt Wien – Stadt Fair Teilen – Gender Mainstreaming in Mariahilf beitet für Frauen und Männer, Mädchen und Burschen gleiche Chancen im Stadtraum. Leitstelle für alltags- und frauengerechtes Bauen und Wohnen.
Stadt Wien – Step 2005 – Stadtentwicklungsplan.
Wankiewicz H., Schrenk M. 2004: Fakten – Zahlen – Regionalanalyse unter Berücksichtung von geschlechtsspezifischen Unerschieden, Bedürfnissen, Entwicklungen und Potentiale. (i.A. der Salzburger Landesregierung, Landesplanung). Grundlagenstudie für die Überarbeitung des Sachprogramms Siedlungsentwicklung und Betriebsstandorte im Salzburger Zentralraum (i.A. der Landeplanung des Landes Salzburg). Salzburg.
Universität für Bodenkultur – Departement für Landschaftsplanung 2005: Lebensqualität im ländlichen Raum für Frauen und Männer, Jung und Alt. Projektbericht aus der Gemeinde Lengau, OÖ. (GenderAlp! Projekt). http://www.rali.boku.ac.at/6016.html
Zweckverband Großraum Braunschweig & Universität Hannover Fakultät Architektur + Landschaft 2005: good practices. Praxisbeispiele zum Thema Wohnen und Versorgung.
Zibell, B. 2005: Wohnen und Arbeiten in Salzburg. Teil 1: Gender Practice, Teil 2: Qualitätskriterien in der Raumplanung. i.A. des GenderAlp! Leadpartnerteams Salzburg. Teilveröffentlichung aus www.genderalp.com/ Sektion news/press – Wird im 1. Quartal 2006 erscheinen.

14

[14] Finanziert durch die EU (INTERREG IIIB Nord-West Europa) und das Hessische Ministerium für Umwelt, ländlichen Raum und Verbraucherschutz. Teil des internationalen Forschungsvorhaben „Creating new Landscapes for Flood Risk Management“ („Floodscape“ www.floodscape.net) Projektleitung: FG Wasserbau/Wasserwirtschaft der Universität Kassel. Weitere Projektpartner: TU Braunschweig (Leichtweiß Institut für Wasserbau), TU Darmstadt (Institut IWAR - FG Umwelt- und Raumplanung), FG Landschaftsplanung/Naturschutz der Universität Kassel, Wissenschaftliches Zentrum für Umweltforschung - WZ III Abteilung für integriertes Gewässermanagement

[14] Lebensraumkorridore für Mensch und Natur – Initiativskizze (Grobkonzept) zur Entwicklung eines Netzes bundesweit bedeutsamer Lebensraumkorridore. Gefördert: Bundesamt für Naturschutz mit Mitteln des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit
im Auftrag des Deutschen Jagdschutzverbandes e.V. Laufzeit: 11/2003–4/2004. Universität-Kassel Fachgebiet Landschaftsökologie / Bodenkunde Dipl.-Ing. Kersten Hänel Dipl.-Ing. Jens Jeßberger (www.uni-kassel.de/fb6/fgloebo/biotopverbund.html). Weitere Projektpartner: Dr. H. Reck (Fachabteilung Landschaftsökologie des Ökologie-Zentrums der Universität Kiel), M. Strein, U. Müller, Dr. R. Suchant (Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg (FVA), Abt. Landespflege, Freiburg).

reviewed paper

"Frauen und Männer unterwegs" - Gendersensibler Planungsprozess am Beispiel der Gemeinde Hermagor - Pressegger See

Doris DAMYANOVIC

(DIin Doris Damyanovic, Universität für Bodenkultur Wien, Department für Raum, Landschaft und Infrastruktur, Institut für Landschaftsplanung, Peter-Jordan Straße 65, 1180 Wien, doris.damyanovic@boku.ac.at)

1 GENDERSENSIBLER PLANUNGSPROZESS UNTERSTÜTZT DIE LEBENSQUALITÄT IM LÄNDLICHEN RAUM FÜR FRAUEN UND MÄNNER, JUNG UND ALT!

In gendersensiblen Planungsprozessen werden Alltage und die daraus resultierenden Bedürfnisse von Frauen und Männern in den Mittelpunkt gestellt. Die Wertschätzung der unterschiedlichen Ansprüche bezogen auf Geschlecht, Alter und Lebenssituation sind der Maßstab für den Planungsprozess.

Am Beispiel von "Frauen und Männer unterwegs", ein landschaftsplanerisches Pilotprojekt zur qualitativen Wegenetzplanung im Sinne von Gender Mainstreaming am Beispiel der Stadtgemeinde Hermagor-Pressegger See, Kärnten, werden die Arbeitsschritte eines gendersensiblen Planungsprozesses vorgestellt. Das Projekt ist ein Beitrag zu Conspace[1] - ein Interreg III B Cadses Projekt, das den Aufbau eines gemeinsamen strategischen Netzwerkes für Raumentwicklung und praktischer Umsetzung zum Ziel hat.

Die Gemeinde Hermagor mit ca. 7000 EinwohnerInnen und einer Flächen von ca. 200 km² liegt im oberen Gailtal in Oberkärnten und weist städtische, ländliche und "funktionalisierte[2]" Siedlungs- und Erschließungsstrukturen auf. Die vielen Haufendörfer mit Streifen- und Blockflur prägen vor allem die ländlich strukturierte Gemeinde. Die größte, städtische Siedlung ist Hermagor Stadt mit 1527 EinwohnerInnen. Die räumliche Entwicklung der Stadt und der Dörfer ist durch die Wirtschaftsentwicklung der letzten 50 Jahre, insbesondere durch Investionen in den Tourismus und Verkehr, geprägt. Gegenstand für die Bewertung von "Frauen und Männer unterwegs" waren Wege und Wegenetze, Infrastruktureinrichtungen, der öffentliche Personennahverkehr und sozial-ökonomische Rahmenbedingungen der Gemeinde Hermagor-Pressegger See.

Die Strategie des Gender Mainstreaming als Querschnittsmaterie wurde im Projekt bei allen Arbeitsschritten - von der Zielformulierung bei der Maßnahmenplanung bis hin zur Umsetzung und Evaluierung - angewandt. In diesem Beitrag gehe ich auf die Erfassung von spezifischen Mobilitätsbedürfnissen von Frauen und Männern und auf die landschaftsplanerische Bewertung und Formulierung der Maßnahmen ein. Entscheidend für die Umsetzung der Strategie des Gender Mainstreaming in der räumlichen Planung war die planerische Bewertung der bestehenden Planungskonzepte und -instrumente. Sie wurden darauf hin überprüft, wie sie den Anforderungen bezogen auf die Ergebnisse aus einer Genderperspektive in der Umsetzung unterstützen. Ergebnis war, dass die Einbettung in bestehende Planungsinstrumente auf örtlicher Ebene zur Implementierung von Gender Mainstreaming auf Gemeindebene zielführend ist. *"Gerade in der örtlichen Raumplanung steht mit dem Örtlichen Entwicklungskonzept ein Planungsinstrument zur Verfügung, in dem die BürgerInnen und Planungsbeteiligten ihre Vorstellungen und Wünsche einbringen und aufeinander abstimmen können. Die professionelle Moderation und die Tätigkeit von lokalen Arbeitsgruppen ermöglicht es, spezifische Anliegen zum Gegenstand der geplanten Gemeindeentwicklung zu machen und die örtliche Raumordnung danach auszurichten*" (Statement Seidenberger, Christian in Damyanovic, Doris, 2005: 14). Anhand des Örtlichen Entwicklungskonzeptes werden die möglichen Anknüpfungspunkte für eine genderwirksame Wegenetzplanung, die Einflußnahme der beteiligten AkteuerInnen (BürgermeisterIn, Gemeinderat, Landesregierung, BürgerInnen) und Maßnahmen zur Umsetzung von Gender Mainstreaming vorgestellt.

Ziel des gendersensiblen Planungsprozesses war die Qualitäten des "differenzierten Blickes" den Planungsfachleuten zu vermitteln, damit die unterschiedlichen Bedürfnisse von Frauen und Männern unter Berücksichtigung von Lebensphase und -situation erkannt werden und bei der Umsetzung auf Landes- und Gemeindeebene Berücksichtigung finden. Durch Präsentationen, Gespräche und Expertinnenworkshops wurde eine fachspezifische Sensibilisierung und Wissensvermittlung im Planungsbereich eingeleitet. In den Workshops mit den zuständigen Planungsabteilungen, der Genderexpertin des Landes Kärnten und den EntscheidungsträgerInnen wurde anhand von exemplarischen Beispielen in der Gemeinde Hermagor-Pressegger See und verschiedenen Methoden der Ansatz des Gender Mainstreaming bearbeitet.

Eine Sensibilisierung und Qualifizierung der Planungsfachleute in der Verwaltung auf Landes- und Gemeindeebene[3] und im selbstständigen Bereich hinsichtlich der Strategie des Gender Mainstreaming als Qualitätssicherung in der Planung ist daher ein entscheidender Schritt in der Landschaftsplanung und räumlichen Planung, um Gender Mainstreaming auf eine breitere Basis umzusetzen.

[1] Finanziert wurde das Projekt von der Europäischen Union, vom Amt der Kärntner Landesregierung, Abteilung 20, Unterabteilung Überörtliche Raumplanung und vom Referat für Frauen und Gleichbehandlung. Durchgeführt wurde es von der Planungskooperative drinnen.draussen, Institut für Landschaftsplanung, Universität für Bodenkultur Wien, Landschaftsplanungsbüro tilia mayrhofer.staller.studer oeg, Wien, LWK-ZT-Büro für Landschafts- und Raumplanung.

[2] Funktionalisierte Siedlungsstrukturen bedeutet, dass die Siedlungsform auf nur eine Funktion wie z.B. touristische Nutzung bzw. „nur“ Wohnen ausgerichtet ist und oft eine geringe Bebauungsdichte und hohen Flächenverbrauch nach sich zieht. Diese Siedlungsstrukturen beruhen auf die im monofunktionalistischen Städtebau propagierte Funktionstrennung in Wohnen, Arbeiten, Erholung und Verkehr (vgl. Panerai, Philippe et. al. 1977, Damyanovic, Doris 1997).

[3] Ein wichtiger Beitrag dazu ist das Projekt GenderAlp!, welches zum Ziel ein innovatives, administratives Netzwerk zur Sicherung einer qualitativen Planungspraxis strategisch auf- und auszubauen und die Umsetzung von Gender Mainstreaming als top down strategy voranzutreiben.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

2 WAS BEDEUTET DIE UMSETZUNG VON GENDER MAINSTREAMING IN DER PLANUNG?

Gender Mainstreaming in der Landschaftsplanung und räumlichen Entwicklung[4]

- bewertet räumliche Strukturen danach, ob sich diese im Alltag von Frauen und Männern und in den unterschiedlichen Lebenszusammenhängen bewährt haben. Bewertet werden Bau- und Freiraumstrukturen, das sind Dorf- und Stadtstrukturen, Erschließungsnetze sowie Ausstattungen von Straßen, Wegen und Plätzen.
- berücksichtigt Ansprüche von Frauen und Männern, Mädchen und Burschen bereits bei der Zielformulierung, bei der Maßnahmenplanung bishin zur Umsetzung und Evaluierung.
- legt die gesellschaftlichen Rahmenbedingungen und Wertvorstellungen von PlanerInnen und Planungen offen.
- verändert räumliche Strukturen, Rahmenbedingungen und Werthaltungen, die Frauen und Männer benachteiligen.
- schafft mehr Chancengleichheit (vgl. Pimminger, Irene: 2001).

3 WOZU GENDER MAINSTREAMING IM PLANUNGSPROZESS?[5]

Die Umsetzung von Gender Mainstreaming in Planungsprozessen zielt auf eine Qualitätsicherung in der räumlichen Entwicklung ab:

Der Blick auf die Geschlechterverhältnisse fördert die Lebensqualität im ländlichen Raum

Die Berücksichtigung der unterschiedlichen Ansprüche von Frauen und Männern erleichtert ihren Lebensalltag. Ziel eines gendersensiblen Planungsprozesses ist, dass räumliche Strukturen zur Verfügung stehen, die die unterschiedlichen Lebensalltage von Frauen und Männern unterstützen. Lebensqualität zu fördern bedeutet, der Abwanderung aus den ländlichen Regionen entgegenzuwirken.

GM erhöht die Effektivität und Nachhaltigkeit von Planungen

Durch die Einbindung möglichst vieler AkteurInnen sind die Ansprüche besser repräsentiert. Das bedeutet auch die Minimierung von Planungsfehlern und Ausgleichsmaßnahmen und unterstützt das Nachhaltigkeitsprinzip.

GM in der räumlichen Planung wird von der Europäischen Union gefördert

Die Förderung der Gleichstellung von Frauen und Männern ist eine Aufgabe der Europäischen Union. Die Anfänge in der Europäischen Union liegen im dritten Aktionsprogramm für Chancengleichheit (1991 bis 1995).Der Amsterdamer Vertrag von 1999 verpflichtet die Mitgliedsstaaten der EU zu einer aktiven Gleichstellungspolitik im Sinne von Gender Mainstreaming. In der Mitteilung der Kommission über die Strukturfondes (Leitlinien für die Programme des Zeitraums 2000-2006) wurde Chancengleichheit als ein horizontaler Grundsatz für die Strukturfonds festgelegt. An Planungsprojekte, die die Umsetzung von Geschlechterdemokratie unterstützen, werden bevorzugt Fördermittel aus dem Europäischen Strukturfonds vergeben.

4 GENDER MAINSTREAMING ALS QUERSCHNITTSMATERIE IM PLANUNGSPROZESS

Die Umsetzung der Strategie des Gender Mainstreaming wurde beim Projekt "Frauen und Männer unterwegs" bei allen Planungsschritten angewandt. In der Landschaft- und Freiraumplanung gehen wir davon aus, dass gute Mobilitätsbedingungen notwendig sind, damit Frauen und Männer ihren Alltag und ihre alltäglichen Arbeiten im ländlichen Raum erledigen können und dass sie bezogen auf ihre Lebensphase und -situation unterschiedlichste Bedingungen vorfinden. Vor allem Frauen aber auch Männer mit Betreuungspflichten werden dadurch oft benachteiligt (vgl. Zech, Sibylla, Tiß, Michaela, Koch Helmut 1999). Die vielfältigen Bedingungen sind darauf zurückzuführen, dass der Wertmaßstab in der Raumordnung und Verkehrsplanung der autofahrende, erwerbstätige und gesunde Mann ist. Dieser stellt die Norm da, an dem Frauen und Männer, die dieser nicht entsprechen, gemessen werden. Die Familien- und Versorgungsarbeit als ein wichtiger Teil der Arbeit findet in den Konzepten wenig Beachtung und oft keinen Eingang in die Planung (vgl. Damyanovic, Doris, Müller, Gudrun, Schneider, Gerda, 2005).
Ziel der gendergerechten Planung am Gegenstand der Wegenetzplanung ist die Berücksichtung und Unterstützung der unterschiedlichen Alltage und Arbeitsorganisationen von Frauen und Männern. Aus landschaftsplanerischer Sicht gehen wir davon aus, dass die Alltagsorganisation durch qualitätsvolle Straßenräume und Wegenetze, das Vorhandsein von Infrastruktur und von einem guten, flexiblen öffentlichen Verkehr unterstützt wird. Entscheidend ist die Sichtbarmachung der Vielfalt der Alltage von Frauen und Männern und die Ausrichtung der Maßnahmen zur Erreichung der Chancengleichheit für Frauen und Männer. Ausgangspunkt für den Planungsprozess waren die unterschiedlichen Erhebungen von Mobilitätsbedürfnissen von Frauen und Männern (statistische Auswertungen, Befragungen und Beteiligung) und die landschaftsplanerische Bewertung der Wegenetze.

---

[4] Die Inhalte und Ziele von Gender Mainstreaming in der räumlichen Planung wurden im Projekt "Frauen und Männer unterwegs" definiert (Damyanovic, Doris, Schneider, Gerda, Müller, Gudrun, 2005).

[5] In Anlehnung an den Leitfaden "Frauen und Männer unterwegs" - Leitfaden zur Umsetzung von Gender Mainstreaming in der Wegenetzplanung in Gemeinden am Beispiel der Gemeinde Hermagor-Pressegger See (vgl. Damyanovic, Doris, 2005).

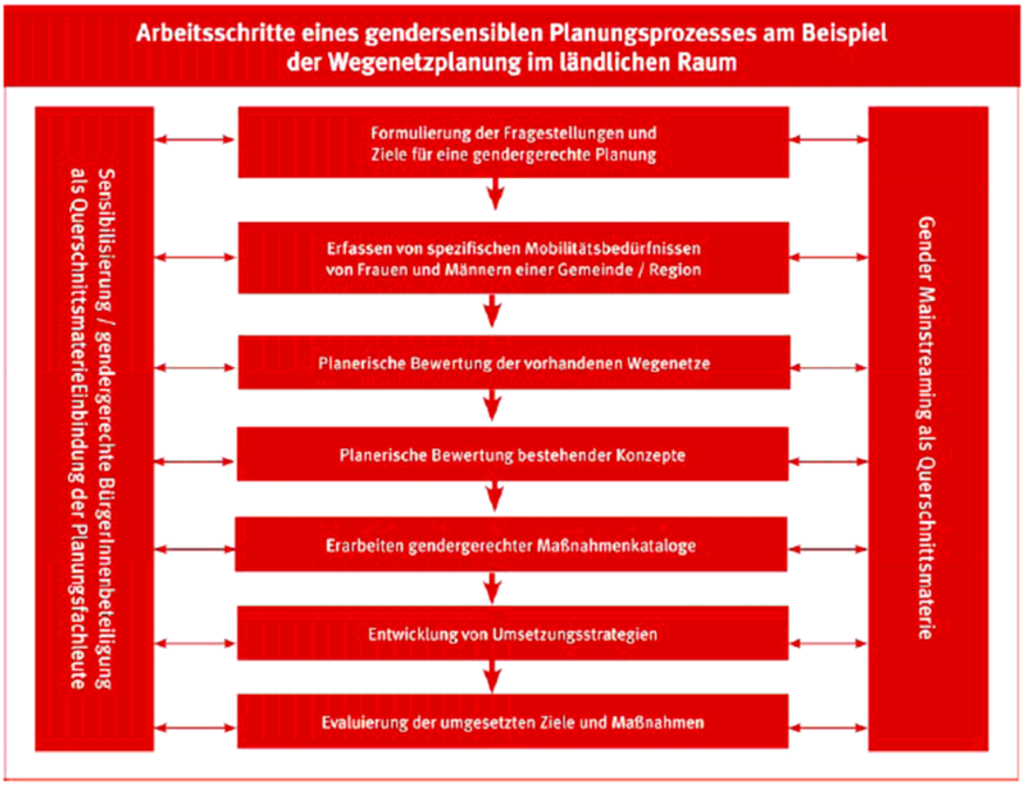


Abb. 1: Arbeitsschritte eines gendersensiblen Planungsprozesses (Damyanovic, Doris 2005: 17)

5 ERFASSEN VON SPEZIFISCHEN MOBILITÄTSBEDÜRFNISSEN VON FRAUEN UND MÄNNERN IN DER GEMEINDE HERMAGOR-PRESSEGGER SEE

Zum Erfassen der spezifischen Mobiliätsbedürfnisse wurden beim Pilotprojekt "Frauen und Männer unterwegs" verschiedene Methoden verwendet. Die signifikanten demografischen und sozioökomomsichen Bevölkerungsdaten wurden aufbereitet. Vertiefend dazu wurden mittels BürgerInnenbefragungen und durch Beteiligung von Frauen und Männern die Mobilitätsgewohnheiten von Frauen und Männern hinsichtlich Lebensphase und Lebensituation erhoben. Einleitend die wichtigsten Ergebnissen:

- **Die Wegezwecke und Verkehrsmittelwahl spiegeln die geschlechtliche Arbeitsteilung wider. Die Alltage der Frauen sind von Haus- und Versorgungsarbeit und (Teil-)Erwerbsarbeit geprägt. Die Alltage der Männer sind über die Vollerwerbstätigkeit bestimmt.**

- **Frauen und Männer nutzen Wege und Wegenetze unterschiedlich. Frauen gehen mehr zu Fuß und Männer nützen mehr den öffentlichen Verkehr in der Gemeinde Hermagor - Pressegger See.**

- **Frauen und Männer eignen sich Räume unterschiedlich an. Die soziale Verfügbarkeit und Aneignung ist abhängig von Geschlecht, Alter und Lebenssituation.**

5.1 Auswertung von demographischen und sozioökonomischen Bevölkerungsdaten

Die geschlechtliche Arbeitsteilung wurde durch die Auswertung der demographischen und sozioökonomischen Daten sichtbar und durch weitere Erhebungungsmethoden des Projektes bestätigt. Wichtige Daten, die das Mobilitätsverhalten beeinflussen sind: (vgl. Simma, Anja , 2001): Geschlecht, Alter, Haushaltsgröße, Kinder im Haushalt, Erwerbstätigkeit, Einkommen (Statistik Austria November 2005). In Hermagor leben im Jahr 2001 7232 Personen, davon sind 52% Frauen (3765) und 48% Männer (3467). Die geschlechtliche Arbeitsteilung lässt sich gut an der Erwerbstätigkeit und den PendlerInnenströmen erkennen. In Hermagor-Pressegger See sind mit 50,6 % deutlich mehr Männer erwerbstätig als Frauen (34,2%). Die Auswertung der Daten zeigte auch einen hohen Anteil an vollerwerbstätigen Männern (93% der erwerbstätigen Männer) und im Vergleich dazu eine hohe Anzahl an Teilzeit und geringfügig-lohnerwerbstätigen Frauen (27% der erwerbstätigen Frauen). Die PendlerInnenzahlen stehen in engem Zusammenhang mit der Erwerbsarbeit. Auf Grund der Größe der Gemeinde gibt es auch viele BinnenpendlerInnen – 46% Frauen und 54% Männer. Deutliche Unterschiede gibt es bei den AuspendlerInnen, hier ist das Verhältnis 27% Frauen und 73% Männer.

Die unterschiedlichen Mobilitätsmuster sind über die geschlechtliche Arbeitsteilung geprägt. Der weibliche Alltag ist daher über die Zeitansprüche der eigenen Erwerbstätigkeit, die Zeitsysteme der zu betreuenden Personen und den Zeitbedarf der Familien- und Versorgungsarbeit bestimmt. Der männliche Alltag ist oft über die Freistellung von Haus- und Reproduktionsarbeit charakterisiert. Frauen haben daher ein komplexes räumliches Mobilitätsmuster, sie kombinieren meist relativ viele Wege n zwischen verschiedenen Orten zu Wegkette. Das Mobilitätsmuster der Männer ist stark über die Erwerbstätigkeit bestimmt, es entsteht der klassische Pendlerverkehr zwischen Wohnung und Arbeitsplatz (vgl. Bauhardt, Christine, 1994: 25-26).

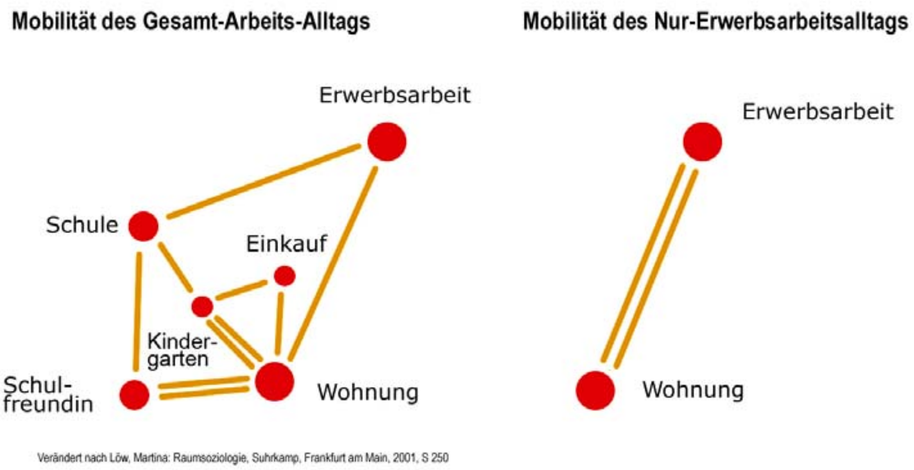


Abb. 2: Mobiliätsmuster in Anhängigkeit von der Arbeit (Damyanovic, Doris, Schneider, Gerda, Müller, Gudrun, 2005: 55)

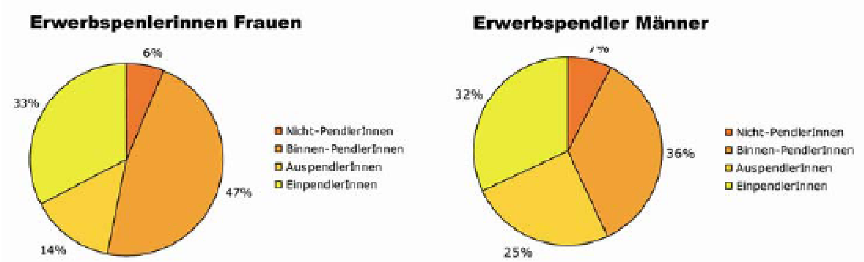


Abb. 3: Vergleich der PendlerInnenstöme in Hermagor (Damyanovic, Doris, Schneider, Gerda, Müller, Gudrun, 2005: 19)

Abb. 4: Vergleich der Erwebsttätigkeit von Frauen und Männern in Hermagor (Damyanovic, Doris, Schneider, Gerda, Müller, Gudrun, 2005: 19)

5.2 Erhebung der Mobilitätsgewohnheiten und Bewertung der Wegenetze mittels BürgerInnenbefragung

Die Erhebung der spezifischen Mobilitätsgewohnheiten wurde durch BürgerInnenbefragungen erweitert, da keine qualitativen und quantitativen Daten aus geschlechtsspezifischer Sicht vorhanden waren. Bei der Befragung „[mit]stimmen und gewinnen“ wurden Fragekarten zu Verkehrsmittelwahl und Wegezweck an alle Haushalte gesendet und bei Veranstaltungen aufgelegt. Durch die Frage nach den Gründen und Mitteln des Unterwegsseins konnten Schlüsse über das alltägliche Unterwegssein und die Ansprüche in Hinblick auf Geschlecht, Alter und Lebenssituation gezogen werden. Die Unterschiede wurden bei Wegezwecke und Verkehrsmittelwahl deutlich.

Als Hauptzweck des Unterwegsseins wurde bei der Befragung von Frauen der Gemeinde Hermagor - Pressegger die Versorgungsarbeit (85%), gefolgt von der Erwerbsarbeit (55%), angegeben. Von den Männern wurden gleichermaßen die Erwerbsarbeit und die Versorgungsarbeit (52%) genannt. Die Betreuungsarbeit (Begleitung von anderen Personen) wurde von Frauen öfters angegeben. Geschlechtsspezifische unterschiedliche Angaben gab es bei „andere Aktivitäten“. Frauen gaben Sport, Besuche und Kinderbetreuung an, Männer vor allem Sportaktivitäten. Bei den Angaben zur Schule gab es geschlechtsspezifisch keine Unterschiede. Mit den unterschiedlichen Wegezwecken ergeben sich unterschiedliche Ansprüche an die Verkehrsmittelwahl und an den Raum.

Das Auto ist das wichtigste Verkehrsmittel im ländlichen Raum, Frauen und Männer gaben bei der Befragung gleichermaßen das Auto an. Frauen gehen mehr zu Fuß als Männer, dies konnte auch bei der Aktion „Netze machen mobil"[6] noch einmal bestätigt werden. Die Anmerkungen zu den Qualitäten der Alltagsfußwege wurden schwerpunktmäßig von Frauen formuliert. An den ausgewerteten Plänen war ersichtlich, dass Frauen häufiger zu Fuß im Stadtzentrum unterwegs sind, um Einkäufe und Erledigungen zu tätigen. Die befragten Frauen hatten im Vergleich zu den Männern sehr konkret formulierte Anmerkungen zu den Alltags- und Freizeitfußwegen. Die weitere Auswertung ergab, dass bei der Verwendung des Fahrrades es keine großen Unterschiede gibt. Bei der Benutzung des Öffentlichen Verkehrs (ÖPNV) wurde hingegen der Zusammenhang der Ansprüche in Bezug auf Geschlecht, Alter und Lebenssituation sehr deutlich. Der ÖPNV wird deutlich mehr von Männern genutzt. Vor allem Jugendliche, Mädchen und Buben sind auf den ÖPNV angewiesen. Personen, die im Alltag keine komplexen Wegeketten haben bzw. Frauen und Männer, die als Hauptaktivität einer Erwerbsarbeit nachgehen, sind mit dem ÖPNV unterwegs.

Auswertung der Befragung „[mit]stimmen und gewinnen"

Differenziert nach Verkehrsmittelwahl	Frauen	Männer
Auto	80 %	79 %
zu Fuß	64 %	58 %
Rad	40 %	40 %
ÖPNV	5 %	14 %
Differenziert nach Aktivitäten	**Frauen**	**Männer**
Einkaufen /Erledigungen	85 %	52 %
Arbeit	55 %	52 %
andere Aktivitäten	28 %	24 %
Begleitung von Personen	19 %	14 %
Schule	0,5 %	1 %

Abb. 5: Ergebnisse der Befragung „[mit]stimmen und gewinnen" (Damyanovic, Doris 2005: 21)

5.3 Erhebung der Mobilitätsgewohnheiten durch Workshops mit unterschiedlichen Zielgruppen

Um uns genauer den Alltagsmobiliätserfahrungen nähern zu können, war uns eine Zusammenarbeit mit den BewohnerInnen und ihren spezifischen Bedürfnissen und Erfahrungen unerlässlich und notwendig. Die soziale Verfügbarkeit und Aneignung wurde in den durchgeführten Workshops mit Frauen und Männern aus Hermagor-Pressegger See und mit Mädchen und Buben deutlich. Im Workshop [7] wurden Frauen und Männer gebeten einen Ortsplan (Mental Map) mit einem kurzen Text zu zeichnen. Die Methode der Mental Maps wurde in Anlehnung an Downs/Stea und Gould/White verwendet. *„Downs and Stea beschreiben kognitive Karten als ein Abbild (Repräsentation) der Umwelt, die das jeweils spezielle Verständnis der Welt durch die/den Zeichnenden wiedergibt. „Eine kognitive Karte ist vor allem ein Querschnitt, der die Welt zu einem bestimmten Zeitpunkt zeigt. Sie spiegelt die Welt so wieder, wie ein Mensch glaubt, dass sie ist, sie muss nicht korrekt sein*" (Damyanovic, Doris, Studer, Heide, Staller,Susanne, 2005: 67). Die Mental Maps wurden systematisch verglichen und die Gemeinsamkeiten und Unterschiede herausgearbeitet. Die Wegeverläufe von Frauen und Männern sind ähnlich, wobei Frauen stärker auf das Zentrum und die Hauptstraße fokussiert sind. Männer legen mehr Gewicht auf die Verbindung zur Umgebung und auf Freizeitwege. Für Frauen hat das Zentrum größere Bedeutung für die Haus- und Versorgungsarbeit und als Treffpunkt, eventuell auch für Geschäfte und Gastgewerbe als Erwerbsstätten. Dies ist darauf zurückzuführen dass sie viele Versorgungseinrichtungen für den täglichen Bedarf, Schulen, medizinische Versorgung und Gaststätten einzeichneten. In den Mental Maps der Männer werden die Einrichtungen des produzierenden Gewerbes, der Verwaltung, Kirche und Politik sowie des Sports mehr Gewicht gegeben. Die Karten weisen auf Erwerbsarbeitsplätze in Verwaltung und Gewerbe und auf eine größere Bedeutung von örtlichen Institutionen hin. Bei den Workshops wurde auch hier die klassische Arbeitsaufteilung deutlich sichtbar, Frauen sind für die Versorgungsarbeit zuständig, die Männer identifizieren sich über die Erwerbsarbeit (vgl. Döge, Peter, 1999: 24-31).

Geschlechtsspezifische Unterschiede in der Aneignung des Raumes wurden auch in den Workshops mit Jugendlichen sichtbar. Mädchen eigneten sich den Raum durch Kommunikation und Interaktion mit anderen Menschen an. Sie fotografierten Personen, redeten mit Frauen und Männern, die Ihnen begegneten und bezogen auch noch die Schulleitung mit ein. Buben nahmen den Raum durch Bewegung ein. Sie hatten einen größeren Aktionsradius und traten nicht in Kommunikation mit anderen Menschen[8].

---

[6] Am Aktionstag wurden im Rahmen „Netze machen mobil" Frauen und Männer zu ihren alltäglichen Mobilitätsverhalten befragt. Die TeilnehmerInnen hatten die Möglichkeit ihre alltäglichen Wege in die ÖK (25 000) einzuzeichnen, ihre Verkehrsmittelwahl nach Häufigkeit der Nutzung zu nennen und drei positive und drei negative Beispiele/Anmerkungen hinsichtlich der Verkehrsmittelwahl anzugeben. Alle Befragungen wurden nach Geschlecht und Alter ausgewertet.

[7] Das Thema des Workshops war „Geschlechterverhältnis und Mobilität". Schwerpunkt war die Sichtweise von Frauen und Männern der Stadt Hermagor. Zu Beginn gab es eine gemeinsame Vorstellungsrunde. Bei der Erstellung und Vorstellung der Karten wurde in geschlechtshomogenen Gruppen gearbeitet. Den Abschluss bildet eine gemeinsame Diskussion zu den Perspektiven hinsichtlich des Unterwegsseins in Hermagor.

[8] Die Projektergebnisse spiegeln ähnliche Erfahrungen und Erkenntnisse aus Studien und Projekten in Österreich, Deutschland und in der Schweiz (vgl. Damyanovic, Doris, Müller, Gudrun, Schneider, Gerda: 6-7). Dazu vergleiche auch die Arbeiten von Martha und Hans Heinrich Muchow 1935 und Martina Löw 2001.

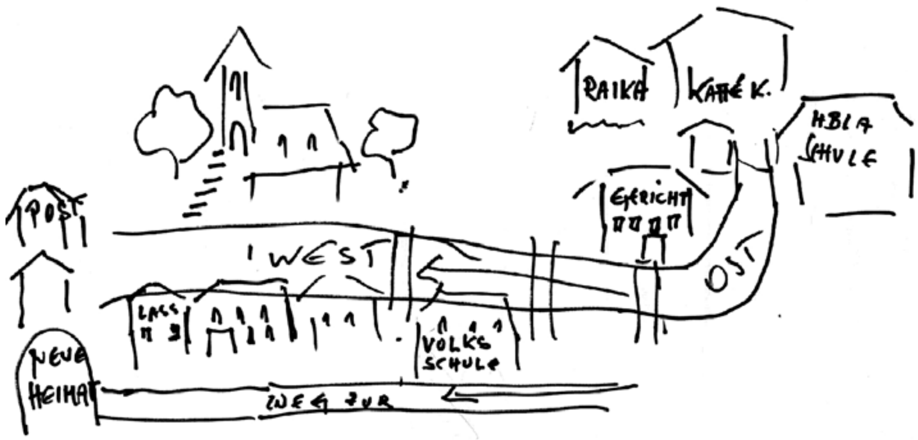


Abb. 6: Beispiel einer „Mental Map" einer Bewohnerin von Hermagor Pressegger See
(Damyanovic, Doris, Schneider, Gerda, Müller, Gudrun, 2005: 66)

6 LANDSCHAFTSPLANERISCHE BEWERTUNG DER WEGENETZE IN HERMOGOR-PRESSEGGER SEE

Die landschaftsplanerische Bewertung hat zum Ziel die Stärken und Schwächen der unterschiedlichen Qualitäten der Erschließungsstrukturen für den Alltag von Frauen und Männern in der Gemeinde Hermagor-Pressegger See herauszuarbeiten. Dabei wurden die Wegequalitäten in den Ortschaften, die Wege zwischen den Ortschaften, die regionalen und überregionalen Verbindungen beurteilt. Ausgangspunkt war eine detaillierte Kartierung vor Ort. Der Kartierschlüssel entstand über den Vergleich und Typisierung der lokalen Beispiele. Die Beispiele wurden zeichnerisch dokumentiert, textlich beschrieben und mit Hilfe einer tabellarischen Gegenüberstellung verglichen. Im Vergleich wurden ähnliche Beispiele zu Gruppen, Typen zusammengefaßt. Grundlage der Zuordnung in eine Gruppe waren Merkmale der baulich-räumlichen Organisation, der Erschließung und der Nutzung. Die Typen beschreiben eine Systematik der Beispiele bezogen auf unsere Fragestellungen. Die Systematik[9] der Bebauungs-, Straßen- und Nutzungstypen war Grundlage der Kartierung der realen Nutzung und für die planerische Bewertung im Kontekt zu Gender Mainstreaming. In den ausgewählten Ortschaften wurde die Bau- und Freiraumstrukturen, Nutzungen und Infrastruktureinrichtungen erhoben. Ergänzt wurde die Erhebungen durch die Auswertung des Fahrplans und Liniennetzes des öffentlichen Nahverkehrs.

Die Straßen und Wege im ländlichen Raum sind Weg und Ort zugleich.

Die Straßen und Wege haben eine Funktion als Aufenthaltsort und Verbindungsraum in und zwischen den Ortschaften. Im Ort sind sie immer Weg und Ort zugleich (vgl. Böse, Helmut ,1981). Sie sind Wege zum Einkaufen, zur Erwerbsarbeit, zum Kindergarten, zur Schule und gleichzeitig Orte der Begegnung und Kommunikation.

[9] Die Methode des Vergleichs, der Typisierung und der Interpretation wurde von Harenburg und Wannangs sowie von Braun und Linne als Typologie der Wohnbebauung eingeführt und in zahlreichen Arbeiten am Institut für Landschaftsplanung, Department für Raum, Landschaft und Infrastruktur geprüft und erweitert (vgl. Harenburg, Wannags, 1991: 21ff, Braun, Linne, 1991: 141 ff). Bei der Erhebung in Hermagor Pressegger See konnte auf landschaftsplanerische und siedlungsgeografische Arbeiten zurückgegriffen werden (vgl. AutorInnengemeinschaft 2000, 2002, Fuchs, Britta ,1999, Klar, Adalbert,1942).

6.1 Landschaftsplanerische Bewertung am Beispiel Tröpolach

Die Ortschaft Tröpolach ist ein Haufendorf mit Breitstreifenlflur, die durch freistehende Häuser ab den 30er Jahre und großflächige touristische Einrichtungen (Hotels, Talstation, Parkflächen) ab den 80er Jahren erweitert wurde. Die Ortschaft verfügt über eine Kirche, eine Volksschule, mehrere Geschäfte, Gaststätten und Hotels. Das hierarchisch, abgestufte Wegenetz teilt sich in:

- Hauptverbindungstraße mit einer Breite von mehr als 6 m, welche innerhalb der Ortschaft mit Gehsteigen ausgestattet sind (violett)
- in Dorfstraßen mit einer Fahrbahnbreite von mindestens 3 Meter, im Haufendorf Aufweitungen mittels Hausvor- und Straßenplätze (hellrosa)
- Einspure Straße mit einer Fahrbahnbreite von 3-4 Meter, meist mit seitlichen Rasenstreifen (gelb)
- Geschottete Fahrwege (magenta)
- Fußwege (rot) und Trampelpfade (Ocker)

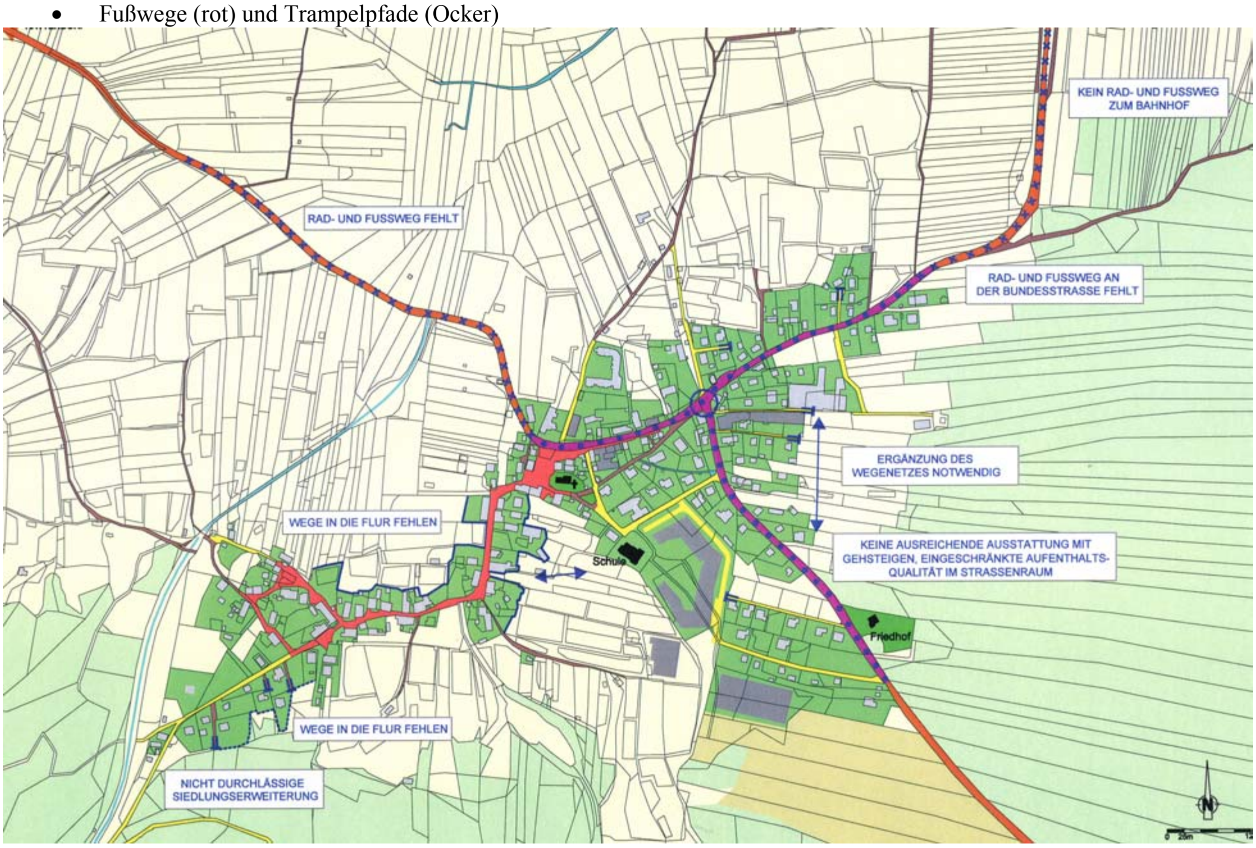


Abb. 7: Bewertung der Wege und Wegenetze in Tröpolach (Damyanovic, Doris, 2005: 24)

Ein Großteil der landwirtschaftlichen Betriebe befindet sich im Westen der Ortschaft entlang der Dorfstraße. Die Hotels, Geschäfte und Infrastruktureinrichtungen befinden sich im Osten von Tröpolach. Sie liegen an den Hauptverkehrsstraßen sowie in der Nähe der Talstation im Südwesten. Im gesamten Ortsgebiet sind wohn- und landwirtschaftliche Nutzungen mit Beherbergung kombiniert. In etwa der Hälfte aller Höfe, Häuser und Gebäude werden Zimmer vermietet.

Tröpolach verfügt über ein engmaschiges Fußwegenetz im Ortskern, eine gute Aufenthaltsqualität in den Dorfstraßen und alltägliche Versorgungseinrichtungen, die fußläufig erreichbar sind und über Erwerbsarbeitsplätze (vor allem durch den Tourismus) vor Ort. Die netzartige engmaschige Erschließung ermöglicht kurze Wege von und zu allen Orten innerhalb von Tröpolach. Die meist höhere AnliegerInnendichte bedeutet auch das Vorhandensein von Schulen, Geschäften, Nahversorgung und Gasthäusern. Die Stärkung des Wegenetzes kommen vor allem Frauen aber auch Männern zu Gute, die im Ort arbeiten (Hausarbeit, Versorgungsarbeit, Kinderbetreuung, Landwirtschaft, Beherbung u.ä.) und FußgängerInnen, Kindern und Frauen jeder Altersstufe.

Das Wegenetz der Erweiterung ist grobmaschiger und weniger durchlässig. Das Erschließungsnetz teilt sich in Haupt-, Siedlungserschließungsstraßen und Wohnwege auf. Es gibt oft Sackgassen und die Anbindung an die alten Ortsteile funktioniert oft nicht sehr gut. Durch die Organisation des Wegenetzes werden längere Wege produziert, da viele Einrichtungen und Geschäfte in den Zentren liegen und fußläufig nicht gut erreichbar sind. Die Menschen, die entlang der Haupterschließungsstraßen leben, sind von einem erhöhten Verkehrsaufkommen betroffen. Ein Vorteil ist, dass die Siedlungserschließungsstraßen weniger Verkehr aufweisen. Die BewohnerInnen aber, die entlang der Haupterschließungsstraßen bzw. in der Nähe des touristischen Zentrums (Talstation) leben, wo sich die ganze Infrastruktur befindet, sind durch den zunehmenden Verkehr belastet.

Die Qualität der Fußwege hängt einerseits vom Wegesystem und andererseits von der Ausstattung und der Qualität des Wegenetzes ab. Durchgängig ist zu beobachten, dass die Zonierung und Ausstattung der Straßen den Kfz-Verkehr bevorzugt, was vor allem die AutofahrerInnen unterstützt. Die Gehsteige sind meist zu schmal. Besser funktioniert es bei Straßen mit Hausvorplätzen, wie in den Dorfstraßen, mit weniger Verkehr. Hier ist die Aufenthaltsqualität besser und sicherer.

Fußläufige, engmaschige und durchlässige Wegenetze unterstützen den Alltag von Frauen und Männern unabhängig von Alter, Geschlecht und Lebenssituation. *„Zu Fuß sind die Menschen mehr oder minder gleichgestellt. Menschen, die nur zu Fuß gehen,* *bewegen sich spontan, mit einer Geschwindigkeit von 4 bis 6 km/h in jede Richtung und an jeden Ort, soweit ihnen dies nicht rechtlich oder physisch verwehrt ist*“ (Illich, Ivan 1974, 24). Für Kinder, Mädchen, Buben und ältere Menschen sind fußläufige Verbindungen für ihre Alltagsbewältigung sehr entscheidend, weil sie meist über kein Auto verfügen bzw. auf andere Personen angewiesen sind. Diese Begleitpersonen sind vor allem Frauen, die für die Versorgungsarbeit (Einkaufen, Erledigungen) und die Betreuung der Kinder, Mädchen, Buben und älteren Menschen zuständig sind. Es betrifft aber auch Männer, die vermehrt Haus- und Versorgungsarbeit leisten.

7 PLANERISCHE BEWERTUNG VON BESTEHENDEN KONZEPTEN

Für die Ausarbeitung der Maßnahmen war es entscheidend die Ergebnisse aus der planerischen Bewertung, den Sensiblisierungs- und Beteilungsverfahren mit den Strategien, Zielen und Maßnahmen aus dem Örtlichen Entwicklungskonzept (ÖEK), dem Flächenwidmungsplan (FLÄWI) und dem Gesamtverkehrskonzept Kärnten (GVK) zu vergleichen. Die Konzepte wurden überprüft, ob die Ergebnisse und die formulierten Maßnahmen aus einer Genderperspektive beinhaltet sind bzw. an welchen Stellen Ergänzungen bzw. Maßnahmen notwendig sind. Die aus der landschaftsplanerischen Bewertung abgeleiteten Ziele und Maßnahmen deckten sich an vielen Punkten mit den Maßnahmen und Zielen der bestehenden Planungen (OEK, GVK).
Der Vergleich mit dem Gesamtverkehrskonzept Kärnten als Beispiel zeigte, dass verkehrsplanerische Maßnahmen und Ziele zwar auf die Ansprüche vieler Bevölkerungsgruppen abgestimmt sind, obwohl diese in der Regel nicht explizit genannt sind, jedoch in der Umsetzung ohne differenzierten Blick auf den Alltag, bestimmte Bevölkerungsgruppen deutlich benachteiligt werden. Primäres Ziel des Konzeptes*: "Die Landesverkehrspolitik dient dem Gesamtwohl der heutigen und zukünfigen Bevölkerung"* (vgl. Gesamtverkehrskonzept Kärnten 1995:32). Aus der Genderperspektive verlangt die Definition des Gesamtwohls eine differenzierte Definition. Im Projekt "Frauen und Männer unterwegs" wurde die Alltagsbewältigung von Frauen und Männern ins Zentrum der Betrachtung gerückt. "*Sie dient als Maßstab für das Wohlergehen. Dies ist nur möglich, wenn nach unterschiedlichen Lebenszusammenhängen und dem Lebensalltag befragt, differenziert und bewertet wird*" (Damyanovic, Doris, Müller, Gudrun, Schneider, Gerda, 2005: 80).
Mit dem Gedanken des Gender Mainstreaming wird die Definition der heutigen und zukünftigen Bevölkerung konkretisiert. Mit "Bevölkerung" sind Frauen und Männer unter Berücksichtung des Alters und Lebenssituation gemeint. Die Fragenstellungen, Ziele und Maßnahmen sind zu formulieren, dass die Chancengleichheit von Frauen und Männer gefördert wird.

8 ERARBEITUNG VON GENDERGERECHTEN MASSNAHMEN UND UMSETZUNGS-STRATEGIEN

Grundlage für die Empfehlungen waren die landschaftsplanerische Bewertung, die Sensiblisierungs- und Beteiliungsverfahren vor Ort und die Reflexion der bestehenden Konzepte aus einer landschaftsplanerischen und gendersensiblen Sicht. Die Empfehlungen und die Umsetzung wurde auf vier Ebenen formuliert:

- Empfehlungen für die Wege und Wegeverbindungen im Ort
- Empfehlungen für die Wege- und Wegeverbindungen zwischen den Gemeinden (insbesondere Radverkehr, ÖPNV)
- Empfehlungen für Straßenquerschnitte
- Empfehlungen zur Verankung von Gender Mainstreaming in der Planung

8.1 Empfehlungen zur Umsetzung und Maßnahmen am Beispiel Tröpolach

Am Beispiel Tröpolach werden die Maßnahmen für das innerörtliche Wegenetz beschrieben und die Möglichkeiten der Umsetzung konkretisiert. Ausgehend von den Zielformulierungen müssen Frauen und Männer unterstützt werden, die eine Benachteiligung in ihrem Lebensalltag erfahren. Wichtig ist die Zielgruppen genau anzugeben, damit es auch in der Evaluierung überprüfbar ist.

Empfehlungen für Maßnahmen für Wegenetze in Dorf und Stadt
Beispiel: ländliche Erschließungsstrukturen in größeren Haufendörfern mit flächenhaft erfolgter Erweiterung und Verdichtung im 20./21. Jahrhundert

Planerische Anknüpfungspunkte	Ziele	Unterstützt den Alltag von	Betrifft
• Parzellierung • Erschließung • Bauformen • Bauweisen • Straßenquerschnitte (-gestaltung) • Verkehrsregelung • Nutzungsmischung (statt räumlicher Funktionalisierung) • Regionalentwicklung	• Erhaltung der Aufenthaltsqualität und Sicherheit in Dorfstraßen • Verbesserung der Aufenthaltsqualität und Sicherheit in Ortsdurchfahrten und Siedlungsstraßen • Erhaltung der kurzen Wege im Dorf • Dorferweiterung und -verdichtung, die kurze Wege und qualitätvolle Straßenfreiräume garantiert • Förderung von lokalen Ökonomien und dörflicher Infrastruktur	• VolksschülerInnen	♀♀♂♂
		• Erwachsenen, die im Dorf lohnarbeiten (in der Landwirtschaft, Zimmervermietung, im Tourismus)	♀♀♂
		• Erwachsenen, die keiner Vollzeit-Lohnarbeit außerhalb des Dorfes nachgehen	♀ ♀♂
		• Menschen mit Betreuungspflichten	♀♀♂
		• Menschen, die Haus- und Familienarbeit leisten	♀♀♂
		• Menschen, die sich viel im Ort aufhalten, immobile und wenig mobile BewohnerInnen: ältere Menschen, Erwachsene, Kinder	♀♀♂
		• Menschen mit besonderen Bedürfnissen	♀♂

♀ Frauen; ♂ Männer; ♀♂ Ein Teil der BewohnerInnen, Anteil Frauen und Männer etwa ausgeglichen
♀♀♂ Ein Teil der BewohnerInnen, Anteil Frauen ist deutlich höher als jener der Männer
♀♀♂♂ Großteil der BewohnerInnen, Anteil Frauen und Männer ungefähr ausgeglichen

Planungsprinzipien für Gemeinde	Maßnahmen für Beispiel: Tröpolach	Priorität	Anknüpfungspunkte für Umsetzung
• Tempo 30 km/h im Ortsgebiet außer auf Bundesstraßen	• Tempo 30 km/h im gesamten Ortsgebiet	•••	• Intergration von GM-Kriterien bei der Überarbeitung des örtlichen Entwicklungskonzeptes • Überprüfung FLÄWI und BEP nach Gender Kriterien • Integration von GM-Kriterien und Methoden bei der Evaluierung des Gesamtverkehrskonzeptes Kärnten • Überarbeitung und Prüfung von überörtlichen Raumordnungsprogrammen und Leitbildern für die räumliche Entwicklung
• Zonierung in Dorfstraßen erhalten oder wiederherstellen: Gliederung in Hausvor- und Straßenplätze und Straße mittels Differenzierung der Oberflächengestaltung	• Erhaltung der Zonierung in der Dorfstraße (Differenzierung der Oberflächengestaltung Hausvorplätze – Fahrbahn)	•••	
• In Ortsdurchfahrten Kfz-Geschwindigkeiten reduzieren, Gehsteige verbreitern oder anlegen, Fahrbahnen schmälern, ausreichende und sichere Querungshilfen schaffen • Rad-Anbindung an den Gailtalradweg und zum Bahnhof	• Ortsdurchfahrt Richtung Rattendorf: Neugestaltung bei Oberflächenreparaturen oder Grabungsarbeiten	•••	
	• Umgestaltung Naßfeldstraße nach Anlage der Ortsumfahrung	••	
	• Radweg an B111 ab Kreuzung Richtung Rattendorf mit Anbindung an Gailtalradweg und Bahnhof	•••	
	• Schaffen einer Radverbindung über die Gail zum Bahnhof	•••	
• Ergänzen und Verdichten der Wegenetze in bestehenden Erweiterungsgebieten sowie bei Umnutzungen der Hofparzellen	• Erschließung lt. ÖEK im Siedlungsbereich östlich der Naßfeldstraße ergänzen	•••	
	• Weggrundstücke zwischen Grundstücken an der Dorfstraße aufkaufen oder Nutzungsrechte sichern (Wegverbindung Dorfstraße Schule)	••	
	• Hintausweg nördlich Straße Richtung B111 anlegen: Flächenkauf oder Nutzungsrecht	••	
• Neue Erweiterungen nach den Prinzipien: Orientierung der Häuser zu den Straßen, rasterförmiges Erschließungsnetz, längliche Parzellenformen • NahversorgerInnen und dörfliche Initiativen unterstützen (z.B. zur Verfügung stellen von leerstehenden Gemeindegebäuden)	• B-Plan und Erschließungskonzept (ÖEK) für Erweiterungsgebiete lt. ÖEK bzw. Fläwi	•••	

••• erste Priorität, sobald als möglich umsetzen (z.B. bei Erneuerungen von Straßeneinbauten, vor Grundstückverkauf)
•• zweite Priorität, innerhalb von 5 Jahren umsetzen • dritte Priorität, innerhalb von 10 Jahren umsetzen

Abb. 8: Beispiel für Planungsziele und Maßnahmen für Wegenetze in Tröpolach (Damyanovic, Doris 2005: 29)

9 RECHTLICHE RAHMENBEDINGUNGEN FÜR GENDER MAINSTREAMING IN DER PLANUNG AM BEISPIEL DES LANDES KÄRNTEN

Die europaweite Implementierung von Gender Mainstreaming in politische Vorgaben, Gesetze, Richtlinien und Förderprogramme hat im Primärecht (Amsterdamer Vertrag 1999) seine rechtliche Verankerung. Die Grundlage für die Umsetzung in Österreich ist der Artikel 7 des Bundesverfassungsgesetzes und die Implementierung von Gender Mainstreaming in Ministerratsbeschlüssen[10]. Auf Bundesebene gilt der Gleichheitsgrundsatz, der besagt, dass "*Alle Bundesbürger vor dem Gesetz gleich sind. Vorrechte der Geburt, des Geschlechtes, des Standes, der Klasse und des Bekenntnisses sind ausgeschlossen*" (Artikel 7. Abs. 1).
Der Artikel 7 Abs. 2 besagt: "*Bund, Länder und Gemeinden bekennen sich zur tatsächlichen Gleichstellung von Mann und Frau. Maßnahmen zur Förderung der faktischen Gleichstellung von Frauen und Männern insbesondere zur Beseitigung tatsächlich bestehender Ungleichheiten sind zulässig"*.
Die Gleichstellung von Frau und Mann wurde auch in den einzelnen Landtags- und Regierungsbeschlüssen der Länder verankert. Im Land Kärnten sind die Grundlagen das Kärntner Landes-Gleichbehandlungsgesetz LGBl. Nr. 56/1994 i.d.g.F. und zwei Regierungsbeschlüsse zur Implementierung von Gender Mainstreaming in der Verwaltung[11]. Die Beratung und Koordination der Wissensvermittlung liegt derzeit in der Zuständigkeit des Referates für Frauen und Gleichbehandlung des Landes. Auf Landesebene wurde die Arbeitsgruppe Gender Mainstreaming (GEMEX), die abteilungs- und ressortübergreifend zusammengesetzt ist, eingesetzt. Über den MulitplikatorInneneffekt der Arbeitsgruppe GEMEX, durch Gender Trainings in der Verwaltungsakademie und durch Pilotprojekte wie z. B. „Frauen und Männer unterwegs“ wird Schritt für Schritt die Strategie des Gender Mainstreaming umgesetzt

Abb. 9: Rechtliche Implementierung von Gender Mainstreaming in Kärnten (Damyanovic, Doris 2005: 8)

[10] Ministerratsbeschlüsse 11. Juli 2000: Einrichtung der ministeriellen Arbeitsgruppe Gender Mainstreaming; 3. April 2002: Arbeitsprogramm zur Umsetzung von Gender Mainstreaming für die nächsten Jahre; 9. März 2004 zur Implementierung von Gender Mainstreaming in Fortsetzung der bisherigen Beschlüsse;

[11] Regierungsbeschlüsse Kärnten, 2000,Geschlechtergerechter Sprachgebrauch; 2001, Gender Mainstreaming in der Verwaltung

10 UMSETZUNG VON GENDER MAINSTREAMING IM ÖRTLICHEN ENTWICKLUNGSKONZEPT

Die gesetzliche Rahmenbedingung zur Umsetzung von GM in der Planung auf kommunaler Ebene ist das Kärntner Gemeindeplanungsgesetz. Das Projekt hat gezeigt, dass es vor allem im Örtlichen Entwicklungskonzept (ÖEK) Möglichkeiten gibt, gendersensible Planung und Planungsprozesse in die örtliche Raumordung zu integrieren.
Die im ÖEK verankerten Inhalte und Ziele wie z. B. statistische Anlayse von Bevölkerungsdaten, Festlegung von öffentlichem Verkehr und Siedlungsentwicklung sind gendergerecht zu formulieren und auszuarbeiten. Auch eine aktive Einbindung der Bevölkerung - Frauen, Männer, Mädchen, Burschen und ältere Menschen ist bei der Erstellung und Ausarbeitung sehr entscheidend. Im Rahmen des Projektes wurden verschiedene qualitative Methoden (Aktionstag, Workshop mit Erwachsenen und Jugendlichen) und qualitative Methoden (Befragungen) erarbeitet. Wichtig im Planungsprozess ist eine gezielte Einbindung von BewohnerInnen, die in gängigen Planungsprozessen meist nicht zu Wort kommen (z. B. Jugendliche , ältere Menschen).
Die Übersicht zeigt Anknüpfungspunke im ÖEK für die Einflußnahme der beteiligten AkteurInnen (BürgermeisterIn, Gemeinderat, Landesregierung, BürgerInnen) und Maßnahmen zur Umsetzung von Gender Mainstreaming.

Örtliches Entwicklungskonzept (ÖEK)
K-GplG 1995 igF, §2

Das ÖEK enthält folgende Anknüpfungspunkte für eine genderwirksame Wegenetzplanung
(legt wirtschaftliche, soziale, ökologische und kulturelle Inhalte und Ziele fest)

- Enthält statistische Analyse von Bevölkerungsdaten: legt damit Analysekategorien fest und macht einzelne Bevölkerungsgruppen sichtbar
- Beschäftigungs- / Arbeitsplatzentwicklung / Wirtschaft: beeinflusst die Erreichbarkeit von Arbeitsplätzen (zeitlich und räumlich)
- Soziale Infrastruktur: beeinflusst die Erreichbarkeit von Nahversorgung, Schulen, Kindergärten, ÄrztInnen, sozialen Dienstleistungen
- Festlegung öffentlicher Verkehrswege einschließlich von Radwegen / Verkehrswegenetz: sichert Fuß- und Radwegverbindungen, legt Ziele und Maßnahmen für ÖPNV fest, schreibt Grundzüge eines Radverkehrskonzeptes fest
- Siedlungsentwicklung (Besiedelung und Bebauung): legt die Distanzen zwischen und die Erreichbarkeit von funktional definierten Teilräumen (Wohn- und Gewerbegebiete, land- und forstwirtschaftliche Flächen, Grünzüge, Einkaufszentren, ...) und die Möglichkeit für Mischnutzungen (Dorfgebiete, Kerngebiete, ...) fest

Beteiligte AkteurInnen und Einflussnahme	... und die Umsetzung von Gender Mainstreaming
• Erstellung und Beschluss durch Gemeinderat	• Verpflichtung zu Umsetzung von Gender-Mainstreaming-Kriterien
• Üblicherweise sind die Bewohnerinnen und Bewohner in die Erstellung im Rahmen thematischer Workshops eingebunden	• Gezielte Einbindung benachteiligter Bevölkerungsgruppen, gendergerechte Beteiligungsverfahren, Lobbying für unterrepräsentierte Anliegen
• Verbindliche Stellungnahme seitens der Landesregierung	• Überprüfung der Genderwirksamkeit
• Beratung seitens der Landesregierung	• Empfehlungen zur Umsetzung in der Gemeinde
• Jede/r, der ein berechtigtes Interesse glaubhaft macht, kann schriftlich begründete Vorschläge gegen den Entwurf während einer 4-wöchigen Auflage zur allgemeinen Einsicht einbringen	• Stellungnahmen zu Gender-Themen seitens der Bewohnerinnen und Bewohner, Interessensvertretungen, GM-Beauftragte, etc.
• Gemeinde hat Anspruch auf Beratung durch Landesregierung	• Forderung nach Beratung durch PlanerInnen mit Gendererfahrung

Abkürzungen: Kärntner Gemeindeplanungsgesetz: K-GplG

Abb. 10: Örtliches Entwicklungskonzept im Kontext zu GM (Damyanovic, Doris 2005: 15)

11 LANDSCHAFTSPLANERISCHE ARBEITSWEISE ZUR ENTWICKLUNG VON STRATEGIEN ZUR IMPLEMENTIERUNG VON GENDER MAINSTREAMING IN DER RÄUMLICHEN PLANUNG

"*Gender Mainstreaming ist die (Re-)Organisation, Verbesserung, Entwicklung und Evaluierung grundsatzpolitischer Prozesse, mit dem Ziele, eine geschlechterbezogene Sichtweise in alle politischen Konzepte auf allen Ebenen und in allen Phasen durch alle normalerweise an politischen Entscheidungsprozessen beteiligten Akteure und Akteurinnen einzubringen*" (EUROPARAT 1998).
Die Top-Down-Strategie Gender Mainstreaming ist eine Verwaltungsstrategie, die in allen Bereichen abzielt Ungleichheiten zu beseitigen und die Gleichstellung von Frauen und Männern zu fördern (vgl. Amsterdamer Vertrag 1999: Artikel 3). Entscheidend in gendersensiblen Planungsprozessen und für die Umsetzung in der Landschaftsplanung und räumlichen Planung ist daher die Sensibilisierung und Qualifizierung der Planungsfachleute und EntscheidungsträgerInnen des Landes und der Gemeinden. Für die Umsetzung von Gender Mainstreaming bedarf es einer Sichtbarmachung der Strukturen, die Benachteiligungen hervorbringen, damit sie im Sinne von Gender Mainstreaming verändert werden können.
In der räumlichen Planung benötigt es planerische Ansätze und Methoden zur Bewußtseinsmachung von Strukturen. Eine strukturalistische Betrachtung, wie in der kritischen Landschafts- und Freiraumplanung angewendet wird, ermöglicht ein besseres Verstehen der Phänomene und ihrer Verbindungen zueinander.[12] In der Landschaftsplanung gehen wir von realer, imaginärer und symbolischer Strukturen aus.Unter der realen Ebene werden die bauliche-räumliche und sozio-ökonomische Situation verstanden. Strukturiert wird die reale Ebene von der imaginären und symbolischen Ebene. Mit dem Imaginären werden die Planungsleitbilder verstanden, wie zum Beispiel der funktionalistische Städtebau. Die Werthaltungen, die in Planungen beinhaltet sind und die Arbeit der Planerinnen und Planer strukturieren, sind die symbolische Ebene. "*Mit anderen Worten: unser Denken und unser gesellschaftliches Leben werden von einem geistigen Muster von Regeln, Wertungen und Begriffen strukturiert*" (Fuchs, Britta et. al.

12 Methodisch baut der Ansatz auf Gilles Deleuze (vgl. Deleuze, Gille, 1973) auf, der für die Landschaftsplanung übersetzt wurde. Die strukturalistische Betrachtung wurde erstmals von Gerda Schneider (1989) und in weiterer Folge in Arbeiten und Dissertationen am Institut für Landschaftsplanung weiter bearbeitet und formuliert. Ausführlich nachzulesen bei Fuchs, Britta, 2003 und Kurowski, Matthias, 2003.

2002: 8). Wird auf der symbolischen Ebene die Haus- und Versorgungsarbeit, die meist von Frauen durchgeführt wird, wenig wertgeschätzt, so finden sich diese Wertmaßstäbe in den Leitbildern bzw. spiegeln sich in der baulich-räumlichen Struktur wieder.

Eine oft verwendete Methode 5R+1E[13] ist sehr gut geeignet für die Bewußsseinmachung von Strukturen und wurde im Rahmen des Projekts GenderAlp!- Räumliche Entwicklung für Frauen und Männer für die Landschaftsplanung und räumliche Planung weiterentwickelt (vgl. Damyanovic, Doris, Schneider, Gerda, Florian, Reinwald, 2005). Die Methode beinhaltet Fragen zur realen Situation, wer ist im Planungsprozess beteiligt ist, wie ist die Verteilung der Ressourcen (Raum, Zeit, Geld) ist bzw. welche gesetzliche Rahmenbedingungen gibt es. Sie ermöglicht aber auch die Bewußtseinsmachung der imaginären Ebene, welche zu Beispiel Leitbilder sind bzw. nach der symbolischen Ebene, welche Wertvorstellungen und Denkstrukturen in Planungsprojekte bzw. -prozessen beinhaltet sind.

Ziel der Landschafts- und Freiraumplanung ist es planerische Ansätze und Methoden anhand von konkreten Beispielen zu vermitteln, die im alltäglichen Arbeiten der Planer und Planerinnen umsetzbar sind und die Implementierung der Strategie des Gender Mainstreaming als Qualitätssicherung in den räumlichen Planungen durch die Sensibilisierung und Qualifizierung von EntscheidungsträgerInnen und Planungsfachleuten in der Verwaltung auf Landes- und Gemeindeebene auf eine breite Basis zu setzen.

12 VERWENDETE LITERATUR

Amt der Niederösterreichischen Landesregierung, Abteilung Gesamtverkehrsangelegenheiten (Hrsg.): Gehen in Niederösterreich, St. Pölten, 2002

Arbeitskreis „Broschüre Gender Planning“ (Hrsg.): Gender Mainstreaming in der räumlichen Planung - Gender Planning, Von Peking über Amsterdam in die Westpfalz, oder: Die Ankunft einer weltumspannenden Idee vor Ort, 1. Auflage 11/2002

Aufhauser, Elisabeth; Herzog, Sigrun; Hinterleitner, Vera; Oedl-Wieser, Theresa; Reisinger, Eva: Grundlagen für eine „Gleichstellungsorientierte Regionalentwicklung“. Studie im Auftrag des Bundeskanzleramtes, Abteilung IV/4, Wien, 2003

AutorInnengemeinschaft: Wo der Kaiser (nicht) spazieren ging. Erschließung als Thema der Gemeindeplanung in Bad Ischl, OÖ, Landschaftsplanung II Übungen Sommersemester 2000, Seminarbericht, Arbeitsbereich Landschaftsplanung am Institut für Landschaftsplanung und Ingenieurbiologie, Universität für Bodenkultur Wien, Betreuung: DIin Renate Fuxjäger, Kirsten Förster, Barbara Gungl, Wien, 2000

AutorInnengemeinschaft: Ort mit Zukunft. Ein landschaftsplanerischer Beitrag zur Stadterweiterung in Wolfsberg (Kärnten), Seminararbeit zu Landschaftsplanung II Übungen und Feldarbeiten Sommersemester 2001, Arbeitsbereich Landschaftsplanung am Institut für Landschaftsplanung und Ingenieurbiologie, Universität für Bodenkultur Wien, Betreuung: DIin Doris Damyanovic, Elke Szalai, Simone König, Wien, 2001

AutorInnengemeinschaft: Freiraumplanerische Projektberichte über Leibnitz, Projektberichte Übungen mit Feldarbeiten zu Landschaftsplanung in Leibnitz, Betreuung: Univ. Lekt. DI Peter Kurz, DIin Martina Jauschneg, Christoph Heilmann und Landschaftskonzept Leibnitz - Planungsinstrumente der Landschaftsplanung mit Feldarbeiten, Betreuung: DIin Doris Damyanovic, Florian Reinwald, Marianne Schrötter, Arbeitsbereich Landschaftsplanung am Institut für Landschaftsplanung und Ingenieurbiologie, Universität für Bodenkultur Wien, 2002

Bauhardt, Christine: Stadtentwicklung und Verkehrspolitik, Eine Analyse aus feministischer Sicht, Birkhäuser Verlag, Basel, 1995

Bergmann, Nadja; Pimminger, Irene: Toolbox Gender Mainstreaming, GeM-Koordinationsstelle für Gender Mainstreaming im ESF (Hrsg.), Wien, 2004

Böse, Helmut: Die Aneignung von städtischen Freiräumen, Beiträge zur Theorie und sozialen Praxis des Freiraums, AG Freiraum und Vegetation (Hrsg.), Notizbuch 22 der Kasseler Schule, 1981

Bundesministerium für Bildung, Wissenschaft und Kultur (Hrsg.): Handbuch Gender Mainstreaming in der Regionalentwicklung, Einführung in die Programmplanung, Forschungsprogramm Kulturlandschaft, Wien, 2001

Deleuze, Gilles: Woran erkennt man den Struckturalismus, Berlin, 1973

Damyanovic, Doris: Von Häusern und Gebäuden, Ein freiraumplanerischer Vergleich der gängigen Stadtplanung mit dem mittelalterlichen Stadtbau und seinen bewährten Prinzipien am Beispiel Braunau am Inn, Diplomarbeit am Institut für Landschaftsplanung und Ingenieurbiologie an der Universität für Bodenkultur, Wien, 1997

Damyanovic, Doris (Hrsg.): Frauen und Männer unterwegs. Ein Leitfaden zur Umsetzung von Gender Mainstreaming in der Wegenetzplanung in Gemeinden am Beispiel der Stadtgemeinde Hermagor - Pressegger See. Im Auftrag des Amtes der Kärntner Landesregierung, Abteilung 20 -Landesplanung, Überörtliche Raumplanung und Abteilung 13 - Referat für Frauen und Gleichbehandlung. Wien/Klagenfurt/Hermagor, 2005

Damyanovic, Doris; Schneider, Gerda; Müller, Gudrun; Staller, Susanne; Studer, Heide: Endbericht Frauen und Männer unterwegs, Landschaftsplanerisches Projekt zur qualitativen Wegenetzplanung im Sinne von Gender Mainstreaming am Beispiel der Stadtgemeinde Hermagor - Pressegger See, Klagenfurt-Villach-Wien, 2005

Damyanovic, Doris; Schneider, Gerda; Reinwald, Florian: Anleitung für die Eingabe von Gender Mainstreaming Beispielen in die good practice database. Wien, 2005, www.rali.boku.ac.at/ilap.html

Döge, Peter: Männerforschung als Beitrag zur Geschlechterdemokratie, Ansätze kritischer Männerforschung im Überblick, Hrsg.: Bundesministerium für Familie, Senioren, Frauen und Jugend, Berlin, 1999

Frauenbüro MA 57 (Hrsg.): Leitfaden. Gender Mainstreaming, Wien, 2003

Fuchs, Britta: Die Stadt kommt aufs Land, Die Gründerzeitliche Parzellierungsplanung von Lothar Abel in Reichenau an der Rax/NÖ und ihre Auswirkung auf die aktuellen landschafts- und freiraumplanerischen Qualitäten des Ortes, Dissertation an der Universität für Bodenkultur, Wien, 2005

Fuchs, Britta: Straßen - frei - räume in Bruck an der Leitha: Eine freiraumplanerische Betrachtung der Gassen, Straßen und Plätze einer mittelalterlichen Stadt, Diplomarbeit am Institut für Landschaftsplanung und Ingenieurbiologie, Arbeitsbereich Landschaftsplanung an der Universität für Bodenkultur Wien, 1999

Fuchs, Britta; Schneider, Gerda; Fuxjäger, Renate; Jauschnegg, Martina: Lebensqualität für Frauen und Männer in drei Wohnhausanlagen in Graz, Gutachten zur baulich-räumlichen und sozialen, imaginären und symbolischen Ebene, Institut für Landschaftsplanung und Ingenieurbiologie, Universität für Bodenkultur, Wien, 2002

Fuxjäger, Renate; Rosenbichler, Ursula; Schörghuber, Karl: Gender Mainstreaming in Förderstellen und in der regionalen Programmplanung. Hrsg. von abz.austria im Rahmen der EQUAL-Entwicklungspartnerschaft „Frauenförderung und Gender Mainstreaming im Burgenland“. Wien, Eisenstadt, 2004

Grafschafter, Helga: Gender Mainstreaming EU - Strategie, Referat für Frauen und Gleichbehandlung des Landes Kärnten, Tischvorlage, 2005

[13] Die Methode baut auf die 4R Methode (nach Swedisch Asociation of Local Authorities), und der um 1 R +1 E erweiterten 5R+1E Mehtode (vgl. Gender Mainstreaming in der GPA, Schlussbericht der Projektgruppe des Bundesvorstandes der GPA, Herausgeberin: GPA, Wien 2002.) zu Analye von GM Projekten und Prozessen auf.

Harenburg, Bernd; Wannags, Ingeborg: Von Haustür zu Haustür, Organisationsformen und ihre Gebrauchsmerkmale. In: Notizbuch 23 der Kasseler Schule, Hrsg.: Arbeitsgemeinschaft Freiraum und Vegetation, Kassel, 1991
Klaar, Adalbert: Siedlungsformenkarte der reichsgaue Wien, Kärnten, Niederdonau, Oberdonau, Salzburg, Steiermark und Tirol und Vorarlberg, Herausgegeben von der Berglandabteilung des Reichsministeriums für Ernährung und Landwirtschaft in Berlin, 1942
Kurowski, Mathias: Freiräume im Garten, Organisation von Handlungsfreräumen in der Landschafts- und Freiraumplanung, Dissertation an der Universität für Bodenkultur Wien, 2003
Löw, Martina: Raumsoziologie, Suhrkamp, Frankfurt, 2001
Muchow, Martha, Muchow, Hans Heinrich: Der Lebensraum des Großstadtkindes, Hrsg: Zinneker, Jürgen, 1935/1998
Pimminger, Irene: Handbuch Gender Mainstreaming in der Regionalentwicklung -Einführung in die Programmplanung, Bundesministerium für Bildung, Wissenschaft und Kultur (Hrsg.), Forschungsprogramm Kulturlandschaft, Wien, 2001
Panerai, Philippe, Castex, Jean, Depaule, Jean-Charles: Vom Block zur Zeile. Wandlungen der Stadtstrutkur, Bauwelt Fundmente. Friedr. Vieweg Sohn. Brauschweig/Wiesbaden, 1977
Schneider, Gerda: Die Liebe zur Macht, Über die Reproduktion der Enteignung in der Landespflege, AG Freiraum und Vegetation (Hrsg.), Notizbuch 15 der Kasseler Schule, 1989
Simma, Anja: Verkehrsverhalten als eine Funktion soziodemografischer und räumlicher Faktoren, Dissertation an der Leopold-Franzens-Universität Innsbruck, Innsbruck, 2000
Simma, Anja: Frauen & Mobilität, VCÖ Verkehrsclub Österreich (Hrsg.): Wissenschaft und Verkehr 3/1996, Wien, 1996
Amt der Kärntner Landesregierung, Referat für Frauen und Gleichbehandlung (Hrsg.): Kärntner GenderstudieGeschlechterverhältnisse und geschlechtstypische Disparitäten, Drava Verlag, Klagenfurt, 2004

Sammer, Gerd; Weber Gerlinde: MOVE - Mobilitäts- und Versorgungserfordernisse im strukturschwachen Raum als Folge des Strukturwandels, 1. Zwischenbericht, Universität für Bodenkultur Wien, 2001
tilia mayrhofer.staller.studer oeg: Netze machen mobil. Freiraumplanerische Beiträge zur Mobilität von Frauen und Mädchen im Zusammenhang mit dem Car Free Day 2000, Dezember, 2000
Wotha, Brigitte: Gender Planning und Verwaltungshandeln. Umsetzung von Genderbelangen in räumliche Planung - unter Berücksichtigung von Verwaltungsmodernisierung und neuerer Tendenzen im Planungsbereich. Geographisches Institut der Universität Kiel (Hg.): Kieler Arbeitspapiere zur Landeskunde und Raumordnung 42/2000, Kiel, 2000
Zech, Sibylla; Tiß, Michaela; Koch, Helmut: Schlussbericht der Modellstudie Pöttsching, Modellprojekt zur Frauenmobilität am Beispiel der Marktgemeinde Pöttsching mit dem Ziel der Reduzierung von Begleitverkehren, 1999

🏆 **reviewed paper**

Gender Mainstreaming und Standortentwicklung

Christine ITZLINGER

(DI^{in} Christine Itzlinger, Amt der Salzburger Landesregierung, Raumplanung,

GenderAlp![1] - Projekt Wohnen und Arbeiten für Frauen und Männer in Salzburg, Michael Pacher Str. 36, 5020 Salzburg, christine.itzlinger@salzburg.gv.at

1 DIE RAUMPLANUNG UND IHRE FUNKTIONEN

Die Charta von Athen und die darin geforderte Entflechtung der Funktionen reagierte auf städtebauliche Missstände, die durch eine unplanmäßige Vermischung unverträglicher Funktionen entstanden. Damit einher ging, und dies war mit Sicherheit nicht in dieser Form von den Verfassern beabsichtigt, eine apodiktische Trennung der Funktionen, die wohl in den 80er Jahren als Fehlentwicklung erkannt wurde, aber im Denken von Planungsverantwortlichen noch immer zu finden ist.

Das Ziel der Raumordnung ist die geordnete Nutzung des Raumes. Zu diesem Zweck werden Räume mit Funktionen belegt. In den Räumlichen Entwicklungskonzepten wird die funktionelle Gliederung des Gemeindegebietes vorgegeben und in den Flächenwidmungsplänen werden Wohngebiete, Gewerbegebiete, Erholungsgebiete, Einkaufszentren, etc. ausgewiesen. Auch wenn das Raumordnungsgesetz davon spricht, dass die Bedürfnisse der Bevölkerung zu berücksichtigen sind, hat man doch oft den Eindruck, dass bei der Zuordnung von Funktionen der Blick auf die Menschen, zumindest bestimmter Bevölkerungsgruppen verloren ging. Denn so einfach lassen sich die Bedürfnisse nicht generalisieren, wenn man sich die Bevölkerung und ihre bedürfnisbestimmenden Alltage genauer ansieht. Eine Wohnung dient nicht nur der Befriedigung des Wohnbedürfnisses, sondern sie ist auch ein Ort der Erholung und insbesondere für jene Personen, die für die Betreuung der Kinder und des Haushaltes zuständig sind, ein Ort der Arbeit. Ein Ort der Erholung, zB die stadtnahen Erholungsräume, mag zugleich auch Arbeitsort sein für jene, die dort in der Landwirtschaft ihre Existenz erwirtschaften oder Versorgungsort für jene, die ihre Lebensmittel direkt beim Biobauern vor Ort kaufen. Einkaufszentren sind nicht nur Orte der Versorgung, sondern für viele Arbeitsorte, Kommunikationsorte, und sogar Orte der Erholung.

Standortqualität

Unser Alltag und unsere Rollen bestimmen, welche Funktionen wir dem jeweiligen Ort zuweisen. Je mehr die Funktion des Standortes mit dem jeweiligen Bedürfnis korreliert, desto höher ist die empfundene Qualität des Standortes für die jeweiligen NutzerInnen. Eine gute Raumplanung zeichnet sich dadurch aus, dass die Bedürfnisse möglichst vieler NutzerInnen am Standort befriedigt werden. Nun sind die Bedürfnisse aber sehr verschieden: Ein Wohnhaus im Umland von Wien, nahe, aber doch nicht zu nah der nächsten Autobahnauffahrt, mag für einen Vertreter im Außendienst eine gute Standortqualität aufweisen. Für seine Frau, die für die Betreuung der Kinder und des Haushaltes verantwortlich ist, stellen sich andere Standortbedingungen, wenn man die mit der Rolle verbundenen Aufgaben bedenkt. Einkaufsfahrten, Bring- und Holdienste für die Kinder und nicht mehr so mobile Familienmitglieder setzen ein Zweitauto voraus. Die im Umland reduzierte Bedienungshäufigkeit der öffentlichen Verkehrsmittel, das knappe Zeitbudget, die Fülle der zu bewältigenden Aufgaben, zumeist an verschiedenen Destinationen, erschweren nicht nur die Benützung öffentlicher Verkehrsmittel, sondern in Kombination mit der geringen Anzahl qualitativer Arbeitsplätze außerhalb urbaner Räume, auch die Möglichkeit Beruf und Familie zu vereinbaren. Ein Standort in integrierter Lage, in der Nähe der sozialen Infrastrukur, Nahversorgungseinrichtungen, leistungsfähiger öffentlicher Verkehrsmittel würde die zu erledigenden Aufgaben deutlich erleichtern. Ein Standort, aber zwei unterschiedlich wahrgenommene Qualitäten. Die Standortqualität ist für den Laien also etwas subjektives und das wird dem Raum, der geordnet werden will, spätestens zum Zeitpunkt der notwendigen Umsetzung der Raumordnungsziele zum Problem, wenn man bedenkt, dass zu viele (Laien) über den Raum Entscheidungsmacht haben.

Raumplanerische Verantwortung

Die RaumplanerInnen wüssten wohl, wo sich die Standorte befinden, die volkswirtschaftlich und betriebswirtschaftlich gesehen die Gunstlagen sind. Diese zu finden wäre wahrlich nicht schwer: es sind die zentralen, städtebaulich integrierten, mit Einrichtungen der sozialen Infrastruktur gut versorgten und öffentlichen Vekehrsmitteln gut ausgestatteten Standorte. Aber es mangelt den RaumplanerInnen offensichtlich an Argumenten, um die EntscheidungsträgerInnen vom Nutzen der Raumordnung zu überzeugen und die Konsequenzen einer mangelhaften Umsetzung in ihrer gesamten Tragweite aufzuzeigen. Vielleicht hängt die mangelnde Überzeugungskraft der RaumplanerInnen auch damit zusammen, dass PlanerInnen meist selbst diese Alltage nicht leben und somit nur schwer mitdenken. Die Implementierung von Gender Mainstreaming in die Raumplanung stellt für RaumplanerInnen eine wertvolle Argumentationshilfe dar, indem der Blick auf die unterschiedlichen Bedürfnisse bewusst macht, dass die Bevölkerung von einer mangelhaften Umsetzung der Raumordnungsziele unterschiedlich betroffen ist. Denn wenn wir durch eine weiter fortschreitende disperse Siedlungspolitik à la long den Einsatz des öffentlichen Verkehrs verunmöglichen, trifft es nicht alle gleich schwer. Es sind vor allem nicht mobile Jugendliche, halbtagswerberbstätige Personen mit Betreuungspflichten und ältere Personen, deren Selbständigkeit damit verloren geht. Die Implementierung von Gender Mainstreaming in die Raumplanung ist wichtig; weniger um neue Inhalte in die Raumplanung zu bringen, sondern um aufzuzeigen, dass hinter den Leitbildern und Zielen der Raumplanung "alltägliche" Bedürfnisse von Bevölkerungsgruppen stehen und dass eine mangelnde Umsetzung der Leitbilder vor allem jene Bevölkerungsgruppen stärker benachteiligt, die in der Regel auch in den Entscheidungsgremien unterrepräsentiert sind. Kein Ziel und keine Maßnahme ist geschlechtsneutral. Es ist die Aufgabe der PlanerInnen die Wirkung von Planungsmaßnahmen für

[1] GenderAlp! Raumentwickulng für Frauen und Männer. Ein EU-kofinanziertes Projekt aus Mitteln des INTERREG IIIB-Programms Alpenraum und aus 12 ProjektpartnerInnen aus Verwaltungsabteilungen von Ländern und Städten aus Österreich, Deutschland, Frankreich, Italien und Slowenien. Gesamtverantwortung sprich Leadpartner Land Salzburg, Laufzeit 2005 – 2007.
Näheres zum Projekt im selben corp Band unter Wankiewicz Heidrun: 1 Jahr GenderAlp! Raumentwicklung für Frauen und Männer. Ein Werkstattbericht.
Weitere Beiträge aus dem Projektumfeld siehe auch Krause Johanna (GenderAlp! Projekt der Stadt Frreiburg Entwurfsdesign und Beteiligungsverfahren für eine Stadtbahnverlängerung und Lamprechter Astrid (Projekt Salzburg Bedarfsgerechte Förderung).
Homepage www.genderalp.com (Englisch) und www.genderalp.at (Deutsch ab März 2006).

alle Bevölkerungsgruppen zu analysieren und den Planungsverantwortlichen und EntscheidungsträgerInnen mitzuteilen sowie die Konsequenzen einer mangelnden Umsetzung aufzuzeigen.

2 BETEILIGUNG DER SALZBURGER LANDESPLANUNG AN GENDERALP!

Die Erkenntnis, dass die Raumplanung keine geschlechtsneutrale Wirkung hat sowie der Auftrag der Salzburger Landesregierung vom 10.04.2003 die Strategie Gender Mainstreaming in das Verwaltungshandeln einzubeziehen und Verordnungen, Gesetze und sonstige Rechtsvorschriften einer „Gender-Mainstreaming-Prüfung“ zu unterziehen, war Motivation für die Salzburger Raumplanung sich am Interreg III B- Projekt „GenderAlp“ zu beteiligen. Zur Erarbeitung der für die Umsetzung und Implementierung von Gender Mainstreaming in die Raumplanung erforderlichen Grundlagen wurde eine Sammlung von Gute Praxis Beispielen in Auftrag gegeben. Die Entscheidung fiel dabei auf Unif.Prof. Barbara Zibell, die im Bereich Gender Planning bereits hohe Erfahrung hat. Die nunmehr vorliegenden Beispiele geben einen wertvollen Überblick, durch welche materiellen Qualitätskriterien und –ziele die Raumordnung zu mehr Chancengleichheit beitragen kann, und dies jeweils für die Ebene der Landesplanung, der Regionalplanung und der Kommunalplanung. Ein besonderes Anliegen ist es der GutachterIn darauf hinzuweisen, dass es nicht ausreichend ist, nur auf materieller Ebene die Ziele der Chancengleichheit zu berücksichtigen, sondern dass es ebenso notwendig ist, durch den Aufbau von Genderkompetenz mehr Problembewusstsein zu schaffen und durch die Implementierung neuer Beteiligungs-und Partizipationsprozesse daran zu arbeiten, dass alle Bevölkerungsgruppen Gelegenheit zur Artikulation bekommen sowie in den Entscheidungsgremien adäquat vertreten sind. Ebenso betont die Gutachterin, dass eine erfolgreiche Implementierung der Berücksichtigung chancengleichheitsfördernder Ziele auf allen Ebenen der Raumplanung bedarf. Eine Stadt der kurzen Wege kann nur realisiert werden, wenn sie in ein System aus entsprechenden Regionen der kurzen Wege eingebunden ist.

3 AUSGEWÄHLTE ERGEBNISSE DER BEST PRACTICE SAMMLUNG[2]

Qualitätsziele und –kriterien auf Landesebene		
Materielle Ziele und -kriterien	**Prozessziele und –kriterien**	**Strukturelle Ziele und –kriterien**
Siedlungsstruktur • Verwirklichung des Prinzips der Geschlechtergerechtigkeit (RhPf 2003) • Abbau siedlungsstrukturell bedingter Benachteiligungen von Frauen (RhPf 1995) • Berücksichtigung der besonderen Lebensbedürfnisse von Frauen (Hessen 1994) • Vorrang der Innenentwicklung sowohl in den verdichteten als auch in den ländlichen Räumen (RhPf 2004) • Weitere Flächen für die Funktion Wohnen vorrangig in solchen Orten, die über eine gute Versorgung mit Leistungen des ÖPNV verfügen (Rh Pf 2004) **Ländlicher Raum** Infrastrukturelle Grundversorgung in Ländlichen Räumen unter Berücksichtigung der konkreten Lebenssituaiton von Frauen und Männern (MeckPomm 2005) **Arbeit und Ausbildung** Wohnstättennahe Arbeitsplätze und Bildungsmöglichkeiten, insbesondere für Frauen (Hessen 1994) **Grundversorgung** Mindeststandards der Versorgung sichern – Grundausstattung in fußläufiger Entfernung: Kindergarten, Volksschule, Kinderspielplatz/ Jugendzentrum, Begegnungsstätte, Einkaufsmöglichkeit, Post- und Bankdienste, Behördenaußenstelle, Arzt, ÖV-Haltestelle	**Beteiligung** • Frühzeitige BürgerInnenbeteiligung durch Gewäh rleistung der Berücksichigung geschlechterspezifischer Anforderungen (RhPf 2004) • Begleitung von Landesplanungsprogrammen durch Frauenbeirat (RhPf 2004) **Abwägung** Frauen- und Männerbelange als abwägungserhebliche Belange im Planungsverfahren (BauGB 2004) **Controlling/Evaluation** Überprüfung raumbedeutsamer Planungen und Maßnahmen auf ihre geschlechtsspezifische Wirkung (Nds 2002)	**GenderWissen** Geschlechterdifferenzierte Datenanalyse und Benennung geschlechterrelevaner Problemlagen (MeckPomm 2005) **GenderKompetenz** Kompetenz der Landesplanungsstelle, geschlechterbedingte Probleme zu erkennen (MeckPomm 2005)

Qualitätsziele und –kriterien auf Regionaler Ebene

[2] Zibell, Barbara: Gender Practice in der Raumplanung - 2005. Bedarfsgerecht Planen. Im Rahmen von GenderAlp! beauftragte Studie – Veröffentlichung Feb. 2005. Auszug des Zwischenberichts siehe www.genderalp.com/news/press/Salzburg project und bald auch in Deutsch auf www.genderalp.at.

Materielle Ziele und Kriterien	**Prozessziele und –kriterien**	**Strukturziele und -kriterien**
Raum- und Siedlungsstruktur Schaffung gleichwertiger Lebensbedingungen für Frauen und Männer (RhPf 2004) **Ländliche Räume** Erweiterungen der Siedlungsgebiete abgleichen mit Wohnfolgeeinrichtungen (Region Hannover 2004) **Grundversorgung** • Wohnortnahe Grundversorgung – Erreichbarkeit und Erschließung der Einzelhandelsstandorte mit Verkehrsmitteln des Umweltverbundes (RHPf 2004) • Grundausstattung in fußläufiger Entfernung (FrauenRatschl Stgt 2002)	**Beteiligung** • Einbezug regionaler FrauenNetzwerke (Hannover) • Frauenvertreterin in regionalen Planungsbeiräten (RhPf bis 2003) **Abwägung** Leitfaden zur Beurteilung der Wirkung von räumlichen Planungen auf die Situation von Frauen (KGH 2000)	**Gleichstellung** • Gleichmäßige Vertretung von Frauen und Männern in der Regionalversammlung (Verhältnis Frauen:Männer 1:1) **GenderKompetenz** • Gleichstellungsstellen mit planerischer Fachkompetenz (RVR, KGH) • GM in Aufgabenbeschreibung von MitarbeiterInnen • Verwaltungsinterne Frauen- bzw. GenderArbeitskreise
Qualitätsziele und –kriterien auf kommunaler Ebene		
Materielle Ziele und –kriterien	**Prozellziele und –kriterien**	**Strukturziele und -kriterien**
Baulich-Räumliche Strukturen • Geschlechtergerechte Planung (Landesfrauenrat Hamburg 2004) • Nutzungsmischung (München 2004) • Gemischte und verdichtete Baustrukuren im Einzugsbereich des ÖPNV (München 2004) • Ausweisung von Mischgebieten (Frankfurt 1996) • Vermeidung von monofunktionalen und barrierebildenden Siedlungsbereichen (Nds 1996) • Kleinräumige Zuordnung unterschiedlicher Baugebietsarten (Mainz 1994) • Gewerbe- undEinzelhandelsflächen in Wohngebieten (FR Rieselfeld 1992) • Kleinräumige Nutzungsmischung (Wohnen, Arbeiten, Versorgung, Erholung) • Großflächige Einzelhandelsbetriebe vermeiden (Frankfurt 1996) • Wohnungsnahe Freiraumbereiche (50 m) für Kinder ohne Begleitung erreichbar (Mainz 1994) • Keinen reinen Wohngebiete (Frankfurt 1996) • Grundversorgung • Wohnungsnahe Infrastruktur- und Einzelhandelsstandorte – Lebensmitteleinzelhandel in 500 m Distanz in Wohn- und Mischgebieten (Ludwigsburg 2003) • Wonortnahe bzw. fußläufige Erreichbarkeit von Grundschulen (Freiburg 1997) • Gewerbegebiete/Arbeitsstätten • Zuordnung Standorte von Erwerbsarbeitsstätten zu städtischen Infrastrukturen (Hessen 1996) • Gewerbe- und Mischgebiete in Anlehnung an vorhandene Infrastrukturen (Mainz 1994) • Hochwertige Gestaltung von Gewerbegebieten/Aufenthaltsqualitä ten (Mainz 1994) **Verkehr/Mobilität**	**Beteiligung** • Beteiligungsstrukturen für Frauen und Männer in den Quartieren (Hamburg 2004) • Bürgergutachten (München 2004) • Vorgezogene Öffentlichkeitsbeteiligngn bzw. erweiterte BürgerInnenbeteiligung (Freiburg 2001) • Paritätisch mit Frauen und Männern besetzte Beiräte (Landesfrauenrat Hamburg 2004) • Gleichstellungsbeauftragte als TÖB (München 2002) **Kooperation** • Verwaltungsvereinbarungen (Wien 2003, Münster 2001) • Zusammenarbeit mit Gleichstellungsbeauftragten in Planungsprozessen (München 2004) • Einbezug Fachfrauen • Architektinnenwettbewerbe (Hamburg 2004) **Abwägung** • Frauen- und Männerbelange als abwägungserhebliche Belange in Planungsverfahren (BauGB 2004) • GM als Entscheidungskriterium bei Zielkonflikten (Wien 2003) • Flächenbewertungen durch die Gleichstellungsbeauftragte (FNP Freiburg 2020) **Controlling/Evaluation** • Auswirkungen der Planugnen auf Geschlechterrelevanz prüfen (Münster 2004) • Leitfaden Gender Planning (Dortmund 2002) **Modellprojekte/Wettbewerbe** GenderBelange als Anforderungen formulieren (Hamburg 2004)	**Gleichstellung** • Spezielle Fach- und Leitstellen für Genderfragen innerhalb der Verwaltung (Wien, Bern) • Gezielte Personalentwicklung • GenderWissen • Geschlechterdifferenzierte Datengrundlagen (Wien 2002) **GenderKompetenz** • MitarbeiterInnen mit GenderKompetenz inBau-/Planungsverwatlugnen ausstatten • GM in Aufgabenbeschreibung von MitarbieterInnen (Bern) Verwaltungsinerne, abteilungsübergreifende Frauen- bzw. Gender Arbeitskreise (Münster) **GenderBudget** • Geschlechterbewusste Budgetierung (Wien 2002)

• Berücksichtigung geschlechterspezifischer Mobilitätsmuster und –chancen, die die unerschiedlichen Anforderungen von Männern und Frauen sowie ihre unterscheidlichen Rollen im Alltag, in der erwerbsarbeit oder in der Reproduktionsarbeit betreffen (München 2004) • Vernetzung von Ortsteilen (Ludwigsburg 2003) • Erreichbarkeit von Infrastruktureinrichtungen		

4 IMPLEMENTIERUNGSBEISPIEL BEDARFSGERECHTE ÜBERARBEITUNG SACHPROGRAMM SIEDLUNGSENTWICKLUNG UND BETRIEBSSTANDORTE

Die Landesplanung Salzburg ist im Rahmen von GenderAlp! nicht nur an einer Sammlung von Grundlagen für eine erfolgreiche Umsetzung von Gender Mainstreaming in die Raumplanung interessiert, sondern will die gesammelten Ergebnisse anhand eines konkreten Implementierungsprojektes umsetzen. „Wohnen und Arbeiten für Frauen und Männer in Salzburg" lautet der Titel und zusammen mit der Niederösterreichischen Landesregierung arbeitet die Landesplanung am Thema „Standortoptimierung durch geschlechtergerechte Planung". Während das Land Niederösterreich auf kommunaler Ebene arbeitet und für die Industriezonen Wolkersdorf und Niederösterreich Süd geschlechtersensible Nutzungsanalysen durchführt, um daraus Maßnahmen zur Schaffung qualifizierter Arbeitsplätze und chancengleicher Arbeitsbedingungen für Frauen und Männer abzuleiten, bringt die Landesplanung Salzburg auf überörtlicher Ebene die bedarfsgerechte Überarbeitung des Sachprogrammes „Siedlungsentwicklung und Betriebsstandorte im Salzburger Zentralraum" ein. Dieses im Jahr 1995 verordnete Sachprogramm setzte sich durch die Berücksichigung eines polyzentrischen Strukurmodelles, an welches ein bestimmtes Wohnungswachstum geknüpft wurde, eine Eindämmung des fortschreitenden Suburbanisierungsprozesses im Salzburger Zentralraum zum Ziel. Darüber hinaus wurden großflächige Gewerbegebiete, welche die Möglichkeit eines Schienenanschlusses aufweisen, gesichert. Derzeit liegt ein Entwurf des überarbeiteten Sachprogrammes vor, für welchen Univ.Prof. Barbara Zibell, als Teil II des erteilten Auftrages, eine GenderExpertise erstellen wird. Der Entwurf beinhaltet 5 Leitbilder:

- Polyzentrisches Strukturmodell bestehend aus Regionalzentren, Ergänzungsgemeinden, Regionalen Nebenzentren, Sonstigen Gemeinden sowie dem Stadt- Umlandbereich
- Region der kurzen Wege - Orientierung der Siedlungsentwicklung an den Einrichtungen der Grundversorgung
- Konzentration und Verdichtung der Siedlungsentwicklung an den Einrichtungen des leistungsfähigen öffentlichen Verkehrs
- Kooperation statt Konkurrenz
- Sicherung großer zusammenhängender Flächen für Gewerbe und Industrie

Die abschließende Expertise der Expertin zum vorliegenden Entwurf des Sachprogrammes liegt noch nicht vor. Erste Ergebnisse stellen Salzburg jedoch ein gutes Zeugnis aus. In Übereinstimmung mit den GenderPrinzipien und somit die Ziele der Chancengleichheit unterstützend, werden die Leitbilder Polyzentrisches Strukturmodell, Region der kurzen Wege, Konzentration und Verdichtung der Siedlungsentwicklung entlang des leistungsfähigen öffentlichen Verkehrs gesehen. Betreffend das Leitbild Sicherung großer zusammenhängender Flächen für Gewerbe und Industrie empfiehlt die Gutachterin die zusätzliche Verankerung von Standort- und Qualitätskriterien, welche sicherstellen sollen, dass diese Standorte mit öffentlichen Verkehrsmitteln attraktiv erreichbar sind und somit weniger mobile Bevölkerungsgruppen nicht benachteiligt werden. Die mangelhafte Erreichbarkeit des Standortes mit leistungsfähigen öffentlichen Verkehrsmittel kann nämlich Personen mit Betreuungspflichten und deren damit oft verbundenen geringeren Zeit- und Geldbudgets von bestimmten Arbeitsplätzen ausschließen. Aufgabe der Raumplanung ist es dies bewusst zu machen und zu vermeiden, dass durch Planungsfehler diese Benachteiligungen entstehen. Bei großen Gewerbezonen empfiehlt die Gutachterin in zentralen Bereichen die Flächenfreihaltung zur Ansiedlung von Einrichtungen der sozialen Infrastruktur (zB Betriebskindergarten), Nahversorgungseinrichtungen und Orten der Kommunikation, um zum einen die Aufenthaltsqualität in diesen Zonen zu erhöhen und zum anderen die Vereinbarkeit von Beruf und Familie durch die Bündelung zu erledigender Wege (Kindergarten, Einkauf) zu erleichtern. Zusammenfassend sieht die Gutachterin in ihrer Expertise zum Sachprogramm einen Handlungsbedarf weniger auf inhaltlicher Ebene, sondern im Bereich von Prozess- und Strukturkriterien. Auf Ebene der Prozesse schlägt sie deshalb Verbesserungen vor, durch

- Vorgaben zum Einbezug von GenderKompetenz
- Vorgaben zur Beurteilung von Planungen und Maßnahmen (Abwägungskriterien)
- Vorgaben zu Beteiligungsanforderungen
- Vorgaben zur ämterübergreifenden Zusammenarbeit
- Vorgaben zur Prüfung der Auswirkungen von Planungen

oder auf Ebene der Strukturen, durch

- Vorgaben zur paritätischen Vertretung von Frauen und Männern in Gremien und Arbeitskreisen
- Einrichtung verwaltungsinterner Frauen- und GenderArbeitskreise
- Einsetzung externer Frauen- / GenderBeiräte
- Vorgaben zu Verwaltungsvereinbarungen zwischen Ämtern / Gemeinden und mit Institutionen
- Vorgaben zur Vergabe von Aufträgen.

5 NÄCHSTE SCHRITTE – MASZNAHMENBÜNDEL

Für die Landesplanung ergeben sich aufgrund der nunmehr vorliegenden Ergebnisse folgende Aufgaben für das nächste GenderAlp-Jahr 2006. Zum einen gilt es die Empfehlungen der Gutachterin zur Überarbeitung des Sachprogrammes „Siedlungsentwicklung und Betriebsstandorte im Salzburger Zentralraum" im Hinblick auf Möglichkeiten zur Berücksichtigung zu überprüfen. Für die erfolgreiche Implementierung von Gender Mainstreaming in die Raumplanung ist darüber hinaus die Ausarbeitung eines Maßnahmenbündels erforderlich, welches für alle Ebenen der Salzburger Raumplanung sozusagen einen Mindestforderungskatalog beinhaltet, der beispielsweise unten angeführte Forderungen beinhalten könnte:

Ebene der Landesplanung	
Raumordnungsgesetz	• Als Grundsatz das Prinzip der Geschlechtergerechtigkeit verankern • Frauen- und Männerbelange als abwägungserhebliche Belange im Planungsverfahren verankern • Geschlechterdifferenzierte Datenanalyse und Benennung geschlechterrelevaner Problemlagen fordern • Neue BürgerInnenbeteiligungsverfahren vorsehen • Controlling durch die Überprüfung raumbedeutsamer Planungen und Maßnahmen auf ihre geschlechtsspezifische Wirkung einführen
Landesentwicklungsprogramm	• Als Grundsatz das Prinzip der Geschlechtergerechtigkeit verankern (seit 2004 bereits als Oberziel vorhanden) • Grundversorgung sichern durch Vorgabe von Mindestversorgungsstandards
Sachprogramme	• Fortsetzung der Arbeiten an der Überarbeitung des Sachprogrammes Siedlungsentwicklung und Betriebsstandorte im Salzburger Zentralraum • Erarbeitung eines Sachprogrammes Wohnen und Arbeiten für den Ländlichen Raum • Erarbeitung eines Sachprogrammes Verkehr unter Berücksichtigung einer integrierten Verkehrs- und Siedlugnsenwicklung • Erarbeitung eines Sachprogrammes Versorgungsinfrastruktur mit Bindung von Versorgungsstandorten an Siedlungsschwerpunkte
Ebene der Regionalplanung	**Regionalprogramme** Berücksichtigung des Prinzips der Geschlechtergerechtigkeit bei der Erstellung und Überarbeitung der Regionalprogramme durch • Geschlechtsspezifische Datenanalysen • Erweiterte Bürgerbeteiligungsverfahren • Frauenvertreterin im Vorstand des Regionalverbandes • Gleichmäßige Vertretung von Frauen und Männern in Regionalverbandsversammlungen fordern • Definition entsprechender Leitbilder, die das Prinzip Geschlechtergerechtigkeit stärken (Region der kurzen Wege, Orientierung der Siedlungsentwicklung am leistungsfähigen, vorzugsweise schienengebundenen öffentlichen Verkehr, dezentrale Konzentration, Sicherung einer Grundversorgung, etc.) • Controlling durch die Überprüfung raumbedeutsamer Planungen und Maßnahmen auf ihre geschlechtsspezifische Wirkung einführen
Auf kommunaler Ebene	**Räumliche Entwicklungskonzepte** • Geschlechtsspezifische Datenanalysen • Erweiterte Bürgerbeteiligungsverfahren • Prinzip Gleichstellung fördern durch inhaltliche Vorgaben wie ➢ Siedlungsentwicklung vorrangig in Siedlungsschwerpunkten ➢ Vernetzung von Ortsteilen ➢ Wohnungsnahe Infrastruktur- und Einzelhandelsstandorte – Lebensmitteleinzelhandel in 500 m Distanz in Wohn- und Mischgebieten ➢ Wohnortnahe bzw. fußläufige Erreichbarkeit von Grundschulen ➢ Zuordnung Standorte von Erwerbsarbeitsstätten zu städtischen Infrastrukturen ➢ Hochwertige Gestaltung von Gewerbegebieten/Aufenthaltsqualitäten ➢ Verträgliche Nutzungsmischung ➢ Gemischte und verdichtete Baustrukuren im Einzugsbereich des ÖPNV **Flächenwidmungspläne** • Geschlechtsspezifische Datenanalysen • Erweiterte Bürgerbeteiligungsverfahren • Frauen- und Männerbelange als abwägungserhebliche Belange in Planungsverfahren • GM als Entscheidungskriterium bei Zielkonflikten • Flächenbewertungen durch die Gleichstellungsbeauftragte • Auswirkungen der Planungen auf Geschlechterrelevanz prüfen

	• Prinzip Gleichstellung fördern durch inhaltliche Vorgaben wie ➢ Vermeidung von reinen Wohngebieten ➢ Vermeidung von großflächige Einzelhandelsbetrieben ➢ Kleinräumige Zuordnung unterschiedlicher Baugebietsarten ➢ Wohnungsnahe Infrastruktur- und Einzelhandelsstandorte – Lebensmitteleinzelhandel in 500 m Distanz in Wohn- und Mischgebieten ➢ Wohnortnahe bzw. fußläufige Erreichbarkeit von Volksschulen **Bebauungspläne** • Geschlechtsspezifische Datenanalysen • Erweiterte Bürgerbeteiligungsverfahren • Frauen- und Männerbelange als abwägungserhebliche Belange in Planungsverfahren • GM als Entscheidungskriterium bei Zielkonflikten • Auswirkungen der Planungen auf Geschlechterrelevanz prüfen • Prinzip Gleichstellung fördern durch inhaltliche Vorgaben wie ➢ Gemischte und verdichtete Baustrukuren im Einzugsbereich des ÖPNV ➢ Mindestdichten ➢ Festlegung von Nutzungsanteilen ➢ Wohnungsnahe Freiraumbereiche vorsehen - (50 m) für Kinder ohne Begleitung erreichbar

Während das Jahr 2006 vorrangig der Erarbeitung notwendiger Grundlagen zur erfolgreichen Implementierung von Gender Mainstreaming in die Raumplanung diente, wird das Jahr 2006 ganz im Zeichen des Aufbaues von GenderKompetenz stehen. Anliegen dabei ist es, den von oben initiierten Prozess Gender Mainstreaming zum Anliegen der für die Umsetzung relevanten kommunalen Ebene zu machen. Nur dann ist eine erfolgreiche Implementierung von Gender Mainstreaming wirklich gelungen.

Bedarfsgerechte Förderkriterien für Frauen und Männer – Ein Projekt des Landes Salzburg im Rahmen von GenderAlp! Raumentwicklung für Frauen und Männer

Astrid LAMPRECHTER

(Astrid Lamprechter, c/o Büro für Frauenfragen und Chancengleichheit, Land Salzburg Abt. 2, Michael-Pacher-Str. 28, A-5020 Salzburg, astrid.lamprechter@salzburg.gv.at)

1 PROJEKTDARSTELLUNG

Das hier präsentierte Projekt "Bedarfsgerechte Förderkriterien für Frauen und Männer" ist eines von 47 Teilprojekten des internationalen Interreg IIIB Projekts "GenderAlp! Raumentwicklung für Frauen und Männer". Die grundlegende Idee zu diesem Teilprojekt war im Rahmen von Gender Budgeting, die Fragestellung des Nutzenzugangs von Frauen und Männer auf das Gebiet der öffentlichen Förderungen anzuwenden. Da das Projekt jedoch mit begrenzten finanziellen und zeitlichen Ressourcen ausgestattet ist, wurde der Fokus auf eine Förderschiene begrenzt. Davon ausgehend, dass grundsätzliche Ableitungen und Instrumente aus diesem Teilbereich auch für andere Abbrten der öffentlichen Förderung anwendbar sind.
Im Mai 2005 wurde die Studie ausgeschrieben und anschliessend an das Sozialwissenschaftliche Institut München (SIM) vergeben. Der Abschluss wird für März 2006 erwartet. Derzeit steht das Projekt am Beginn des 2. Teils – der Erarbeitung von Indikatoren.

Der Prozess wurde folgendermaßen aufgesplittet:

1.1 Teil 1: Analyse

Der erste Teil der Studie befasst sich mit der Analyse der Ziel 2 (inkl. Phasing-out) Förderkriterien des Landes Salzburg in der Budget-Periode 2000-2006 und die Berücksichtigung des Faktors der Chancengleichheit zwischen Frauen und Männer. In diesem Teil soll der Status-quo hinsichtlich der Umsetzung des Prinzips des Gender Mainstreaming als Querschnittsmaterie herausgearbeitet werden. Besonders zu betonen ist in diesem Zusammenhang, dass keine Projekte aus diesen Fondsmitteln analysiert wurden, sondern ausschliesslich die programmatischen Rahmendokumente, die die Vergabe und die Prozesse innerhalb der Mittelvergabe der EU-Struktufonds für das Land Salzburg in dieser Zeit regeln. Wie kann die Verwaltung in der Gestaltung der Förderkriterien Chancengleichheit begünstigen oder erschweren? Ergänzend dazu wurden Interviews mit ExpertInnen der Regionalmanagements in den Ziel 2 Gebieten des Landes Salzburg sowie der fördervergebenden Stelle der Wirtschaftsabteilung des Landes geführt.

1.2 Teil 2: Instrumente, Indikatoren….

In Teil 2 des Projekts wird das eigentliche Kernstück des Projekts entwickelt. Ausghend von den Erkenntnissen aus der Analyse werden Chancengleichheits-Indikatoren erarbeitet, die sowohl für die kommende Strukturfondsperiode 2007-2013 als auch für andere bereiche der Wirtschafts- und Infrastrukturförderung verwendet werden können. Besonderes Augenmerk wird hier auf die Praktikabilität der vorgeschlagenen Instrumente geachtet, sowie auf deren Integrierbarkeit in bestehende Evaluierungs- und Selektionskriterien.

1.3 Begleitende Maßnahmen: Das Sounding Board

Um das Projekt und seine Inhalte so breit wie möglich zu kommunizieren, wurde als Begleitung zum Prozess ein Sounding Board geschaffen. Zusätzlich zu einer internen Arbeitsgruppe im Land Salzburg soll das Sounding Board die Ergebnisse und Ambitionen des Projekts nach aussen zu den PraktikerInnen und EntscheidungsträgerInnen tragen. "Sounding Board" ist der Resonanzkörper eines Saiteninstruments. RegionalmanagerInnen, Wirtschaftskammer, Arbeiterkammer, Industriellenvereinigung, VertreterInnen der Gemeinden, VertreterInnen der befassten Abteilungen des Landes etc. können hier ihr Feedback zum Thema einbringen – diese Resonanz geht mit in das Projekt ein. Bisher hat ein Sounding Board zum ersten Teil der Studie stattgefunden. Als zentrale Anliegen der TeilnehmerInnen - und das gilt wohl für viele Projekte mit ähnlichen Inhalten – wurde an das Projektteam kommuniziert, die Sprache zu vereinfachen (z. Bsp. Gender Mainstreaming etc.) und mit den Vorschlägen auch an die PraktikerInnen "an der Front" zu denken und sie einfach, integer und leicht praktikabel zu gestalten.

Auch andere GenderAlp! PartnerInnen befassen sich mit dem Thema Gender Budgeting. So sind sowohl aus der Stadt München als auch aus dem Land Oberösterreich Synergieeffekte für das Salzburger Projekt zu erwarten.

2 FRAUEN UND MÄNNER IM ALPINEN RAUM – DAS ZIELGEBIET

In den Lebenszusammenhängen von Frauen und Männern ergeben sich typische Muster, welche nicht für alle gelten müssen, aber doch so häufig auftreten, dass deshalb von typisch „weiblichen" und „männlichen" Lebenslagen und Biografie-Mustern gesprochen werden kann. Die wichtigsten Unterschiede dieser typischen weiblichen und männlichen Lebenslagenmuster lassen sich folgendermaßen darstellen:

- Unterschiedliches Eingebundensein in Erwerbsarbeit und Versorgungsarbeit
- Verschiedenartige Qualifikationen und verschiedenartige gesellschaftliche Vorstellungen bezügliche der Eignung für bestimmte Tätigkeiten
- Daraus resultierende differierende Berufsfelder
- Daraus resultierende geringere Einkommen und Einkommenschancen
- Unterschiedliche Mobilitätsmöglichkeiten
- Unterschiedliche Zeitverwendungsstile und –möglichkeiten
- Geringere soziale, wirtschaftliche und politische Partizipationsmöglichkeiten und daraus resultierende Disparitäten im Zugang zu Macht und Einfluss

Hieraus ergeben sich unterschiedliche Auswirkungen von regionalpolitischen Maßnahmen auf Frauen und Männer. Hervorgehoben werden muss in diesem Zusammenhang die besondere Bedeutung dieser Disparitäten zwischen Frauen und Männern in Bezug auf den ländlichen Raum. Die Gebiete der Ziel 2 Förderungen finden sich ausschließlich im alpinen Raum des Landes Salzburg (Pinzgau, Pongau, Lungau). auf eine genauere und statistische gestützte Darstellung der Geschlechterdisparitäten im Zielgebiet wird hier aus Platzgründen verzichtet, auch davon ausgehend, dass die Tatsachen der Geschlechterdisparitäten in diesen Bereichen hinlänglich bekannt sind.

3 REGIONALENTWICKLUNG – CHANCENGLEICHHEIT ALS ERFOLGSFAKTOR

3.1 Chancengleichheit als Qualitätskriterium für erfolgreiche Regionalentwicklung

Davon ausgehend dass Regionalentwicklung zum Ziel hat, eine Region in ihrer Wettbewerbsfähigkeit und Standortattraktivität (für Unternehmen und Menschen) zu stärken, muss – unter Berücksichtigung der Annahme, dass Frauen und Männer aufgrund ihrer Lebenslagenmuster unterschiedliche Bedürfnisse haben - jede Fördermaßnahme diese unterschiedlichen Wirkungsweisen "mitdenken", um erfolgreich zu sein. Keine Region kann es sich leisten, das Leistungs-und Know-how Potenzial der Hälfte der Bevölkerung brach liegen zu lassen.

In diesem Aspekt greift das Projekt auf bereits publizierte Analysen zum Thema Regionalentwicklung und Chancengleichheit zurück.

Aufhauser u.a. (eine Studie zum Thema im Auftrag des österr. Bundeskanzleramtes 2003) identifizieren in ihrer Untersuchung der Grundlagen für eine „Gleichstellungsorientierte Regionalentwicklung" eine Reihe solcher „Problemzonen" in der regionalen Entwicklung aus der Sicht der Gleichstellung von Männern und Frauen (Aufhauser u.a. 2003, S. 115). So ist im Zuge der zunehmenden räumlichen Ausdifferenzierungen auch eine Zunahme der Trennung „weiblicher" und „männlicher" Bildungsbereiche, Arbeitsmärkte und sozialer Versorgungsstrukturen festzustellen, welche in der Folge wiederum einen hohen Mobilitätsdruck erzeugen und sogar zu sozialen Disparitäten bis hin zum „Männerüberschuss" führen können. Aufhauser u.a. plädieren daher dafür, auch in der Regionalpolitik in Österreich – so wie es von der Österreichischen Raumordnungskonferenz gefordert wird – auf den Ausgleich regionaler und sozialer Disparitäten zu achten, „…um unerwünschte Konsequenzen (verstärkte Arbeitskräftewanderung, Peripherisierungsprozesse, wachsende soziale Ungleichheit) zu verhindern" (ÖROK 2002, S.1). Dagegen werden durch regionalpolitische Interventionen wie die Unterstützung von Clusterbildungen und Technologiezentren diese Tendenzen noch verstärkt, weil hierdurch vor allem männerdominierte Arbeitszusammenhänge gefördert werden und Frauen nur unterproportional von diesen Förderungen profitieren. (Aufhauser u.a. S. 116). In der Folge kommt erschwerend hinzu, dass gerade auch in wirtschaftlich prosperierenden Regionen ein zunehmendes Auseinanderdriften der Einkommen von Frauen und Männern zu verzeichnen ist.

Deshalb müssen regionale Entwicklungen, die sich im Sinne einer Gleichstellungsorientierung als problematisch erweisen, korrigiert werden und es bedarf neuer regionaler Zielrichtungen:

- Nicht nur Stärkung der regionalen Exportwirtschaft, sondern auch Stärkung der regionalen Versorgungswirtschaft, um die Lebensqualität aller in der Region zu sichern
- Nicht nur auf regionale Stärken, sondern auch auf regionalen Ausgleich setzen
- Nicht nur regional spezialisieren und profilieren (Qualifikations- und Wirtschaftsclustern schaffen), sondern die regionale Wissensbasis umfassend stärken
- Nicht nur auf Mobilität setzen, sondern regionale Zugänglichkeiten schaffen
- Nicht nur geschlechtsneutral regionale Kooperationen anstreben, sondern die Mitwirkung weiblicher Akteurinnen in diesen Kooperationen massiv fördern

(Diese Zielrichtungen sind sinngemäß Aufhauser u.a. 2003, S. 118 entnommen)

Die strukturellen Rahmenbedingungen der ländlichen Regionen verlangen in diesem Bezug erhöhte Aufmerksamkeit, da sie die geschlechtsspezifischen Disparitäten (hinsichtlich Einkommen, Erwerbsbeteiligung, Mobilität etc.) verstärken.
So wirkt der stark zentralisierteArbeitsmarkt (Hauptorte – Nebentäler) im ländlichen Raum kombiniert mit der unterschiedlichen individuellen Mobilität von Frauen und Männern, negativ auf die Erwerbsbeteiligung von Frauen - zum Beispiel:
Zentralisierter Arbeitsmarkt + diff. Mobilität = weniger Erwerbsbeteiligung von Frauen
Starke Abhängigkeit vom Tourismus + diff. Zeitbudgets/Betreuungspflichten = weniger Erwerbsbeteiligung von Frauen

3.2 Kosten und Nutzen von Chancengleichheit in der Regionalentwicklung

In ihrer Untersuchung „Gleichstellungsorientierte Regionalentwicklung" (Aufhauser u.a. 2003, S. 158 ff.) zeigen Aufhauser u.a., welche Kosten entstehen, wenn der Gleichstellung der Geschlechter keine ausreichende Bedeutung beigemessen wird. Diese Kosten betreffen die Gesellschaft insgesamt, einzelne Regionen oder einzelne Individuen. Sie entstehen vor allem durch die folgenden Faktoren:

- Mangelhafte Möglichkeiten zur besseren Vereinbarkeit von Beruf und Familie vergeuden wertvolle Humanressourcen
- Brachliegendes Potenzial durch mangelnde Umsetzbarkeit beruflicher Qualifikationen
- Mangelnde Ausschöpfung des weiblichen Gründungspotenzials
- Sinkende Geburtenraten und Abwanderung vor allem hochqualifizierter Bevölkerungsschichten
- Der „brain drain" durch Abwanderung hat negative Auswirkungen auf das regionale Gefüge, die regionale Wissensbasis und die kulturelle Identität
- Abwanderung vieler Frauen führt zu ungleichmäßigen Verhältnis Männer: Frauen in der Bevölkerung
- Abwanderung schwächt auch die bäuerliche Landwirtschaft und verstärkt damit den Abbau der Kulturlandschaft
- Es entstehen Kosten für das Gesundheitswesen durch besonders belastete Gruppen

Es zeigt sich auf breiter internationaler Basis, dass Länder, in denen eine gute Vereinbarkeit von beruflichen und privaten Aufgaben möglich ist (wie z.B. Frankreich und Schweden), ansteigende Geburtenziffern aufweisen, im Gegensatz zu Ländern, wo dies schwierig ist (z.B. Spanien, Italien, Japan). Der Zugang von Frauen zum Arbeitsmarkt steht in enger Verbindung mit der Entwicklung der Geburtenzahlen (vgl. Aufhauser u.a. 2003). Hinzu kommt, dass wirtschaftliche und soziale Ziele ohne die Einbindung aller Bevölkerungsgruppen nicht zu erreichen sind. Von der Kommission der Europäischen Union wird gefordert, Frauen stärker auf allen Ebenen des Arbeitsmarktes zu beteiligen, um die Effizienz und Wirksamkeit der Investitionen in die Humanressourcen zu erhöhen, weil die von Frauen entwickelten Tätigkeiten häufig innovative Antworten auf Marktchancen und den örtlichen Bedarf seien. (EU-Kommission 2000: Technisches Papier 3).

Soziale wie ökonomische Nutzenfaktoren einer umgesetzten Geschlechtergleichstellung lassen sich folgendermaßen zusammenfassen:

- Ökonomisches Wachstum durch bestmögliche Nutzung aller Humanressourcen
- Höhere Geburtenraten
- Durch Erhöhung der Lebensqualität für Frauen in den Regionen sinkt die Abwanderung --> dadurch Entfaltung des vorhandenen Humankapitals in der Region
- Zwischen Gleichstellung und Wirtschaftskraft einer Region besteht ein enger statistischer Zusammenhang
- Auch zwischen Nachhaltigkeit und der Einbindung aller Bevölkerungsgruppen besteht ein enger Zusammenhang Stabilisierung des gesellschaftlichen Zusammenhalts

4 LEGISLATIVE GRUNDLAGEN ZUR UMSETZUNG VON CHANCENGLEICHHEIT EU UND LAND SALZBURG

Die Forderung Chancengleichheit zwischen Frauen und Männern als Querschnittsmaterie in alle Inhalte des öffentlichen Handelns zu integrieren, stützt sich auf ein fundierte rechtliche Basis.

auf EU-Ebene:

- Vertrag von Amsterdam 1999, Art. 2 und 3, *Gleichstellungsziel als Kernaufgabe in das Primärrecht aufgenommen*
- Strukturfonds-Verordnungen 1999-2006
- Entwurf zur Europäische Verfassung 2003

im Land Salzburg:

- Beschluss der Landeshauptleute-Konferenz Juni 2002
- Entschließung des Salzburger Landtags März 2002
- Beschluss der Salzburger Landesregierung April 2003

5 DIE STRUKTURFONDS 2000-2006 – DAS ZIEL2 PROGRAMM IM LAND SALZBURG

5.1 Aufbau des Ziel 2 Programms in Salzburg

Das Ziel 2 Programm des Landes Salzburg 2000-2006 wird im Wesentlichen in zwei Dokumenten festgelegt.

i. Einheitliches Programmplanungsdokument Ziel 2 Salzburg 2000-2006

Das Einheitliche Programmplanungsdokument (EPPD) gibt die regionalwirtschaftlichen Problemstellungen im ländlichen Raum Salzburgs, das strategische Konzept zur sozio-ökonomischen Entwicklung dieses Gebiets sowie den Maßnahmenplan zur Umsetzung des Entwicklungskonzepts vor. Es formuliert zu diesem Zweck die folgenden Leitziele (EPPD S. 77):

1. Stärkung der betrieblichen Basis durch gezielte Standortattraktivierung in Kombination mit einer Forcierung von Neugründungen, insbesondere durch JungunternehmerInnen
2. Erhöhung der Innovationsaktivitäten der Betriebe in Industrie und Tourismus als zentrale Strategie zur Erhöhung der Wertschöpfung (Steigerung der „unit values“ der verkauften Produkte und Dienstleistungen) und damit zur **Verbesserung der betrieblichen Wettbewerbsfähigkeit**
3. **Verringerung von Arbeitslosigkeit, Abwanderung und Arbeitspendelwanderung**, insbesondere im Hinblick auf Frauen und junge Menschen, durch eine Sicherung bzw. Verbesserung der Lebensqualität im ländlichen Raum
4. **Erhaltung der spezifischen Stärken und Wettbewerbsvorteile** der Region im Bereich von Umwelt und Naturraumpotenzial sowie der Kulturlandschaft als eine Grundvoraussetzung für die Lebensqualität der Bevölkerung und die Wettbewerbsfähigkeit im Tourismus.

Im EPPD-Text heißt es im Anschluss an die Auflistung dieser Leitziele: „Ergänzt werden diese Leitziele um die allgemeinen Zielsetzungen des Erhalts einer intakten natürlichen Umwelt und der Erreichung der Chancengleichheit zwischen Frauen und Männern.“ (EPPD, S. 77) Es soll an dieser Stelle anhand der „Ergänzung“ der Leitziele um die allgemeine Zielsetzung „Chancengleichheit zwischen Frauen und Männern“ noch einmal auf die prinzipielle Diskrepanz zwischen dieser additiven Zuordnung des Themas und dem eigentlichen Grundgedanken des Gender Mainstreaming eingegangen werden. Das Thema Chancengleichheit wird zwar als Querschnittsthema bezeichnet, das in alle anderen Zielvorstellungen und Fragestellungen mit einbezogen werden muss, aber de facto geschieht dies nicht. „Chancengleichheit“ wird als modernes Zubehör gesehen, welches eben *auch* mit Hilfe von *Zusatzmaßnahmen* abgedeckt werden muss. Diese Sichtweise setzt grundlegend falsche Akzente und widerspricht den EU-Vorgaben zur Integration der Chancengleichheit als Querschnittsthema.

ii. Ergänzung zur Programmplanung Ziel 2 Salzburg 2000-2006

Die Ergänzung zur Programmplanung (EzP) formuliert die konkreten Prioritätenachsen und Maßnahmen zum Programm aus, legt die konkretisierten Zielsetzungen, Förderauswahlkriterien und ex-ante Bewertungen von Projektanträgen und Wirkungsindikatoren fest.

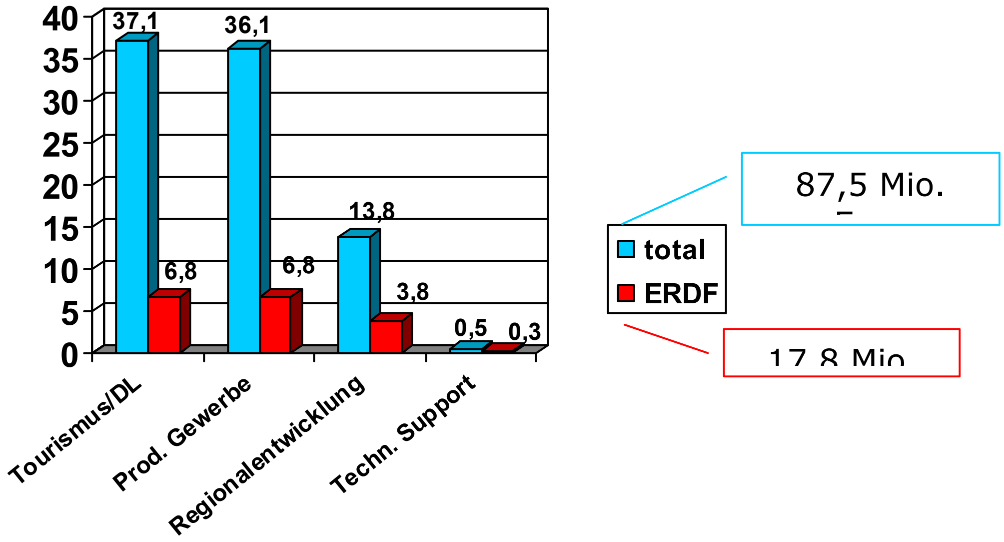
Es gliedert sich in Prioritätenachsen mit insgesamt 15 Maßnahmen:
1. Tourismus und Freizeitwirtschaft
2. Produktionssektor und produktionsnahe Dienstleistungen
3. Regionalentwicklung
4. Technische Hilfe für die Programmumsetzung

5.2 Förderzielgebiete und Finanzvolumina – Österreich/Salzburg

Die Förderzielgebiete des Landes Salzburg für die Ziel 2 Förderungen der EU-Strukturfonds 2000-2006 liegen ausschliesslich in den südlichen Bezirken und damit im ländlichen Raum.

Graph 1: Land Salzburg, Darstellung der Zielgebieter, EU-Strukturfonds 2000-2006

Das Ziel 2 Programm in Salzburg 2000-2006 umfasst rein EFRE-kofinanzierte Interventionen in Ziel 2 und Übergangsgebieten nach Ziel 5b, sog. Phasing-Out Gebieten mit einem Gesamtvolumen von 25,3 Mio. Euro an öffentlichen Mitteln. Dabei ist eine Beteiligung durch den EFRE in der Höhe von 17,8 Mio. Euro, dies entspricht einem Anteil von 70% vorgesehen. Inklusive der Privatausgaben soll ein Gesamtinvestitionsvolumen von 87,5 Mio. Euro stimuliert werden.



Graph 2: Mittelallokation Ziel 2 Land Salzburg 2000-2006, Quelle: Aktualisierung der Halbzeitbewertung des Ziel-2 Programms Salzburg 2000-2006, Austrian Research Centers

5.3 Halbzeitevaluierung ÖROK August 2005 und Chancengleichheit

Begleitend zum laufenden Prozess wurde 2003 eine Halbzeitevaluierung zur Feststellung der Ergebnisse und Wirkungen sowie der finanzielle Leistungsfähigkeit und den Fortschritt erstellt. Im August 2005 wurde diese Halbzeitevaluierung aktualisiert und kommt beim Aspekt Chancengleichheit zu dem Schluss, dass die Aufnahme der Maßnahme 3 in Prioritätenachse III, die Projektmanagerinnen für Chancengleichheit in den Regionalmanagements des Lungaus und des Pinzgaus, eine Maßnahme mit innovative Maßnahme ist, die die Realisierung von anderen Chancengleichheitsprojekten begünstigt. Auch die Maßnahme 4 in der Prioritätenachse III zur Erhöhung der Erwerbsquote von Frauen im Zielgebiet ist eine wichtige wenn auch gering dotierte Maßnahme, deren Beiträge betreffend Chancengleichheit a priori als gering einzuschätzen ist.
Die überwiegende Zahl der bis jetzt eingereichten 208 Projekte wird als Chancengleichheits-neutral eingestuft (194 neutral, 3 chancengleichheitsprojekte, 11 Projekte auf Chancengleichheit ausgerichtet). "*Es ist jedoch davon auszugehen dass zahlreiche Projekte durchaus unterschiedlich auf die Situation von Frauen im Vergleich zu Männern wirken. Wie bereits in der Halbzeitevaluierung hingewiesen, wäre eine Prüfung, auf welcher Basis diese Beurteilungen zustande gekommen sind, lohnenswert. Hemmend für die breitere Umsetzung von Chancengleichheit ist auch die geringe institutionelle Verankerung auf der operativen Ebene der Programmumsetzung – bei den Fördereinrichtungen bzw. in den Regionen selbst*." (Aktualisierung der Halbzeitevaluierung 2005, S. 33).

Und stellt hinsichtlich der Potenziale in der begleitenden Evaluierung der Regionalmanagements fest: "*Weiters ist die regionsübergreifende Zusammenarbeit in Form von Stimulierung von interregionalen Netzwerken, gemeinsame Qualifizierungsmaßnahmen, Nahversorgung, etc. ein potenzielles künftiges Tärkefeld sowohl für die RegionalmanagerInnen als auch ProjektmanagerInnen für Chancengleichheit, das die weiterführende Bereitstellung entsprechender Ressourcen erfordern würde*." (Aktualisierung der Halbzeitevaluierung 2005, S. 35)

6 CHANCENGLEICHHEIT IM ZIEL 2 PROGRAMM IM LAND SALZBURG 2000-2006

Grundsätzlich ist festzustellen, dass mehrere gesetzliche Vorgaben auf EU-Ebene als auch auf Landesebene, die Integration des Aspekts der Chancengleichheit für Frauen und Männer als Queschnittsziel - und damit anzuwenden auf alle Maßnahmen - festschreibt.

6.1 13 vs 2 Die Hintertür – als ex-ante-Bewertung

Die Ergänzung zum Programm enthält in den vier Prioritätsachsen 15 Maßnahmen fest. Von diesen 15 Maßnahmen sind zwei explizit auf das Thema Chancengleichheit ausgerichtet:

Maßnahme III.3: ProjektmanagerInnen für Chancengleichheit in den Regionalmanagements Lungau und Pinzgau
Maßnahme III.4: Verbesserung der Chancengleichheit durch die Errichtung und den Ausbau von Weiterbildungs- und betrieblichen Kinderbetreuungseinrichtungen

Dazu ist grundsätzlich zu sagen, dass es wichtig und richtig ist explizite Chancengleichheits-Schienen im Förderprogramm zu etablieren. Allerdings kann dies keine Verankerung des Themas als Querschnittsmaterie ersetzen. Für alle restlichen 13 Maßnahmen des Programms entbindet folgender Passus in der ex-ante Bewertung indirekt von der Umsetzung des Aspekts der Chancengleichheit in der betroffenen Maßnahme:
"*Aufgrund der Schwierigkeit der realistischen Messbarkeit von Auswirkungen auf die Gleichstellung von Männern und Frauen wurden dafür die spezifischen Maßnahmen .....III.3 ...III.4 ...geschaffen*." (EzP, z. Bsp. S 53)

Die ex-ante Bewertung bezieht sich in allen Maßnahmen auf die Bereiche

- Situation auf dem Arbeitsmarkt
- Beurteilung der Umweltsituation
- Gleichstellung von Männern und Frauen

Jenen Bereichen, die als Projektselektionskriterien (EzP, S. 4) genannt werden. In der Umsetzung des EzP zeigt sich jedoch, dass für das Thema der Gleichstellung angenommen wird, dass die Wirkung von Fördermaßnahmen in Tourismus, Produktion und Regionalentwicklung (die eine erhebliche Bedeutung für die ländlichen Regionen in Salzburg und für Frauen als Erwerbsbranche haben) auf Frauen und Männer gleich ist. Dem muss aus den oben angeführten Gründen der Relevanz geschlechtsspezifischer Bedürfnisse für die Regionalentwicklung entschieden widersprochen werden.

6.2 Die scheinbare Neutralität – als Wirkungsindikatoren

Bereits erwähnt wurde die Kategorisierung von Projekten mithilfe von Wirkungsindikatoren. Diese decken die folgenden Bereiche ab:

- Umwelt
- Chancengleichheit
- Städtischer/ländlicher Raum

In Bezug auf die Chancengleichheit wird folgendes Schema vorgegeben:

- hauptsächlich auf die Gleichbehandlung von Frauen und Männern gerichtet
- die Gleichbehandlung fördernd
- in Bezug auf die Gleichbehandlung neutral

Wie bereits in der Aktualisierung der Halbzeitevaluierung dargestellt, sind mit Ende 2004 194 von 208 Projekten als chancengleichheitsneutral eingestuft worden. Beispielhaft sei hier noch einmal der Bereich der Tourismusförderung angesprochen. Die ländlichen Regionen zeichnen sich durch eine erhöhrte Abhängigkeit von diesem Wirtschaftsbereich aus, insbesondere als die Erwerbsquote von Frauen in diesem Bereich überproportional hoch ist. Nicht zu vergessen sind auch die indirekt an den Tourismus angekoppelten, weiblich dominierten Dienstleistungsbereiche (MasseurInnen, FriseurInnen, etc.).

Davon ausgehend dass Frauen und Männer aufgrund ihrer unterschiedlichen Lebenslagenmuster auch unterschiedliche Bedürfnisse an den Arbeitsplatz (Erreichbarkeit, Arbeitszeite, saisonale Stabilität, Einkommen) haben, sind geschlechtsspezifisch unterschiedliche Auswirkung von Tourismusmfördermassnahmen logisch kohärent. Einerseits ist hier die Tatsache des Nutzenzugangs unterschiedlicher Ziel- und Bevölkerungsgruppen zu beleuchten andererseits der möglichst effiziente und transparente Mitteleinsatz öffentlicher (Steuer-)Gelder. Beides ist im überwiegenden Teil der Programmgestaltung des Ziel 2 Land Salzburg 2000-2006 Programms nicht durchgängig gegeben bzw. berücksichtigt.

6.3 Intendierte vs. nicht-intendierte Nebenwirkungen

Im besonderen Maße beruht das Ergebnis der oben ausgeführten Analyse der Programmplanungsdokumente darauf, dass wohl die intendierten (also beabsichtigten) Wirkungen einer Maßnahme genau definiert sind – Arbeitsmarkt, Umwelt, Wettbewerbsfähigkeit etc. – jedoch das Blickfeld der nicht-intendierten oder indirekten "Nebenwirkungen" von Maßnahmen ausgeblendet werden. Genau diese Perspektive wäre die Aufgabe einer Querschnittsmaterie wie dem Thema der Chancengleichheit, die jedoch wie dargestellt nicht in der vorgesehen Art und Weise realisiert wurde.

iii. Das Prinzip der nicht-intendierten Nebenwirkungen

Das Prinzip der Nicht-intendierten Nebenwirkungen geht davon aus, dass in einem Wirtschafts- und Gesellschaftssystem mit einer Vielzahl von Parametern, die miteinander in Wechselwirkung stehen, keine Aktion ausschliesslich in eine Richtung wirkt. Besonders zu berücksichtigen wäre dieses Prinzip im Bereich der ex-ante Evaluierung und der Wirkungsindikatoren. Bereiche, in denen der Beitrag eines Projekts zur Gleichstellung von Frauen und Männern belegt und gemessen werden soll. Im Laufe der Diskussionen um das Projekt der "Bedarfsgerechten Förderkriterien für Frauen und Männer" stellt sich immer mehr heraus, das dieses Prinzip eine Art zu denken ist, die erlernt werden muss, aber – und das erscheint in diesem Prozess besonders wichtig – auch relativ rasch erlernt werden kann. Als Beispiel sei hier die Hochtechnologieförderung angeführt, die die Schaffung von Arbeitsplätzen als beabsichtigte Wirkung deklariert und die vor allen in der Schaffung von Arbeitsplätzen in höherqualifizierter technischer Ausprägung, Frauen tendenziell benachteiligt – nicht in der Absicht, dies zu tun, aber doch als messbare und tatsächliche nicht-beabsichtigte Nebenwirkung.

Ebenso ist es eine nicht intendierte Nebenwirkung der höheren Bildungsbeteiligung von Frauen, dass dadurch Abwanderungstendenzen in einer Region verstärkt werden: Wenn viele junge Frauen in größerer Zahl in Ballungszentren abwandern, weil sie dort bessere Berufschancen und eine größere persönliche Freiheit in ihrer allgemeinen Lebensgestaltung erwarten, dann tun sie dies auch nicht in der Absicht, ihrer Heimatregion oder gar der bäuerlich strukturierten Landwirtschaft zu schaden. Dennoch ist es eine messbare Folge der veränderten Lebensplanungen junger Frauen, dass es für junge Landwirte immer schwerer wird, eine Partnerin zu finden. Dies trägt – als nicht intendierte Nebenwirkung – auch mit zu den starken Veränderungen im landwirtschaftlichen Sektor bei.

Ungleiche Nutzenverteilungen werden sich nicht immer vermeiden lassen und es ist eine politische Entscheidung, wie damit umgegangen wird, aber es ist in jedem Fall erforderlich, nicht intendierte Nebenwirkungen zu beachten, in geeigneter Weise zu quantifizieren und in die Entscheidungsfindung mit einzubeziehen. Sie sollten aber nicht ignoriert werden, wenn man nicht unliebsame Spätfolgen sozialer Fehlentwicklungen riskieren möchte.

Es gibt also nur sehr wenige Fördermaßnahmen, deren Auswirkungen tatsächlich völlig geschlechtsneutral sind. Auch der Nutzen ist meist geschlechtsabhängig. Wenn sich also bei Folgenabschätzungen gravierende Nachteile für eine bestimmt Gruppe ergeben (dies gilt auch für andere Sozialkategorien, z.B. Jugendliche, SeniorInnen, MigrantInnen etc.) sind diese Nachteile zumindest durch andere Maßnahmen zu kompensieren. Eine unumgängliche Voraussetzung dafür ist es aber, unterschiedliche Wirkungs- und Nutzeneffekte wahrzunehmen. Die Einstufung von Maßnahmen und Projekten ex ante als „neutral in Bezug auf Geschlechtergleichstellung" verhindert diese Wahrnehmung per Definition!

iv. Nicht-intendierte Nebenwirkungen am Beispiel des Tourismus im Land Salzburg

Charakteristisch für den ländlichen Raum Salzburgs ist vor allem die starke Spezialisierung auf den Tourismus mit einem Beschäftigungsanteil von über 50 %. Diese Region ist eine der tourismusintensivsten in ganz Österreich. Problematisch in diesem Bereich sind teilweise Nachfragerückgänge, die vorwiegend durch strukturelle Nachfrageveränderungen bedingt sind: Es zeichnet sich eine deutliche Aufteilung in ein niedrigpreisorientiertes und ein qualitätsorientiertes (Hochpreis)-Segment ab, während die bisher dominierende Nachfrageschicht der FamilienurlauberInnen im mittleren Preis- und Qualitätssegment an Bedeutung abnimmt. Der Tourismusbereich ist mit großem Abstand der wichtigste Arbeitsmarkt für Frauen im ländlichen Raum Salzburg. Frauen sind daher die Hauptbetroffenen von Problemen und Schwankungen in diesem Sektor. Bei einer gleichstellungsorientierten Förderpolitik müssten die folgenden Fragen gestellt werden:

- Wer ist wo beschäftigt?
- Wer profitiert von Expansion besonders?
- Wie wirken sich saisonale Schwankungen speziell auf Frauenarbeitsplätze aus?
- Welche Arbeitsplätze sind von allgemeinen Nachfrageverschiebungen vorwiegend betroffen?
- Sind von strukturellen Verschiebungen (mehr Hochpreis-Angebote, weniger niedriges Preissegment) auch z.B. Kleinunternehmerinnen betroffen?
- Wie wirken sich die typischen Arbeitszeiten im Tourismus (mit Spitzenbelastungen in den Abendstunden, an Wochenenden und in den Ferien) geschlechtsspezifisch aus
- Wie wirkt sich die allgemein akzeptierte Zielsetzung einer permanenten Anhebung des Standards der Beherbergungsbetriebe auf die Art der Arbeitsplätze aus
- Wie viele Beherbergungsbetriebe im Niedrigpreissektor gehen verloren, wer ist davon im Wesentlichen betroffen?
- Wie ist die Lage der Kleinunternehmerinnen im Tourismus, z.B. freie Masseurinnen, Friseurinnen etc. im Hochpreisangebot der Hotellerie (hinsichtlich existenzsichernder Einkommen, Arbeitszeiten oder sozialer Sicherheit)?

6.4 Instrumente für die Zukunft – Indikatoren

v. Sozialindikatoren

Um Veränderungen, also Wirkungen und Ergebnisse, die mit Hilfe von Fördermaßnahmen erzielt wurden, messen und bewerten zu können, braucht man Messgrößen und Instrumente. Solche Instrumente zur Messung von sozialen Sachverhalten und Lebenslagen heißen „Sozialindikatoren". Es handelt sich hierbei meist um statistische Maßzahlen, welche bedeutsame gesellschaftliche Sachverhalte und Entwicklungen abbilden, einen raschen Überblick über den zu messenden Sachverhalt vermitteln und zeitliche Veränderungen nachzeichnen sollen.

Im Hinblick auf Wirtschaftsförderung und Geschlechtergleichstellung sollen Sozialindikatoren folgendes leisten:

- Sie sollen einen Überblick über die Lebenslagen von Frauen und Männern geben
- Sie sollen zeigen, inwieweit Förderungen die besonderen Bedürfnisse der verschiedenen Zielgruppen erreichen und abdecken können
- Sie sollen über den Wirkungsgrad von Förderungen auf die Zielgruppe Aufschluss geben
- Sie sollen aktuelle Probleme und unerwünschte Entwicklungen aufzeigen
- Sie sollen auch Chancengleichheit und deren Veränderung messen.

Sozialindikatoren werden seit langer Zeit für die Sozialberichterstattung verwendet, allerdings werden erst seit kurzer Zeit Anstrengungen unternommen, um mit Hilfe von geschlechtssensiblen Indikatoren auch die Chancengleichheit zwischen Frauen und Männern in einer Gesellschaft abzubilden. Geschlechtssensible Sozialindikatoren können auch Veränderungen in Sozialräumen bezüglich der Chancengleichheit aufzeigen und sie können deshalb auch – bei entsprechend vorsichtigen Interpretationen – Aufschluss geben über den Wirkungsgrad von Fördermaßnahmen im Hinblick auf die Verbesserung der Geschlechtergleichstellung.

Indikatoren können auf der Ebene des zu messenden Sozialraums gebildet werden (zur Abbildung der Lebenslagen von Frauen und Männern oder sonstigen sozialen Gruppen). Sie können aber auch als „Maßnahmenindikatoren" oder „Projektindikatoren" bezüglich der Wirkung und des Outcomes von Einzelprojekten oder ganzen Maßnahmenbündeln gebildet werden.

Schwierig ist vor allem die Verknüpfung eines Einzelprojektes mit Veränderungen im Sozialraum, weil ein Einzelprojekt niemals die einzige Ursache für soziale Wandlungsprozesse darstellt und deshalb festgestellte Änderungen in einem Sozialraum nicht unmittelbar auf einzelne Einwirkungen durch Projekte zurückgeführt werden können. Es lassen sich aber Trends ablesen und durch geeignete Vorgehensweisen (z.B. Gründungsforschung, Biografieforschung, Verbleibsanalysen, Wanderungsmotivuntersuchungen, Bürgerbefragungen etc.) einige Wirkungszusammenhänge herausfiltern.

Für die Bildung von geschlechtssensiblen Sozialindikatoren müssen u.a. die folgenden Voraussetzungen vorliegen:

- Quantifizierte Zielvorgaben
- Systematische geschlechtergetrennte Datenerfassung in den Projekten
- Umfassende nach Geschlecht, Alter und weiteren soziodemografischen Variablen aufgeschlüsselte Statistiken der Projekte
- Wirkungsmessung (z.B. Verbleibsforschung bei Unternehmensgründungen) nach einigen Jahren
- Erhebung von regionalen Sozialraumdaten nach Alter, Geschlecht und weiteren soziodemografischen Variablen

vi. Geschlechtsspezifische Indikatoren – Gender-Indikatoren

Eine gesonderte Gruppe von Sozialindikatoren können Gender-Indikatoren sein. Indikatoren, die den Nutzenzugang von Frauen und Männer zu Fördermaßnahmen abbilden und messen, müssen in ihrer **Definition und Anwendbarkeit in einer Linie mit anderen Indikatorensets und Messinstrument** stehen. Nur dann kann gewährleistet werden, dass kein zusätzlicher Aufwand entsteht und die Instrumente auch korrekt verwendet werden. Konkret: Es muss bekannt sein, wie die Programmbehörde plant, andere Teilbereiche zu messen und welche Art von Indikatoren dazu verwendet werden.

Es ist gesondert darauf hinzuweisen, dass Indikatoren – in welcher Form auch immer – die **Erreichung von Zielen** messen, d.h. Ziele müssen "gut" und konkret formuliert werden. Dazu ist im Regelfall die Ex-ante-Evaluierung eine wichtige Grundlage.

Als Beispiel wird hier der Bereich von Förderungen mit der Zielsetzung der **Stärkung der regionalen Entwicklungspotenziale, Sicherung und Verbesserung der Standortattraktivität vorgestellt.** Eine Zielsetzung, die vielen Programmen der Regional-und Wirtschaftsförderung zugrundeliegt.
Die Zielsetzung muss hinterfragt und konkretisiert werden, um daraus quantifizier- und messbare Ziele zu machen. Dazu können Fragen wie die folgenden hilfreich sein:

- Gibt es "männliche" und "weibliche" Entwicklungspotenziale in der Region - Welche? Wie ist der Status-quo bei diesen Entwicklungspotenzialen?
- Zielt die Stärkung der vorhandenen Entwicklungspotenziale auf beide Geschlechter ab?
- Ermöglichen die vorhandenen Strukturen auch die Nutzung der in der Region vorhandenen weiblichen Potenziale?
- Wird bei der Einschätzung der Standortattraktivität auch die Sichtweise weiblicher Unternehmerinnen mit einbezogen? Unterscheidet sich diese Sichtweise von der männlicher Unternehmer?

Für die Bildung von Indikatoren - je nach Art und Bedarf könnte aus folgende Kriterien gewählt werden, um das Ziel der Chancengleichheit in der Evaluierung sicherzustellen und die Erreichung zu messen.:

- Zahl der geschaffenen Arbeitsplätze – Frauen/Männer
- Zahl der nach zwei Jahren noch bestehenden Arbeitsplätze – Frauen/Männer
- Einkommen der geschaffenen Arbeitsplätze - Frauen/Männer
- Arbeitszeiten der geschaffenen Arbeitsplätze - Frauen/Männer
- Qualifikation der nach zwei Jahren noch bestehenden Arbeitsplätze (Weiterbildungs-, Qualifizierungsmaßnahmen) – männl. /weibl. Beschäftigte
- Zahl der geschaffenen Teilzeit-Stellen – männl. /weibl. Beschäftigte
- Erreichbarkeit der geschaffenen Arbeitsplätze, welches Transportmittel möglich
- Zufriedenheit der Beschäftigten mit den neu geschaffenen Arbeitsplätzen - Frauen/Männer
- Konjunkturelle, saisonale Abhängigkeit der geschaffenen Arbeitsplätze - Frauen/Männer
- Zusammensetzung der regionalen und kommunalen (politischen) Entscheidungsgremien - Frauen/Männer
- Zunahme der Teilhabe von Frauen an diesen Entscheidungsgremien
- Anzahl der Entscheidungspositionen von Frauen in wirtschaftlichen oder betrieblichen Schlüsselpositionen
- Zunahme von Frauen in wirtschaftlichen oder betrieblichen Schlüsselpositionen
- Zahl der Neugründungen durch Frauen und Männer
- Existenz des Betriebes nach zwei Jahren – Frauen/Männer
- Umsätze, Gewinne - Frauen/Männer
- Arbeitszeiten – Frauen/Männer
- Umsatz pro Einheit Arbeitszeit, Gewinn pro Einheit Arbeitszeit – Frauen/Männer
- Stabilität des Unternehmens aus GründerInnen-Sicht: Zufriedenheit mit Einkommenssituation, Arbeitsbelastung, Rentabilität etc. – Frauen/Männer
- Zahl der ProjektteilnehmerInnen - Frauen/Männer
- Veränderung der Abwanderungsquote - Frauen/Männer
- Veränderung der Pendlerbewegung - Frauen/Männer
- Kaufkraftveränderung der regionalen Bevölkerung - Frauen/Männer

6.5 Fördernde und hinderliche Faktoren

vii. Hinderliche Faktoren

Manche Förderrichtlinien werden von Fachleuten als problematisch hinsichtlich der Umsetzung von Chancengleichheit angesprochen. Es wird auch beklagt, dass zu viel „Überregulierung" durch eine allzu große Vorschriftenflut bedarfsgerechte Projektzuschnitte verhindere. Wichtig wäre es nach Ansicht von ExpertInnen, in die Programm- und Maßnahmengestaltung sowohl die Praktiker vor Ort als auch verschiedene Betroffenengruppen mit einzubinden. Auch die Auswirkungen von Projekten müssten systematisch mit Hilfe von Zielvereinbarungen und deren Überprüfung auch im Hinblick auf Gesichtspunkte der Geschlechtergleichstellung untersucht werden.

Ein gutes Beispiel für wenig zielführende Förderrichtlinien ist die Förderung von Betriebskindergärten. Diese Förderung passt nur schlecht mit den regionalen Strukturen zusammen, weil zum einen nur wenige interessierte Betriebe in der erforderlichen Größenordnung vorhanden sind, und zum anderen betriebliche Kinderbetreuungseinrichtungen in direktem Wettbewerb zu den gemeindlichen Einrichtungen stehen.

Ein weiteres Beispiel ungünstiger Richtlinien für Frauen ist die Koppelung der Jungunternehmerförderung an betriebliche Investitionen. Die Betriebsstrukturen weiblicher Unternehmen erfordern viel seltener hohe Investitionen, als dies bei von Männern gegründeten Betrieben der Fall ist, weil Frauen sehr häufig im Dienstleistungsbereich gründen (z.B. im Wellnessbereich, als Masseurin in einem Hotel o.ä.). Wenn die Höhe der Förderung aber von der Höhe der Investitionen und der Betriebsmittel abhängig sind, kommen Frauen kaum in den Nutzen von Fördermitteln. Gleiches gilt für die Vorgabe, dass keine Handelsbetriebe gefördert werden können. Durch diese Einschränkung dürften weit mehr Frauen als Männer von Fördermitteln ausgeschlossen werden.

Schwierig ist z.B. auch die Vorfinanzierung von Projekten. Die meisten Projekte scheitern daran, dass im Vorfeld kein Geld für die Vorfinanzierung aufgebracht werden kann. Bei so genannten Chancengleichheitsprojekten kommt noch das spezifische Problem hinzu, dass im Vorfeld eines Projektes bereits viel Geld für Öffentlichkeitsarbeit ausgegeben werden muss, damit das Projekt überhaupt zustande kommt.

Neben den teilweise sehr behindernden Förderrichtlinien sind es vor allem noch Zeit- und Kostenfaktoren, die sich als hemmend für die Implementierung von Gender Mainstreaming in regionalen Förderprogrammen erweisen.

viii. Fördernde Faktoren

Von einem der befragten ExpertInnen wurde die politische Partizipation von Frauen als „ausgesprochen förderlicher Faktor" für Chancengleichheit genannt. Dies sei nicht nur deshalb der Fall, weil es wichtig ist, dass Frauen ihre Bedürfnisse selbst öffentlich artikulieren und Frauen, die dazu nicht selbst in der Lage sind, durch weibliche Vertreterinnen ein öffentliches Sprachrohr erhalten müssen. Wichtig sei vor allem der Effekt des „Schlüsselerlebnisses", das sich durch Frauen in wichtigen öffentlichen Positionen oft einstelle. „Es gibt fast nichts Lehrreicheres als positive Beispiele: Im Pinzgau gibt's jetzt die ersten 3 Bürgermeisterinnen. Die machen hervorragende Arbeit. Da sieht man erst mal richtig deutlich, wie Frauen anders an die Dinge herangehen und herandenken und was dann dabei herauskommt." Den Bürgermeisterinnen wird ein pragmatisches nutzen- und zielorientiertes Vorgehen zugeschrieben, das sehr erfolgreich ist und bei den BürgerInnen sehr gut ankommt.

Ein pragmatisch nutzenorientiertes Vorgehen wird von Experten allgemein als fördernder Faktor für die Implementierung von Gender Mainstreaming in Förderprogramme angesehen. Dazu gehöre auch (gemäß einer expliziten Expertenaussage), auf Polarisierung zu verzichten und auf mehr Zusammenarbeit zu achten. Es sei generell zu beobachten, dass sich immer bestimme Zirkel bestimmten Problemen widmen würden, ohne andere Fachleute oder Betroffene hinzu zu ziehen. Dies gelte für Programmplanungen ebenso wie für Gender-Veranstaltungen. Besonders hier säßen meist nur Frauen auf den Podien, obwohl hier doch auch Männer betroffen seien. Grundsätzlich sollte bei allen Themen darauf geachtet werden, dass nicht eine Gruppe für eine andere mitdenkt, sondern dass deren jeweilige Erfahrungen mit einbezogen werden.

7 RESÜMEE UND EMPFEHLUNGEN

7.1 Resümee über das bestehende Ziel 2 Programm Land Salzburg 2000 - 2006

Zusammenfassend kann über den Stand der Umsetzung des Leitziels der Chancengleichheit zwischen Frauen und Männern im bestehenden Ziel 2 Programm des Landes Salzburg 2000 – 2006 folgendes festgehalten werden:

- GM als **Querschnittsmaterie** ist nicht umgesetzt
- Scheinbare „**Neutralität**" der Mehrzahl der Projekte ist irreführend
- Selektions- und Evaluationskriterien sind nicht konkret und geschlechter-bewußt
- Starker Bedarf an **Instrumenten**, um die Geschlechterperspektive in die Prozesse zu integrieren

- Schwaches **Bewußtsein** über geschlechterrelevante Wirkungen aller Maßnahmen im Proramm (z. Bsp. Tourismus, Produktionssektor, Regionalentwicklung)

Trotz des Versuchs Chancengleichheit in zwei spezifischen Maßnahmen im Programm zu verankern, der als innovativ und ambitioniert bezeichnet werden muss, kann festgehalten werden, dass die Programm- und Maßnahmengestaltung starke Defizite im Zusammenhang mit dem Leitziel der Gleichstellung der Geschlechter enthält. Eine Vielzahl von Studien und Untersuchungen belegen, dass die Berücksichtigung unterschiedlicher Bedürfnisse von Frauen und Männern in der Gestaltung von Fördermaßnahmen vor allem im ländlichen Raum deren Wirkung zur Verbesserung von Wettbewerbsfähigkeit und Standortqualität massgeblich beitrgagen. Auch die Halbzeitevaluierung 2003 des laufenden Ziel 2 Programms Land Salzburg und die Aktualisierung dieser Evaluierung 2005 weisen eindeutig darauf hin, dass die überwiegende Zahl der neutralen Projekte in Hinblick auf die Gleichstellung zu hinterfragen ist und die dafür verwendeten Instrumente (Wirkungsindikatoren) zu verbessern sind. Abgesehen vom nachgewiesenen Nutzen einer derartigen Vorgehensweise für eine verbesserte Wirkungsweise von Fördermassnahmen für ländliche Regionen ist sowohl in den massgeblichen EU-Dokumenten als auch in der Legislative des Landes Salzburg die Umsetzung von Chancengleichheit von Frauen und Männern vorgegeben.

7.2 Empfehlungen für die Gestaltung von Förderrahmenbedingungen zur durchgängigen Umsetzung von Chancengleichheit zwischen Frauen und Männern

Abgeleitet aus den Ergebnissen zum laufenden Ziel 2 Programm Land Salzburg können sowohl für andere Fördermaßnahmen als auch im besonderen für die kommenden Strukturfonds-Programme der Budgetperiode 2007 – 2013 folgende Empfehlungen zur besseren Umsetzung vorgeschlagen werden:

- **Gender ExpertInnen** in den Prozess der Gestaltung der Förderkriterien integrieren (z. Bsp. Programmplanung 2007-2013)
- Entwicklung von praktikablen **Gender-Indikatoren** für die Selektion und Evaluation von Projekten
- Training von **EntscheidungsträgerInnen** in den Regionen (RegionalmanagerInnen, BürgemeisterInnen) und in der Administration (Fördervergabestellen) über die geschlechterspezifischen Auswirkungen von „neutralen" Maßnahmen
- Begleitung des Vergabe- und Evaluierungsprozesses durch Gender ExpertInnen
- Einfache **Sprache** für Erklärungen verwenden und den **Nutzen** für die Regionen kommunizieren

Besonders wichtig erscheint in erster Linie allen EntscheidungsträgerInnen und PraktikerInnen (RegionalmanagerInnen, Fördervergabestellen, etc.) den Nutzen der Umsetzung von Chancengleichheit in den Förderprogrammen zu kommunizieren. Die gesetzliche Verpflichtung der Verwaltung (die im Land Salzburg de facto besteht) ist ein wichtiger Grundstein, ersetzt jedoch nicht die Qualifikation geschlechtssensibel zu denken und sein Handeln darauf abzustimmen. Dies ist ein Prozess, der Zeit in Anspruch nimmt. Zur Überbrückung und Beschleunigung dieses Prozesses wird vorgeschlagen, in die Planungsperiode von Fördermassnahmen Gender ExpertInnen einzubinden, die dieses Know-how einbringen. Weiters könnten Pilotbereiche – z. Bsp. Tourismus mit seiner hohen Bedeutung für den Arbeitsmarkt und den Wirtschaftsstandort in den Regionen, speziell für Frauen – abgesteckt werden, in den Gender ExpertInnen in die Prozesse der Projektselektion und –evaluierung eingebunden werden, um die Praktikabilität von geschlechtssensiblen Instrumenten herauszuarbeiten und die PraktikerInnen zu unterstützen und zu qualifizieren.

8 LITERATUR

Aufhauser, Elisabeth / Herzog, Siegrun / Hinterleitner, Vera / Oedl-Wieser, Theresia / Reisinger, Eva (2003): Grundlagen für eine „Gleichstellungsorientierte Regionalentwicklung". Endbericht zur Studie im Auftrag des Bundeskanzleramts, Abteilung IV/4, Wien.

Österreichische Raumordungskonferenz (ÖROK) (2002): Österreichisches Raumentwicklungskonzept 2001. Wien: Österreichische Raumordnungskonferenz. (=ÖROK Schriftenreihe Nr. 163).

Wagner, Petra / Kaufmann Alexander (2005): Aktualisierung der Halbzeitbewertung des Ziel-2-Programms Salzburg 2000-2006. Seibersdorf: ARC systems research GmbH.

Amt der Salzburger Landesregierung, Abteilung 15: Wirtschaft, Tourismus, Energie: Einheitliches Programmplanungsdokument (EPPD) für Ziel 2 Salzburg 2000-2006 inkl. Übergangsgebiete 2000-2005 gem. VO (EG) Nr. 1260/99, aktualisierte Fassung vom 14.05.2004.

Amt der Salzburger Landesregierung, Abteilung 15: Wirtschaft, Tourismus, Energie: Ergänzung zur Programmplanung (EzP) Ziel 2 Salzburg 2000-2006, aktualisierte Fassung vom 14.05.2004. .

reviewed paper

Simulation und Visualisierung der Dynamik räumlicher Prozesse
Wechselwirkungen räumlicher Phänomene und dynamischer Prozesse

Reinhard KÖNIG

Dipl. Ing. Reinhard König, Lehrstuhl für Stadtquartiersplanung und Entwerfen, TU Karlsruhe,
koenig@entwurfsforschung.de, www.entwurfsforschung.de

1 EINLEITUNG

Städtische Strukturen resultieren aus verschiedenen kontinuierlich ablaufenden, sich wechselseitig beeinflussenden Prozessen. Stellt man das Erscheinungsbild einer Stadt zu einem bestimmten Zeitpunkt dar, erhält man lediglich eine Momentaufnahme dieses dynamischen Systems. Ziel des im Folgenden beschriebenen Projekts ist die Repräsentation der Stadt als kontinuierlicher Prozess.

Das Tätigkeitsfeld der Raumplanung umfasst die Organisation räumlicher Strukturen und deren Wechselwirkungen mit gesellschaftlichen Prozessen. Planung bedeutet stets die konzeptionelle Vorwegnahme noch nicht existierender Zustände. Dabei konzentriert sich die gegenwärtige Praxis der Planung lediglich auf den Vergleich von Soll und Ist. Wesentlich für eine nachhaltige Stadtentwicklung wäre aber eine Auseinandersetzung mit den Prozessen, die zu den jeweiligen Zuständen geführt haben bzw. führen sollen. Sowohl eine eingehende Analyse der für die städtische Entwicklung relevanten Zusammenhänge als auch ein bewusster Umgang mit der Dynamik und den zeitlichen Eigenschaften von Prozessen sind der räumlichen Planung fremd geblieben. Dementsprechend sind Pläne immer noch statische Repräsentationen, während solche in der Form dynamischer Karten nicht bekannt sind.

Für eine Visualisierung räumlicher Prozesse ist zuerst einmal die städtische Dynamik in Raum und Zeit zu simulieren. Grundlage dieser Simulation ist eine ‚bottom-up' Beschreibung urbaner Vorgänge mittels mathematischer Modelle, welche in einem weiteren Schritt für eine computertechnische Verarbeitung in Algorithmen übertragen werden. Der Verlauf der Berechnungen und die Entwicklung des Systems sollen grafisch dargestellt werden.

2 STAND DER FORSCHUNG

Die formale Darstellung und Simulation einer Stadt unter Einbeziehung aller wesentlichen Teilbereiche[1] wird in der Fachliteratur als ‚Large-Scale Urban Model' bezeichnet. Die Entwicklung solcher umfassenden Stadtmodelle begann in den 1950er Jahren in den USA. Ausgangspunkt bildete die Standorttheorie von Johann Heinrich von Thünen aus dem Jahr 1826, welche der Frage nachging, wie es zu einer räumlichen Gleichgewichtsverteilung von Siedlungen, Flächennutzungen und Bevölkerung kommt[2].

Von dieser Arbeit ausgehend wurden verschiedene, grundlegende geographische "Gesetze" entdeckt, die alle auf einem ökonomischen Verständnis von Optimalität beruhen. Für das Verständnis urbaner Systeme sind besonders drei dieser Gesetze relevant: Das Gesetz der Verteilung zentraler Orte[3], das Gesetz der Aufteilung des Entwicklungspotentials in Abhängigkeit von der Siedlungsgröße[4] und das Gesetz der Gleichgewichtsverteilung der Grundrente, deren Höhe mit der Entfernung zum Stadtzentrum abnimmt[5]. Weitere Komponenten wie Bevölkerung, Arbeitsplätze, Dienstleistungen und Verkehrssystem wurden ergänzend hinzugefügt und nahmen Einfluss auf die Gleichgewichtsbildung. Von Bedeutung ist außerdem die 1952 erstmals veröffentlichte Theorie von Torsten Hägerstrand über die räumliche Ausbreitung von Innovationen[6].

Den ersten Versuch, diese Komponenten in einem „integrierten" Stadtmodell zu vereinen machte Lowry[7] 1964 am Beispiel von Pittsburgh. Dieses Modell war allerdings statisch und unterlag der Annahme, dass sich eine Stadt als Ganzes stets in einem Gleichgewichtszustand befindet. Für die Gliederung einer Stadt in Sektoren, in welche die Aktivitäten aufgeteilt waren, wurde ein Raster in der Auflösung von einer Quadratmeile angenommen. Diese Aufteilung erinnert bereits an die Struktur eines zellulären Automaten.

Jay Forrester[8] entwickelte 1969 als erster einen Ansatz für ein dynamisches Stadtmodell. Darin werden positive Rückkoppelungen als Hauptursache für komplexe und intuitiv nicht nachvollziehbare Verhaltensweisen natürlicher und im speziellen urbaner Systeme beschrieben. In Forresters Modell dominiert stets eine Rückkoppelungsschleife das gesamte System, bis sie von einer anderen abgelöst wird. Für die Untersuchungen des Verhaltens dieses dynamischen Modells war der Computer ein unentbehrliches Werkzeug. Aus einer Änderung der Eingabeparameter resultierte eine Veränderung des Gleichgewichtszustandes. Dieser Zusammenhang war intuitiv nachvollziehbar und linear. Das Problem an seinem Modell war hauptsächlich, dass es eine zu generelle Sicht des urbanen Systems (basierend auf Durchschnittswerten) beinhaltete und jeglichen Raumbezugs ermangelte (numerische Simulation ohne graphische Oberfläche), was seine Ursache vermutlich in der Ignoranz Forresters gegenüber der geografischen Theorie seiner Zeit hatte.

Die meisten Simulationen, die bis heute entwickelt wurden, basieren auf den Grundkonzepten von Lowry und Forrester und versuchen die wesentlichen Komponenten einer Stadt – Wohnen, Arbeiten, Dienstleistungen, Flächennutzung und Verkehrssystem – im Rahmen eines Modells zueinander in Beziehung zu setzen. Für eine detaillierte Erläuterung der Funktionsweisen der aktuellsten Modelle verweise ich auf M. Wegeners Artikel „Urban Land-Use Transportation Models"[9]. Das Ziel bei der Entwicklung dieser Modelle war, die Ausgewogenheit zwischen dem Verständnis des Prozesses, der Komplexität der Beschreibung und der

---

1 Dieses sind: Verkehrsnetz mit Personenverkehr und Warentransport, Bevölkerung mit Wohnungsstruktur und Beschäftigungsverhältnissen, Arbeitsmarkt, Flächennutzung. Siehe Wegener (1994)

2 siehe Hagget (1983): Thünen und seine Landnutzungszonen: S. 526-536

3 ebd.: Weber: S. 537-549, Christaller und Lösch: S.463-480

4 ebd.: Räumliche Aspekte der ökonomischen Entwicklung: S. 646 - 653

5 ebd.: Die Geometrie von Bodenpreisen: S. 484-488

6 ebd.: Räumliche Diffusion: S. 383-400

7 siehe Lowry (1964). Im Internet erhältlich unter: http://people.hofstra.edu/geotrans/eng/ch6en/meth6en/ch6m2en.html

8 siehe Forrester (1969). Das Modell „Urban Dynamics" ist im Internet erhältlich unter: http://www.sd3.info/models/

9 siehe Wegener (2004)

Verfügbarkeit der Daten zu gewährleisten. Die Gemeinsamkeit all dieser Modellkonzeptionen besteht in einer reduktionistischen Sichtweise (top-down), welche Systeme durch die Unterteilung in logisch begründete Komponenten zu studieren versucht.
Im Folgenden möchte ich mich auf die Kritik an den umfassenden Modellansätzen konzentrieren. Der einflussreichste und populärste Angriff stammt von Douglas B. Lee[10] und wurde 1973 unter dem Titel „Requiem for Large-Scale Models" veröffentlicht. Darin werden ‚Seven Sins of Large-Scale Models' beschrieben, die den Kern der Kritik bilden und in abgewandelter Form teilweise bis heute ins Feld geführt werden.
Lees Liste der sieben Sünden beginnt mit *‚Hypercomprehensiveness'* (Hyperausführlichkeit), den Versuch, zu viel mit einem Modell erklären zu wollen. Konkret bedeutet dies, dass zu viele Variablen zu Prozessen gekoppelt werden, deren Aussagefähigkeit und Richtigkeit nicht überprüfbar sind. Das Hinzufügen weiterer Teilaspekte in der Absicht, das Modell zu komplettieren führt entgegen der Absicht zu geringerer Genauigkeit, da mehr „Unwissen" einfließt. Außerdem führt *‚Wrongheadedness'* (Verbohrtheit) dazu, dass durch die Integration zu vieler Einschränkungen und Beziehungen innerhalb der Modellstruktur, die sich daraus ergebenden Mechanismen selbst für den Hersteller des Modells nicht mehr zu verstehen oder zu unterschieden sind. Aus heutiger Perspektive lässt sich (z.B. im Hinblick auf die Chaosforschung) leicht einsehen, dass zusätzliche Variablen und Beziehungen ein System immer mehr von den Anfangsparametern abhängig machen und dass relativ kleine Fehler zu einem vollständig anderen und falschen Verständnis des zugrunde liegenden Prozesses führen können.
Ein weiteres Problem wird durch den Begriff *‚hungriness'* (Hunger) aufgezeigt, der die ungeheure Menge an benötigen Daten ausdrückt. In Kombination mit *‚complicatedness'* (Kompliziertheit), führt dies zu dem Vorwurf der Unfähigkeit der Modellbauer, bei komplexen Modellen ein angemessenes Verständnis für die selbst erzeugten ‚Black-Box' Konstrukte zu entwickeln. Damit ist gemeint, dass ein Benutzer keinen Anhaltspunkt hat, wie nach einer Änderung einer Eingangsvariablen der entsprechende Ausgangswert zustande kommt[11]. Dieses Problem der Nachvollziehbarkeit führt im Zweifelsfall zu einem Verlust der Vertrauenswürdigkeit des Modells. Ferner ermöglicht es dem Programmierer durch die Festsetzung von Restriktionen das Modell so zu justieren, dass es die gewünschten Ergebnisse liefert. *‚Grossness'* (Grobheit) verstärkt die Probleme zusätzlich, indem die Modelle mit „aggregierten" Daten (Durchschnittswerten) arbeiten, um die Kompliziertheit zu verringern, dadurch aber trotz der enormen Datenmengen nur allgemeine Aussagen auf globaler Ebene ermöglichen und nicht auf lokaler, wo sie für Planungsentscheidungen notwendig wären.
Neben diesen noch heute problematischen Punkten werden Sünden angeführt, die aus gegenwärtiger Sicht durch den Fortschritt der Technik ihre Relevanz verloren haben: *‚Mechanicalness'*, womit die damaligen computertechnischen Probleme angesprochen wurden, die durch Rundungsfehler oder die Bedeutung der sequentiellen Bearbeitung einer Aufgabe zustande kommen, sowie durch die Schwierigkeiten, ein Problem computergerecht aufzubereiten, *‚Expensiveness'* (Kostspieligkeit), steht für die hohen Kosten, welche für die Beschaffung der erforderlichen Daten und Prognosen aufgewandt werden mussten. Die kommunalen und regionalen Geo-Informations-Systeme (GIS), die seit den 1980er Jahren eingeführt wurden, kosteten zwar ein Vermögen, sind heute aber etabliert und können als Datengrundlage für die Modelle verwandt werden.
In dem vorliegenden Projekt wird für einen Umgang mit dem skizzierten Problemkreis auf Erkenntnisse der Systemtheorie und speziell dem Teilbereich zurückgegriffen, der sich mit komplexen Systemen beschäftigt, der Komplexitätstheorie, auf welche später detailliert eingegangen wird. Vorgreifend lässt sich feststellen, dass die mittlerweile allgemeingültigen Richtlinien für Modellbauer, die Lee in seinem Artikel abschließend anführt, mit den Grundsätzen der Komplexitätsforschung übereinstimmen.
Nach Lee ist eines der wichtigsten Kriterien eines Modells dessen *Transparenz*. Es soll mit einem zumutbaren Aufwand für jeden Benutzer leicht verständlich sein. Diese Forderung entspricht der Reduktion auf die wesentlichen Systemparameter und deren Relationen. Dadurch wird gewährleistet, dass bei Unstimmigkeiten im Modell die beteiligten Personen diese entdecken und benennen können, was wiederum ermöglicht, nach einem Konsens über die Anfangsannahmen Einigkeit über die Ergebnisse zu erzielen und eine fruchtbare Zusammenarbeit der am Planungsprozess beteiligten Personen zu gewährleisten.
Ferner ist bei der Modellkonzeption eine Balance zwischen Theorie, Objektivität und Intuition anzustreben. Das Vorgehen sollte sich an der Problemstellung orientieren und dementsprechende Methoden auswählen, nicht umgekehrt.
Zusammengefasst sollte ein Modell formal so einfach wie möglich gehalten werden, da Komplexität „automatisch" innerhalb der Modellstruktur entsteht.

3 ZIELSETZUNG

Eine Stadt ist ein komplexes System par excellence. Die Bewohner und ihre Wohnstätten, die Geschäfte und Produktionsstätten, der Verkehr von Waren und Personen sind eng miteinander verwoben. Zwischen ihnen besteht eine Vielzahl dynamischer Abhängigkeiten insofern als eine Veränderung, die eines der Teile betrifft, komplexe Auswirkungen auf andere Teile innerhalb des gesamten Systems haben kann.
Die zentrale Aufgabenstellung des Vorhabens besteht darin, die Regeln der einzelnen Elemente zu erkunden, die in ihrem Zusammenwirken durch Selbstorganisationsmechanismen jene komplexen Strukturen bilden, die wir in Städten beobachten können. Ich gehe davon aus, dass bestimmte Zusammenhänge - mit jeweils verschiedenen Gewichtungen - für alle Siedlungen weltweit gelten[12]. In erster Linie betrifft das die ökonomischen Gesetze des Handels mit Waren und Ressourcen, sowie das Verhalten der individuellen und kollektiven Akteure in einer Stadt, also das der Bürger und politischer oder wirtschaftlicher Gruppierungen. Diese Beziehungen werden in der Raumwirtschaftstheorie als Wechselwirkungen von Struktur (Standorttheorie), Interaktion (räumliche Mobilitätstheorie) und Prozess (regionale Wachstums- und Entwicklungstheorie) behandelt[13].
Im Kontext der Komplexitätstheorie, in welchem das Forschungsvorhaben entwickelt wird, müssen die Untersuchungen von den kleinsten sinnvollen Elementen ausgehen, um die übergeordneten Emergenzphänomene zu erklären. Dementsprechend muss vor der Beschäftigung mit den Modellen der einzelnen urbanen Komponenten ein *Simulationskonzept* eingeführt werden, welches darstellt wie das System Stadt computertechnisch repräsentiert werden kann. Dieses Konzept umfasst die generelle Herangehensweise sowie

10 siehe Lee (1973)

11 Bei dem Stadtsimulationsspiel „Sim City" kann diese Problematik gut nachvollzogen werden.

12 siehe Gaebe (2004), S.315

13 siehe Schätzel (2003), S. 25-26

die Repräsentation der Elemente und deren Wechselwirkungen. Die daran anschließende Methodik wird auf dieser Grundlage aufbauen.
Die Beschaffenheit des urbanen Systems wird erkundet, indem zuerst die jeweiligen Teilbereiche anhand einfacher, abstrakter Teilmodelle untersucht werden, deren Beziehungen untereinander die Fragestellungen der Teilbereiche erklären sollen. In der letzten Projektphase werden die einzelnen Bereiche schließlich miteinander verbunden und bilden so ein dynamisches Gesamtsystem.
Der erste Teilbereich beschäftigt sich mit der *Bevölkerungsverteilung* im Raum. Warum siedeln die Akteure wo, mit welchen Elementen interagieren sie und welche Aktionsräume nehmen sie für sich in Anspruch?
Daran schließt der Bereich des *Bodenmarkts* an, der Aufschluss darüber geben soll, was zur Bildung von Zentren sowohl bei monozentrischen als auch polyzentrischen Strukturen führt, wie sich die urbanen Funktionen verteilen und welche Kräfte hinter den Vorgängen der Zersiedelung und der Ballung stehen.
Einen weiteren Bereich bildet der *Verkehr*. Dieser ist eng verknüpft mit den ersten beiden Bereichen und behandelt den Einfluss des Verkehrssystems und der Verkehrstechnologie auf den Bodenmarkt und die Bevölkerungsverteilung und vice versa.
Nach der Behandlung dieser Grundthemen folgt eine Beschäftigung mit den *Veränderungen* von Strukturen. Warum und nach welchem Muster (periodisch oder chaotisch) verändern sich die Strukturen im Verlauf der Zeit?
Schließlich rückt die *Umwelt* in den Fokus der Auseinandersetzungen. Hier gilt es zu klären, welche Rolle die Umwelteinflüsse auf die urbane Entwicklung haben und welche Rückkoppelungen auf die anderen Bereiche sich durch Emissionen und Immissionen ergeben.
Abschließend wird erläutert, warum die *Visualisierung* des Verlaufs der dynamischen Prozesse ein wichtiger Bestandteil des Projekts ist und welche Möglichkeiten sich für die *Planung* eröffnen. Also wie Strategien für eine nachhaltige Stadtentwicklung aussehen können und wie sich diese in der Ausbildung von Städtebauern und der Praxis des städtebaulichen Entwerfens nutzen lassen.

4 METHODIK

Es war bereits wiederholt von Komplexität und Selbstorganisation die Rede. An dieser Stelle sollen die Grundlagen, welche hinter diesen Begriffen stehen, nochmals zusammenfassend erläutert werden.
Die hier konzipierte Simulation von Stadt kann als adaptives Kollektiv interagierender Einheiten verstanden werden und steht damit im Gegensatz zu den ‚top-down' Ansätzen der ‚Large-Scale Urban Models', die im Abschnitt Stand der Forschung beschrieben wurden. Das vorliegende Projekt ist durch eine *generative* Vorgehensweise (bottom-up) charakterisiert. Dabei werden Phänomene als ein Produkt (oder Synthese) vielfacher Interaktionen einfacher elementare Einheiten aufgefasst.
Für das Verständnis generativer Systeme sind Selbstorganisation und Emergenz wesentlich. Das Zutagetreten übergeordneter (globaler) Phänomene auf der Grundlage einer beschränkten Anzahl von Regeln oder Vorschriften, die auf lokaler Ebene auf viele abstrakte Entitäten angewandt werden, wird als Emergenz bezeichnet. Derlei Emergenzphänomene können z.B. kollektives Verhalten oder räumliche Muster darstellen, die sich scheinbar selbst durch das Zusammenwirken der einzelnen Teile organisieren, indem die Interaktionen im Verlauf der Zeit zu gegenseitigen Adaptionen führen. Das Wesen der Selbstorganisation liegt dabei in der Art und Weise, wie die Wechselwirkungen zwischen den Elementen und mit der Umwelt stattfinden. John Holland hat diese Zusammenhänge mit der einprägsamen Formel „much coming from little" umschrieben. Beispiele für derartige Phänomene lassen sich in Verkehrsstaus, städtischen Slums oder ethnisch homogenen Stadtbezirken finden.
Da das Verhalten dieser Systeme nicht linear und vorhersehbar, sondern an sich unvorhersehbar ist, werden sie als komplexe Systeme bezeichnet. Der einzige Weg das Verhalten dieser Systeme zu erforschen, ist sie zu simulieren.

4.1 Simulationskonzept

Ich beginne mit der Erklärung, wie sich das System Stadt computertechnisch repräsentiert lässt. Dazu werden verschiedene Repräsentationsformen für Raum, Zeit und Akteure eingeführt. Ausgehend von dem Paradigma der Objekt orientierten Programmierung (OOP) wird es jeweils eine Klasse geben für:

Räumliche Elemente wie Straßen, Parzellen und Gebäude[14], die als örtlich fixierte Objekte behandelt werden, deren Zustände (Eigenschaften) sich aber zu bestimmten Zeitpunkten verändern. In einem ersten Abstraktionsschritt werden diese Elemente in die Zellen eines regelmäßigen Rasters übertragen und anhand des Status einer solchen Zelle gespeichert. Diese Struktur bildet die Grundlage für die Funktionsweise eines Zellulären Automaten (ZA). Bei einem ZA können der Status und die Eigenschaften einer Zelle von den Zuständen seiner Nachbarzellen abhängig gemacht werden und sich bei jedem Zeitschritt verändern[15].

Akteure, deren Entitäten im Folgenden als Agenten bezeichnet werden. Mittels diesen können sowohl individuelle als auch kollektive urbane Akteure[16] dargestellt werden. Im Gegensatz zu den Zellen sind Agenten mobil und können sich frei über das Zellenraster (zellulärer Raum) bewegen. Dabei lassen sich verschiedene Arten der Kommunikation der Agenten untereinander, sowie mit den Zellen anhand der Objektmethoden (interne Verarbeitungsregeln der Objekte) definieren. Das gesamte System der Agenten wird als Multi-Agenten System (MAS) bezeichnet[17]. Ein aus den beiden Komponenten ZA und MAS bestehendes System bildet ein ‚Inter Representation Network' (IRN)[18].

Ein einfaches Beispiel für ein IRN ist das Modell ‚Wegesystem' (siehe Prototyp Abb. 01), bei welchem sich die Agenten des MAS frei über den zellulären Raum bewegen und dabei jene Zellen markieren, welche sie überquert haben. Stößt ein Agent in seiner nächsten Umgebung auf eine markierte Zelle, so bewegt er sich tendenziell in deren Richtung und verstärkt dadurch die bestehende

[14] siehe Humpert (1994), S. 28. Für eine Anwendung anhand eines Computergenerierten Entwurfsverfahrens für städtische Strukturen siehe Bauriedel / König (2004)

[15] Für eine einführende Darstellung zellulärer Automaten in der Geografie siehe Benenson / Torrens (2004): Kapitel 4.3, Urban Cellular Automata, S. 106 ff

[16] Individuelle Akteure sind beispielsweise der einzelne Bürger oder politische Entscheidungsträger, kollektive Akteure sind beispielsweise Interessengruppen oder Institutionen.

[17] Für eine einführende Darstellung von Multi-Agenten Systemen in der Geografie siehe Benenson/Torrens (2004): Kapitel 5, Modeling Urban Dynamics with Multiagent Systems, S. 153 ff

[18] siehe Portugali (2000)

Markierung. Das System lässt sich mit Fußspuren über einem frisch verschneiten Platz vergleichen, welche im Verlauf der Zeit durch andere Fußgänger verstärkt, oder bei Nichtbenutzung wieder verweht werden.

Für die Repräsentation des Vergehens der *Zeit* ist beabsichtigt, mit zwei Zeitkoordinaten zu arbeiten, die jedem Objekt des Systems zugewiesen werden, um eine Unterscheidung von Ereignissen nach Gegenwart, Zukunft und Vergangenheit zu ermöglichen. Dies ist notwendig, um z.B. die Auswirkungen einer zukünftigen Planung in Bezug zu einer gegenwärtigen Entwicklung oder Überschneidungen mit anderen Planungen berücksichtigen zu können.
Ferner müssen die unterschiedlichen Geschwindigkeiten und zeitlichen Rhythmen der Komponenten berücksichtigt werden: Verkehrssysteme und Flächennutzungen verändern sich nur in sehr großen Zeiträumen (Jahrhunderte), die Wohnungsstruktur und der Arbeitsmarkt unterliegen einer mittelschnellen (Jahrzehnte), die Beschäftigungsstruktur und Bevölkerung dagegen einer schnellen (Jahre) Veränderungsrate. Der Warentransport und Personenverkehr erfolgen unmittelbar, wogegen die Auswirkungen wie Luft- und Lärmbelastung, welche die Umwelt betreffen, indirekt ablaufen[19]. Hierzu lassen sich den spezifischen Objekten mittels ihrer Methoden interne Uhren zuweisen, welche die Geschwindigkeiten kontrollieren. Eine Umsetzung der Veränderungsrhythmen kann über Schwellenwerte erfolgen, indem ein Objekt marginale Veränderungsanforderungen in einem Potentialparameter speichert und eine Veränderung erst dann stattfindet, wenn das Potential den Schellenwert überschreitet.
Als Datengrundlage für die Simulationsmodelle dienen GIS, auf deren Datenbanken über ein ‚loose coupling' zugegriffen wird[20], oder indem spezieller GIS Funktionen in die Simulationsumgebung integriert werden, die einen direkten Datenaustausch erlauben[21]. Die Auswahl der Methodik wird sich erst im Fortgang des Projektes aus den möglichen Planungsanwendungen ergeben.

4.2 Bevölkerungsverteilung

Eine Antwort auf die Fragestellungen, warum bestimmte Akteure wo siedeln und welche Aktionsräume sie für sich in Anspruch nehmen, hängt mit einer Vielzahl von Einflussfaktoren zusammen. Zu diesen gehört insbesondere im städtischen Raum der Bodenmarkt, welcher unter dem nächsten Punkt besprochen wird. Bodenpreise und Nutzungsdichten sind eng miteinander verknüpft, sie sind sozusagen verschiedene Seiten derselben Medaille (Eine Veränderung in dem einen Bereich findet nicht ohne Auswirkungen auf den Anderen statt): Beide Teilsysteme bilden zusammen eine zirkuläre Kausalität. Unter diesem Punkt soll betrachtet werden, wie es zur Bildung von Zentren kommt. Deren Wirkungen sollen unter Punkt 4.3 Bodenmarkt untersucht werden.
Der Begriff des Zentrums kann in seiner Bedeutung je nach Betrachtungsebene variieren. So verteilen sich beispielsweise über die ganze Welt Handels- oder Technologiezentren in Form bedeutender Städte oder Regionen. Begrenzt man das Blickfeld auf ein Land, werden Städte nach ihrem Rang geordnet, entsprechend ihrer Bevölkerungszahl oder Produktionsleistung. Eine Stadt für sich beinhaltet wiederum mindestens ein Stadtzentrum, den so genannten zentralen Handelsbereich (Central Business Distrikt CBD). Einzelne Stadtgebiete unterscheiden sich danach, ob sie vorwiegend Produktions-, Handels- oder Wohnnutzungen beherbergen oder bei einer heterogenen Zusammensetzung als Mischgebiet gelten. Die verschiedenen Gebiete bilden untergeordnete Zentren innerhalb der Stadt, welche die Bebauungsart und -dichte definieren. Diese Hierarchie der Zentren setzt sich fort bis in die Wohnungen, in welchen die Zimmer mit der höchsten Nutzungsdauer die zentralen Räume darstellen.
Die Entstehung und Dynamik der Zentren innerhalb einer Stadt, welche hier besprochen werden, hängen von exogenen sowie endogenen Einflüssen ab. Exogene Einflüsse sind z.B. topographische Gegebenheiten oder stadtplanerische Konzepte. Die endogenen Faktoren, welche dem Prozess der Zentrenbildung zugrunde liegen, setzen sich zusammen aus den Präferenzen der individuellen oder kollektiven Akteure, welche sich ökonomisch anhand des Wertes eines Standortes ausdrücken lassen und als „anziehende" oder „abstoßende" Wechselwirkung zwischen den unterschiedlichen Bebauungsarten modelliert werden können (siehe Segregationsmodell, Prototyp Abb. 2). Der Wert eines Standorts hängt ab von dessen Entfernung zu anderen Standorten (zu ermitteln über Erreichbarkeitsanalysen[22]) und dem sozialen Umfeld. Diese Entfernungen werden auf zweierlei Weise bewertet: erstens gemäß der Fahrtkosten, die durch die Wahl des Standortes ent- bzw. anfallen (siehe Skalenerträge, Prototyp Abb. P3), und zweitens danach, ob der Ausblick angenehm, die Umgebung passend und die Emissionsquellen von Störungen und Beeinträchtigungen fern sind. Die Bewertung der Bezüge der letzteren Art leitet sich nicht aus den Preisen für knappe Ressourcen ab, sondern aus den Raten räumlicher Diskontierung[23].

Segregationsmodell (siehe Abb.2): Verschiedene Agenten (in Abb. 2 blau und gelb markierte Punkte) repräsentieren Nutzungen, die räumlich nicht zusammen liegen sollen. Im Modell werden die Zellen um einen Agenten herum seiner Nutzung entsprechend markiert. Dieser Raum ist beispielsweise durch Emissionen eines Gewerbebetriebs beeinträchtigt (blau). Wohnnutzungen (gelb) bleiben diesen Flächen fern. Es entstehen automatisch Cluster der verschiedenen Farben um die Anlagerungspunkte (rot).

Skalenerträge (siehe Abb. 3): Das Modell zeigt, wie sich positive Skalenerträge auf das Einzugsgebiet eines Herstellers/Händlers (Markt) auswirken: Bei der Herstellung eines Produktes fallen bestimmte Kosten an. Kann eine größere Anzahl der Produkte verkauft werden (versch. farbige Einzugsgebiete), sinken die Kosten pro Produkt (Skalenertrag). Es lohnt sich somit für einen Käufer, einen weiteren Weg zurückzulegen, um das billiger gehandelte Produkt zu erwerben, wodurch allerdings seine Fahrtkosten steigen. Die erhöhte Nachfrage in einem Markt führt wiederum zu einer weiteren Preissenkung. Bei dem dadurch entstehenden Konkurrenzkampf um Absatzgebiete können sich einige Anbieter durchsetzen und örtliche Monopole bilden. An den Grenzen der Einzugsgebiete gleichen sich die Fahrtkosten und die Kosten des Produkts im nächstgelegenen Markt aus. Bei teureren Produkten verstärkt sich diese Wirkung der Skalenerträge.

---

19 siehe Franck / Wegener (2002), S. 149 – 153: Anpassungsgeschwindigkeiten, *Tabelle 1 Städtische Veränderungsprozesse* und *Tabelle 2 Demographische Veränderungen*.

20 siehe Wegener (2004), S. 215: "With loose coupling the linkage between model and GIS is performed by ASCII or binary files."

21 Für ein solches Vorgehen kann auf die ESRI MapObjects Komponenten zurückgegriffen werden, die es erlauben, dynamische Karten und GIS Funktionalität in eigene Applikationen zu integrieren.
Eine Beschreibung findet sich im Internet unter: http://www.esri-germany.de/products/mapobjects/

22 siehe Wegener / Spiekermann (2002), S. 135

23 siehe Frank (2002), S. 66, sowie Franck (1992), S. 3: Diskontierung meint die Bewertung räumlicher und zeitlicher Entfernung im Sinne des Abstandes vom Hier bzw. Jetzt. Sie ist unabhängig von der Bewertung des Raums als nutzbares Volumen und von der Bewertung der Zeit als nutzbare Stunde.

Die Umwelteinflüsse (Ressourcen, Emissionen und Immissionen) werden mittels der Objekteigenschaften der Zellen als Umweltdaten in das Rastermodell aufgenommen, welches mindestens die Komponenten Luftverschmutzung, Lärmbelastung, Verbrauch natürlicher Ressourcen, Umwelt- und Landschaftsqualitäten sowie unverbauter Raum enthält.

4.3 Bodenmarkt

Ist das System der Zentren ansatzweise definiert, sind auch die Randbedingungen für ein Bodenmarktmodell in Anlehnung an Thünen (siehe Abb. 4) und Alonso zustande gekommen. Dieses regelt auf gesamtstädtischer (Makro-) Ebene das Layout der Grundstücke und Erschließungswege. Ferner stellen die Bodenpreise den Zusammenhang zwischen Fahrtkosten und Nutzungsdichten her (siehe Punkt 4.2).

Als ein erster Lösungsansatz soll hier ein Verhandlungsmodell für die Landnutzung nach von Thünen vorgestellt werden (siehe Prototyp Abb. 4). Im Gegensatz zur Berechnung idealer Landzonierungen, wird hier für eine gegebene Menge von Nutzungen deren ideale Verteilung verhandelt.

Verhandlungsmodell (siehe Abb. 4): Eine Zelle repräsentiert im Modell einen Landwirt, der versucht, den Gewinn mit seinem Anbauprodukt zu maximieren. Der Gewinn ist abhängig von der Produktivität, der Entfernung zum Markt und den Transportkosten für die unterschiedlichen Güter. Die Verhandlungsregeln sind so definiert, dass jeder Landwirt innerhalb eines definierten Umgebungsbereichs vergleicht, ob er auf einem anderen Grundstück mit seinem Anbauprodukt einen höheren Gewinn erzielen kann. Ist dies der Fall, versucht er dieses einzutauschen. Kommt es dabei zu einer Konkurrenz bei der Nutzung einer Parzelle, unterliegt derjenige Landwirt, der mit seinem Produkt an dieser Stelle einen geringeren Gewinn erwirtschaften würde als sein Konkurrent. Eine erste Besonderheit bei diesem ‚bottom-up' Ansatz ist die Abhängigkeit der Landnutzungsstruktur von dem Umgebungsbereich, innerhalb welchem ein Vergleich stattfindet. Ist dieser relativ gering, kommt es nicht zu einer idealen Verteilung.

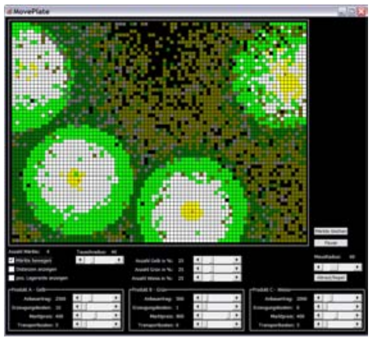


Abb. 4: Verhandlungsmodell

Auf einem derartigen dezentralen Verhandlungs- und Vergleichsmodell aufbauend soll eine der grundlegenden Aufgaben dieses Projektes angegangen werden, die darin besteht, dass Zusammenwirken mit den Teilmodellen für die Bevölkerungsumverteilung (4.1) und des Verkehrssystems (4.3) aufzuzeigen, wodurch sich das Zustandekommen sowie die Auswirkungen der Bodenpreise eingehend untersuchen lassen: Die Nachfrage nach zentralen Gütern führt zu einem erhöhten Verkehrsaufkommen zum Zentrum hin und resultiert in der Nachfrage nach Raum für mobile und immobile Nutzungen, was sich in den Quadratmeterpreisen widerspiegelt. Dieses Zusammenspiel kann zu einem effizienten Marktgleichgewicht führen[24], welches den Ausgleich räumlicher und zeitlicher Knappheit herstellt und den Verlauf der Dichte- und Bodenpreisgradienten reproduziert, dessen statistische Regelmäßigkeit sich empirisch nachweisen lässt. Die Relativität räumlicher und zeitlicher Knappheit besteht darin, dass erstens räumliche Entfernung in Fahrtzeit übersetzt und Fahrzeit zweitens zur Geräumigkeit der Verkehrskorridore in Abhängigkeit gesetzt wird. Der dem Verkehr gewidmete Raum geht vom Raum für die immobilen Nutzungen ab, die er verbindet. Je mehr Raum für einen schnell und reibungslos fließenden Verkehr verwandt wird, desto knapper wird der Raum für diejenigen Nutzungen, welche die Nähe zum Zentrum wegen der Zeitersparnis und den höheren Erträgen suchen.

Schließlich bilden die Verkehrsbelastungen in Form von Lärmbelästigung und Luftverschmutzung die Emissionen für das Umweltmodell und die Dichte der Besiedlung wirkt sich auf die Ressourcen an unverbauter Landschaft aus. Als technische Grundlage, z.B. für die Berechnung der Ausbreitung von Abgasen greife ich auf das Diffusionsmodell[25] zurück. Als Immissionen wirken die Belastungen und Beeinträchtigungen auf die Raten räumlicher Diskontierung zurück, wodurch sich ein weiterer Rückkoppelungskreis über das Umweltmodell zur Standortbewertung schließt.

4.4 Verkehr

Wie das Verkehrs-Teilmodell in das Gesamtmodell zu integrieren ist, wurde unter dem letzten Punkt (4.3) dargestellt. Im Folgenden wird erläutert, wie erstens die Struktur der Verkehrsverbindungen computertechnisch erfasst werden kann und wie sich zweitens die Benutzung dieser Struktur ausdrücken lässt.

Fraktale Struktur des Transportsystems: Als weitere Form der Selbstorganisation wird die fraktale Geometrie von erschließenden und erschlossenen Räumen behandelt[26]. Von der kleinsten architektonischen Einheit –dem einzelnen Zimmer – ausgehend, stellt sich die gebaute Struktur als eine Abfolge von erschlossener Raumeinheit und erschließendem Umraum dar: Das Zimmer wird vom Gang, die Wohnung vom Treppenhaus, das Treppenhaus vom Grundstückszugang, der Häuserblock von der Anliegerstraße, das Quartier von der Durchgangsstraße usw. erschlossen.

Als Grundlage für die Ableitung des beschriebenen fraktalen Graphen können die Daten des Verkehrsnetzes der untersuchten Region aus einem GIS herangezogen werden. Dadurch erhält man die geometrisch-räumliche Struktur des Netzwerks, welches die Ausgangsdaten für Wegelängen, Verkehrsauslastungen, Instandhaltungskosten usw. liefert. Daraus werden die topologischen Eigenschaften eines gewichteten Graphen hergeleitet, auf dessen Basis sich Erreichbarkeitsanalysen anhand der Konvektivität des Graphen sowie Kosten-Nutzen-Verhältniswerte berechnen lassen. Erstere sind relevant für Standortanalysen und Aussagen über die Ausprägung der abgestuften Zugangsrechte bestimmter Räumlichkeiten, welche eng verbunden sind mit der sozialen Struktur einer Stadt. Letztere schließen im Zusammenspiel mit den Daten der Flächennutzungen den Wirkungskreis zum Bodenmarkt. Diese zirkuläre Abhängigkeit geht mit Effekten sich multiplizierender Parameter einher, deren Untersuchung einen der zentralen Gegenstände dieses Vorhabens darstellt.

Benutzung des Transportsystems: Analog zu der räumlich fraktalen Struktur des Erschließungssystems lässt sich eine fraktale Zeitstruktur bei dessen Benutzung feststellen: Man geht so und so oft im Zimmer umher, bevor man auf den Gang tritt; man geht so und so oft in der Wohnung umher, bevor man sie verlässt; man legt so und so viele Hin- und Rückwege im Quartier zurück, bevor

[24] siehe Frank (1992) S. 76: Der Nachweis wurde von Edwin S. Mills geführt.

[25] siehe Hagget (1983): Hägerstrand-Modell: S. 392 - 406

[26] siehe Batty; Longley (1994), sowie Hillier (1996)

man umliegende Quartiere aufsucht; man fährt so und so oft in der eigenen Stadt umher, bevor man eine andere besucht usw. Diese Pendelbewegungen bilden zusammengenommen eine Hierarchie von wiederum sich selbst ähnlichen Rhythmen und sind meist typisch stabile Prozesse. Sie führen zum Ausgangspunkt zurück und streben einem Gleichgewicht zu.

Die Summe der Bewegungen eines Akteurs in einem bestimmten Zeitraum kann als ‚Spur' dargestellt werden, welche als *Trajektorie* bezeichnet wird, deren räumliche Ausdehnung wiederum den *Aktionsraum* eines Akteurs bildet. Trajektorien werden bei jedem Akteursobjekt (Agent) erfasst, indem eine Eigenschaft als ‚historischer Container' die Raumkoordinaten der zurückgelegten Wege des Akteurs mit den zugehörigen Zeitkoordinate speichert. Dadurch lassen sich die Trajektorien und Aktionsräume in allen möglichen Zeiträumen abrufen und analysieren, was für den folgenden Punkt wichtig ist.

4.5 Veränderungen

In einer Stadt findet sich keine zentrale Planungseinrichtung, welche das Problem der Verteilung von Angebot und Nachfrage löst. Trotzdem werden verheerende Schwankungen zwischen Knappheit und Überangebot über die Jahre und Dekaden hinweg vermieden. Diese geheimnisvolle Selbstregulierung wird umso rätselhafter, wenn man die facettenreiche Natur großer Städte in Betracht zieht. Käufer, Verkäufer, Verwaltung, Straßen, Brücken und Gebäude unterliegen einer ständigen Veränderung, so dass die Kohärenz einer Stadt auf wundersame Weise aus einem kontinuierlichen Fluss von Menschen und Strukturen besteht. Gleichsam einer stehenden Welle vor einem Fels in einem schnell fließenden Strom, bildet eine Stadt ein Muster in der Zeit.

Dieses Bild von John Holland wird in der Sprache der Komplexitätstheorie als seltsamer Attraktor beschrieben, ein System am Rande des Chaos, welches weder einem Gleichgewichtspunkt (Attraktor) zustrebt, noch in unregelmäßiges Chaos abgleitet, sondern dazwischen pendelt (siehe Abb. 5).

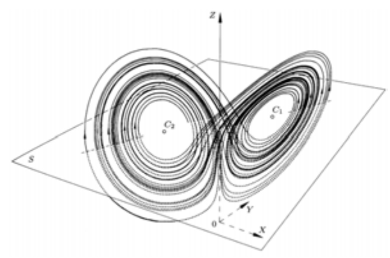


Abb. 5: Trajektorie eines Lorenz-Attraktors

Um die Vorgänge in einer Stadt für meine Untersuchungen greifbar zu machen, werden nicht nur die Bewegungen eines Akteurs, sondern auch der Verlauf aller möglichen Prozesse mittels Trajektorien erfasst, deren Gestalten als vierdimensionale (drei Raumkoordinaten zur Positionsbeschreibung plus Zeitkoordinate) ‚Linien', ‚Röhren' oder ‚Bäume' dargestellt werden können. Ein anschaulicher Beispielfall von röhrenartigen Prozessen sind Fahrzeuge, deren Grundfläche im Prinzip gleich bleibt, aber insofern schwankt, als die in Anspruch genommene Verkehrsfläche mit der Fahrtgeschwindigkeit variiert. Baumartig sind Prozesse, in deren Zustandsfolge Objekte aus Teilen zusammengesetzt und in Teile wieder aufgelöst werden. Das Standardbeispiel eines baumartigen Prozesses ist die Geschichte einer Parzelle, die durch mehrfache Verschmelzung und Teilung ihre aktuelle Gestalt gefunden hat.

Aus der Form der Trajektorien lassen sich Aktivitätsmuster ableiten (tägliche, wöchentliche, saisonale und jährliche Austauschprozesse), die Aussagen erlauben über die Benutzungsfrequenz räumlicher Einheiten. Diese Aktivitätsmuster werden als Rhythmen bezeichnet[27].

Die Klassifikation sozialer Prozesse nach dem Grad der Stabilität ihrer Rhythmen (stabil, konservativ, instabil, selbstorganisierend) eignet sich als neuer und viel versprechender Ansatz zur Beschreibung der räumlichen Wirkungen sich verändernder Zeitstrukturen. Als Generalannahme kann nämlich gelten, dass wir es dort, wo räumlich dauerhafte Strukturen vorliegen, mit stabilen Prozessen in den zugehörigen Aktivitätsmustern zu tun haben. Städte sind als räumliche Strukturen so dauerhaft, weil sie Aktivitätsmuster mit außerordentlich stabilen Rhythmen bergen.

4.6 Visualisierung

Neben der Simulation urbaner Mechanismen ist es ein zentrales Anliegen des Projektes, diese grafisch darzustellen. Nur durch eine allgemeinverständliche Visualisierung der Prozesse kann bei den am Planungsprozess Beteiligten ein Bewusstsein für die Problematik der dynamischen Abhängigkeiten sich gegenseitig beeinflussender Einflussgrößen geschaffen werden. Unter dem Modellkriterium der Transparenz wurde die Bedeutung der Nachvollziehbarkeit einer Simulation bereits diskutiert[28]. Umgesetzt wird diese Anforderung durch den hierarchischen Aufbau der Teilbereiche, deren Funktionsweisen anhand einzelner Teilmodelle nachvollzogen werden können. Als Beispiele für die grafische Aufbereitung der Prozessverläufe können die bereits angefertigten Prototypen herangezogen werden, die als eigene Windowsprogramme konzipiert wurden und technisch auf der Windows Schnittstelle zur Anwendungsprogrammierung (Windows-API) beruhen.

Die Visualisierung räumlicher Prozesse beinhaltet neben einer Darstellung der Dynamik räumlicher Prozesse die vektorbasierte Abbildung der städtischen Struktur. Zu diesem Zweck müssen die topologischen Relationen, die aus den Raumbeziehungen hervorgehen, ständig von einer geometrischen Darstellung begleitet werden. Die Restriktionen, welche mit der Geometrie der räumlichen Elemente verbunden sind, werden an die topologischen Organisationsmöglichkeiten rückgekoppelt[29]. Die dadurch ermöglichte vektorbasierte Abbildung soll eine präzise Darstellung und eine Anbindung an die Datenstruktur bestehender GIS erlauben.

4.7 Planung

Im Verlauf des vorliegenden Projekts soll ein Computerprogramm entwickelt werden, welches die Untersuchung der Auswirkungen alternativer Planungen und Strategien innerhalb des städtischen Gefüges anhand klar umrissener Szenarienmodelle erlaubt. An dieser Stelle wird abschließend noch einmal zusammengefasst, was das Programm leisten soll:

Die Manipulation von Einflussgrößen (Kontrollparameter) mittels einer grafischen Benutzeroberfläche erlaubt die interaktive Einflussnahme auf die ablaufenden Prozesse.

Die einzelnen Teilprogramme können zur Erweiterung der Funktionalität bestehender GIS dienen, beispielsweise zur Visualisierung von Verkehrsströmen und der Kartierung von Aktionsräumen.

---

27 Zu den Grundrhythmen der Stadt sowie der Stabilität räumlicher Prozesse siehe Franck / Wegener (2002), S. 154

28 siehe 2. Stand der Forschung

29 siehe Elezkurtaj / Franck (2002)

Die Simulation der komplexen Zusammenhänge in urbanen Handlungsfeldern, die nicht als allumfassendes Stadtmodell sondern als „Denkwerkzeug“ verstanden werden soll, ermöglicht gezielte Prognosen städtischer Szenarien.

Das zu konzipierende Programm ist zum einen als Planungsinstrumentarium zu nutzen, denn es ermöglicht ein besseres Verständnis komplexer Zusammenhänge verschiedener Einflussgrößen auf die Stadtentwicklung und erleichtert somit administrative und politische Entscheidungen, die als exogene Einflüsse in das Simulationsprogramm aufgenommen werden.

Zum anderen können administrative und politische Entscheidungen der Bevölkerung besser vermittelt werden, wenn die den Entscheidungen zugrunde gelegten Zusammenhänge visualisier- und damit besser nachvollziehbar sind (siehe Abb. 6).

Nicht zuletzt eröffnen sich durch die Visualisierung räumlicher Prozesse neue Möglichkeiten für die Partizipation der Bevölkerung an der Stadtplanung (e-Democracy). Beispielsweise lassen sich unterschiedliche Interessen als Kontrollparameter ausdrücken. Die jeweiligen Simulationsmodelle könnten den Bürgern zugänglich gemacht werden, womit die Auswirkungen der Haltungen unterschiedlicher Interessengruppen für den Einzelnen unmittelbar einsichtig würden (siehe Abb. 6).

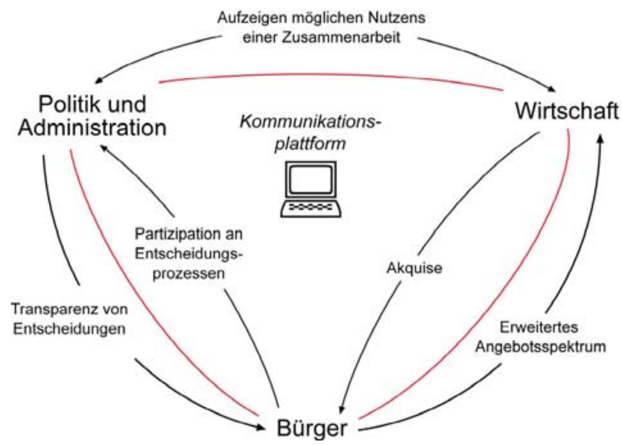


Abb. 6: Simulation als Kommunikationsplattform

5 ANMERKUNG

Herrn Prof. Dr. Georg Franck vom Institut für Architekturwissenschaften der TU Wien bin ich für seine hilfreichen Kommentare und wertvollen Anregungen zu Dank verpflichtet. Für die stilistische Unterstützung möchte ich mich bei Frau Eva Brunner bedanken.

Die Programme, denen die Abbildungen für die Prototypen entnommen wurden sind im Internet erhältlich unter: http://www.entwurfsforschung.de/Strukturfor/delphi/delphi.htm

5 LITERATUR

BATTY, Michael (2005): *Cities and Complexity. Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals.* Cambridge: MIT Press.

BAURIEDEL, Christan / KÖNIG, Reinhard (2004): *Computergenerierte Stadtstrukturen.* München: Eigenverlag. Internet unter http://www.entwurfsforschung.de/compStadt/compStadt.htm.

BENENSON, Itzhak / TORRENS, Paus M. (2004): *Geosimulation – Automata-based modeling of urban phenomena.* England: John Wiley & Sons.

ELEZKURTAJ, Tomor / FRANCK, Georg (2002): *Algorithmic Support of Creative Architectural Design*, IEMAR, Vienna University of Technology.

FORRESTER, J. W. (1969): *Urban Dynamics.* Cambridge, MA, MIT Press.

FRANCK, Georg / WEGENER, Michael (2002): Die Dynamik Räumlicher Prozesse. In *Raumzeitpolitik*. Edited by Henckel, Dietrich and Eberling, Matthias, 145-162, Opladen: Leske + Budrich.

FRANCK, Georg (2002): Soziale Raumzeit. In *Raumzeitpolitik*. Edited by Henckel, Dietrich and Eberling, Matthias, 61-80, Opladen: Leske + Budrich.

FRANCK, Georg (1992): *Raumökonomie, Stadtentwicklung und Umweltpolitik,* Stuttgart: Kohlhammer.

GEDDES, Patrick (1915): *Cities in Evolution.* London: Wiliams and Norgate.

GAEBE, Wolf (2004): *Urbane Räume.* Stuttgart: Eugen Ulmer.

HAGGETT, Peter (1983): *Geographie. Eine moderne Synthese.* New York: Harper & Row.

HILLIER, Bill (1996): *Space is the Machine.* Cambridge University Press.

HUMPERT, Klaus (1994): *Das Phänomen der Stadt. Berichte aus Forschung und Lehre.* Arbeitsbericht des Städtebaulichen Instituts der Universität Stuttgart.

LEE, Douglas B. (1973): A requiem for large scale modeling. In: *Journal Of The American Institute Of Planners* 39(3): 163 – 178.

LOWRY, I. S. (1964): *A model of metropolis*. Santa Monica, DA, The RAND Corporation: 136.

PORTUGALI, Juval (2000): *Self-Organization and the City*. Edited by Hermann Haken, Springer Series in Synergetics. Berlin Heidelberg: Springer.

SCHÄTZL, Ludwig (2003): *Wirtschaftsgeographie 1*, Theorie. 9.Auflage, Erstveröffentlicht 1979. UTB 782, Paderborn: Ferdinand Schöningh.

SIMON, Herbert A. (1994): *Die Wissenschaften vom Künstlichen.* 2. Auflage, Wien: Springer. (Originalausgabe 1981: The Sciences of the Artificial. Cambridge: MIT Press.)

WEGENER, Michael (1994): Operational Urban Models – State of the Art. In *American Planning Association* Journal, Vol. 60, No.1, Winter 1994, Chicago.

WEGENER, Michael / SPIEKERMANN, Klaus (2002): Beschleunigung und Raumgerechtigkeit. In *Raumzeitpolitik*. Edited by Henckel, Dietrich and Eberling, Matthias, 145-162, Opladen: Leske + Budrich.

WEGENER, Michael (2004): Urban Land-Use Transportation Models. In: David Maguire, Michael Batty and Michael F. Goodchild (Eds.): *GIS, Spatial Analysis and Modeling*. Redlands, CA: ESRI Press, 203-220.

ECHTZEITPLANUNG | REAL-TIME-SIMULATION IN DER PLANUNG

Ralph SCHILDWÄCHTER, Tony POESCH, Peter ZEILE

(Stadtplaner Dipl.-Ing. Ralph Schildwächter, Schildwächter Ingenieure, Mehlweiherkopf 9, 67691 Hochspeyer | Kaiserslautern)
(Dipl.-Ing. Peter Zeile, cand.-Ing. Tony Poesch, Universität Kaiserslautern, Lehr- und Forschungsgebiet für Computergestützte Planungs- und Entwurfsmethoden in Architektur und Raum- und Umweltplanung (CPE), Pfaffenbergstraße 95, D-67663 Kaiserslautern)
Mail: ingenieure@schildwaechter.name, peter@zeile.net , tony@poesch.net
home: www.schildwaechter.name | http://cpe.arubi.uni-kl.de

1 ABSTRACT / ZUSAMMENFASSUNG

3D-GIS, photorealistische Visualisierung und Simulationen kommen immer häufiger zum Einsatz, insbesondere bei planerischen Entscheidungen mit entsprechender (politischer) Tragweite. Die computergestützte Echtzeit-Planung ist prädestiniert um diese Entscheidungsprozesse zu unterstützen.
3D-Stadtmodelle unterschiedlichen Detaillierungsgrades werden hierbei zur Voraussetzung!

2 3D-STADTMODELLE

2.1 3D-Stadtmodelle aus kommunalen Geodaten

In den Kommunen Deutschlands schlummert weitestgehend ungenutzt ein großer Schatz: GEODATEN! Denn fast 80% aller kommunalen Daten weisen einen Raumbezug auf.
Vor diesem Hintergrund erscheint es nahe liegend auch 3D-Stadtmodelle aus dieser kommunalen Geodatenbasis zu generieren, Datenbestände zusammenzufassen, zu aggregieren und in einem (gesamtstädtischen) 3D-Stadtmodell-Workflow abzubilden.
Dabei gilt es folgende Aspekte zu beachten:

- Integration vorhandener kommunaler Geodaten
- Ergänzung um aktuelle Messdaten (Laserscans etc.)
- Modifizierbarkeit / Aktualisierbarkeit der Daten in einem offenen Workflow
- Lage- und Höhengenauigkeit der zu erzeugenden Modelle
- Offene Datenschnittstellen / Datenformate (Industriestandards, Austauschformate)
- Kompatibilität zu gängigen Softwareapplikationen (DXF, 3DS, Direct X)
- Integrierbarkeit der Stadtmodelldaten in kommunale Anwendungen
- Weiterbearbeitbarkeit der neu erzeugten Geodaten (intern)
- Sicherheit durch Verschlüsselung der Stadtmodelldaten (extern)
- Einfache Handhabung und Navigation - auch für Laien
- Finanzierbarkeit (Nutzung von Bestandsdaten)
- Refinanzierbarkeit (Tourismus, Automobilindustrie, Versorger, Sicherheit etc.)

Neben den o.g. Aspekten zeichnen sich 3D-Stadtmodelle vor allem durch ihren Detaillierungsgrad aus. Die Spannbreite aktueller 3D-Stadtmodelle reicht von einfachen „Klötzchenmodellen“ bis hin zu photorealistischen städtischen Szenen. Neben der detailgetreuen Modellierung der Geometrie bewirken insbesondere hoch auflösend Texturen eine verblüffende Realitätsnähe. Entsprechend gängiger Klassifizierungen unterscheidet man diese Detaillierungsgrade in fünf Stufen: LOD 0 (Regionalmodell), LOD 1 (Kubaturenmodell) ,LOD 2 (Kubaturen + Dächer), LOD 3 (Kubaturen + Dächer + Fassadentextur), LOD 4 (Innenraummodell).

Abbildung 3: Detaillierungsstufen / Level-of-Detail 0 bis 4 [eigene Darstellung]

Ein hieraus abgeleitetes Workflow-Modell sollte die Anforderungen an Genauigkeit, einfache Erstellung, rasche Aktualisierung und Modifizierbarkeit sowie offene Datenschnittstellen uneingeschränkt erfüllen. Ebenfalls ist es notwendig, die jeweils erforderlichen Level-of-Detail Spezifikationen (LOD 1-4) zu integrieren. Neben der Grundrissgeometrie der Gebäude (2D-Polygone der ALK oder digitalen Stadtgrundkarte) und einem digitalen Höhenmodell, sind hierfür insbesondere stereoskopisch ausgewertete Dachstrukturen aus Luftbildern oder aus Laserscanüberfliegungen erforderlich. Fassadentexturen, bspw. mit einer Digitalkamera aufgenommen, erhöhen den Detaillierungsgrad der Modelle bis zum Fotorealismus.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

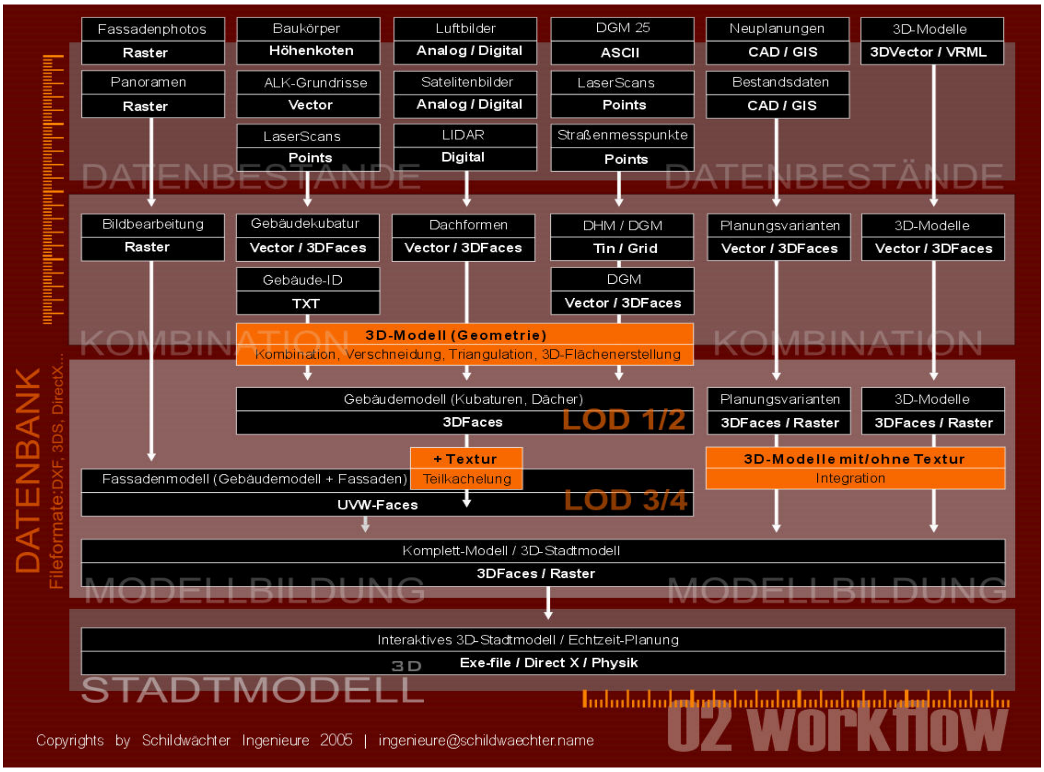


Abbildung 4: Workflow: „Erstellung von 3D-Stadtmodellen in Echtzeitplanungsumgebungen“[eigene Darstellung]

2.2 Warum 3D-Stadtmodelle?

Besonders in dem kleinmaßstäblichen Architekturbereich, der Darstellung gesamtstädtischer Situationen gewinnt das Thema 3D-Stadtmodelle zunehmend an Bedeutung. Experten gehen davon aus, dass es zukünftig als unumgänglich erachtet werden kann, universell einsetzbare Stadtmodelle für die unterschiedlichsten Anwendungsfelder (Sicherheit, Katastrophenschutz, Tourismus, Infrastruktur etc.) vorzuhalten. Neben den vielfältigen Möglichkeiten im Planungsprozess selbst, werden vor allem Potenziale in der Darstellung räumlicher Zusammenhänge städtebaulicher Strukturen gesehen, die in 2D- Darstellung oftmals nicht wahrgenommen werden. Die ästhetische Attraktivität sowie der hohe Detaillierungsgrad lässt überdies virtuelle Welten entstehen, die Dynamik und auch Spaß bei Auseinandersetzung mit dem Thema Stadt mit sich bringen.

2.3 Anwendungsfelder

Öffentlich ausgeschriebene **Wettbewerbe** sind wesentliche Bestandteile der Baukultur und nehmen einen immer bedeutenderen Platz bei der Vergabe von Bauprojekten ein. Sie dienen dem Auslober als Instrument der Entscheidungsfindung, um hochwertige Architekturentwürfe und Realisierungskonzepte für bestimmte, im öffentlichen Raum bestehende Situationen zu diskutieren, und diese baulich neu zu ordnen [Petschek & Lange 2004]. Die Wettbewerbsbeiträge sollen zum einen durch qualitativ hochwertige Architektur bestechen, zum anderen müssen sie auch auf bestehende Baustrukturen reagieren und sich in den Stadtkörper einfügen. Im Zuge der Chancengleichheit, der Kostenreduzierung, der besseren Vergleichsmöglichkeiten sowie einer objektiveren Bewertbarkeit von Architektur – die sich im Übrigen in ihrer Qualität nur schwerlich messen lässt – sind 3D- Stadtmodelle bestens geeignet, um eine ansatzweise wertneutrale Beurteilung zu ermöglichen. Insbesondere im Wertbewerbswesen leistet ein, für alle Teilnehmer gleichwertiges 3D-Stadtmodell, das, von darstellungstechnischen Unterschieden des umgebenen Stadtkörpers befreit, eine vielleicht objektivere Bewertung des eigentlichen Wettbewerbsbeitrages.

Abbildung 5: Echtzeit- Vergleich von Planungsalternativen [eigene Darstellung]

Planung allgemein setzt sich aus den einzelnen Verfahrensschritten der Informationsgewinnung, der Ziel- und Problemstrukturierung, der Prognosenformulierung, der Planentwicklung und der dazu gehörigen Alternativenfindung, der Planbewertung und Entscheidung sowie der nachfolgenden Planverwirklichung und Erfolgskontrolle zusammen. Der zielgerichtete Einsatz von 3D-Stadtmodellen zur Wissensvermittlung und Kommunikation kann in den jeweiligen Planungsstufen die Transparenz der Entscheidung maßgeblich erhöhen. Anhand dieser Modelle ist es möglich, **Varianten, Planungen** und **Veränderungen** im Stadtgefüge zum Einen zeitlich und räumlich zu analysieren und zu bewerten, und zum Anderen eine Diskussionsgrundlage zu erstellen, um verschiedene Planungsvarianten und – Versionen zu diskutieren [Achleitner, Schmidinger, Voigt 2003].

Je nach Planungsanlass wird zu entscheiden sein, ob es, vor allem aus Kostengründen, sinnvoll erscheint, die Planung dreidimensional zu visualisieren. Hinsichtlich der Nachvollziehbarkeit und der Transparenz der Entscheidungsfindung sind diese neuen Einsatzmöglichkeiten jedoch ein probates Mittel, um jedem am Planungsprozess beteiligten Akteur auch ohne Kenntnis der jeweiligen fachspezifischen Plandarstellung und des damit verbundenen Fachvokabulars bestmöglichst zu informieren.

Die **Ausbreitung von Immissionen** kann im virtuellen Modell unter zu Hilfenahme der Klassifizierung der Stoffeigenschaften bzw. durch Bennnenung der Stoffe selbst, mittels Software in Echtzeit durchgeführt werden. Angefangen von Simulationen über Starkregenereignissen oder Kanalbrüchen bis hin zu Szenarien des Katastrophenschutzes bei Unfällen mit Chemikalien können so detaillierte und dezidierte Aussagen zur Ausbreitung dieser Stoffe, auch über einen längeren Zeitraum hinweg, getroffen werden.

Bei baulichen Veränderungen an **Wasserwegen** wie Brückenbauten, Durchlässe und Uferbebauungen von **Fließgewässern** verändern sich die Fließbedingungen und damit das hydraulische Leistungsvermögen des Gewässers. Dennoch muss für die Gefahrenabwehr die schadlose Ableitung eines Jahrhunderthochwasserabflusses gewährleistet sein. Durch Versiegelung geht natürliches Retentionsvolumen verloren, dieses muss an anderer Stelle wieder ausgeglichen werden.

Für diese erforderlichen Untersuchungen wird ein digitales Geländemodell benötigt. Nur auf dessen Datengrundlage können Nachweise sinnvoll und wirtschaftlich erbracht werden, das heißt über ein DGM, Abflussmengen und Volumina von Retentionsräumen sowie von Stauzielen einfach und kurzfristig berechnet werden, wobei Wasserspiegelveränderungen im Zentimeterbereich ermittelbar sind [Endres 2003].

Idealerweise sollte ein DGM aber auch noch Zusatzinformationen über die bauliche Situation vor Ort enthalten. So kann das Abflussverhalten des Wassers exakter simuliert werden, insbesondere wenn sich durch bauliche Kubaturen die Fließrichtungen ändern.

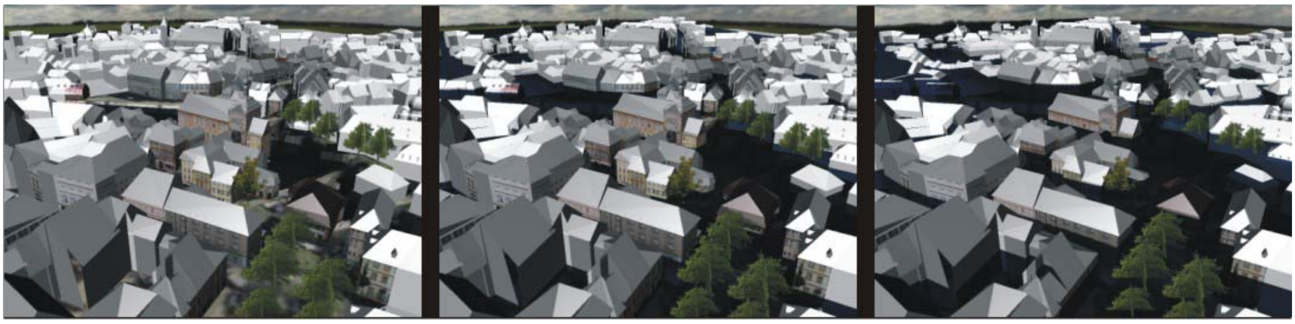


Abbildung 6: Hochwassersimulation [eigene Darstellung]

Für **Lärmmodellrechnungen** werden bereits jetzt abstrahierte 3D-Stadtmodelle eingesetzt. Dabei werden in ein LOD1- Modell Lärmquellen integriert und deren Schallausbreitung im Bestand als Isolinien oder mithilfe von Farbverläufen visualisiert. Hierbei kann man auch die Lärmbelastung über den Tagesverlauf mit sich ändernden Lärmemissionen simulieren. Eine grobe Berechnung der Schallausbreitung gelingt mit dem reinen Volumenmodell. Benötigt man dagegen genauere Messwerte, so müssen den einzelnen Objekten differenzierte Reflexionseigenschaften zugewiesen werden. Kleinere Objekte, die eine geringere Oberfläche als 8-9qm aufweisen, sind für die Berechnungen weitest gehend unerheblich. Grundsätzlich nimmt die Schallenergie mit zunehmender Entfernung vom Emittenten ab.

Wichtig ist die exakte Erfassung der Schallintensität an der Emissionsquelle; je weiter die Emissionsquelle entfernt ist, desto ungenauer darf die Datengrundlage sein. Neben der Reflexion des Schalls muss auch die Schallabschirmung berücksichtigt werden. Durch die Abschirmung verlängert sich der Weg des Schalls vom Emittenten bis zur Immissionsstelle. Jede Verlängerung des Schallweges führt hierbei zu einer allerdings nur geringen Schallreduktion. Die Schallberechnungen werden in der Praxis für die Lärmminderungsplanung eingesetzt. Durch steigende Hardwareleistungskapazitäten sind solche Berechnungen sehr detailliert durchführbar. Sofern schon eine Stadtmodellgrundlage vorliegt, sind die vorhandenen Daten schnell zu modifizieren und die Lärmberechnung kann problemlos durchgeführt werden. Allerdings haben einige Systeme bei komplexen geometrischen Strukturen Probleme mit der Datenverarbeitung. Mit einfachen Volumenmodellen (LOD1) erreicht man dennoch relativ verlässliche Ergebnisse.

Im **Katastrophenschutz** werden bislang zu Übungszwecken haptische 3D-Modelle aus Kunststoff oder Holz eingesetzt. Diese sind jedoch nicht an eine reale Situation gebunden, sondern stellen immer nur einen Ausschnitt aus einer fiktiven Stadt oder ländlichen Gegend mit den dazugehörigen Infrastrukturen dar. Die Gebäude werden mit aufklappbaren Fensteröffnungen und Türen ausgearbeitet. Mit Zubehör wie Autos, Zügen und Flugzeugen teilen diese oftmals sehr kostenaufwendigen Modelle die Grundlage für die Simulation von Katastrophenszenarien. Nachteilig wirkt sich hierbei der mangelnde Realitätsbezug aus. Dementsprechend erachten es Brandschutzexperten als sinnvoll, die Übungen in realen Strukturen durchzuführen, in denen z.B. auch Fahrtzeiten und Verkehrsaufkommen simuliert werden können [Schildwächter, Zeile, Poesch et al. 2004]. In der Praxis dienen 3D-Daten dem Katastrophenschutz nur unterstützend, da eigenständige 3D- GIS -Systeme noch nicht verfügbar sind. Allerdings werden derzeit schon 2,5D-Modelle (Geländemodelle) für Ausbreitungsberechnungen auf der Oberfläche genutzt, wobei störende Volumina in Form von Gebäuden oder Stützmauern noch nicht berücksichtigt werden. Zur genaueren Berechnung sind zumindest die Gebäudekubaturen ein sinnvolles ergänzendes Detail. Grundsätzlich bedeutet die bislang unbekannte Einbeziehung der dritten Dimension in Analysen nicht nur für den Katastrophenschutz einen enormen Vorteil für die Geodatenstruktur vor Ort. Jeder Benutzer kann die räumliche Situation vielmehr besser erfassen und aufgrund dieser Basis viel intuitiver und schneller Entscheidungen treffen. Auch lassen sich im präventiven Bereich die Trainingsszenarien eindringlicher darstellen.

Bei der Planung von **Funknetzen**, etwa für die Aufstellung neuer UMTS- Sendemasten oder auch für die Gestaltung der Netzausbreitung von WLAN, ist es wichtig, ein 3D-Modell der Umgebung zu besitzen, in der die bereits aufgestellten Sender registriert sind. Durch die Stellung von Gebäuden, in engen Straßenschluchten oder durch bewegte Topografie kann es zu sogenannten Funklöchern kommen, die für den Anwender zum Ausfall des Netzes bzw. des Dienstes, auf den er angewiesen ist, führen.

Weiterhin ist es möglich, die CAD- Datengrundlage für die Erstellung von **CNC-gefrästen Modellen** zu verwenden. Durch den Einsatz von CAD/ CAAD- Systemen können mithilfe geeigneter Schnittstellen und verschiedensten Verfahrensweisen wie 2D-Schneideverfahren, 3D-Fräsverfahren, Stereolithografie, Lasersintering, Gipsplottern und vieles mehr, physische Modelle hergestellt werden.

Allerdings stellt sich hier nun die Frage: warum wird überhaupt noch ein haptisches Modell erstellt, wenn schon das virtuelle Modell vorliegt? Zumal die Kosten für die Erstellung immer noch verhältnismäßig hoch sind! Um die Tragweite der Problematik in der Auswahl konkurrierender Modelltypen besser zu verstehen, sei zunächst eine kleine Episode geschildert. Im Laufe des Projekts Bamberg-3D wurde am Lehrgebiet cpe ein erstes kleines Modell von Bamberg gefräst. Bei einer Präsentation wurde zum einen das virtuelle LOD2-Modell präsentiert, zum anderen das gefräste Modell mit den Maßen125x125x80 mm. Das Modell wurde angefasst, gedreht, man diskutierte darüber. Das haptische Erlebnis, das in die Mitte nehmen und begreifen löst kommunikative Prozesse aus. Demzufolge ist es logisch, dass man versucht, nachdem das virtuelle 3D-Modell nun schon besteht, durch vergleichsweise kostengünstige Verfahren haptische Modelle zu erzeugen.

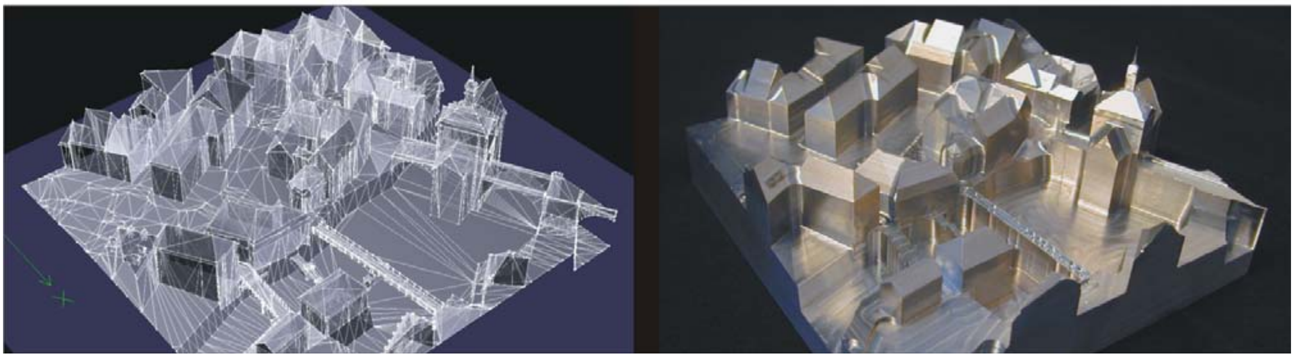


Abbildung 7: Digitales und physisches Modell [eigene Darstellung]

Die Beschäftigung mit **Lichtmasterplanungen** zur Kostenreduktion in Kommunen sowie die Inszenierung von Plätzen durch den effektvollen Einsatz von Licht ist momentan en vogue. Mithilfe eines dreidimensionalen Stadtmodells und einem geeigneten Rendering- Programm lassen sich im Vorfeld einer sehr aufwendigen und teuren Lichtplanung erste Planungsziele verhältnismäßig einfach und vor allem auch für den Laien verständnisvoll visualisieren. Teure Prototypenerstellung zu Testzwecken in der realen Umgebung lassen sich zwar nicht gänzlich vermeiden, jedoch werden zumindest stark divergierende Ansätze darstellbar und somit entscheidbar. Alle für die Lichtplanung wichtigen Parameter wie die verwendete Lumenzahl, die auf die Oberfläche auftreffenden Candela- Werte, die Farbtemperatur in Kelvin, die Integration von IES- Dateien zur exakten Wiedergabe der Leuchteigenschaften eines im Handel erhältlichen Glühmittels bis hin zur Fotonenreflexion von auf die Oberfläche aufprallender Lichtpartikel sind möglich.Durch den gezielten Einsatz digitaler Simulationsmethoden kann schon im Vorfeld einer Lichtplanung die Kommunikation zwischen Fachleuten und Laien erheblich verbessert und Zielvorstellungen exakt formuliert werden.

Abbildung 8: Beleuchtungssimulationen [eigene Darstellung]

Eine Vielzahl weiterer Einsatzfelder und Anwendungsbereiche von 3D-Stadtmodellen ließe sich allein aus planerischer Sicht definieren, von den Potentialen in den Bereichen Tourismus, Kultur, Bildung, Infotainment, Immobilien, Liegenschaften, Wirtschaft, Idustrie etc. ganz zu schweigen.

3 ECHTZEITPLANUNG

Aktuelle technische Lösungen zur interaktiven Visualisierungen von CAD/GIS-Daten dreidimensionaler Modelle gestatten neue Ansätze in der Darstellung architektonischer, stadtplanerischer und sonst. Projekte mit Raumbezug.

Anfänglich ausschließlich auf Hightech-Rechnern in Speziallabors, den sog. CAVE`s (Computer Automatic Virtual Environment) einsatzfähig - bedienbar mittels kostspieligem VR-Equipment wie dem Datenhelm bzw. dem Datenhandschuh - entwickelt sich die Desktop-VR zu einer kostengünstigen Alternative. Das Eintauchen in virtuelle Welten, dem sog. „Cyberspace“ wird nunmehr möglich und eröffnet auch für die Planung eine neue Dimension räumlicher Erfahrungen.

Im Gegensatz zu Anwendungen anderer computergestützter Visualisierungstechniken, die aus den Bereichen GIS und CAD bereits seit geraumer Zeit in der Fachöffentlichkeit bekannt sind, stellt die Desktop-VR einen weitergehenden Ansatz der dreidimensionalen Repräsentation von Geometrien dar. Der Fokus liegt weniger auf der aufwendigen Inszenierung fotorealistischer Momentaufnahmen

(Stils) oder virtueller Rundflüge durch z.B. städtebauliche Situationen (Fly through), sondern vielmehr auf der Integration einer multimedialen und vernetzten Informationsvermittlung mit Raumbezug. Im Gegensatz zu selbständig ablaufenden Filmsequenzen in der Highend-Visualisierung (Rendering) ermöglichen Echtzeit-Systemen die individuelle Navigation in der computergenerierten Welt.
Neben der Integration physikalischer Parameter, wie Schwerkraft, Kolission, Oberflächenbeschaffenheiten, Lichtverhältnisse, Schattenwürfe etc., stellt die vollkommene Bewegungsfreiheit in der virtuellen Welt das entscheidende Novum dar. Durch die Echtzeit-Visualisierung direkt im Home-PC des jeweiligen Anwenders wird es dem Betrachter möglicht, eine aktive Rolle im dreidimensionalen Modell einzunehmen. Das zukünftige Aussehen geplanter Gebäude, die Dimensionen neuer Stadtteil oder rekonstruierte historische Situation etc. werden somit auch für den Laien nachvollziehbar – räunliche Situationen werden interaktiv erlebbar.
Neue Ansätze zum Umgang mit großen Zeichnungen kommen zurzeit aus der Unterhaltungsbranche, da besonders im Bereich der Computerspiele große Mengen an dreidimensionalen Daten anfallen und in Echtzeit verarbeitet werden müssen. Es ist nahe liegend diese Entwicklungen mit den Aufgaben der Verarbeitung von 3D-Stadtstrukturen zu verbinden und von der Geschwindigkeit und den maximalen Datenmengen dieser Game- Engines zu profitieren. Wesentliche Ansätze liegen hierbei in der Handhabung der Grafik, nämlich von DirectX bzw. OpenGL.

Abbildung 9: Echtzeitsimulation „Meckesheim“ bei Heidelberg. Ortskernerneuerung mit verschiedenen Planungsvarianten, Tag-Nachtsimulationen, unterschiedlicher Möblierung, wechselnden Materialien und Bodenbelägen etc.[eigene Darstellung]

Auch **Google Earth** wird in diesem Kontext zunehmend zum Thema für die Planung! Der interaktive 3D-Weltatlas holt hoch aufgelöste Satellitenbilder jeder beliebigen Stelle des blauen Planeten direkt auf den heimischen PC. Halb Routenplaner, halb 3D-Atlas, verbindet der kostenlose Erdnavigator Satellitenfotos, Kartenmaterial und modellierte 3D-Ansichten mit bekannt leistungsstarker Google-Suche zu einem Atem beraubenden Geografie-Erlebnis der modernen Art.
Durch die Verknüpfung von Satellitenbildern und Kartenmaterial sind Hotels und Wege leicht auszumachen. Ortsbezeichnungen erscheinen optisch hervorgehoben, so dass man auch im Tiefflug nicht die Orientierung verliert. Die Informations-"Overlays" sind ideale Werbeplätze. Schon jetzt nutzen Immobilienmakler diese Internetplattform, um ihre Objekte anzubieten, Firmen werben mit ihren Standorten und die Gastronomie verweist auf ihre Angebotspalette. Die kostenfreie Basis-Version von Google Earth erreicht somit eine weltweite, ständig anwachsende Nutzerzahl.
Luft- und Satellitenbilder üben nicht nur für den Planer eine große Faszination aus. Die großmaßstäbliche Übersicht der Physiognomie einer Landschaft, die Analyse von sowohl organischen als auch geometrischen Strukturen innerhalb eines vom Menschen veränderten Raum, sowie die Entdeckung von kleinen Details, die, im Stadtraum zwar nur eine Randnotiz darstellen, machen den Reiz dieser Bilder aus.
Die Abkehr von der analogen zur digitalen Karte erleichtert in Verbindung mit dem Global Positioning System (GPS) und Location Based Services (LBS) nicht nur die Navigation in einem unbekannten Raum, sondern lässt auch die Grenzen der Maßstäblichkeit eines Planwerks verschwinden. Wurden früher Karten für eine spezielle Nutzung oder Darstellung in einem dem Zweck dienenden Maßstab extra angefertigt, so verschwimmen heute durch Level of Detail (LOD) Techniken die eigentlichen Grenzen des traditionellen Maßstabes.
Ein weiterer wichtiger Faktor der postindustrielle Gesellschaft am Übergang zur Informationsgesellschaft ist die Entmaterialisierung von Daten und Wissen durch das 1969 von Wissenschaftlern und Militär entwickelten Internet, das Informationen in bis dato nicht gekannten Tempo und Volumen verteilt. Somit gilt gerade das Internet gleichermaßen als Metapher für die Ursache, die Folge und als Kennzeichen der Globalisierung. Kommunikation, Handel, Willensbildung, Kultur/ PopKultur, Medien werden durch das Medium Internet virtualisiert: Der Standort der Information wir irrelevant, es findet eine „Entortung“ statt.
Vor diesem Hintergrund ist das Phänomen Google Earth zu sehen:
Die Informationen aus dem Internet erlangen so erstmalig beim Browsen wieder einen Orts-/ Geobezug, der Benutzer kann ohne Maßstabszwänge frei in Sekundenbruchteile auf dem Globus navigieren (Virtual Globe Prinzip) und nimmt dabei die eigene GOD-

Perspektive ein. Zusätzlich ist es möglich, durch eigene aufgestellte Filterregeln und Placemarks die Welt mit Informationen so anzupassen, dass sie den persönlichen Interessen entsprechen. Der User bildet die Welt nach seinen Wünschen ab, ähnlich einem Echtzeitstrategiespiel und surft gleichzeitig wie gewohnt durch das WorlWideWeb.

Abbildung 10: 3D-Stadtmodelle in Google Earth [eigene Darstellung]

4 FAZIT

Gerade in der jetzigen Zeit des Iconic Turns [Maar, Burda 2004], in der Bilder zunehmend Informationen und Inhalte vermitteln und an Macht gewinnen, müssen die für die gebaute Umwelt verantwortlichen planenden Disziplinen, ihre, den Lebensraum der Natur und des Menschen betreffenden Planungen, allgemein verständlich vermitteln. Tendenzen, menschheits- relevante Planungen vermehrt nur textlich zu artikulieren und zu präsentieren, überfordern den Bürger und zunehmend auch politische Entscheidungsträger. Die interaktiv bewegte, bildhafte Präsentation ist, sofern politisch gewünscht, die beste Möglichkeit der allgemein verständlichen Kommunikation aller am Planungsprozess beteiligten Akteure, weil sie mehr als alle übrigen Medien mit Präsentationscharakter die volle Aufmerksamkeit des Beobachters erzwingt.

3D-Stadtmodelle in Echtzeitumgebungen bieten hierfür eine unverzichtbare Planungsgrundlage. Der Stadtraum wird neu erlebbar, transformier- und veränderbar. Als positiven Nebeneffekt sind Daten eines 3D-Stadtmodells – wie bereits oben beschrieben – geeignet, um in den unterschiedlichsten Bereichen wie dem Katastrophenschutz, der Denkmalpflege, dem Umweltschutz etc. ihren Einsatz zu finden. Auch für den Tourismus und die Wirtschaft wird die Echtzeitpräsentation ganz neue Potentiale eröffnen und zu einem neuen, leistungsstarken Marketinginstrument heranreifen.

Nicht zuletzt für die Kommunen, als Bewahrer umfangreicher, z. T. immer noch brach liegender Geodatenbestände, sollte dieses Thema von gesteigertem Interesse sein.

5 LITERATUR

Achleitner, E., Schmidinger, E., Voigt, A.: Dimensionen eines digitalen Stadtmodelles am Beispiel der Stadt Linz, in Schrenk, M. (Hrsg.): 8. Symposion „Computergestützte Raumplanung“ – CORP 2003, Wien, 2003

Endres, S.: Digitale Geländemodelle im Gewässerbau, auf http://www.ibmiller.de/fach/gewaesser/DGM.html03 am 5.12.2003

Maar, C., Burda, H. (Hrsg.): Iconic Turn - Die neue Macht der Bilder, DuMont Literatur und Kunst Verlag, Köln, 2004

Petschek, P., Lange, E.: Planung des öffentlichen Raumes - der Einsatz von neuen Medien und 3D Visualisierungen am Beispiel des Entwicklungs-gebietes Zürich-Leutschenbach, in Schrenk, Manfred (Hrsg.): 9. Symposion „Computergestützte Raumplanung“ – CORP 2004, Wien, 2004

Schildwächter, R., Zeile, P, P. Poesch.: Eine Stadt wird dreidimensional: 3D Stadtmodell Bamberg, in Schrenk, Manfred (Hrsg.): 9. Symposion „Computergestützte Raumplanung“ – CORP 2004, Wien, 2004

Schildwächter, R., Zeile, P. Poesch, T. et al: 3D-4D-Stadtmodelle, Lehrgebiet cpe, TU Kaiserslautern, 2004

Schildwächter, R., Poesch, T., Wettels, P., Zeile, P.: 3D Stadtmodell Bamberg – Visualisierung mit 3D- Game- Engines, Vortrag im Rahmen der OWHC Regional Conference 2004 in Bamberg, Kaiserslautern, 2004

Nachhaltige Aufklärungsmethoden für die Informationsgesellschaft. Diplomatische Trittsteine zwischen landschaftlicher Realität und Vision

Philip PAAR, Jörg REKITTKE

(Zuse-Institut Berlin, Abteilung Visualisierung und Datenanalyse, Takustr. 7, D-14195 Berlin, paar@zib.de, Landschaftsarchitekt, Schirmerstr. 46/48, D-50825 Köln, rekittke@email.de)

1 ABSTRACT

Mit dem System Lenné3D wurde der Prototyp eines Visualisierungswerkzeugs für dreidimensionale und interaktiv erfahrbare Landschaften entwickelt. Das Einsatzgebiet von Lenné3D sind primär landschaftsrelevante Planungsprozesse, in denen anschauliche Zukunftsszenarien — geplante Landschaften — sichtbar und erfahrbar gemacht werden sollen. Mittlerweile gibt es auch erste Anwendungen im Städtebau und in der Freiraumplanung.

Die Visualisierungsergebnisse lassen vor den Augen der Planungsbeteiligten Landschaften entstehen, die aufgrund des Detailgrads der Vegetationssimulation als überzeugend, wenn nicht als „echt" eingestuft werden. Der Erfolg solcher Visualisierungen, der erst am Umsetzungsgrad der geplanten Landschaft gemessen werden kann, stellt sich allerdings nur dann ein, wenn den Planungsbeteiligten im Vakuum zwischen Ist- und Sollzustand Möglichkeiten angeboten werden, mental in die digital visualisierten Planungsszenarien einzusteigen. An diesem Punkt ist der Planer gefordert, diplomatisch — klug berechnend — vorzugehen. Veränderung löst primär Mißtrauen und Verunsicherung aus, der Planer muß diesen Reflexen mit der Verleihung von Zuversicht und der Gewährleistung von Kontrollierbarkeit systematisch entgegensteuern.

Zur Verdeutlichung dieses Zusammenhangs kann die Notwendigkeit graphischer Unterscheidungen zwischen Elementen dienen, die verändert werden sollen und jenen, die auch in Zukunft im bisherigen Zustand belassen werden sollen. Die interaktive Visualisierung von landschaftlichen Planungen muß auch Interimszustände explizit veranschaulichen können und sich zu diesem Zweck der Kombination von photorealistischen und non-photorealistischen bzw. graphisch reduzierten Darstellungstechniken bedienen. Wenn solche Kennzeichnungsmethoden nicht angewandt werden, kommt es bei der heute möglichen Perfektion digitaler Visualisierungen schnell zu dem Effekt, daß zwischen Bestand und Eingriff nicht mehr unterschieden werden kann — mit anderen Worten: Man sieht den geplanten Wald vor lauter Bäumen nicht mehr.

Wir möchten die Ergebnisse unserer Untersuchung von Visualisierungsmethoden präsentieren, die darauf vorbereiten sollen, daß digitale Landschaftsbilder paradiesisch sein können, die Realität jedoch stets nüchtern bleibt.

2 EINLEITUNG

Mit dem System Lenné3D wurde der Prototyp eines GIS-datenbasierten Visualisierungswerkzeugs für dreidimensionale und interaktiv erfahrbare Landschaften und Vegetationsensembles entwickelt (PAAR und REKITTKE 2003 und 2005, WERNER et al. 2005). Das Einsatzgebiet von Lenné3D sind primär landschaftsrelevante Planungsprozesse, in denen anschauliche Zukunftsszenarien — geplante Landschaften — sichtbar und erfahrbar gemacht werden sollen. Während der Vorbereitungen des Lenné3D-Projekts im Jahr 1999 wurde von drei zu entwickelnden Darstellungsmodi ausgegangen: a) Photorealistische Visualisierung als Standbilder oder Animationen; b) Interaktive Visualisierung mit graphisch reduziertem Detaillierungsgrad; c) Interaktive Visualisierung in skizzenhafter Darstellungsform.

Zu Beginn des Projekts im Jahr 2002 erschienen die Möglichkeiten programmierbarer Graphikkarten, welche photorealistische Landschaftsvisualisierung in Echtzeit auf PC's in Aussicht stellten, noch äußerst verlockend. Demzufolge hatte sich die Lenné3D-Softwareentwicklung zunächst auf die interaktive Simulation des Landschaftsbilds mit einer hochdetaillierten und möglichst originalgetreuen Darstellung von Pflanzen und Vegetation konzentriert.

Es ist möglich geworden, vor den Augen der Planungsbeteiligten Landschaften entstehen zu lassen, die insbesondere aufgrund des Detailgrads der Vegetationssimulationen als überzeugend, wenn nicht als *echt* eingestuft werden. Der Erfolg solcher aufwendigen Visualisierungen, der im engeren Sinne am Umsetzungsgrad der geplanten Landschaft gemessen werden könnte, stellt sich allerdings nur dann ein, wenn den Planungsbeteiligten im Vakuum zwischen Ist- und Sollzustand gezielt Möglichkeiten angeboten werden, mental in die digital visualisierten Planungsszenarien einzusteigen. Autoren wie TUFTE (1990) haben die unterstützenden Möglichkeiten von Visualisierungstechniken für das Verständnis komplexer Probleme aufgezeigt. Daß bereits ein einziges Bild *mehr sagen kann, als tausend Worte*, ist eine Volksweisheit, die Gefahr, daß ein Bild mehr Schaden anrichten kann, als tausend Worte anschließend reparieren können, stellt die andere Seite der Medaille dar, die gerne vergessen wird.

Landschaftsvisualisierung wurde bisher in der Praxis vor allem zur Präsentation, Erläuterung und zum Marketing von Planungsergebnissen eingesetzt (ORLAND 1992). Nach LANGE (1999) übernehmen Visualisierungen zumeist eine dekorative Funktion, um ein Planungsprodukt zu „verkaufen", anstatt einen substanziellen Beitrag für ein verbessertes Ergebnis zu liefern. Dabei tritt nicht selten folgendes Dilemma auf: Um den Eindruck eines photorealistischen Bildes wiederzugeben, scheint es [...] häufig unvermeidlich, fehlende Daten zu fabrizieren oder existente Daten so zu manipulieren, daß sie *passen* (ORLAND et al. 1997). SHEPPARD (1999) schreibt hierzu: „...oft fehlen korrekt aufbereitete Landschaftsdaten, was die extrem realistische Visualisierung jedoch nicht erkennen lässt."

Eine noch weiter gehende Problematik zeigte sich bei einer Erprobung des Lenné3D-Systems im Rahmen des Interaktiven Landschaftsplans Königslutter (WARREN-KRETZSCHMAR und V. HAAREN 2005). Dort war zu beobachten, daß sich der Betrachter auf inkonsistent erscheinende oder weniger detaillierte Bildelemente fokussiert, welche die Glaubwürdigkeit der gesamten Visualisierung beeinträchtigen können. Dieses Phänomen der Fehlersuche beschreiben APPLETON und LOVETT (2003) als Effekt des kleinsten gemeinsamen Nenners.

In der Literatur finden sich divergierende Ansichten, ob zur effektiven Unterstützung der Planungskommunikation möglichst realistische, der geplanten Wirklichkeit entsprechende Visualisierungen (OH, 1994), oder eher abstrakte Darstellungen geeignet seien (MUHAR 1992). LEHMKÜHLER (1998) spricht sich entschieden gegen eine Reduktion auf das Wesentliche durch Abstraktion oder Verzicht auf einzelne Objekte aus, da sie lediglich die subjektiven Wertungen des Erstellers der Planungsvisualisierung repräsentieren würden. ZUBE ET AL. (1987) schlagen hingegen eine differenzierte Herangehensweise vor und lehnen eine pauschale Ausgrenzung einzelner Darstellungsarten ab: "It is important to correlate the type of visualization to each project phase".

Auf den Punkt bringt es ERVIN, er macht deutlich, daß die Mittel grundsätzlich aus dem Zweck abgeleitet werden müssen, "[...] there is never a single correct answer to any of the many representational and abstraction problems [...], and so reference to the questions: "What is the purpose?", and "What is the question?", is an important touchstone for understanding visualization tasks and evaluating representations" (2004).
Medien und Darstellungstechniken haben eines gemeinsam: ihre Weiterentwicklung und Neuerfindung führt niemals zur vollständigen Substituierung ihrer Vorläufer, sondern lediglich zu deren mehr oder weniger ausgeprägten Verdrängung beziehungsweise Ergänzung. Vor diesem Hintergrund wurden die drei wesentlichen Ziele dieses Beitrags entwickelt: a) die Aufstellung von sechs Thesen zu graphisch reduzierten Planungsvisualisierungen; b) die Vorstellung graphischer Reduktionsmethoden speziell für interaktive digitale Vegetationsdarstellungen mit dem System Lenné3D, sowie c) der Rekurs auf bewährte analoge Graphik- und Kommunikationsmittel, deren Implementierung im *großen digitalen Werkzeugkasten* grundsätzlich sinnvoll erscheint. Den dargestellten Reflexionen ist gemeinsam, daß sie Einblicke in die theoretische und konzeptionelle Entwicklungsarbeit des Visualisierungssystems *Lenné3D* bilden.

3 KATHARSIS

Verschiedene Kunstrichtungen haben sich seit der Antike um eine Steigerung der Wirklichkeitstreue von Bildern bemüht. Im antiken Griechenland galten illusionistische Bildeffekte ab dem vierten Jahrhundert vor Christi als wichtigstes Kriterium zur Beurteilung des Könnens eines Malers. Die antike Kunst hat sich weitgehend am Ideal der Mimesis orientiert und die platonische Bilderkritik läßt sich als kritische Reaktion auf die Dominanz des mimetischen Aspektes verstehen (BOEHM 1994). Platon war der Ansicht, daß Bilder lediglich die Oberfläche der Dinge, ihre äußere Ansicht reproduzieren, wie sehr sie auch die Anwesenheit des dargestellten Gegenstandes suggerieren mögen. Der äußerlichen Darstellung stellt Platon die wissenschaftliche bzw. philosophische Erkenntnis der Dinge als die höherwertige Aufgabe gegenüber.
Die in den 1960er Jahren begründete Disziplin Computergraphik war Jahrzehnte bestrebt synthetische Bilder von simulierten 3D-Umgebungen zu generieren, die so aussehen sollten, als seien sie photographierte Ausschnitte der Realität — *Photorealismus* lautete die Devise der digitalen Zauberei. Photorealismus blieb damit nicht mehr nur eine Kunstform, sondern wurde auch zu einem Forschungs- und Anwendungsgebiet der Computergraphik, beispielsweise für die Visualisierung virtueller Welten. Paradox und Faszinosum zugleich bildet in diesem Zusammenhang die Tatsache, daß ein Bild faktisch *nicht-realistisch*, optisch jedoch *photorealistisch* sein kann. Die abgebildete Welt kann *echt* aussehen, muß aber nicht notwendigerweise eine physische Entsprechung besitzen. Photorealistische Computersimulationen suggerieren in grundsätzlicher Weise Eigenschaften wie Genauigkeit, Perfektion und Echtheit, die jedoch unter Umständen lediglich schöner Schein sein können (SHEPPARD 2001). BUHMANN (1994) vertritt die Ansicht, daß aus der erreichbaren Glaubwürdig- und Gefälligkeit von Simulationen für den Planer eine große Verantwortung erwachse.
Methoden der Landschaftsvisualisierung müssen sich sowohl am technisch Machbaren der Computergraphik als auch an Vorbildern konventioneller Darstellungsweisen orientieren. Computergenerierte Bilder mit intendiertem Photorealismus haben eine kurze ästhetische Halbwertszeit. Lediglich die frühen Pionierleistungen der Computergraphik vermögen es, einen dauerhaften Charme zu versprühen. Retrospektiv betrachtet, können ihre damaligen Ergebnisse als ungewollte Vertreter eines heute hochaktuellen „Non Photorealistic Rendering" betrachtet werden. Seit Ende der 90er Jahre wird in der Computergraphik vermehrt in Richtung solcher non-photorealistischen Darstellungsverfahren (NPR) geforscht. Als non-photorealistisch werden heute computergraphische Darstellungen bezeichnet, deren Elemente zwar realistische Aspekte der Abbildung beinhalten, deren Darstellungsweise jedoch aufgrund der Anwendung bestimmter Darstellungsmittel bezüglich Form, Farbe, Struktur, Schattierung, Licht, Schattenwurf oder Perspektive eindeutig von der wahrnehmbaren Wirklichkeit abweichen. Ziel des NPR ist es, komplexe Informationen durch die Nachbildung manueller Darstellungstechniken einfacher und schneller transportieren und kommunizieren zu können. Rufen wir uns in Erinnerung: Medien und Darstellungstechniken substituieren ihrer Vorläufer nicht, sondern ergänzen sie lediglich.
Mit der Einsicht, daß photorealistische Bilder nicht immer eine geeignete Lösung für die Vermittlung visueller Information darstellen, hat ein Prozeß der kollektiven Läuterung eingesetzt. Galt es bisher als *hohe Kunst*, Darstellungen von gewollter Realität so anzufertigen, daß sie Photos gleichen — photorealistisch wirken —, scheint der Punkt erreicht, an dem sich eine allgemeine Abkehr von diesem Streben vollzieht. Mit dem Vokabular der Ökonomen ausgedrückt: Es scheint beim Konsumenten eine *Sättigung* bezüglich photorealistischer Bilder eingetreten zu sein. Sättigung tritt dann ein, wenn der *Grenznutzen* gleich Null ist, das bedeutet, trotz einer weiteren Anstrengung ist kein zusätzlicher Nutzen mehr meßbar — jenseits der Sättigung treten negative Effekte auf.
Noch nie war es so einfach, *Bilder, die lügen* herzustellen, wie heute mit den Werkzeugen und Systemen, die jeder Privatperson für wenig Geld zur Verfügung stehen. Als es zur analogen Photographie noch keine Alternativen gab, war es eine regelrechte Kunst, Bilder mit den Mitteln der Retusche zu verfälschen. Man wandte dieses anspruchsvolle Handwerk stets an, um Bilder zu schönen oder um sie propagandistisch zu mißbrauchen. Heutzutage verführt das Überangebot an Filtern und Werkzeugen im Bereich des Desktop-Publishing den Anwender dazu, an fast jedem Bild tatkräftig zu manipulieren, vom Pressebild, Bewerbungsphoto bis zum privaten Urlaubsschnappschuß. Die inflationäre Manipulationspraxis und der damit inflationär einhergehende Mißbrauch hat auch der Glaubwürdigkeit professioneller und wissenschaftlich anspruchsvoller digitaler Visualisierungen irreparablen Schaden zugefügt — man glaubt nicht mehr unbedingt, was man sieht. Wer kennt nicht irgendein architektonisches Großprojekt, das in den neunziger Jahren des vergangenen Jahrhunderts mit seinerzeit beeindruckenden Computervisualisierungen beworben wurde. Vergleicht man dann das gebaute Ergebnis mit den damals gezeigten Bildern, stellt sich im besten Fall ein mildes Lächeln ein — man hat gelernt, daß digitale Träume schnell zerplatzen können.
Besonders ernst nehmen müssen diesen grundsätzlichen Vertrauensverlust jene Disziplinen, die traditionell auf Visualisierungen von unrealisierten Maßnahmen angewiesen sind, das sind alle planenden und entwerfenden Disziplinen, die ihre Projekte graphisch kommunizieren. Im vorliegenden Beitrag wird diesbezüglich die Visualisierungspraxis von Landschaftsplanern und Landschaftsarchitekten fokussiert, also jener Berufsgruppen, deren Ziel es ist, geplante Landschaften und Freiraumgestaltungen Realität werden zu lassen. Der mit Zukunftsbildern operierende Planer und Entwerfer ist verstärkt gefordert, diplomatisch — im Sinne von *klug berechnend* — vorzugehen. Sichtbare Veränderung löst primär Mißtrauen und Verunsicherung aus, ein Reflex, dem durch die Verleihung eines Vetrauensgefühls und der Gewährleistung von Kontrollierbarkeit systematisch entgegengesteuert werden kann und muß. Es steht außer Frage, daß photorealistische Bilder bei der landschaftsrelevanten Planungskommunikation wertvolle Dienste leisten können, zum Beispiel visuelle Erfahrungen zu beleuchten, die in Zukunft zu erwarten sind. In seiner Tendenz zur Suggestion, seinem Verführungspotential zum bildlichen Realitätsersatz sowie seiner Inflationssymptome als Bilderflut muß der

gegenwärtige Photorealismus als antizipatorische Geste jedoch sehr kritisch betrachtet werden. Photorealistische Simulationen steigern die Darstellung zu einem perfekt aussehenden „als-ob“ – Faktum und Fiktum konvergieren in ihnen (BOEHM 1994) — und können nicht mehr einzeln identifiziert werden. Planungskommunikation sollte sich jedoch vor der Streuung von Mißverständnissen oder Falschaussagen jeglicher Art systematisch schützen. Bilder in den Köpfen entstehen zu lassen, ist nicht schwer, Bilder aus den Köpfen wieder zu entfernen, ist nahezu unmöglich. Planungskommunikation muß deshalb stets deutlich machen, mit welcher Unschärfe die Prognose von Landschaftsentwicklung behaftet ist (MUHAR 1992).

4 VERTRAUENSBILDENDE MASSNAHMEN

Mit dem Wissen um die allgemeine Verunsicherung des Bildkonsumenten im Hinterkopf, kann daran gegangen werden, systematisch vertrauensbildende Maßnahmen in Planungsvisualisierungen einzubauen, diplomatische Trittsteine zu legen, die jedem Halt bieten. Dem Adressaten muß das Gefühl vermittelt werden, die Kontrolle beziehungsweise Urteilsfähigkeit bezüglich der Wahrheiten und Spekulationen digital generierter Visualisierungen behalten zu können. Die Schlüsselbegriffe im Zuge der Wiedererlangung visueller Kontrolle lauten *Graphische Reduktion* und *Abstraktion*. Reduktion bezeichnet die *Verminderung* oder den *Entzug* von etwas; Abstraktion hat mit dem *Verzicht* auf etwas und mit *Verallgemeinerung* zu tun, sie beschreibt Dinge, die *nicht gegenständlich* sein müssen und nicht den *unmittelbaren* Bezug zur Realität suchen.

Maximaler Detailreichtum führte zu hochkomplexen Bildern, die intellektuell nicht mehr durchdrungen werden konnten, da sie keinerlei Vergleichsmöglichkeiten mehr zwischen Realität und Fiktion, zwischen Bestand und Entwurf anzubieten hatten. Logische Folge war der beschriebene Vertrauensverlust, notwendige Reaktionen sind die systematische *Depräzisierung*, *Reduktion* und *Abstraktion* der graphischen Informationsflut. ERVIN (2001, S. 62) writing about abstraction, states that “(...) we landscape modelers must also remember the valuable roles of abstraction in both cognition and communication, and not believe that ‘photo-realism’ – or even ‘physical realism’ – is the be-all, end-all of digital modeling. We make models to make explorations or to convey messages, and the infinite variety of explorations and messages will surely yield an equally boundless variety of digital landscape models”. Gegen Photorealismus als das Nonplusultra von Landschaftsvisualisierung spricht auch die Tatsache, daß mit planerischen Darstellungsmethoden im allgemeinen beabsichtigte bzw. mögliche Veränderungen besonders hervorgehoben, sichtbar herausgearbeitet werden müssen. Geschieht dies nicht, verliert der Betrachter den Blick für das Wesentliche.

Planung impliziert Spielraum und kann ohne diesen nicht erfolgreich umgesetzt werden. Eine hundertprozentig präzise Vorausschau geplanter Veränderungen ist prinzipiell nicht möglich, das starre Festhalten an beabsichtigten, aber sich nicht erfüllenden Entwicklungen führt zu Unflexibilität und Kompromißlosigkeit. Die Einkalkulierung eines gewissen *Spiels*, einer *Toleranz* zwischen den Zahnrädern einer komplexen Maschinerie ist zwingend notwendig, um Scheitern und Frustration zu vermeiden. Anschauliche Beispiele für die Unerläßlichkeit jener Spielräume, die der Zufall beansprucht, sind zu enge Fahrpläne, die auf Idealzustände ausgelegt sind und durch Unvorhergesehenes — Wetter, Unfälle etc. ständig zum Erliegen gebracht werden. Sie stellen auch deshalb besonders negative Beispiele für jeden Planer dar, weil sehr deutlich wird, welches Ausmaß an Ärger und Frustration auf Seiten der Kunden — der Zielgruppe — durch ein solches Mißmanagement provoziert wird. Mehr Spielraum würde mehr Verständnis und Toleranz bei der Kundschaft erzeugen, die Chance des reibungslosen Ablaufs wäre grundsätzlich höher und die Glaubwürdigkeit der Fahrpläne und mit ihnen der Anbieter schlichtweg höher.

Räumliche landschaftliche Planung ist ein Prozess mit unendlich vielen Variablen. Angefangen bei der Vegetation, die im Gegensatz zu Architektur in ständiger Veränderung begriffen ist, bis hin zur politischen Wetterlage können die meisten Faktoren im Planungsprozeß nicht präzise vorhergesagt und kalkuliert werden. Die Akzeptanz dieses Zusammenhangs muß durch die bewußte Depräzisierung auch der visuellen Planungspräsentation dokumentiert werden.

5 SECHS THESEN ZU GRAPHISCH REDUZIERTEN PLANUNGSVISUALISIERUNGEN

Unter graphischer Reduktion wird hier die spezielle Vorgehensweise des Systems Lenné3D verstanden, bei allen Reduktionsverfahren vom maximal detaillierten Visualisierungsobjekt auszugehen, um auf diese Weise den hohen Modellierungsaufwand, der zum Erzielen photorealistischer Visualisierungen notwendig ist, nicht zu verschenken. Vereinfachte Darstellungen profitieren so auf ökonomische Weise vom Detaillierungspotential der hochleistungsfähigen Software. Das hier angesprochene und im folgenden Kapitel beispielhaft illustrierte Verfahren der graphischen Reduktion zeichnet sich dadurch aus, daß es auf künstlerische Individualität, die in Planungsdarstellungen zu groben Fehlinterpretationen führen kann, grundsätzlich verzichtet. Die vereinfachte Optik graphisch reduzierter Darstellungen resultiert nicht aus einem genialischen Bauchgefühl, sondern aus einem wissenschaftlich nachvollziehbaren Reduktionsverfahren. Diese Vorgehensweise wird dem Umstand gerecht, that landscape planners and architects „ are doctors, in a figurative sense; though they do not perform operations out on people, they must nonetheless intervene in the process of nature and landscape with the dexterity and precision of a surgeon.“ (REKITTKE 2002, S. 121).

Digital generierte, aber graphisch reduzierte Planungsvisualisierungen besitzen gegenüber ihren photorealistischen Ablegern prinzipielle Vorteile, die in der gängigen Praxis nicht selten ignoriert werden. Diese Einsicht mag auf den ersten Blick irritierend trivial erscheinen, die Vielfalt digitaler Werkzeuge und die Möglichkeiten, die sich damit ergeben haben, ließen die Vorteile graphisch reduzierter Darstellungsarten jedoch weitgehend aus dem Blick und dem Bewußtsein der Anwender geraten. Selbstverständlichkeiten kommen schnell unter die Räder, deshalb sei in der Folge im Kontext digitaler Planungsvisualisierung in Thesenform aufgeführt, zu welchem Zweck und auf welche Weise graphische Reduktionen grundsätzlich eingesetzt werden können.

1. Graphische Reduktion als freiwillige Selbstkontrolle. *Je unsicherer die geplante Aussage ist, desto mehr schützt graphische Reduktion den Planer davor, Details erfinden zu müssen oder sich zu weit aus dem Fenster zu lehnen.*

Die Verallgemeinerung visueller Planungsinformationen—sollte zu einer erhöhten Trefferquote bei der Realisierung der dokumentierten Absichten und zu einem erhöhten Identifikationspotential des einzelnen Planungsakteurs mit dem erzielten Ergebnis führen. Graphische Reduktion ersetzt allerdings nicht die Notwendigkeit des Aufzeigens verschiedener Varianten — anderer wahrscheinlicher Entwicklungsrichtungen.

2. Erkennbare Unterscheidung von Realität und Fiktion. *Realität kann durch realitätsorientierte Darstellungsformen („Photorealismus“) repräsentiert werden. Fiktion muß sich hingegen durch abstrahierte Darstellungsformen davon unterscheiden.*

So selbstverständlich dieses Prinzip erscheinen mag, in der Planungs- und Visualisierungspraxis wird dieser Grundsatz sehr oft mißachtet. Daß man den Wald vor lauter Bäumen nicht mehr sieht, passiert in der visuellen Planungskommunikation genau dann, wenn die Bestandskomponenten, welche die Planungsbeteiligten zumeist sehr gut kennen, nicht mehr eindeutig von den Entwurfskomponenten, dem Neuen, zu unterscheiden sind.

3. Kongruenz von Bedeutungsgewicht und visueller Prägnanz. *Das spezifische Bedeutungsgewicht der gezeigten Planungsmaßnahmen muß durch entsprechende visuelle Prägnanz und graphische Variation verdeutlicht werden.*

Ein Bild sagt mehr als tausend Worte, doch nicht jeder liest das Gezeigte auf die gleiche Weise. Visuelle Kommunikation muß sich mittels einer systematischen Führung durch das Gesamtbild auszeichnen, um Wichtiges zu betonen und weniger Wichtiges zu relativieren. Visuelle Prägnanz ist nicht mit visueller Perfektion gleichzusetzen, das beabsichtigte Bedeutungsgewicht muß durch die Variation graphischer Reduktionsschritte sensibel austariert werden.

4. Graphische Gradation von zeitlich aufeinander folgenden Prozeßschritten. *Nicht nur Bedeutungen von Planungsmaßnahmen variieren, sondern auch die zeitliche Reihenfolge der Realisierung ist von entscheidender Bedeutung für den Planungserfolg und muß veranschaulicht werden.*

Bei der Präsentation von Planung wird im Regelfall der beabsichtigte endgültige Zustand des Geplanten gezeigt. Für den Umsetzungserfolg ist jedoch die zeitliche, prioritäre oder pragmatische Reihenfolge einzelner Maßnahmen relevant und sollte durch graphische Mittel dementsprechend sichtbar gemacht werden. Auch langwierige Baustellenphasen, die mit Belastungen von Mensch und Umwelt verbunden sind sowie prozeßbedingte Interimszustände müssen in Zeitscheiben dargelegt werden können. Der Planer schlüpft hier in die Rolle des dokumentarischen nonfiktionalen Erzählers, der in Bildern den Landschaftswandel in einer Art didaktisch aufbereitetem Zeitraffer erläutert. Die computergraphische Visualisierung landschaftlicher Interimsstadien erweitert HUMPHRY REPTONS Konzept der Vorher-Nachher-Bilder (1803), das seine *Red Books* berühmt und seine Planungen erfolgreich gemacht hat.

5. Sichtbarmachung von Unsichtbarem. *Planung „als solche" ist weitgehend unsichtbar, sie manifestiert sich final in Form realisierter Maßnahmen. Realisierte Planungsmaßnahmen erzeugen wiederum Wirkungen, die optisch nicht unmittelbar erfaßbar sind oder sich außerhalb des allgemeinen Vorstellungsvermögens befinden. Dennoch sollten diese Effekte im Planungsprozeß visuell markiert werden— Abstraktion invers.*

Planungsmaßnahmen haben einen größeren Wirkungsbereich als ihr Grundriß bedeckt. Das kann sich positiv auswirken — im Sinne einer günstigen Aura, kann aber auch negative Folgen haben — beispielsweise in Form von Beeinträchtigungen und Belästigungen. Im Abwägungsprozeß von Planung sind diese Faktoren sehr wichtig und können meist nur dann in Erwägung gezogen werden, wenn sie veranschaulicht — sichtbar gemacht werden. Planungsvisualisierung kann auf diesem Gebiet vieles ausprobieren und muß hinsichtlich entsprechender Potentiale noch umfangreich erforscht werden. Was in Realität nicht sichtbar ist, kann grundsätzlich nicht mittels Realismus dargestellt werden, in diesem Visualisierungssegment wird Non-Photorealismus zukünftig eine entscheidende Rolle spielen.

6. Graphische Askese anstatt medialem Hedonismus. *Je umfangreicher der digitale Werkzeugkoffer gefüllt wird, desto größer wird die Notwendigkeit und Herausforderung, bei der Planungskommunikation graphischen Minimalismus zu praktizieren.*

Der Kanon medialer Möglichkeiten muß vor der Planungspräsentation gegenüber dem Laien zu einfachen und eindeutigen Informationen destilliert werden. Die Halbwertszeit digitaler Effektwirkungen ist verschwindend gering, anfängliche Begeisterung führt im Regelfall sehr schnell zu Verdruß. Graphische Variablen (BERTIN 1982) wie Farbe, Form etc. sollten deshalb nur im notwendigen Maße eingesetzt werden.

6 GRAPHISCHE REDUKTIONSMETHODEN FÜR INTERAKTIVE VEGETATIONSDARSTELLUNGEN

Die vorangegangenen Thesen zu abstrahierten Planungsvisualisierungen bilden den Rahmen für die Entwicklung und den Einsatz Graphischer Reduktionsmethoden, die unter Verwendung des Systems *Lenné3D* im landschaftlichen Kontext dazu dienen sollen, geplante Zukunft besser begreifbar und umsetzbar zu machen. Diese Methoden werden unter dem Anspruch entwickelt, diplomatische Trittsteine zwischen landschaftlicher Realität und Vision zu bilden. In den anschließenden Bildbeispielen gehen alle Reduktionen vom farbigen, höchstaufgelösten, photorealistischen — realitätsorientierten — Bild beziehungsweise der interaktiven dreidimensionalen Szene aus. Hauptdarsteller und thematischer Fokussierpunkt ist dabei die dreidimensionale Visualisierung von Vegetation, jenem Sujet, das von jeher eine der größten Herausforderungen landschaftlicher Darstellung bildet.

Die Röntgenecke — der Blick hinter die Kulissen

Auch das perfekteste Computerbild kann Realität nicht vollständig widerspiegeln, aber manch einer mag eine Simulation mit einem Photo verwechseln (LANGE 1999). Um diese wichtige Tatsache sichtbar zu machen, sollte in allen Visualisierungen ein Hinweis in der Bildunterschrift — oder besser — auch im Bild selbst codiert sein. Beispielsweise könnte ein „Röntgenblick" unmißverständlich klarmachen, daß hier keine Photos, sondern artifizielle Szenen gezeigt werden. Einige Zeitungen kennzeichen Bildmanipulationen mit einem „(M)".

Abb. 1: Die Röntgenecke

Stilfreiheit abstrahierter Darstellung

Im System Lenné3D wird versucht, komplexe Darstellungen stilfrei zu abstrahieren, ohne Nachempfindung oder Generierung eines individuell wirkenden Duktus. Die graphischen Reduktionsmethoden des Systems Lenné3D basieren grundsätzlich auf dem maximal detaillierten Visualisierungsobjekt und nutzen auf diese Weise den hohen Modellierungsaufwand, der zum Erzielen photorealistischer Baum- und anderer Pflanzendarstellungen notwendig ist. Die graphische Reduktion von Landschafts- und speziell Baumdarstellungen wird dabei nicht als künstlerische Aufgabe begriffen, sondern als stilfreie Detailminimierung. Speziell in der Pflanzendarstellung kann nur durch maximierte botanische Treue eine sichere Identifikation der einzelnen Arten und Gattungen gewährleistet werden. Auch in der abstrahierten Form sollten spezifische Erkennungsmerkmale von Pflanzen nicht künstlerisch idealisiert, sondern eindeutig erkennbar dargestellt werden. Jedes Jahr von neuem demonstriert uns die Natur, wie visuelle Reduktion im beschriebenen Sinne funktionieren kann. Werfen die sommergrünen Bäume im Herbst ihr Blätterkleid ab, erfährt ihr Erscheinungsbild eine dramatische Reduktion: Es verbleiben im Regelfall weitgehend farbreduzierte, aus der Distanz als nahezu schwarz wahrgenommene bizarre Silhouetten. Weder verlieren die Bäume während dieses Vorgangs ihren identifizierbaren individuellen Charakter, noch büßen sie aus Spaziergängersicht etwas von ihrer Raumwirksamkeit und Orientierungsfunktion ein. (REKITTKE et al. 2004).

Dosierung des Detailgrads und der Darstellungsart in Kongruenz zum Planungsverlauf

Die graphischen Mittel von Lenné3D können dazu genutzt werden, gleiche Dinge in verschiedenen Planungsstadien auf unterschiedliche Weise darzustellen. Die Dosierung des Detailgrads und der Darstellungsweise wird dabei dem Planungsverlauf auf logische Weise angepaßt. Anhand eines neu geplanten Baumes werden im folgenden beispielhaft fünf Darstellungsarten vorgestellt, die sich zeitlich und planungssystematisch aufeinander beziehen: A. „Scherenschnitt" — B. „Unschärfe" — C. „Transparenz" — D. „Graustufen" — E. „Perfektion".

A. „Scherenschnitt" — Scherenschnittdarstellung in der Entwurfsphase

In der ersten Entwurfsphase reicht es aus, mit einem sehr groben Pflanzenmodell zu arbeiten. Ein Modell in Scherenschnittdarstellung gewährleistet einen ersten Eindruck der Pflanzengröße, des Habitus und der Raumwirksamkeit. Dieser Scherenschnitt kann im Bild frei bewegt werden und gewährleistet eine Konzentration auf das Wesentliche in dieser frühen Planungsphase.

B. „Unschärfe" — Grobjustierung des Standorts

Der ersten Entwurfsphase folgt die Tätigkeit des Ordnens, der ersten Überprüfung und der Grobjustierung bereits intendierter Standorte. In dieser Phase muß der Planende sich bereits ein genaueres Bild der Pflanze machen können, deshalb werden an dieser Stelle die Details in Farbe eingeblendet, die Pflanze wird insgesamt jedoch unscharf dargestellt. Diese Unschärfe indiziert einerseits die noch nicht erfolgte Verankerung des Objekts und die nach wie vor gegebene Flexibilität im Entwurfsprozeß, andererseits leitet sich die unscharfe Darstellungsart aus einem Effekt ab, der aus der analogen Planungsvisualisierung stammt und einen großen Nutzen beinhaltet: Um einen Gesamteindruck eines Entwurfs zu bekommen ist es effektiv, die Augen leicht zusammenzukneifen. Das Gesehene wird dabei etwas unscharf, man erhält aber einen sehr guten Eindruck des räumlich-visuellen Ensembles. Dieses Kneifen der Augen ist auch vor dem Bildschirm oder der Projektionsfläche sinnvoll, der unscharf dargestellte Baum wird dabei gleichwertiger Teil des Ganzen — ausprobieren lohnt sich.

C. „Transparenz" — Feinjustierung des Standorts

Der Grobjustierung folgt die Feinjustierung, der Blick sucht nach Feinheiten und Relationen. In dieser Phase wird die Pflanze transparent, aber hochdetailliert und farbig dargestellt. So kann der Planende sowohl einschätzen, wie sich die Pflanze im gewählten Umfeld zeigen wird als auch überprüfen, was hinter dem neuen Objekt liegt. Auf diese Weise läßt sich die beabsichtigte Wirkung mit hoher Genauigkeit steuern.

D. „Graustufen" — Vorläufige Festlegung

Der Feinjustierung folgt die vorläufige Festlegung der Objektart und ihres Standorts. Ohne den Verzicht auf Detailreichtum und hohe Auflösung des neuen Objekts kann durch den Schritt der partiellen Farbreduktion zu Graustufendarstellung ein deutlicher visueller Unterscheidungsparameter generiert werden. Der Bestand bleibt in diesem Fall farbig dargestellt, die Planung zeigt sich in Graustufen.

E. „Perfektion" — wie ein Photo der Realität

Die Graustufendarstellung der vorangegangenen Phase macht im Gegensatz zur Farbdarstellung sehr deutlich, *daß noch etwas fehlt, unfertig ist*. Der volle Grad der Darstellbarkeit wird bewußt nicht ausgeschöpft, um den nach wie vor existenten Spielraum planerischer Maßnahmen zu betonen. Erst am Ende einer Planung darf für Präsentationszwecke auch die Möglichkeit der photorealistischen Darstellungsart ausgereizt werden, nur so kann sich visuell der geplanten Zukunft maximal angenähert werden.

a) b) c) d)

Abb. 2: Beispiel einer graphischen Gradation verschiedener Planungsstadien. a: „Scherenschnitt", b: „Unschärfe", c: „Transparenz", d/e: „Graustufen/Perfektion"

Kontur-Darstellung zur Kennzeichnung von Verlusten und geplanten Entnahmen

Zum Planen gehört nicht nur die Neuanlage, sondern auch die Entnahme von Landschaftselementen. Häufig muß erst für neues Platz geschaffen werden. Andere Landschaftselemente verschwinden ungeplant. Elemente, in unserem Beispiel Pflanzen, die entnommen werden sollen oder anderweitig verschwinden, werden als Umrißlinien dargestellt. Die im Gesamtbild verharrende Kontur gibt den Blick frei auf das verbleibende Landschaftsbild.

Generelle Farbreduktion zur Kennzeichnung von Rückblenden
Bewegte Bilder in Farbe sind heutiger Standard. Werden vollständige Bildsequenzen in schwarz/weiß gezeigt, assoziiert der Betrachter diese fast automatisch mit Rückblenden, ein Effekt, den man sich systematisch zu Nutze machen kann. Dieser Effekt der Retrospektive wird mit einer Sepia-Tönung noch verstärkt. Generelle Farbreduktion löst einen auf visuellen Konventionen basierenden Reflex aus, der die Assoziation *Vergangenheit* evoziert — der Schwarz-Weiß-Film war gestern, Farbe ist heute.
Skizzen als Grundlagen und Extrakte realistischer Visualisierungen
Einfache Skizzen eignen sich sehr gut, um komplexe Szenen zu entwickeln. Auch der computertechnisch aufwendigste Hollywood-Film wird heute noch durch handgezeichnete *story books* skizzenhaft entwickelt. Computergenerierter Planungsgraphik können diese Skizzenbücher ein wertvolles Vorbild sein. Das System Lenné3D ist in der Lage, die Reihenfolge zwischen Skizze und Bildprodukt auch chronologisch umzudrehen und kann aus photorealistischen Visualisierungsobjekten skizzenhafte und damit strukturell beurteilbare Bilder generieren. Auch beim Skizzenmodus gilt: Die vereinfachten Bilder basieren auf dem hochkomplexen Computermodell und verzichten grundsätzlich auf künstlerischen Stil.

Abb. 3: Kombination von photorealistischer, slizzenhafter und graphisch reduzierter Darstellung in der 3D-Landschaftsvisualisierung aus Spaziergängerperspektive (Bildschirmfoto vom Lenné3D-Player, 05/2005). Alle Pflanzen liegen als detailreiche, realitätsorientierte 3D-Modelle vor. Die Repräsentation wird durch Eingabe des Nutzers gesteuert und in Echtzeit berechnet.

7 GUTE ALTE DINGE

Um reduzierte, vereinfachte Darstellungsarten im Interesse der Planungskommunikation entwickeln zu können, ist es sinnvoll, auch tradierte visuelle Konventionen zu nutzen. Da die sogenannten „Neuen Medien“ lediglich Ergänzungen zum bestehenden Repertoire visueller Darstellungsmittel bilden, sollten sie am bestehenden Vokabular — visuellen Konventionen — anknüpfen und es nutzen. Das Rad muß nicht neu erfunden werden. Die Entwicklungsgeschichte des Menschen wird von Gesten, Symbolen und Zeichen begleitet, die auf Konventionen basieren und dadurch eine großflächige, wenn nicht allgemeine Wirkung erzielen konnten. Ein Beispiel: Nirgends auf der Welt bedeutet eine rote Ampel etwas anderes, als „stehen bleiben“. Abstraktion führt in diesem Fall zu größter Eindeutigkeit.
Nachdem im Zuge der Ausreizung aller Möglichkeiten photorealistischer Simulationen viel Zeit und Energie gebunden wurden, eröffnet sich neuerdings wieder viel Raum für die kritische Reflexion dieses *hype*. Die wesentlichen Fragestellungen jeglicher Planungsvisualisierung rücken wieder in den Vordergrund: Für wen ist die Visualisierung? Was soll wie gezeigt werden? Was ist wirklich wichtig? Was ist weniger relevant? Die photorealistische Darstellungsform ist wie eine Sackgasse, aus ihr führt nur ein Weg zurück, nämlich der gleiche, auf dem man gekommen ist. Auf diesem Rückweg begegnet man vielen alten Bekannten, die man zuvor eventuell nicht hinreichend geschätzt oder gewürdigt hat. Altbewährtes sollte Eingang in neuartige Visualisierungen finden, nur durch die Kombination von Alt und Neu eröffnen sich neue Wege der Planungskommunikation. Einige Ansätze solcher Kombinationen seien hier vorgestellt.
Der menschliche Maßstab und Telepräsenz
Fällt in einer perspektivischen Darstellung die Abschätzung von Größenverhältnissen bereits grundsätzlich schwer, potenziert sich dieses Problem noch im landschaftlichen Perspektivbild. Als Hilfsmittel läßt sich bei Lenné3D das interaktive Maßstabssymbol „Familie mit Kind“ einblenden.
Bei freier Navigation durch dreidimensionale Computerszenen hat es sich zudem als hilfreich erwiesen, dem Navigierenden ein gewisses Abbild seiner selbst einzublenden — es muß ja nicht die in sogenannten *ego-shootern* obligatorische Handfeuerwaffe sein. Für die Spaziergängerperspektive könnte diese Abbildfunktion — Telepräsenz genannt (DRAPER et al. 1998) — durch Fußspuren symbolisiert werden. Die Speicherung, das Einfrieren der Fußspuren des einzelnen Anwenders im Landschaftsbild kann nachfolgenden Spaziergängern als Orientierung und zur Kontrolle bereits vollzogener Wege dienen. Es ist auch denkbar, daß sich mit der Zeit gewisse Pfade austreten, die als Indikator gemeinschaftlichen Gebrauchs beziehungsweise Interesses ernstgenommen werden müssen.

Ein-, Aus- und Aufblenden
Um das Auge auf bestimmte Landschaftselemente oder –strukturen zu lenken, können Objekte und Vegetationsschichten ein- und ausgeblendet werden. Eine Anwendung dieser Layertechnik ermöglicht auch eine Unterscheidung von Maßnahmetypen. Eine weitere Fokussierung wird durch das Leuchten markierter Elemente erreicht, der Heiligenschein in biblischen Darstellungen erfährt unerwartete Würdigung.
Skizzierfunktion „6b“
Skizzenpapier und dicker Bleistift, der Einsatz des „6b“ — Minenstärke und Härtegrad des Bleistifts bezeichnend — durch die Entwurfsbetreuer wird noch jedem Ex-Studenten in den Knochen stecken, schneller und eindrucksvoller kann man keinen Entwurf korrigieren. Wir schlagen vor, den berühmten „6b“ in die Hände des Anwenders von Lenné3D zu geben, damit er ungehemmt ins Bild *eingreifen* kann.
Einsatz von Text
Viele Dinge und Zusammenhänge, die sich nicht in unmißverständlicher Weise visualisieren lassen, können durch Begriffe treffend beschrieben werden. Die Abstraktionsebene *Text* läßt gleichzeitig Raum für Interpretation und Phantasie im Kopf des Betrachters. Wo die Grenze der Visualisierbarkeit erreicht wird, dürfen die konventionellen Mittel der Planungskommunikation nicht vergessen werden.
Positionierbarkeit von Notizzetteln
Die Reaktionsmöglichkeit des Betrachters während der Präsentation bewegter Bilder wird durch die Positioniermöglichkeit von plakativen Haftnotizzetteln im Objektraum unterstützt. Ein Gedanke, eine Idee sind schnell verflogen — die prompte Notiz hält Geistesblitze und Fragen fest und eröffnet den gewünschten Dialog mit den Planungsbeteiligten. Die konventionelle Form des Notizzettels baut falschen Respekt vor digitaler Graphik systematisch ab und verstärkt den Eindruck des unfertigen Bildes. Das interaktive Werkzeug unterstützt den Planer das local knowledge oder Vorschläge und Kritik der Akteure *ad hoc* zu sammeln und im dreidimensionalen Objektraum zu georeferenzieren.

Abb. 4: Interaktive Notizzettel

Logbuch
Ein Logbuch zeichnet den Verlauf des Gezeigten auf und ermöglicht wie ein Flugschreiber das digitale Geschehen wieder abzurufen. Im einfachsten Fall dokumentieren Bildschirmphotos die Chronologie der Planungskommunikation.
Schnittmusterbogeneffekt oder Visueller Palimpsest
Planung legt in zunächst theoretisch-graphischer Weise ständig neue Schichten — Ebenen — über bestehende Oberflächen. Fast jede neue Planungsebene hinterläßt bestimmte Spuren, die in die nächste Ebene übernommen werden. Nachvollziehbar werden diese Prozeßketten dann, wenn die verschiedenen Ebenen sowohl gleichzeitig als auch einzeln eingeblendet werden können — es ergeben sich unter Umständen sehr komplexe, wenn nicht verwirrende Bilder, die jedoch sehr deutlich die Komplexität des Planungsprozesses widerspiegeln. Das Bild eines Schnittmusterbogens macht die Qualität und den Komplexitätsgrad solcher Darstellungsformen deutlich: Aus einem Blatt Papier können zahlreiche verschiedene Formen entstehen — auch jeder Plan hat zahlreiche Variationsmöglichkeiten. Ein letztes Beispiel, das die Phantasie anregen und Raum für weitere Ideen schaffen soll.

8 FAZIT

Was nutzt einem Mechaniker eine Fotografie, wenn er schon das reale Ding vor sich hat (LANSDOWN und SCHOFIELD 1995)? Ähnlich stellt sich die Problematik in der Landschafts- und Freiraumplanung dar: Wenn spezifische Aspekte oder Strukturen einer Landschaft gesehen und verstanden werden sollen, ist die graphisch reduzierte oder illustrierende Darstellung einer photorealistischen schlichtweg vorzuziehen.
Die vorgestellten graphischen Reduktionsmethoden für interaktive Vegetationsdarstellungen erweitern ERVINS (2004) Definition von vier *abstraction levels*. Während ERVIN den Begriff *geo-specific* mit *realistischen* und den Begriff *geo-typical* mit *illustrativen* Darstellungen verknüpft, stellen wir Methoden vor, die eine geospezifische und dennoch illustrierende Repräsentation erlauben.
Der Drang nach photorealistischer Perfektion ist nichts Verwerfliches, es scheint in unseren Genen programmiert zu sein, daß wir dort zu perfektionieren versuchen, wo es uns möglich erscheint.
Eine möglichst realistische Wiedergabe des bildhaften Landschaftseindrucks ist insbesondere für Landschaftsbildbewertungen, Eingriffsverfahren und als Stimulus für Experimente von wissenschaftlicher und planerischer Relevanz. Die Faszination *perfekter Bilder* ist unumstritten und das dazugehörige Handwerk ehrenwert, doch ist Photorealismus nur eine unter vielen Arten, etwas darzustellen beziehungsweise graphisch kommunizieren zu können. Keine Darstellungsmethode hat jemals eine andere vollständig verdrängen können, kein Medium hat jemals ein anderes vollständig ersetzt. So ist auch klar, daß reduzierte Visualisierungsmethoden den Photorealismus niemals ersetzen werden. Doch müssen sich jene, die Geplantes darstellen und anderen *schmackhaft machen* müssen, darüber bewußt sein, daß ihr Planungserfolg in entscheidendem Maße davon abhängt, wie sie sich — auch in der

Visualisierung — auf das wesentliche beschränken, um Platz für Interpretation und individuelles Vorstellungsvermögen zu gewährleisten. Daß weniger mehr ist, bezweifelt im Grunde niemand, doch im Konzert technischer Möglichkeiten wird diese einfache Wahrheit immer wieder verschüttet.

Computergraphische Landschaftsvisualisierungen könnten sich zu einer perzeptuell effektiven „Benutzerschnittstelle" im Planungsprozess entwickeln. Voraussetzung dafür ist es, den Planungsbeteiligten im Vakuum zwischen Ist- und Sollzustand visuelle Trittsteine anzubieten, die sie in die Lage versetzen, mental in die visualisierten Landschaftszustände einzusteigen. Der Vielfalt solchen diplomatischen Handwerkszeugs sind keine Grenzen gesetzt, weitergehende Forschung kann jedoch auf systematische Weise einen Kanon solcher Angebote abgrenzen, durch den dokumentiert würde, daß Verantwortung ernstgenommen und aus Fehlern gelernt wird.

Anmerkungen

Eine ähnliche, englischsprachige Fassung des Beitrags ist in den Proceedings at Anhalt University 2005 erschienen (REKTTIKE und PAAR 2005). Die Deutsche Bundesstiftung Umwelt (DBU) hat das Verbundprojekt Lenné3D zur Entwicklung und Erprobung eines prototypischen 3D-Visualisierungswerkzeugs zur partizipativen Akteursbeteiligung in der Landschaftsplanung gefördert (www.lenne3d.de).

9 LITERATUR

APPLETON, K. & A. LOVETT: GIS-based visualisation of rural landscapes: defining "sufficient" realism for environmental decision-making; Landscape and Urban Planning 65, S. 117-131, 2003.

BERTIN, J.: Graphische Darstellungen und die graphische Weiterverarbeitung der Information; Berlin, New York: Walter de Gruyter, 1982.

BOEHM, G.: Die Wiederkehr der Bilder; in: Boehm, G. (Hrsg.): Was ist ein Bild? München, Fink, S. 11-38, 1994.

BUHMANN, E. (1994): Technische Möglichkeiten - EDV in der Landschaftsbildsimulation; Garten + Landschaft 10, S. 31-32, 1994.

DRAPER, J.V., D.B. KABER & J.M. USHER: Telepresence; Human Factors, 40, pp. 354-375, 1988.

ERVIN, S.M.: Landscape Visualization: Progress and Prospects; ESRI 2004 UC Proc, 2004. URL: http://gis.esri.com/library/userconf/proc04/docs/pap1647.pdf

ERVIN, S.M.: Digital landscape modeling and visualization: a research agenda; Landscape and Urban Planning 54 (1-4): pp. 49-62, 2001.

LANSDOWN, J. & S. SCHOFIELD: Expressive Rendering: A Review of Nonphotorealistic Techniques; IEEE Computer Graphics and Applications 15(3), pp. 29-37, 1995.

LANGE, E.: Realität und computergestützte visuelle Simulation. Eine empirische Untersuchung über den Realitätsgrad virtueller Landschaften am Beispiel des Talraums Brunnen/ Schwyz; ORL-Berichte 106. Zürich, VDF, 1999.

LEHMKÜHLER, S.: VRML – 3D-Standard des Web - Chance für die Raumplanung; CORP 98 Computergestützte Raumplanung, TU Wien, 1998.

MUHAR, A.: EDV-Anwendungen in Landschaftsplanung und Freiraumgestaltung; Stuttgart, Ulmer, 1992.

OH, K.: A Perceptual Evaluation of Computer-based Landscape Simulations; Landscape and Urban Planning 28, pp. 201-216, 1994.

ORLAND, B.: Data visualization techniques in environmental management: a consolidated research agenda; Landscape and Urban Planning 21, pp. 241-244, 1992.

ORLAND, B., C. OGLEBY, H. CAMPBELL & P. YATES: Multi-Media Approaches to Visualization of Ecosystem Dynamics; -in: Proceedings, ASPRS/ACSM/ RT'97, Seattle, American Society for Photogrammetry and Remote Sensing, Washington, DC, vol. 4, pp. 224-236, 1997.

PAAR, P. & J. REKITTKE: Lenné3D – Walk-through Visualization of Planned Landscapes; -in: Bishop, I.D. & E. Lange (eds.), Visualization in landscape and environmental planning, Spon Press, London, pp. 152-162, 2005.

PAAR, P. & J. REKITTKE: Geplante Landschaft – wie sie der Spaziergänger kennt. Lenné3D – Entwicklung eines Programms zur Landschaftsvisualisierung; Stadt+Grün 11, S. 26-30, 2003.

REKITTKE, J. & P. PAAR: Enlightenment Approaches for Digital Absolutism – Diplomatic Steping-Stones Between the Real and the Envisioned. – in: Buhmann, E., Paar, P., Bishop, I.D. & E. Lange (eds.), Trends in Real-time Visualization and Participation, Proc. at Anhalt University of Applied Sciences, Heidelberg, Wichmann, pp. 210-224, 2005.

REKITTKE, J., PAAR, P. & L. COCONU: Dogma 3D. Grundsätze der non-photorealistischen Landschaftsvisualisierung; Stadt+Grün 7, S. 15-21, 2004.

REKITTKE, J.: Drag and Drop – The Compatibility of Existing Landscape Theories and New Virtual Landscapes; -in: E. Buhmann, U. Nothhelfer, M. Pietsch (Eds.), Trends in GIS and Virtualization in Environmental Planning and Design, Proc. at Anhalt University of Applied Sciences, Heidelberg, Herbert Wichmann Verlag, S. 110-123, 2002.

REPTON, H.: Observations on the theory and practice of landscape gardening: including some remarks on Grecian and Gothic architecture; Taylor, London; Phaidon, Oxfort (facs.), 1803.

SHEPPARD, S. R.-J.: Guidance for crystal ball gazers: developing a code of ethics for landscape visualization; Landscape and Urban Planning 54 (1-4), pp. 183-199, 2001.

SHEPPARD, S. R.-J. (1999): Regeln für die Nutzung der digitalen Kristallkugel; Garten + Landschaft 11, S. 28-32.

WARREN-KRETZSCHMAR, B. & C.V. HAAREN: Online landscape planning – What does it take. A case study in Königslutter am Elm; -in: E. Buhmann (Eds.), Online landscape architecture. Proc. at Anhalt University of Applied Sciences. Heidelberg: Wichmann.

WERNER, A.; DEUSSEN, O.; DÖLLNER, J.; HEGE, H.-C.; PAAR, P. & J. REKITTKE: Lenné3D – Walking through Landscape Plans; -in: Buhmann, E., Paar, P., Bishop, I.D. & E. Lange (eds.), Trends in Real-time Visualization and Participation, Proc. at Anhalt University of Applied Sciences, Heidelberg, Wichmann, S. 48-59, 2005.

TUFTE, E.R.: Envisioning Information; Cheshire: Graphics Press, 1990.

ZUBE, E.H.; SIMCOX, D.E. & C.S. LAW: Perceptual landscape simulations: history and prospect; Landscape Journal 6 (1), pp. 62-80.

Von Oper zu Oper
FIRST – Die grenzüberschreitende Fahrplanauskunft für Wien und Bratislava

Lukas MADL, Stefan BRUNTSCH

ARC Seibersdorf research GmbH, Bereich Intelligente Infrastrukturen und Weltraumanwendungen, 2444 Seibersdorf, Österreich
lukas.madl@arcs.ac.at, stefan.bruntsch@arcs.ac.at

(FIRST steht für: **F**easibility of **i**nter**r**egional **s**ervices for **t**ravellers)

1 KURZFASSUNG

Mit der EU Erweiterung hat das Vierländereck Österreich, Tschechien, Slowakei und Ungarn einen wesentlichen Impuls erhalten. Nahezu alle Begrenzungen sind gefallen und die Wege für die Entwicklung eines prosperierenden Lebens- und Wirtschaftsraumes, sind frei. Diese neue „Europa-Region-Mitte" ist CENTROPE genannt worden.

FIRST hat erstmalig eine grenzüberschreitende Auskunft für öffentliche Verkehrsmittel mit einem neuen EU Mitgliedsland implementiert. Durch die Vernetzung der elektronischen Fahrplanauskunft der Region Wien mit Bratislava wird eine durchgehende Tür-zu-Tür Reiseplanung möglich. Ein Reisender erhält von seinem gewohnten Auskunftsportal eine verknüpfte Auskunft, die seine gesamte Reiseroute abzubilden vermag. Zusätzlich können Stadtpläne von den Ein- und Ausstiegsstellen mit den anschließenden Fußwegen abgerufen werden.

Diese Fahrplanauskunft wird aber nicht durch ein zentrales System mit einer integrierten Datenbank realisiert, sondern durch eine verteilte Systemarchitektur. Ein Austausch der regionalen Fahrplandaten ist somit nicht notwendig. Jeder Partner ist für die Pflege der Daten seines Netzes zuständig.

Der grenzüberschreitende FIRST Pilot soll als Katalysator wirken und ein flächendeckendes Informationsnetz in ganz CENTROPE etablieren helfen.

2 ZIEL UND MOTIVATION

Wien war bis 1918 Verkehrsdrehscheibe im ostmitteleuropäischen Raum. Wollte man von der Staatsoper in Wien zur Oper in Bratislava (Pressburg), musste man nur eine Straßenbahn nehmen. Seit 1945 waren alle Verbindungen nach dem Osten unterbrochen. Die Stadt Wien richtete sich ein halbes Jahrhundert ausschließlich nach dem Westen aus. Alle Fernstrecken endeten hier. Heute gibt es in Wien nur mehr Kopfbahnhöfe.

Mit der EU Erweiterung hat das Vierländereck Österreich, Tschechien, Slowakei und Ungarn einen wesentlichen Impuls erhalten. Nahezu alle Begrenzungen sind gefallen und die Wege für die Entwicklung eines prosperierenden Lebens- und Wirtschaftsraumes, sind frei. Im Herbst 2003 haben 14 Landeshauptleute, Präsidenten und Bürgermeister aus der „Europa-Region-Mitte" die Initiative „CENTROPE" gestartet. Ziel von CENTROPE ist es, eine gemeinsame Perspektive für diesen europäisch einmaligen Raum zu entwerfen und ihn durch kooperative Anstrengungen zu einer der Top-Regionen in Europa zu machen.

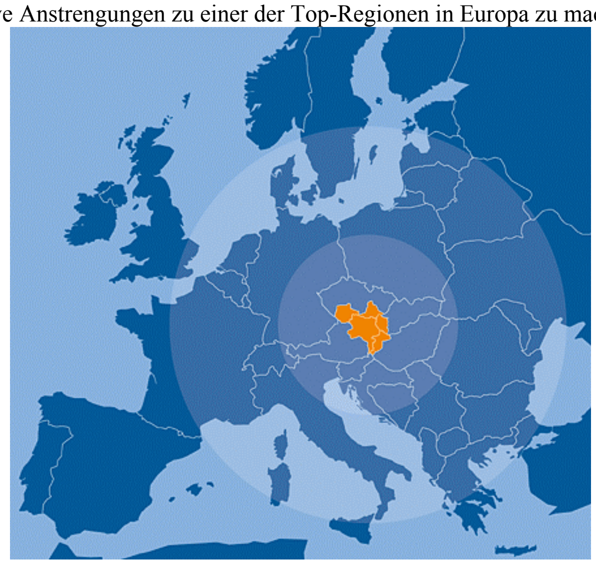


Abbildung 1: CENTROPE: Die neue Europa-Region-Mitte (Quelle: www.centrope.com)

Besonders die unmittelbare Nähe von urbanen Zentren mit außerordentlich schönen und substanzreichen Landschaften macht CENTROPE zu einer Region von höchster Lebensqualität. In CENTROPE soll nun modellhaft gezeigt werden, wie der Mensch im Einklang mit der Natur leben, sie wirtschaftlich nutzen kann, ohne sie zu zerstören.

Die neu entstehenden Verkehrsströme in CENTROPE können nur dann umweltgerecht abgewickelt werden, wenn die öffentlichen Verkehrsmittel verstärkt genützt werden. Neben notwendigen Infrastrukturmaßnahmen ist es wichtig, die öffentlichen Fahrverbindungen attraktiv zu präsentieren und leicht zugänglich zu machen. Deshalb hat sich das EU-Projekt FIRST zum Ziel gesetzt, einen grenzüberschreitenden Reiseinformationsdienst für den öffentlichen Verkehr zu schaffen. Das Projekt wird von den Austrian Research Centers Seibersdorf koordiniert und in dem europäischen Programm eContent kofinanziert. Mit FIRST wurde ein Pilotsystem für die einzigartige „doppelte Hauptstadtregion", nämlich Wien – Bratislava, dem Herz von CENTROPE, implementiert. Ein Reisender kann damit via Internet durchgängige, Tür-zu-Tür Routen über die Grenze hinweg planen.

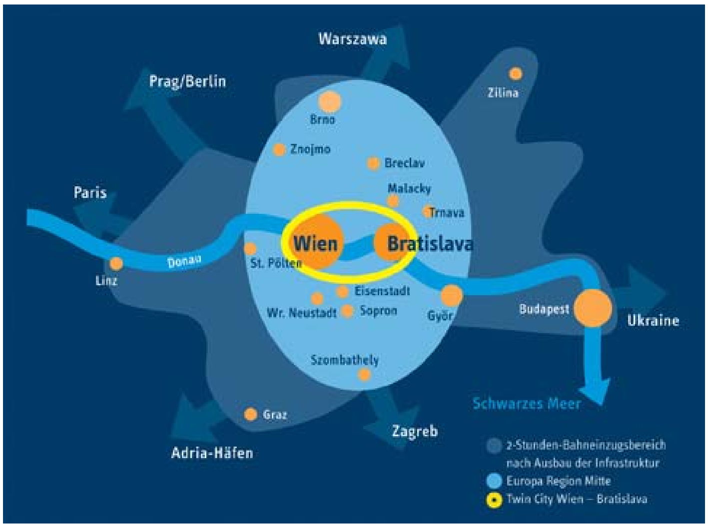


Abbildung 2: Die Twin-City Region: Wien-Bratislava (Quelle:www.twin-city.net Copyright Starmühler)

Dieser grenzüberschreitende FIRST Pilot soll als Katalysator wirken und ein flächendeckendes Informationsnetz in ganz CENTROPE etablieren helfen.

3 DIE ARCHITEKTUR VON FIRST

Die meisten Verkehrsverbünde bieten heute über das Internet online Fahrplan-, Preis- und Streckeninformationen an. So auch zwei Partner aus dem FIRST Konsortium, die Verkehrsverbund Ost Region GmbH (VOR) und die Verkehrsbetriebe Bratislava (DPB). Ihre Kunden können auf diese Weise schnell und immer aktuell die optimale Fahrverbindung abrufen. Die Auskunft ist aber auf die jeweilige Region der Verkehrsbetreiber beschränkt. FIRST verknüpft nun die elektronische Fahrplanauskunft des österreichischen mit dem slowakischen Partner.

Abbildung 3: FIRST: Die grenzüberschreitende Fahrplanauskunft

Ein Reisender erhält von seinem gewohnten Auskunftsportal, sei es VOR oder DPB, mit minimalem Aufwand eine verknüpfte Auskunft, die seine gesamte Reiseroute abzubilden vermag. Diese Fahrplanauskunft wird aber nicht durch ein zentrales System mit einer integrierten Datenbank realisiert, sondern durch eine verteilte Systemarchitektur. Ein Austausch der regionalen Fahrplandaten ist somit nicht notwendig. Jeder Partner ist für die Pflege der Daten seines Netzes zuständig. Dadurch ist eine hohe Qualität und Aktualität der Auskunft gewährleistet.

Die Basis für das verteilte System in diesem Pilotprojekt bilden die Anwendungen

- DIVA (Dialoggesteuertes Verkehrsmanagement- und Auskunftssystem) und
- EFA (Elektronische Fahrplanauskunft).

Diese beiden Software-Applikationen wurden von der Firma Mentz Datenverarbeitung GmbH (MDV), ein weiterer FIRST Partner, entwickelt.

VOR hatte die DIVA-/ EFA-Applikationen bereits vor FIRST in Verwendung. DPB nutzte ein System eines anderen Software-Hauses. Bei FIRST wurde eine im Wesentlichen symmetrische Architektur durch die Installation von DIVA und EFA bei DPB, implementiert.

Die Software-Systeme sind somit auf den souveränen Servern beider Verkehrsunternehmen installiert und ermöglichen damit die durchgängige Fahrplanauskunft. Bei einer überregionalen Auskunft werden die einzelnen Routenteile durch den jeweiligen Server berechnet, der die betreffende Region abdeckt. Eine besondere Herausforderung liegt hier in der Realisierung der Zweisprachigkeit aller Ein- und Ausgaben.

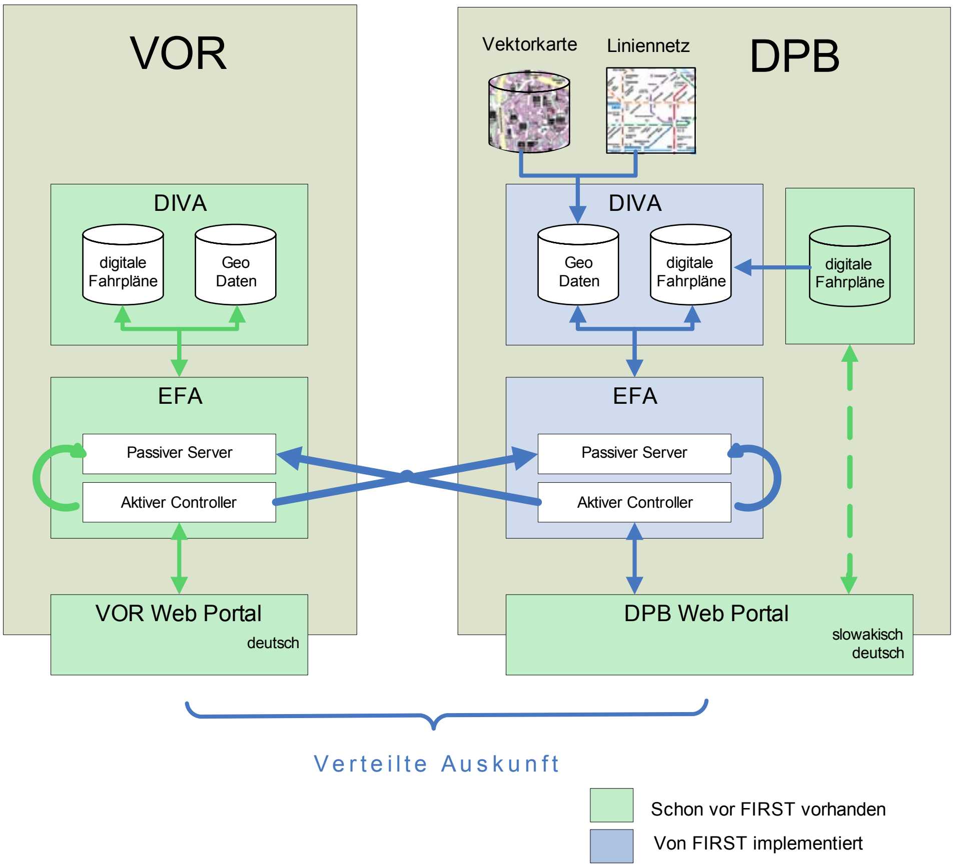


Abbildung 4: Die Architektur von FIRST

4 STADTPLÄNE

Durch die Einbindung von georeferenzierten Informationen in eine Fahrplanauskunft können multimodale Routen dargestellt werden. Die Karten werden einerseits zur optimalen, adressscharfen Tür-zu-Tür Auskunft benutzt, andererseits können dem Kunden auch dynamisch erzeugte, maßgeschneiderte Karten für Fußwege und Umstiege angeboten werden. Karten und Pläne erleichtern damit das Auffinden von Haltestellen erheblich und liefern auch Informationen über den Weg vom Start-/Zielpunkt bis zur Haltestelle.
VOR hatte bereits zu Beginn von FIRST für sein Versorgungsgebiet Karten hinterlegt. Um über die gesamte FIRST Region Karten zur Abfrage zur Verfügung zu haben, hat das Konsortium beschlossen, diese auch für den Raum Bratislava zu erstellen. Es wurden daher kommerziell erhältliche, routingfähige Vektorkarten von Bratislava besorgt. Die Haltestellen des öffentlichen Verkehrsnetzes sind mit Koordinaten versehen und in das DIVA System eingepflegt worden.

Abbildung 5: Umgebungskarten für verschiedene Stationen

5 KERNFUNKTIONALITÄTEN VON FIRST

Mit FIRST werden angeboten:

- alle Fahrpläne der Verkehrsverbund Ostregion (VOR),
- alle Fahrpläne der Bratislavaer Verkehrsbetriebe (DPB) und
- die Fahrpläne der interregionalen Zug- und Busverbindungen (ÖBB und ZSSK) zwischen Wien und Bratislava. Diese Fahrpläne sind auf dem VOR Server abgespeichert.

Die Fahrplanauskunft enthält:

- Fahrtempfehlungen für Fahrten von A nach B mit Abfahrts- und Ankunftszeiten aller Haltepunkte, Fahrtdauer und Umsteigeanzahl der Verbindung sowie Verkehrsmittelbezeichnung und Richtungsangabe.
- Für Adressen (Straße und Hausnummer) als Start und Ziel können dynamisch generierte Stadtplanausschnitte im PDF-Format aufgerufen werden, in die der Fußweg von bzw. zur Haltestelle sowie der Linienverlauf der benutzten Linie, eingetragen ist. An Umsteigehaltestellen werden entsprechende Kartenausschnitte mit den jeweiligen benutzten Linien angeboten.

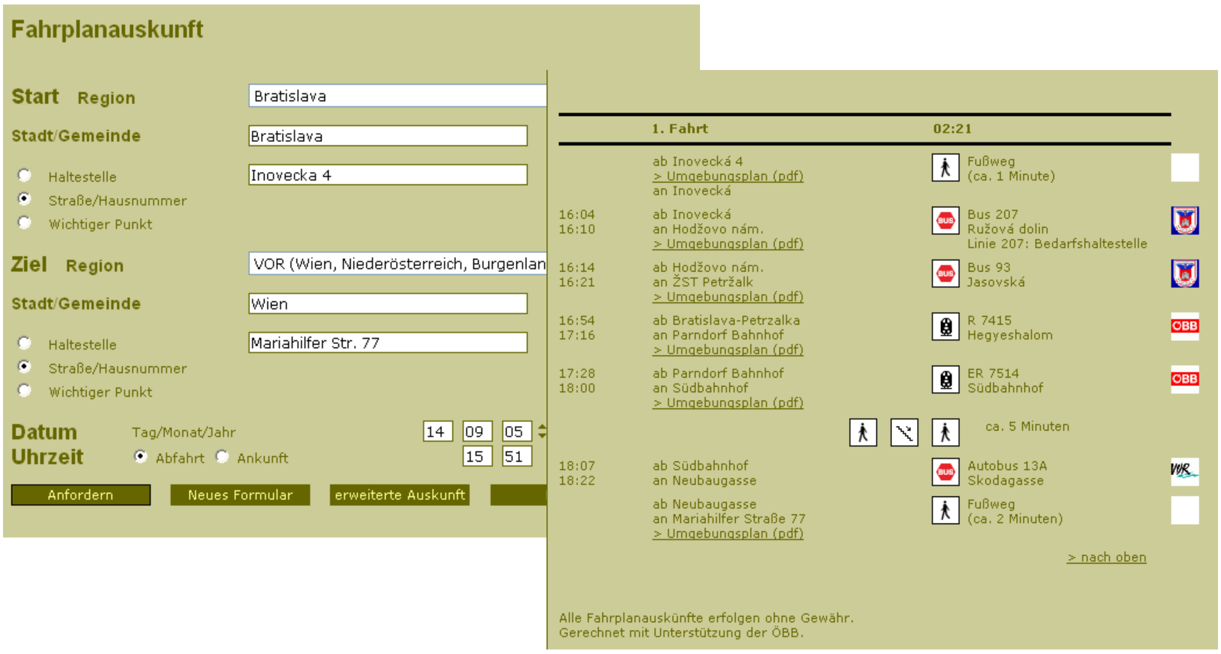


Abbildung 6: Eingabemaske und Routenergebnisse der FIRST Fahrplanauskunft

6 FIRST ERWEITERUNG IN CENTROPE

Der rege Austausch zwischen den Teilregionen von CENTROPE spiegelt sich in einer steigenden Verkehrsnachfrage wieder. Um eine nachhaltige Abwicklung des Verkehrs zu gewährleisten, muss das Reisen mit den öffentlichen Verkehrsmitteln attraktiver gemacht und der Zugang zum öffentlichen Verkehr erleichtert werden. Mit dem FIRST Piloten soll ein interregionales, vernetztes Reiseinformationssystem in ganz CENTROPE initiiert werden.

Wie bei FIRST sollen für die interregionale CENTROPE Fahrplanauskunft nicht alle Fahrplandaten in einer zentralen Datenbank integriert werden. Vielmehr werden bestehende, regionale Fahrplanauskunftssysteme zu einem verteilten System miteinander vernetzt. Der Kunde steigt demnach weiterhin in sein regionales Auskunftsportal ein, gibt die überregionalen Reisedaten ein und das System erkennt automatisch, welcher regionale Server welchen Teil der überregionalen Route zu berechnen hat. Die Routenergebnisse werden wie gewohnt in aller Detailliertheit und mit Übersichts- sowie Umgebungskarten präsentiert. Um dieses verteilte Reiseinformationssystem zu realisieren, müssen Schnittstellen implementiert werden, über die die verschiedenen regionalen Systeme miteinander kommunizieren können. Außerdem werden Übergangspunkte (Orte bzw. Haltestellen) zwischen den einzelnen regionalen Netzen festgelegt, um die Grenzen der Zuständigkeiten der verschiedenen Server zu definieren.

7 INTEROPERABILITÄT

In den letzten Jahren sind in Europa offene Standards entwickelt worden, mit denen isolierte Fahrplandienste untereinander verbunden werden können. Hier ist besonders EU-Spirit[1] und DELFI[2] zu erwähnen. Die EU-Sprit-Technologie eignet sich insbesondere für die Berechnung von Fernreisen, d.h. für Routen mit einem langen Hauptteil und kurzen Zu- und Abgangswegen zum und vom Bahnhof oder Flughafen in der Region. Im Gegensatz dazu ist die DELFI Schnittstelle für Netzwerke gleichberechtigter regionaler Server konzipiert worden. Das System bietet sich an, um räumlich weit verteilte Gebiete per Auskunft zu verknüpfen oder auch um dynamische Informationen einzubinden. DELFI basiert auf einer CORBA (Common Objects Requests Broker Architecture)-Implementierung und einer Schnittstellendefinition in IDL (Interface Definition Language). Koordiniert werden die Abfragen durch einen so genannten Suchkontroller, der über Schnittstellen (APIs) mit den anderen Rechnern verbunden ist und von ihnen die notwendigen Teilinformationen abfragen kann.

1 www.eu-spirit.com
2 www.delfi.de

Auf der Basis von DELFI entwickelt auch die österreichische Initiative austria.net eine regionsübergreifende Fahrplanauskunft. Allerdings wurde die zu Grunde liegende Technologie von CORBA auf XML umgestellt. Mit der verteilten Auskunft austria.net ist es auch in Österreich möglich, überregionale Fahrten über mehrere Server hinweg zu berechnen.
Die Definition der CENTROPE Schnittstelle für die interregionale Vernetzung wird sich am DELFI und austria.net Standard orientieren. Das bedeutet, dass basierend auf XML die verschiedenen regionalen Server verknüpft werden.

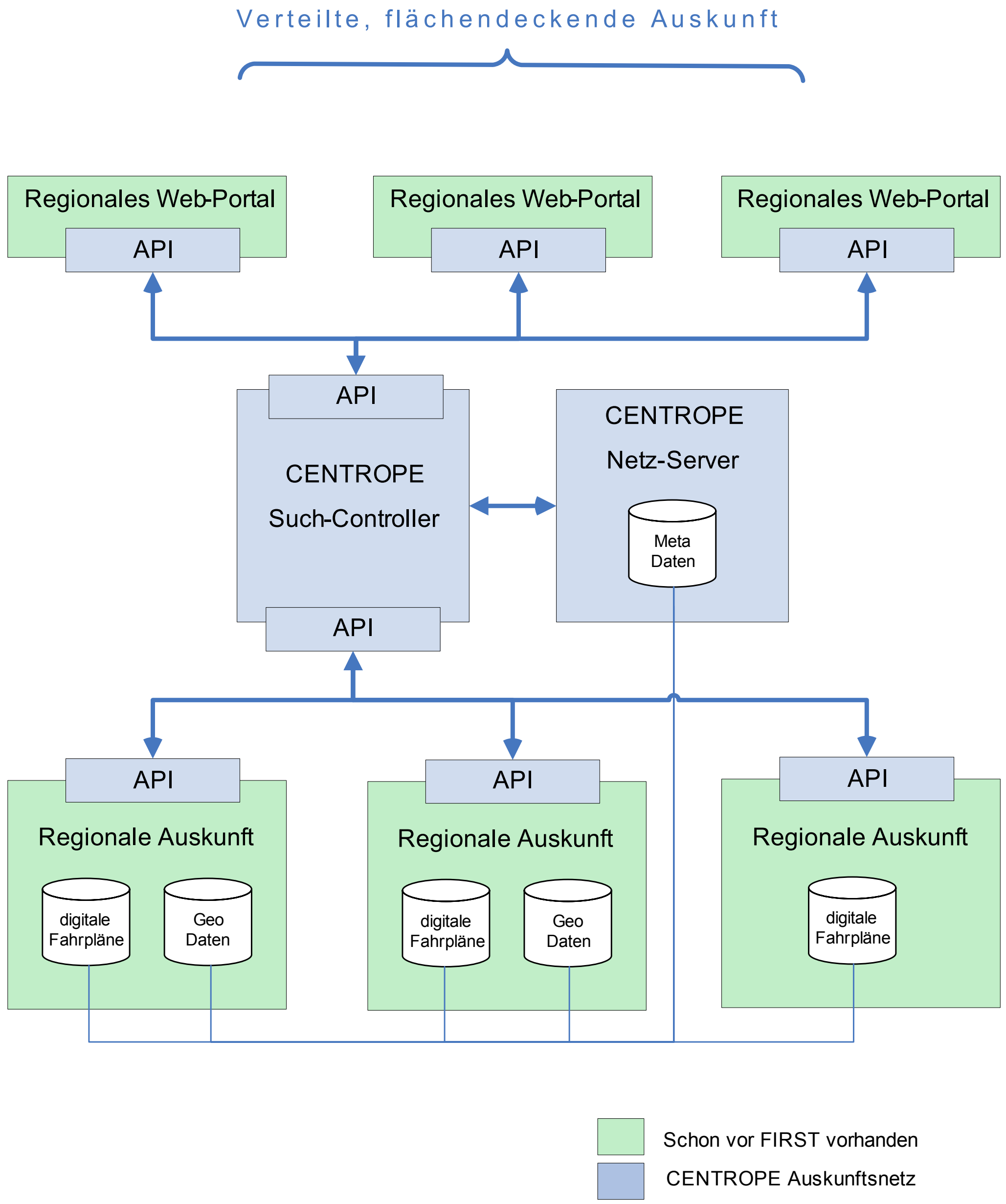


Abbildung 7: Vorgeschlagene Architektur für ein CENTROPE Auskunftsnetz

8 ZUKÜNFTIGE DIENSTE

Neben der geografischen Erweiterung von FIRST sollen in der Zukunft auch weitere Dienste integriert werden. Zum einen können dem Reisenden entsprechende Auskunftsdienste in gleichem Umfang auch auf Mobiltelefonen zugänglich gemacht werden. Zum anderen ist geplant, das Fahrplanauskunftssystem zu einem multimodalen Reiseinformationssystem weiterzuentwickeln, mit dem neben der Routenplanung z.B. auch Parkinformationen oder Informationen über wichtige Punkte und Sehenswürdigkeiten abgerufen werden können. Darüber hinaus wird es möglich sein, das Ticket für die geplante Verbindung elektronisch kaufen und bezahlen zu können.

9 DANKSAGUNGEN

Wir danken unseren Partnern Verkehrsverbund Ost Region GmbH, den Bratislavaer Verkehrsbetrieben und der Firma Mentz Datenverarbeitung GmbH für die produktive Zusammenarbeit im FIRST Projekt.
Außerdem wollen wir uns bei der EU-Kommission und dem Land Niederösterreich für die finanzielle Unterstützung bedanken.

Routennetze für mobile Fußgänger-Navigationsanwendungen: ein neuer Ansatz für die Optimierung auf Basis von quantitativen Bewegungsdaten

Alexandra MILLONIG

(DI Alexandra Millonig, arsenal research, Human Centered Mobility Technologies, Giefingsstraße 2, 1210 Wien, alexandra.millonig@arsenal.ac.at)

1 KURZFASSUNG

Da sich das Navigations- und Routenwahlverhalten von Fußgängern aufgrund einer Vielzahl relevanter Einflussfaktoren als sehr komplex darstellt, ist die Erstellung optimaler Routen eine der wesentlichen Herausforderungen für die derzeit in Entwicklung befindlichen Fußgänger-Navigationssysteme. Während bestimmte Personen möglichst bequeme Wege bevorzugen, legen andere mehr Wert auf Sicherheit. Daraus ergeben sich ungleich gewichtete Qualitäten von Routen (z.B. Komfort, Sicherheit, Attraktivität), die von unterschiedlichen Fußgängergruppen favorisiert werden. Derzeit existieren erst einige wenige Ansätze einer Kategorisierung des Bewegungsverhaltens im Hinblick auf gruppenspezifische Präferenzen für bestimmte Routenqualitäten. Der Fortschritt auf dem Gebiet der automatisierten Verfolgung von Verkehrsströmen eröffnet eine Möglichkeit, das Bewegungsverhalten direkt zu erfassen und zu analysieren. Der vorliegende Beitrag stellt einen innovativen Ansatz vor, mit Hilfe der Gewinnung quantitativer Bewegungsdaten das Routenwahlverhalten von Fußgängern zu analysieren und erlaubt so die Definition typspezifischer Routenqualitäten in Ergänzung zu qualitativen Methoden der Verhaltenskategorisierung. Künftigen mobilen Navigationsdiensten eröffnet sich auf Basis dieser Grundlage die Chance, dem jeweiligen Nutzer zur Erreichung einer bestimmten Destination eine seinen speziellen Präferenzen und den gegebenen Rahmenbedingungen entsprechende optimale Route anzubieten. Dies wiederum kann eine entsprechende Erhöhung des Komforts und damit eine Aufwertung des Fußgängerverkehrs bewirken. Die Untersuchung wird im Rahmens eines Forschungsprojekts durchgeführt, das die Entwicklung eines ubiquitären Navigationssystems für Fußgänger zum Ziel hat.

2 EINLEITUNG

Steigende Verkehrszahlen, immer häufiger auftretende Verkehrsbehinderungen und die Forderung nach einer Erhöhung der Verkehrssicherheit haben in den vergangenen Jahren zur Entwicklung von Verkehrstelematiksystemen geführt, welche eine Steigerung der Effizienz der vorhandenen Verkehrsinfrastruktur versprechen. Ein zentraler Aspekt der Telematik sind Lokalisierungstechnologien und Navigationssysteme. Erst in jüngerer Vergangenheit wurde damit begonnen, diese Technologien auch für Fußgänger nutzbar zu machen. Doch während fahrzeuggebundene Systeme bereits gute Ergebnisse bei der Bereitstellung einer „kürzesten“ oder „schnellsten“ Route zu einem gewünschten Ort erzielen, stehen Fußgängernavigationssysteme noch am Beginn ihrer Entwicklung. Forschungsbedarf besteht unter anderem vor allem im Bereich technischer Einschränkungen wie unzureichende Lokalisierungsgenauigkeit oder ungenügende Datengrundlagen (z.B. fehlende Informationen über Landmarken). Da Fußgänger oft andere Wege als die kürzeste Verbindung zu einem bestimmten Ziel wählen, besteht auch Forschungsbedarf im Bereich der Erstellung relevanter Routennetze,.

Bei der Entwicklung von Fußgängernavigationssystemen muss daher vor allem bei der Generierung von Routennetzen der Einfluss zahlreicher Parameter, die das Routenwahlverhalten bestimmen, berücksichtigt werden. Die Beobachtung des Bewegungsverhaltens liefert dabei notwendige Erkenntnisse, um Rückschlüsse auf gruppenspezifische Routenwahlpräferenzen und individuelle Einflussfaktoren treffen zu können. Der hier vorgestellte Ansatz beinhaltet erstmals die Kombination von qualitativen und quantitativen Untersuchungsmethoden, die eine Definition typspezifischer Routenqualitäten ermöglichen. Dies eröffnet die Chance, in künftigen Navigationssystemen gezielt auf die Bedürfnisse der Nutzer einzugehen, und eine ihren spezifischen Präferenzen und den gegebenen Rahmenbedingungen entsprechende optimale Route vorzuschlagen. Die Untersuchung ist Teil eines Forschungsprojektes, dessen Ziel in der Exploration von Möglichkeiten zur Vermittlung von standortbasierten Informationen und Navigationshilfen über ein ubiquitäres Netzwerk liegt, wodurch die eine Verbesserung der Wegfindung in so genannten „smart environments“ ermöglicht wird. Die Effizienz und der Komfort eines ubiqitären Navigationssystems lassen sich dabei vor allem durch die Möglichkeit steigern, dass das System vom Navigationsverhalten des Benutzers lernen und sich daher an die individuellen Bedürfnisse, Ansprüche und Gewohnheiten des Nutzers anpassen kann. Um eine rasche Adaption an die individuellen Präferenzen gewährleisten zu können, müssen grundlegende Mobilitätsstile identifiziert werden. Die vorliegende Untersuchung setzt sich zum Ziel, ein Modell solcher typbedingter Fußgänger-Mobilitätsstile zu formulieren.

Der Rest dieser Arbeit ist folgendermaßen organisiert: Abschnitt 2 beschreibt die Problemstellung und den aktuellen Stand der Forschung auf dem Gebiet des Routenwahlverhaltens von Fußgängern und bei der Untersuchung des Raumverhaltens. Abschnitt 3 erläutert die Methode des hier vorgestellten Ansatzes und beschreibt die Erstellung eines Modells typbedingter Mobilitätsstile. Abschließend erfolgt in Abschnitt 4 eine kurze Zusammenfassung und zukünftig erforderliche Forschungsschwerpunkte.

3 PROBLEM UND AKTUELLER STAND DER FORSCHUNG

Gegenwärtig orientiert man sich bei der Entwicklung von mobilen Fußgängernavigationssystemen in der Regel vor allem an Konzepten von Fahrzeugnavigationsdiensten. Fußgänger stellen allerdings die weitaus empfindlichste Gruppe von Verkehrsteilnehmern dar, welche entsprechend sensibel auf individuell als ungünstig empfundene Bedingungen reagiert. Daher wird in vielen Fällen von Fußgängern der kürzeste Weg zu einem bestimmten Ziel als nicht optimal bewertet.[1]

3.1 Einflussfaktoren auf das Routenwahlverhalten

Untersuchungsergebnissen in [Wiener et al. 2004] zufolge werden weniger komplexe Routen jenen Wegen vorgezogen, welche zwar eine kürzere Distanz aufweisen, aber eine größere Anzahl von Entscheidungspunkten beinhalten („least-decision-load“-Strategie). Abb. 1 illustriert ein Beispiel für die Neigung von Fußgängern, die Komplexität einer Route zu einem Ziel zu minimieren: An Stelle

[1] unter der Voraussetzung, dass kein zu großer Zeitdruck empfunden wird.

ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

des kürzesten Weges (rote Route, rechts) wird eine Vebindung mit weniger möglichen Richtungsentscheidungen (grüne Route, links) gewählt , selbst wenn dadurch eine längere Distanz zurückgelegt werden muss.

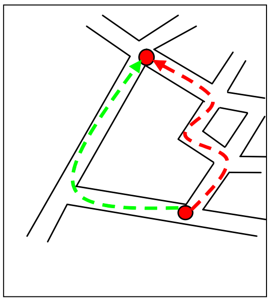


Abb. 1:.Least decision Load Strategie von Fußgängern

Auch innerhalb von Gebäuden werden oft unterschiedliche Wege gewählt, um ein bestimmtes Ziel zu erreichen. Die Resultate einer Befragung [Millonig 2005] an einem großen Bahnhof haben etwa ergeben, dass mehrere unterschiedliche Verbindungen zwischen einem Punkt auf der oberen Bahnsteigebene und einem Punkt auf der U-Bahnebene beschrieben werden, die drei Ebenen darunter liegt. Die Präferenz für bestimmte Routen hängt dabei von mehreren Faktoren ab (Länge der Distanz; Bequemlichkeit: Rolltreppe oder Treppe; Vertrautheit mit der Umgebung; Witterung: komplexerer aber innen gelegener Weg oder weniger komlexer Weg durch den Außenraum). Abb. 2 zeigt die Häufigkeit der bei der Befragung angegebenen Routenanweisungen. Die durchgezogene graue Linie zeigt die am meisten genannte Route, die anderen drei Wege wurden weniger häufig beschrieben.

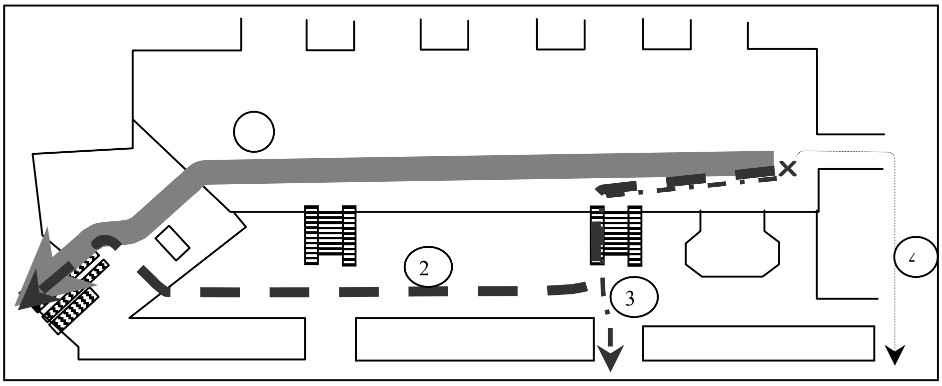


Abb. 2: Häufigkeit der genannten Routen zwischen oberer Bahnsteigebene und drei Ebenen tiefer gelegener U-Bahnebene (siehe Text).

Studienergebnisen in [Thomas 2003]. zufolge verzichten Menschen oft darauf, den „kürzesten“ Weg zu wählen und bevorzugen statt dessen den „schönsten“, den „bequemsten“ oder auch den „sichersten“ Weg Sicherheit ist eine besonders wichtige Qualität, vor allem wenn unbekannte Umgebungen bei Dunkelheit durchquert werden müssen oder eine Route durch ein Gebiet mit zweifelhaftem Ruf führt. Die Bereitschaft, einen längeren Umweg in Kauf zu nehmen, ist dabei einerseits von der individuellen Ängstlichkeit der betreffenden Person als auch von der Erscheinung der Umgebung abhängig. Weitere Studien liefern Erkenntnisse darüber, inwieweit Fußgänger bestimmte Strecken aufgrund ihrer Umweltqualitäten wie relative Ruhe oder Begrünung bevorzugen [Blivice 1974].
Generell lassen sich die Faktoren, welche das Routenwahlverhalten bestimmen, in vier sich zum Teil gegenseitig beeinflussende Kategorien unterteilen: zunächst wird das Verhalten durch physische, psychologische und mentale Routenqualitäten [Millonig und Schechtner 2005] beeinflusst. Physische Routenqualitäten umfassen Einflussgrößen, die den physischen Aufwand für die Bewältigung eines bestimmten Weges betreffen (Entfernung, Steigung, Level of Service, Schutz vor Umwelteinflüssen). Psychologische Routenqualitäten beinhalten die Struktur und das Erscheinungsbild einer Umgebung, welche wesentlichen Einfluss darauf haben, wie „wohl“ sich ein Fußgänger bei der Durchquerung dieser Umgebung fühlt (Attraktivität der Umgebung, Verfügbarkeit bestimmter Einrichtungen, Sicherheit). Mentale Routenqualitäten wiederum betreffen den mentalen Aufwand, der für die Erreichung des gewünschten Ziels erforderlich ist. Sie umfassen einerseits die Komplexität und die Anzahl der vorhandenen möglichen Entscheidungspunkte einer Route. Da Landmarken eine wesentliche Rolle bei der menschlichen Orientierung spielen [Michon und Denis 2001, Tom und Denis 2003], beinhalten mentale Routenqualitäten auch die Verfügbarkeit verlässlicher und auffälliger Landmarken entlang des Weges. Raumbezogenes Handeln, also die Art und Weise, in der der Raum angeeignet und genutzt wird, symbolisiert aber auch die gesellschaftliche Positionierung eines Individuums [Löw 2001]. Der Lebensstil eines Menschen drückt seine Wertvorstellungen und Einstellungen aus und bestimmt auch in wesentlichem Maße, wie und wo sich eine Person durch den Raum bewegt. Daher ist bei der Untersuchung des Routenwahlverhaltens von Fußgängern auch zu berücksichtigen, inwieweit spezifische Lebensstile die Wahl eines bestimmten Weges beeinflussen. Die Einflussfaktoren auf Raumverhalten und Routenwahl werden in Abb. 3 dargestellt.

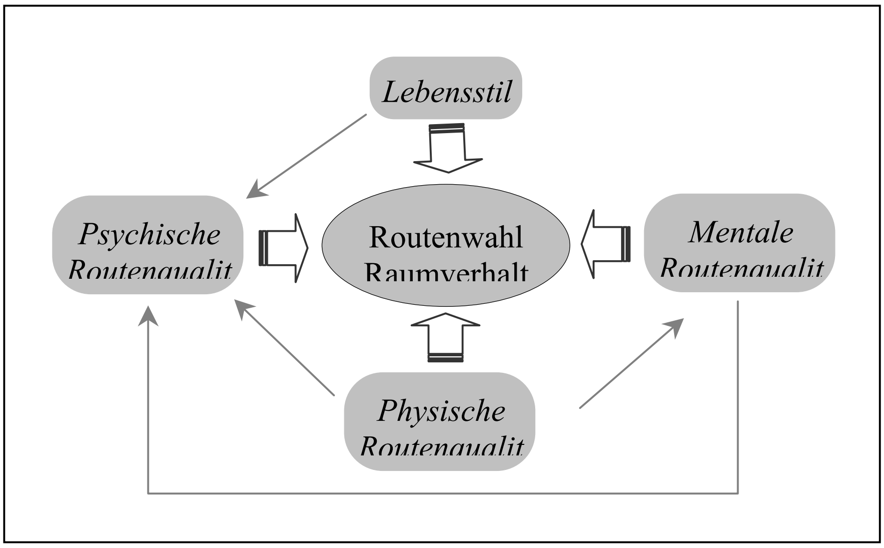


Abb. 3: Haupteinflussfaktoren auf das menschliche Routenwahlverhalten.

3.2 Stand der Forschung bei der Untersuchung des Raumverhaltens

Aufgrund der großen Zahl relevanter Einflussfaktoren auf das menschliche Routenwahlverhalten beschränken sich Forschungen meist auf die Untersuchung und Beschreibung einiger weniger spezifischer Faktoren bei der Analyse des Routenwahlverhaltens und Orientierungsverhaltens von Fußgängern. So werden beispielsweise nur bestimmte Personengruppen betrachtet (z.B. Alterskohorten) [Ahrend 2002], oder es wird das Bewegungsverhalten in einer bestimmten räumlichen Umgebung beobachtet [Yan und Forsyth 2005], oder die Studie konzentriert sich auf das Verhalten in bestimmten Situationen (z.B. in der Freizeit) [Götz et al. 2002].
Hinsichtlich der Methoden werden bei der Erforschung des Orientierungs- und Routenwahlverhaltens vorwiegend qualitative Verfahren wie Beobachtung oder Befragung eingesetzt [Ovstedal und Olaussen Ryeng 2002, Götz und Birzle-Harder 2005, Götz et al. 2003]. Diese Methoden haben allerdings einige Nachteile: Bei der Beobachtung und Skizzierung der Wege einzelner Personen ist aufgrund des hohen Aufwands nur die Betrachtung einer kleinen Stichprobe möglich. Befragungen liefern zwar wichtige Erkenntnisse über Motive und Präferenzen bei der Routenwahl, aber die Validität der Antworten ist nicht gesichert, da Menschen sich zum einen über ihre eigenen Beweggründe nicht immer bewußt sind, und zum anderen je nach Art der Fragestellung antwortverzerrende Effekte auftreten können [Esser 1985].
Um das Verhalten größerer Stichproben zu untersuchen, können quantitative empirische Daten erfasst werden. Die Wege der Personen können dabei mittels automatischer Videoauswertung oder mit satellitengestützten bzw. terrestrischen Lokalisierungstechnologien aufgezeichnet und analysiert werden. Oft werden dabei lediglich Laborexperimente durchgeführt, weil dadurch die Rahmenbedingungen möglichst konstant gehalten werden können [z.B. Daamen und Hoogendorn 2003]. Allerdings bewirkt das künstliche Design der Untersuchung wiederum Verhaltensänderungen der Probanden. Bei der Beobachtung und Analyse von Daten, die in realen, natürlichen Umgebungen erhoben werden, sind solche verzerrenden Effekte nicht vorhanden. Allerdings gibt die reine Beobachtung der Menschen keine Aufschlüsse darüber, welche individuellen Präferenzen, Verhaltensmuster oder Einstellungen zu der Wahl einer bestimmten Route geführt haben [z.B. Shoval und Isaacson 2005].
Die Untersuchung des Routenwahlverhaltens bei Fußgängern gestaltet sich also aufgrund der Komplexität der Einflussfaktoren und der bislang fehlenden Kombination qualitativer und quantiativer Untersuchungsmethoden sehr schwierig. Um das Routenwahlverhalten zu beschreiben, ist es daher nicht ratsam, auf sämtliche oder möglichst viele Einflussfaktoren einzeln einzugehen, sondern das Verhalten zu beobachten und Bewegungsmuster zu klassifizieren. Eine Typologie des Fußgängerverhaltens bei Routenenscheidungen kann Unterschiede im Bewegungsverhalten der Menschen erklären und Hinweise darauf liefern, für welche Personengruppen welche räumlichen Informationen relevant sind. Zur Erstellung einer solchen Typologie ist es zweckmäßig, sowohl qualitative also auch quantitative Methoden einzusetzen, um einerseits den Einfluss von Lebensstil, bestimmten Einstellungen und Präferenzen auf das Routenwahlverhalten untersuchen zu können, und andererseits eine hinreichend große Gruppe von Menschen in verschiedenen Situationen beobachten zu können.

4 ERSTELLUNG EINES MODELLS TYPBEDINGTER MOBILITÄTSSTILE

Der vorliegende Ansatz versucht das Routenwahlverhalten von Fußgängern nicht durch die Untersuchung einzelner Einflußfaktoren zu erklären, sondern geht von der Hypothese aus, dass individuelle Bewegungsmuster und Routenwahlentscheidungen spezifischen Fußgängertypen zugeordnet werden können. Diese Typen werden wiederum zu einem wesentlichen Teil von den dem Verhalten zugrundeliegenden Lebensstilen der Menschen beeinflusst. Lebensstile, Motive und Präferenzen werden mit Hilfe qualitativer Untersuchungsmethoden erhoben, um eine vorläufige Typologie der Mobilitätsstile von Fußgängern zu erstellen. Die Homogenität des Bewegungsverhaltens innerhalb jedes Typus wird mittels quantitativen empirischen Daten, welche mit Hilfe von GPS und Bluetooth gewonnen werden, überprüft. Abbildung 4 zeigt eine Übersicht über die erforderlichen Schritte zur Erstellung eines Modells typbedingter Fußgänger-Mobilitätsstile.

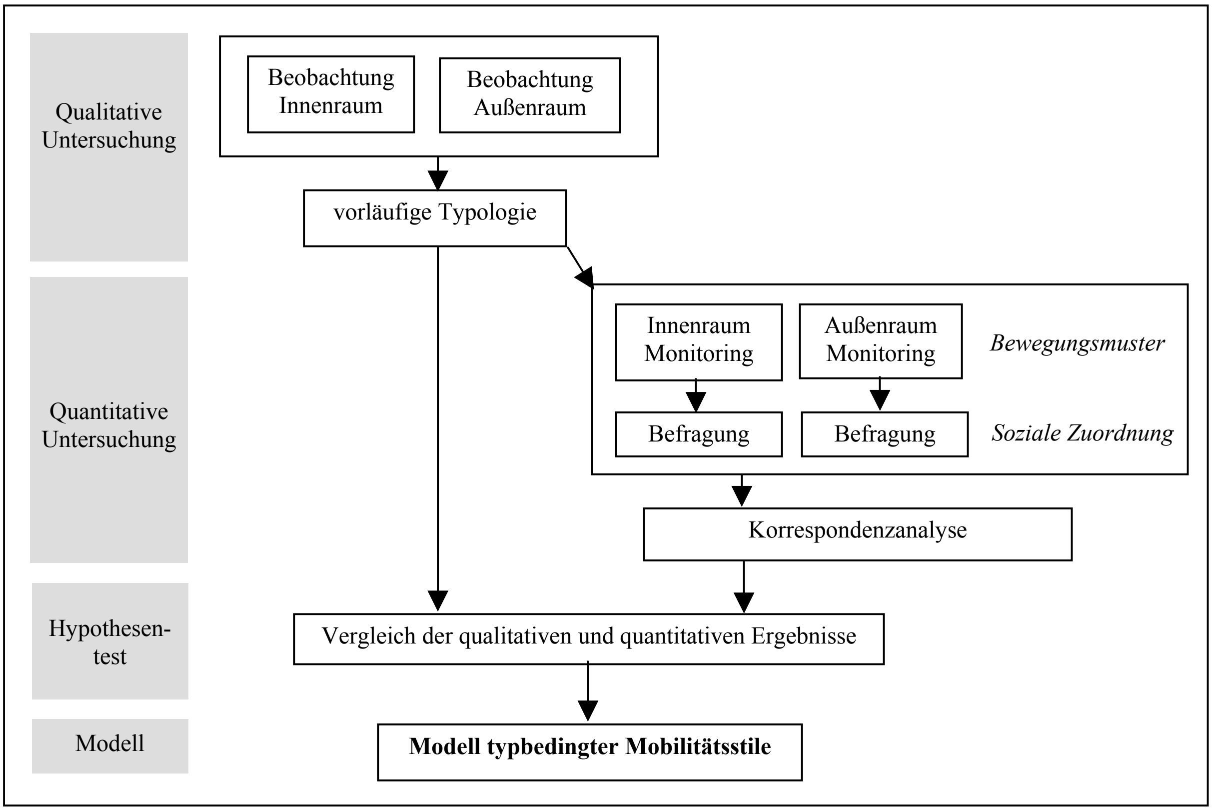


Abb. 4: Untersuchungsschritte zur Erstellung eines Modells typbedingter Fußgänger-Mobilitätsstile

4.1 Untersuchungsmethode

Zur Erstellung vorläufiger Grundtypen hinsichtlich des Orientierungs- und Routenwahlverhaltens werden zunächst Erkenntnisse aus Untersuchungen der wissenschaftlichen Community, welche Klassifizierungsansätze des Bewegungsverhaltens behandeln, analysiert. Anschließend werden duch klassische Feldbeobachtungen (Verfolgen von Fußgängern und Aufzeichnung der Wege durch Versuchsleiter, Stopps und Gehgeschwindigkeiten) grundlegende Typen definiert (z.B. „zielstrebiger Typ“, „bummelnder Typ“ oder ähnliches). Dabei werden Menschen mit verschiedenen soziostrukturellen (Geschlecht, Altersklasse) Eigenschaften beobachtet, gleichzeitig werden Beobachtungen unter unterschiedlichen Rahmenbedingungen hinsichtlich Umgebung (innen-außen), Tageszeit und Witterung durchgeführt.

Bei der anschließenden Erhebung quantitativer empirischer Daten wird das Bewegungsverhalten der Fußgänger in zwei Einkaufsumgebungen (Einkaufszentrum und Einkaufsstraße) aufgezeichnet. Im Innenbereich werden auf Bluetooth basierende Lokalisierungsmethoden angewandt [Pels et al. 2005], im Außenbereich werden die Routen mit Hilfe von GPS verfolgt [Ashbrook und Starner 2003]. Ein Beispiel für die Aufzeichnung von Routen mittels GPS wird in Abbildung 5 dargestellt.

Ebenso wie in der vorangegangenen qualitativen Untersuchungsphase werden auch hier die Beobachtungen unter unterschiedlichen Bedingungen durchgeführt (Tageszeit, Witterung, Wochentag, etc.). Die Personen, die sich zur Teilnahme bereit erklären, werden ersucht, ihre Wege wie geplant zu verfolgen. Im Anschluss an das automatische Verfolgen werden sie einer Befragung unterzogen, bei der neben soziostrukturellen Daten grundlegende Einstellungen, der Lebensstil, individuelle Präferenzen und aktueller Zweck des Weges erhoben werden. Nach der Erhebung der Daten von zumindest 100 Personen in jedem der beiden Untersuchungsfelder werden die Ergebnisse hinsichtlich der zuvor aufgestellten vorläufigen Typologie analysiert. Dabei werden Wegelinien, Geschwindigkeiten, Pausen etc. betrachtet

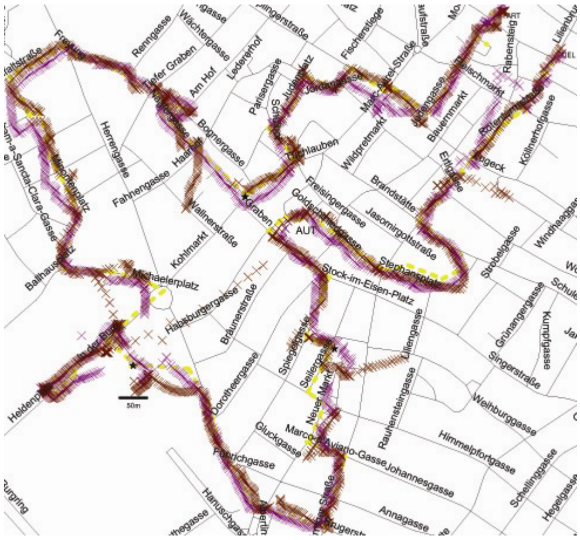


Abb. 5: Tracking von Routen mittels GPS. [Ray 2005]

Die gewonnen Beobachtungsdaten werden den zuvor festgelegten Typen zugeordnet und hinsichtlich interner Homogenität und externer Heterogenität analysiert, d.h. es wird festgestellt, ob das Navigationsverhalten der Personen eines bestimmten Typus sich untereinander stark ähnelt und ob es sich vom Verhalten von Personen anderen Typs stark unterscheidet.

4.2 Erstellung eines Modells typbedingten Routenwahlverhaltens

Das Ergebnis der Untersuchung bildet ein Modell einer Mobilitätsstil-Typologie, in dem die einzelnen Typen detailliert hinsichtlich mehrerer Aspekte (z.B. vorwiegende soziostrukturelle Eigenschaften, Häufigkeit des Typus in der Stichprobe, Verhaltenseigenschaften, Präferenzen, Anforderungen, etc.) beschrieben und untereinander verglichen werden. Es wird untersucht, ob sich ähnliche Verhaltensweisen innerhalb bestimmter Lebensstilgruppen feststellen lassen. Zusätzlich werden Unterschiede im Verhalten im Innen- und Außenbereich untersucht. Darüber hinaus wird gesondert betrachtet, ob die Personen alleine unterwegs waren oder in Begleitung; dies liefert Erkenntnisse darüber, welche Individuen eher über die Planung einer bestimmten Route bestimmen können.

Die einzelnen Typen werden anschließend ausführlich hinsichtlich ihrer Eigenschaften, Zusammensetzung und Unterschiede zu anderen Typen beschrieben. Schlüsselmerkmale der typbedingten Verhaltensweisen werden identifiziert und beschrieben, um die Grundlage für den späteren Einsatz als Basis für die Erstellung von typspezifischen Navigationsanweisungen und Rauminformationen zu schaffen. Dies erhöht den Komfort und die Effizienz zukünftiger Fußgängernavigationssysteme wesentlich, da die Orientierung suchende Person Informationen erhält, die entsprechend ihrer Bedürfnisse adaptiert werden und ein Übermaß redundanter Informationen verhindert wird.

5 ZUSAMMENFASSUNG

Der hier vorgestellte Ansatz verbindet erstmals qualitative und quantitative Methoden zur Untersuchung und Beschreibung des Orientierungs- und Routenwahlverhaltens von Fußgängern. Im Gegensatz zu Untersuchungen, welche lediglich mit Hilfe von Befragungen Erkenntnisse über die Motive für bestimmte Routenentscheidungen erhalten und Antwortverzerrungen in nicht bekanntem Ausmaß annehmen müssen, wird hier die Zuverlässigkeit der Aussagen mittels automatisch gewonnenen Bewegungsdaten überprüft. Die anfangs definierten theoretischen Bewegungstypen werden somit überprüft und erlauben im Rahmen der erzielbaren Genauigkeiten verlässliche Erkenntnisse über das menschliche Routenwahlverhalten. Als Ergebnis wird eine Typologie des Fußgängerverhaltens beschrieben, welche einerseits Erfahrungen über die Gründe für unterschiedliche Routenentscheidungen liefert, und andererseits als Grundlage für die Erstellung typspezifischer Navigationsinformationen herangezogen werden können.

Als weiterer Schritt sind in Zukunft adaptive Verfahren zu entwicklen, welche aufbauend auf den hier beschriebenen grundlegenden Mobilitätsstilen individuelle Mobilitätsprofile entwickeln und den Nutzern von Fußgängernavigationssystemen maßgeschneiderte, effiziente Mobilitätsinformationen bieten können.

6 LITERATUR

AHREND, C.: Mobilitätsstrategien zehnjähriger Jungen und Mädchen als Grundlage städtischer Verkehrsplanung. Internationale Hochschulschriften Bd. 381. Waxmann, Münster/New York/ München/Berlin, 2002
ASHBROOK, D. und STARNER, T.: Using GPS to learn significant locations and predict movement across multiple users. Personal and Ubiquitous Computing, Volume 7 (5), pp. 275-286, 2003
BLIVICE, S.: Pedestrian route choice: a study of walking to work in Munich. Ph.D. Diss. University of Michigan, 1974, zitiert von Hill, M.R.: Walking, crossing streets, and choosing pedestrian routes. Lincoln, NE: University of Lincoln, 1984
DAAMEN, W. und HOOGENDOORN, S.P.: Experimental research of pedestrian walking behaviour. Transportation Research Record 1828, pp. 20-30, 2003
ESSER, H.: Befragtenverhalten als "rationales Handeln" – Zur Erklärung von Antwortverzerrungen in Interviews. ZUMA-Arbeitsbericht 85/01, GESIS – Gesellschaft Sozialwissenschaftlicher Infrastruktureinrichtungen, 1985
GÖTZ, K. und BIRZLE-HARDER, B.: Travel and Holiday Styles – Target Groups for Sustainable Tourism; Results of a socio-empirical survey by the Institute for Social-Ecological Research (ISOE) within the INVENT project, 2005 http://www.invent-tourismus.de/_daten/texte/5%20ISOE% 20Goetz.pdf (last access November 2005)
GÖTZ, K., LOOSE, W., SCHMIED, M. und SCHUBERT, S.: Mobility Styles in Leisure Time. Conference paper, 10th nternational Conference on Travel Behaviour Research, 10.-15. Aug. 2003, Lucerne, 2003
LÖW, M.: Raumsoziologie. Frankfurt am Main, 2001
MICHON, P.-E. und DENIS, M.: When and Why Are Visual Landmarks Used in Giving Directions? Spatial Information Theory, Proc. International Conference COSIT 2001, Heidelberg: Springer, 2001, pp. 292-305, 2001
MILLONIG, A.: Orientierung am Westbahnhof - Untersuchung des Informations- und Leitsystems sowie des Orientierungsverhaltens der Passanten am Wiener Westbahnhof. Untersuchungsbericht, 2005
MILLONIG, A. und SCHECHTNER, K.: Decision Loads and Route Qualities for Pedestrians – Key Requirements for the Design of Pedestrian Navigation Services. 3rd International Conference on Pedestrian and Evacuation Dynamics, 28.-30. September 2005, Vienna, Austria, 2005
OVSTEDAL, L. und OLAUSSEN RYENG, E.: Who Is The Most Pleased Pedestrian? WALK21 3rd International Conference, Steps forward liveable cities, 8.-11. May 2002, Donastia – San Sebastian, 2002
PELS, M., BARHORST, J., MICHELS, M., HOBO, R. und BARENDSE, J.: Tracking people using Bluetooth – Implications of enabling Bluetooth discoverable mode. Final report, University of Amsterdam, 2005
RAY, M.: Mobile GPS-Datenerfassung in urbanen Gebieten. Diplomarbeit ausgeführt am Technikum Wien, 2005
SHOVAL, N. und ISAACSON, M.: The Application of Tracking Technologies to the Study of Pedestrian Spatial Behaviour. Accepted for publication in The Professional Geographer, 2005
THOMAS, C.: Zu Fuss einkaufen. Projektendbericht, http://www.fussverkehr.ch/presse/zufuss_schlussbericht.pdf (letzter Zugriff November 2005), 2003
TOM, A. und DENIS M.: Referring to Landmark or Street Information in Route Directions: What Difference Does It Make? Kuhn, W., Worboys, M. und Timpf, S. (Eds.): Spatial Information Theory. Lecture Notes in Computer Science, Vol. 2825, Heidelberg: Springer, 2003, pp. 384-397, 2003
WIENER, J.M., SCHNEE, A. and MALLOT, H.A.: Navigation Strategies in Regionalized Environments. Technical Report TR-121, Max-Planck-Institut für biologische Kybernetik, Universität Tübingen, 2004
YAN, W. und FORSYTH, D.A.: Learning the Behavior of Users in a Public Space through Video Tracking. 7th IEEE Workshop on Applications of Computer Vision / IEEE Workshop on Motion and Video Computing (WACV/MOTION 2005), 5-7 January 2005, Breckenridge, CO, USA, 2005

Koordination und Kooperation von nationalen Verkehrsforschungsprogrammen in Europa im Rahmen von ERA-NET TRANSPORT – Ein Zwischenbericht

Heimo KROPF

(Dipl.-Ing. Heimo Kropf, Bundesministerium für Verkehr, Innovation und Technologie (bmvit), Abteilung III/I7 – Mobilität und Verkehrstechnologien, Renngasse 5, A-1010 Wien, heimo.kropf@bmvit.gv.at)

1 EINLEITUNG

Die Europäische Union forciert die Koordinierung, gemeinsame Durchführung und Öffnung nationaler und regionaler Politiken und Förderungsprogramme vor allem durch die im 6. Rahmenprogramm entwickelte Programmlinie ERA-NET [RFT, 2005].
ERA-NET's zielen darauf ab, die Entstehung intensiver, dauerhafter Verbindungen zwischen nationalen Forschungsprogrammen mit gemeinsamen Zielen zu begünstigen. Durch die Förderung praktischer Initiativen zur Koordinierung regionaler, nationaler und europäischer Forschungsprogramme in spezifischen Bereichen und die Bündelung der fragmentierten personellen und finanziellen Ressourcen sollen diese zur Entstehung des Europäischen Forschungsraums (European Research Area – ERA) beitragen und dadurch sowohl die Effizienz als auch die Effektivität der europäischen Forschungsanstrengungen verbessern [EC, 2005].
ERA-NET TRANSPORT (ENT) ruht auf dem soliden Fundament der „Europäischen Plattform für die Zusammenarbeit und Koordinierung der Verkehrsforschung (European Platform for Cooperation and Co-ordination of Transport Research – EPTR)". Das ENT-Konsortium, an dem Ministerien und andere Organisationen aus 11 Ländern beteiligt sind, hat es sich zum Ziel gesetzt Programmmanager diverser nationaler Verkehrsforschungsprogramme und aller Verkehrsmodi in Europa zusammenzubringen, um eine weitere strategische Zusammenarbeit anzustossen, sofern diese für die beteiligten Länder einen Zusatznutzen (added-value) erkennen lässt.
Spezielle Workshops dazu wurden im Jahr 2005 durchgeführt. Letztendliches Ziel ist die Schaffung eines effizienten Instruments für gemeinsame Forschungsprogramme mit gemeinsamen Ausschreibungen und gemeinsamen Evaluierungssystemen zu Themen, die für alle Mitglieder von Bedeutung sind.

2 VERKEHRSPOLITIK, VERKEHRSTECHNOLOGIEPOLITIK UND RAUMPLANUNG

Der Aufruf „Integrierte Mobilität statt Rivalität der Verkehrsträger" sollte, wie in der Studie „Zukunftspotentiale der österreichischen Forschung" angerissen, der Leitspruch für die zukünftig intensiver notwendige Zusammenarbeit der nationalen Verkehrspolitiken und Verkehrsforschungspolitiken in Europa sein. Systemisches, interdisziplinäres und intermodales Denken und Handlen aller Akteure der Industrie und Wirtschaft, der universitären, außeruniversitären und angewandten Forschung, sowie der öffentlichen Hand auf allen Verwaltungsebenen ist dafür gefragt, insbesondere wenn Letzteres, das Handeln, im transnationalen, europäischen Kontext angestrebt wird.
Transport und Mobilität sind Voraussetzung zur Befriedigung grundlegender sozialer Bedürfnisse, ermöglichen wirtschaftliche Entwicklung, und beeinflusst die Rahmenbedingungen für periphere Regionen. Die ökologischen, sozialen und gesundheitsbezogenen Auswirkungen des Verkehrs sind groß, besonders in urbanen und ökologisch sensiblen Regionen. Stichwort Verkehrsunfälle und Verkehrssicherheit, verkehrsbedingte Luftverschmutzung oder Lärmemissionen. Gerade die räumliche Trennung von Arbeiten und Wohnen hat zu einem erhöhten Verkehrsaufkommen geführt. Der Problemdruck zur Lösung von Verkehrsproblemen wächst, die Akzeptanz von Einschränkungen des motorisierten Individualverkehrs (MIV) ist praktisch nicht existent. Stichwort NIMBY-Syndrom („not-in-my-back-yard"). Insgesamt wird das Verkehrsaufkommen in den nächsten Jahren weiter wachsen. Prognosen gehen meist davon aus, dass in Österreich bis 2020 der Individualverkehr und der Güterverkehr steigen werden. Interessenkonflikte sind dabei vorprogrammiert.
„Das erstrebenswerte längerfristige Ziel ist es daher, die Korrelation zwischen wirtschaftlichem Wachstum und Wachstum des Verkehrsaufkommens zu entkoppeln. Das Ziel einer gesellschaftsgeleiteten Forschungs- und Technologiepolitik muss es sein, den Zugang zu Verkehr- und Transportsystemen für alle Bürger, Wirtschaftsakteure und Regionen gleichermaßen zu gewährleisten, bei gleichzeitiger Entkopplung des wirtschaftlichen Wachstums vom Verkehrswachstum. Personen mit geringer Mobilität aufgrund des Alters, Behinderung etc., sollten ihre Mobilitätsanspruche ausreichend befriedigen können. Gerade Transport und Mobilität verlangen in einem hohen Ausmaß systemische Lösungen, um die vielfältigen Ansprüche zu gewähren. Der Verlagerung des Verkehrs von der Straße auf andere Verkehrsträger ist hier eine wichtige Strategie, um das Ziel der Entkopplung zu erreichen." [RFT, 2003, S.82f]
Versucht man zukünftig Ziele der Verkehrspolitik und der (Verkehrs) Forschungs- und Technologiepolitik noch besser, im Sinn von systemischen Ansätzen und Lösungen, zu koordinieren und anschließend zu implementieren, so wird man national und europaweit sehr rasch auf die horizontale Disziplin der Raumplanung und Raumordnung stoßen. Denn die Raumplanung, mit ihrer ureigenen Aufgabe räumliche Anforderungen auf den unterschiedlichen Ebenen (Gemeinde, Stadt, Region, Land, Bund) und in Bezug auf die unterschiedliche Aspekte (Verkehr, Umwelt, Bevölkerung, Wirtschaft) abzustimmen und Konflikte auszugleichen sowie Vorsorge für zukünftige Raumfunktionen und -nutzungen zu treffen, ist es welche Instrumente und Erfahrungen bei der Implementierung interdisziplinären Ziele unter Berücksichtigung sozialer, wirtschaftlicher und ökologischer Ansprüche hat. Wie beispielsweise systemische Lösungen zur Senkung des zukünftigen Verkehrsaufkommens aufgrund der räumlichen Integration der Lebensbereiche Wohnen, Arbeiten und Freizeit, damit die Mobilitätszwänge reduzieren werden. Innovative Lösungen aus allen bisher angesprochenen Politikbereichen können dabei auch die klassische Flächenwidmung, Raumentwicklung und Verkehrsplanung verändern.
Erste Anzeichen zu möglichen win-win Situationen sind bereits auf Europäischer Ebene durch die Verschränkung und Abstimmung des kommenden 7. EU-Rahmenprogramm für Forschung und technologische Entwicklung mit anderen Politiken der Gemeinschaft, wie den Strukturfonds, und vice versa, erkennbar.

3 NATIONALE PROGRAMME UND DEREN VERNETZUNG

Nationale Verkehrspolitiken und Verkehrstechnologiepolitiken in Europa sind thematisch aber auch strukturell sehr vielfältig. Dies liegt vor allem an den unterschiedlichen wirtschaftlichen Schwerpunkten und Kompetenzen aber auch an den unterschiedlichen

Politiksystemen und –kulturen. Nichts desto trotz sind nach Überwindung diverser Barrieren („Lack of administrative capacities, staff and financial resource“, „Different programming approaches“,“ Diverse opinions on principal public access and the use of Intellectual Property Rights“, etc.), wie die Arbeit im ERA-NET TRANSPORT zeigt, zahlreiche interessante Berührungspunkte für Programm-Kooperationen möglich.
In den letzten Jahren wurden in Österreich eine Reihe von Forschungsaktivitäten zu Fragen der Mobilität und des Verkehrs initiiert. Das für ENT relevante Förderungsprogramm ist Verkehrstechnologieimpulsprogramm „Intelligente Verkehrssysteme und Services (IV2S)“. Dieses teilt sich in die drei thematischen Programme „Austrian Advanced Automotive Technology (A3)“, „Innovatives System Bahn (ISB)“ und „Intelligente Infrastruktur (I2)“.

3.1 Austrian Advanced Automotive Technology (A3)

Ziele von A3 sind die Steigerung der Wettbewerbsfähigkeit der Kfz-Zulieferindustrie durch Förderung von kooperativen F&E-Projekten sowie die Lösung von umwelt- und verkehrspolitischen Problemen durch Entwicklung und Einsatz neuer Technologien. Angestrebt werden damit echte innovative Technologiesprünge und nicht die inkrementelle Weiterentwicklung bestehender Technologien.
Das Programm deckt den gesamten Innovationszyklus von der Grundlagenforschung bis zu marktnahen Demonstrationsprojekten ab. Wesentlichstes Förderungsinstrument sind Zuschüsse. Darüber hinaus werden aber auch voll finanzierte Grundlagenstudien, Ausbildungsmaßnahmen zur Schaffung ausreichender Humanressourcen mit neu benötigtem Spezial Know-how sowie die internationale Vernetzung österreichischer Forschungsinstitutionen finanziert.
Aufgrund des hohen Potentials von alternativen Antrieben und Treibstoffen zur Lösung akuter umwelt- und verkehrspolitischer Probleme sowie zur Erhöhung der Wettbewerbsfähigkeit der österreichischen Automobilindustrie wurde das A3-Technologieprogramm um die "Österreichische Wasserstoff und Brennstoffzellen Initiative" erweitert und um das Instrument der "Strategischen Leitprojekten" ergänzt.

3.2 Innovatives System Bahn (ISB)

Auch das Impulsprogramm ISB ist Teil des übergreifenden Strategieprogramms Intelligente Verkehrssysteme und Services. Innerhalb eines breiten Konglomerats bahntechnologischer Systeme und Zulieferfirmen ist ein besonders exportorientierter österreichischer Wirtschaftszweig aktiv, der sich auf Grund eines durch die Liberalisierung veränderten Umfeldes großen Herausforderungen bei der wirtschaftlichen Umsetzung neuester Technologien gegenübersieht.
Hier soll das Programm Hilfestellung leisten. Ziel ist es, der Industrie und den mit ihr über die Technologiemärkte kooperierenden nationalen Systembetreibern und Forschungseinrichtungen eine Unterstützung bei der Forschung und Entwicklung bahntechnologischer Innovationen zu bieten, um die internationale Wettbewerbsfähigkeit zu gewährleisten. Das Impulsprogramm ISB verfolgt die Förderung von kooperativer, vorwettbewerblicher Forschung und Entwicklung innovativer Technologien und Systemen im Schienenverkehr. Das Programm richtet sich an Unternehmen der gewerblichen Wirtschaft, Schienenverkehrsbetreiber, universitäre wie außeruniversitäre F&E-Institutionen und Dienstleistungsunternehmen.
Nach zwei Ausschreibungen des Impulsprogramms ISB wird die Forschungsförderung für innovative Bahntechnologien in eine antragsorientierte Förderung durch die Österreichische Forschungsförderungsgesellschaft (FFG) - Basisprogramme übergeführt.

3.3 Intelligente Infrastruktur (I2)

Quantitatives Ziel ist die Steigerung der F&E Aktivitäten der österreichischen Unternehmen im Bereich der Verkehrstelematik auf europäischen Durchschnitt. Damit verbunden ist die Stärkung der Wettbewerbssituation österreichischer Unternehmen auf den internationalen Märkten durch Induzierung von zusätzlichen Forschungs- und Entwicklungsvorhaben im Bereich der Verkehrstelematik. Mit der Überwindung einer kritischen Masse sind österreichische Unternehmen startbereit für die verstärkte Einbindung in Programme der Europäischen Union.
Ziel des Programms I2 ist es, Unternehmen in Österreich zu Innovationsschritten mit hohem Marktpotenzial zu motivieren und dabei jene zu unterstützen, die konkrete Umsetzbarkeit von Verkehrstelematikanwendungen in der bestehenden Infrastruktur beispielhaft nachweisen. Der Aufbau von stabilen F&E Netzwerken unter Einbeziehung der universitären und außeruniversitären Forschung bildet die Ausgangssituation für die angestrebten kooperativen Projektvorhaben für die Entwicklung von Verkehrstelematik und Anwendungen. Zusätzlich zu den verschieden gesetzten Schwerpunkten der bisher durchgeführten drei Ausschreibungen werden zukünftige Impulse auch durch so genannte. Leitprojekte gesetzt. Leitprojekte sind übergreifende innovative Pilotprojekte zu verkehrspolitisch relevanten Themen. Sie werden vom Projektträger konzipiert und bestehen aus aufeinander abgestimmten F&E-Teilprojekten und Begleitmaßnahmen.

3.4 Vernetzungsaktivitäten von Verkehrsforschungsprogrammen im ENT

Transnationale Forschungskooperationen zwischen einer Vielzahl an verschiedenen Institutionen und politischen Akteuren verschiedener EU-Mitgliedsstaaten mit nicht deckungsgleichen Geschäftseinteilungen und unterschiedlichen Politikrationalen sind nicht einfach zu implementieren. Die im ERA-NET TRANSPORT beteiligten Partner sind einerseits Verkehrsministerien, Technologie- und Innovationsministerien, oder Wissenschafts- und Forschungsministerien aber auch Forschungsagenturen. Weiter im Prozess involvierte Akteure sind nationale Forschungszentren, Förderagenturen, Research Councils oder andere den Ministerien vorgelagerte Agenturen.
Starke Unterschiede gibt es auch bei der Art der Finanzierung von Forschungsvorhaben, sowie deren strukturelle Abwicklung. Dies reicht von Direktfinanzierungen von Institutionen bis hin zu unterschiedlich groß dotierten Forschungsförderungsprogrammen. Generell kann man allerdings einen Trend weg von der direkten institutionellen Finanzierung hin zu Projektfinanzierungen über Programme feststellen, wobei die Auswahl der Projekte über „Call for tenders“ und/oder „Call for proposals“ mit anschließender Evaluierung abgewickelt wird. Derzeit gibt es auf der Super-nationalen Ebene (auf EU-Ebene) zahlreiche Plattformen zur Politikkoordination (EPTR). Aber auch auf der Transnationalen Ebene gibt es gemeinsame Forschungsplattformen und –aktivitäten speziell für den Verkehrssektor. Als Ergebnis de Beobachtung de EU-Mitgliedsstaaten kann man klar in zwei Arten von kooperativen Netzwerkansätzen unterscheiden; einerseits in Politiknetzwerke und andererseits in Innovationsnetzwerke. Die Bezeichnung „Politiknetze“ beschreibt eine Struktur, bei der verschiedene Akteure bei einem Politikprozess zusammenarbeiten. Die Bezeichnung

„Innovationsnetzwerk“ kennzeichnet eine Struktur, in der verschiedene Akteure, (z.B. von der öffentlichen Hand, von der Forschungsarena und von der Industrie) zusammenarbeiten, um ein bestimmtes Forschungsresultat und erfinderische Problemlösungen zu erzielen.

ERA-NET TRANSPORT hat als Politiknetzwerk seine Arbeit begonnen und hat während der Laufzeit verschiedene thematische Forschungsbereiche als Innovationsnetzwerk gestartet. Diese thematischen Gruppen werden in ENT als „Action groups“ bezeichnet und bestehen derzeit zu den Themenfeldern „Real-time data collection: Overview of sensor research”, „Trans-national architecture for multimodal information”, „Business models for data collection and use, overview of studies”, „SURSHIP”, „Alternative Fuels, propulsion systems and vehicle technologies - Part 1: European strategy”, „Alternative fuels, propulsion systems and vehicle technologies. Part 2: Joint Demonstration projects”, „Improved understanding on noise effects” und „Environmental performance indicators for heavy duty vehicles“.

Zum aktuelle Stand im Arbeitsprozess sowie weiteren Details zu ENT, besuchen Sie bitte das Webportal von ERA-NET TRANSPORT unter www.transport-era.net.

4 AUSBLICK

„Im 7. Rahmenprogramm sollen die gemeinsame Durchführung und die Öffnung der nationalen und regionalen Forschungsprogramme durch ERA-NET plus und die Anwendung des Artikel 169 noch verstärkt werden. Österreich ist im 6. Rahmenprogramm eines der aktivsten und erfolgreichsten Länder bei dieser grenzüberschreitenden Koordination von Förderungsprogrammen. Ein weiteres Fortschreiten des Integrationsprozesses im Forschungsbereich erfordert auch auf österreichischer Seite eine aktive Mitwirkung. Zum sich entwickelnden Europäischen Forschungsraum gehört die enge Zusammenarbeit zwischen der EU und anderen Forschungsorganisationen (z. B.EUREKA, COST). Alle diese europäischen Forschungsstrukturen werden durch nationale Maßnahmen gestützt, welche in Zukunft noch besser aufeinander abgestimmt werden müssen. […] Für österreichische Unternehmen hat sich in den letzten Jahren u. a. durch die EU-Erweiterung nach Osten das Potenzial an Innovationspartnerschaften stark vergrößert. Viele betriebliche Innovationsnetzwerke sind zumindest teilweise grenzüberschreitend im überregionalen und zunehmend auch internationalen Maßstab. Wirtschaftsbezogene Programme fördern daher Kooperationen, Konsortialprojekte oder transnationalen Netzwerksaufbau zwischen innovativen österreichischen Unternehmen, intermediären Organisationen und innovativen Unternehmen aus Mittel- und Osteuropa. Um die wissenschaftlich-technische Zusammenarbeit zu intensivieren sind zahlreiche bilaterale Abkommen in Kraft, welche im Rahmen bilateraler, wissenschaftlicher Projekte die Mobilität von WissenschafterInnen fördern. Derzeit ist jedoch keine konsistente nationale oder mit der europäischen Ebene abgestimmte Strategie und Schwerpunktsetzung zu erkennen. Im Europäischen Forschungsraum sind die bi- und multilateralen Forschungs-, Technologie- und Wissenschaftsbeziehungen Österreichs mit Drittstaaten nicht mehr von jenen der EU zu trennen. Eine bessere Abstimmung und Kohärenz zwischen den Außenbeziehungen der EU und denen Österreichs im Forschungsbereich ist notwendig.“ [RFT, 2005, S.26 f.] Der Rat empfiehlt in seiner „Strategie 2010“ ausdrücklich die Erarbeitung einer nationalen Strategie zur Beteiligung an den Programmlinien ERA-NET, ERA-NET plus und den Programmen Art. 169 im Rahmen des 7. Forschungsrahmenprogramm.

5 WEITERFÜHRENDE LITERATUR

Europäische Kommission (EC), ERA-NET – 3. Serie – Vernetzung der nationalen Forschungsprogramme im Europäischen Forschungsraum, KI-NA-21461-DE-C, 2005.

Rat für Forschung und Technologieentwicklung (RFT), Weber M., et.al.: Studie im Auftrag des Rats für Forschung und Technologieentwicklung; Zukunftspotentiale der österreichischen Forschung, 2003.

Rat für Forschung und Technologieentwicklung (RFT), Strategie 2010 – Perspektiven für Forschung, Technologie und Innovation in Österreich, 2005.

Halbesma S., Themes for future trans-national cooperation in transport research programming – Foresight report, ERA-NET TRANSPORT Deliverable 2.2., 2005.

Kropf H., Seibt C.: Overview of research programming and cooperation mechanism; ERA-NET TRANSPORT Deliverable 1.1., 2004.

Seibt C., Kropf H.: Analyses of barriers to cooperation and development of an initial proposal of cooperation procedures; ERA-NET TRANSPORT Deliverable 1.2., 2005.

Seibt C., Kropf H.: Benchmark of practices for trans-national cooperation in transport research programmes; ERA-NET TRANSPORT Deliverable 1.3., 2005.

Dynamische Tourenoptimierung durch verkehrstelematische Daten

Wolfgang W. WASSERBURGER

DI Wolfgang WASSERBURGER, Geschäftsführer PLANOVA, Schrottgasse 4/5, A-1030 Wien, +43/699/13 14 67 44, wolfgang@wasserburger.at

1 EINFÜHRUNG

In zahlreichen Untersuchungen wird festgehalten, daß Maßnahmen aus der Verkehrstelematik Verkehr einsparen könnten. Ebenso sind Maßnahmen aus dem Bereich der Logistik geeignet Transportkosten zu minimieren. Eine Kombination dieser beiden Bereiche wurde dabei bisher kaum ins Auge gefaßt. Dabei könnte eine ‚dynamische Tourenoptimierung', also die Kombination von Tourenoptimierungen, die üblicherweise im Rahmen logistischer Verbesserungen von Firmen für ihre Fahrzeugflotten durchgeführt werden, mit Informationen aus der Verkehrstelematik, diese möglichen Einsparungen noch erhöhen. Dabei werden auch Fahrten vermieden, was auch aus Sicht der Verkehrspolitik zu wünschen ist. Die folgenden Ausführungen gehen demnach von der folgenden These aus:

Durch geeignete verkehrsabhängige Tourenberechnung kann der Wirtschaftsverkehr Staus zumindest soweit ausweichen, daß die dafür notwendigen Investitionen amortisierbar sind. Gleichzeitig verringern sich auch die Staus durch den ausweichenden Wirtschaftsverkehr, sodaß auch die Erreichung eines raumplanerisch und volkswirtschaftlichen Optimums näherrückt.

2 SYSTEMELEMENTE

In meinen Forschungen wird nun versucht, die notwendigen Systemelemente zu finden, und eine Beurteilung über deren Brauchbarkeit abzugeben.
Demgemäß sind dazu folgende Systemelemente notwendig:

- Datenerfassung
  - Statische Verkehrsdaten (Straßennetz und Hausnummern) bzw.
  - Dynamische Verkehrsdaten aus
    - Verkehrssensoren oder aus
    - Floating Car Data, die aus folgenden Elementen bestehen:
      - Positionsbestimmung (z. B. GPS)
      - Datenübermittlung (z. B. GSM)
- Datenverarbeitung und –speicherung
- Reisezeitschätzungen soweit notwendig
- Clearingstellen
- Algorithmen für die dynamische Tourenoptimierung

Dabei wird das Hauptgewicht auf den letzten Punkt gelegt, aber versucht die anderen Punkte zumindest grob auf das Vorhandensein abzuchecken.
Vorausgeschickt soll auch werden, daß eine dynamische Modellierung nur auf Hauptstrecken sinnvoll ist. In Nebenstraßen kann im Normalfall von einem langsamen aber freien Verkehrsfluß ausgegangen werden. Tatsächliche Störungen sind üblicherweise weder meß- noch prognostizierbar.
Welche Strecken zu den Hauptstrecken zu zählen sind, wird dabei einerseits durch funktionelle Kriterien bestimmt, andererseits durch die Erfassungsmöglichkeit der dynamischen Daten. Werden die Daten mit straßenseitigen Sensoren erfaßt, können nur Straßen einbezogen werden, die auch über Sensoren verfügen. Bei der Erfassung mit fahrzeugseitigen Geräten können hingegen nur Strecken einbezogen werden, die häufig genug von Fahrten der erfassenden Flotte durchfahren werden. Einige Erfassungsvarianten (z. B. Nummerntafelerfassung) entziehen sich dieser Unterscheidung auch, weshalb einige Autoren die Sensoren lieber in querschnittsbezogene und streckenbezogene einteilen. Da dies aber auf den ersten Blick nicht immer klar ist, halte ich mich an das äußerlich Sichtbare.

3 DATENERFASSUNG

3.1 Straßennetz und Hausnummern:

Sowohl international als auch national (und regional) werden Verkehrsgraphen von guter Qualität erzeugt. Auch Standortkoordinaten stehen in den meisten Ballungsräumen zur Verfügung. Während internationale Hersteller eher den amerikanischen Ansatz der Verspeicherung von Adreßintervallen entlang von Straßenkanten wählen, wird national meist genauer vorgegangen und Adressen punktgenau verortet. Die entsprechen Algorithmen für das Matching stehen jeweils dazu passend zur Verfügung. Vor allem die internationalen Hersteller bieten auch TMC-Codierungen an, mit denen sich Verkehrsmeldungen in die Modellierung einbeziehen lassen. Spezielle Attribute (wie z. B. die benötigten Taxi-Ausnahmen) werden derzeit jedoch nicht angeboten.

3.2 Dynamische Daten

3.2.1 <u>Herkömmliche Datenerfassung aus der Verkehrstelematik bzw. Mautabrechnung</u>

Im Prinzip lassen sich Daten aus der herkömmlichen Verkehrstelematik in Geschwindigkeitsdaten umrechnen und damit auch für Tourenoptimierungen einsetzen.
Die Sensoren sind dabei üblicherweise als Induktionsschleifen ausgeführt. Derzeit bestehen in Österreich jedoch wenig derartige Anlagen. Die Daten der automatischen Zählstellen auf den Autobahnen, Schnell- und Bundesstraßen (nach der Verländerung: Landesstraßen „B") sind derzeit zum Großteil nicht online verfügbar. In diesem Bereich ist also massiver Handlungsbedarf (vor allem durch die ASFINAG) gegeben. Ein entsprechendes Projekt wurde zwar bereits angekündigt, die Umsetzung ist aber offensichtlich noch nicht sehr weit gediehen.

Alternativ können (z. B. im Wiener Bereich) auch die Daten privater Betreiber – wie z. B. von traffic.at – genutzt werden, die hier Infrarotsensoren mit Funkübertragung einsetzen.

Abbildung 11: Verkehrssensor von traffic.at [Foto: www.traffic.at]

Für die Autobahnen und Schnellstraßen könnten in Österreich auch die Daten aus der Mautabrechnung genutzt werden, wofür es bisher allerdings noch keine praktischen und rechtlichen Modelle gibt.
Die abgeleiteten Geschwindigkeiten können allerdings für Touren mit PKWs nur beschränkt eingesetzt werden, weil die freie Fahrgeschwindigkeit der PKWs üblicherweise über jenen der LKWs liegt. Fällt diese jedoch auch bei den LKWs deutlich unter das Maximum, so kann auch für die PKWs von einer entsprechenden Reduktion ausgegangen werden. In meinen Ausführungen wird allerdings davon ausgegangen, daß die Systeme üblicherweise auf LKWs angewendet werden und hierbei also kein Problem entsteht. Technisch ließen sich mit den bestehenden Mautbaken natürlich auch PKWs zählen, die mit entsprechenden Geräten ausgerüstet werden, auch wenn diese keiner Bemautung unterzogen würden. Politisch würde das allerdings wohl als erster Schritt zu einer unpopulären PKW-Maut angesehen.

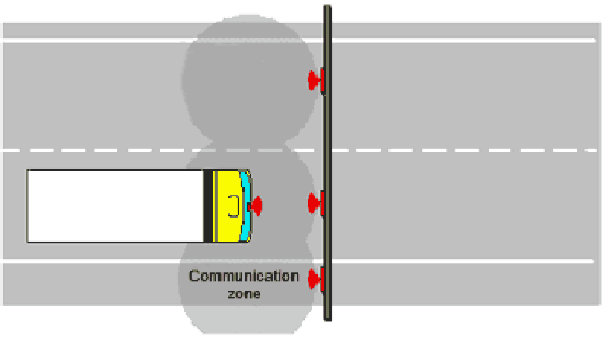


Abbildung 12: Prinzip der Mautabbuchung – die GO-Box im LKW kommuniziert mit dem Mautportal und führt so die Mautabbuchung durch [ASFINAG 2003]

3.2.2 Floating Car Data (FCD)

Als sofort verfügbare Alternative können (vor allem in Großstädten) Daten mit der Methode der Floating Car Data gewonnen werden. Floating Car Data sind Positionsdaten (teilweise auch gleich Geschwindigkeitsdaten) aus Fahrzeugen, die über Funk- oder Mobiltelefonverbindungen in eine Zentrale übermittelt werden. Dort werden diese mit den freien Fahrgeschwindigkeiten verglichen und damit Staus erkannt. Die Positionsdaten werden meist mit GPS-Empfängern erfaßt. Die FCD sind derzeit Sensordaten zwar noch in der Qualität unterlegen, weil die Kalibrierung in Straßen mit Ampeln noch nicht ausreichend ausgereift ist, aber haben im Gegenzug den besonderen Vorteil, daß sie direkt Reisezeiten abbilden und nicht aus der Menge vorbeifahrender Fahrzeuge auf deren Geschwindigkeit mit entsprechenden Modellen geschätzt werden muß. Aufgrund der notwendigen beobachteten Flottendichte, dürfte dieses Verfahren derzeit allerdings nur in Ballungsräumen sinnvoll einsetzbar sein. Für Überlandbereiche wäre dies wiederum durch Daten aus der herkömmlichen Verkehrstelematik zu ergänzen.
Die notwendige Fahrzeugausstattung kann mittlerweile von vielen Herstellern geliefert werden. Die notwendige Positionierung auf GPS-Basis weist derzeit noch eine gewisse Fehlerwahrscheinlichkeit auf, weil verschiedene geometrische und elektronische Fehlerquellen eine Positionierung sich bewegender Objekte nur mit bis zu 100 m Abweichung möglich machen. Zusätzliche Sensoren in den Fahrzeugen und nachträgliches Mapmatching erhöhen hier die Genauigkeit. In den nächsten Jahren wird durch die Ergänzung mit Egnos und Galileo eine Genauigkeit erreicht werden, die FCD-Systeme weiter verbessert. Auch die Kommunikationssysteme stehen mit Datenfunk, GSM und anderen in guter Qualität zur Verfügung.

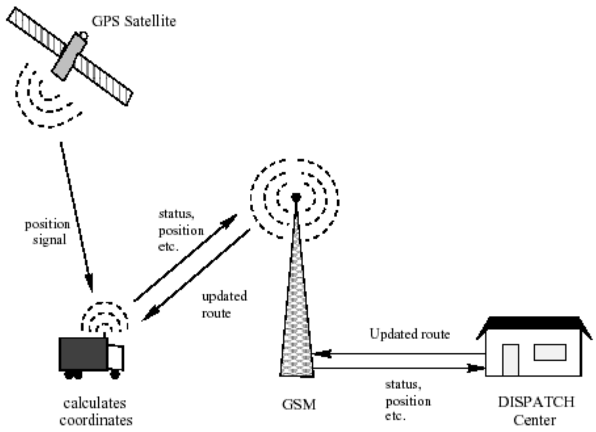


Abbildung 13: Aufbau eines GPS-GSM-Systems zur passiven Positionsbestimmung [LARSEN 2001]

In Wien laufen derzeit zwei konkurrierende Feldversuche mit zwei unterschiedlichen Taxiflotten zur Gewinnung von FCDs. Das Deutsche Zentrum für Luft erfaßt dabei Geschwindigkeiten und überträgt diese in eine Zentrale, die daraus Staubilder berechnet. Der freie Verkehrsfluß wird aus historischen Erfassungen in Nächten und Sonntag Vormittag ermittelt. Die Unterscheidung von Staus und Ampelrückstaus ist dabei derzeit noch nicht ganz geglückt. Die Stadt Wien als Kooperationspartner stellt daher noch gewisse Mängel fest.
Arsenal Research überträgt hingegen laufend Standortkoordinaten und errechnet die durchschnittlichen Geschwindigkeiten aus einer Routenberechnung zwischen diesen Punkten. Die Erfassung der freien Reisegeschwindigkeiten erfolgt hier durch Bestimmung jener Geschwindigkeit, die zumindest von 85 % der Verkehrsteilnehmer erreicht wird.

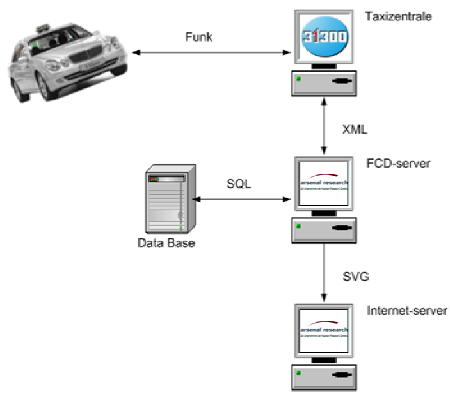


Abbildung 14: Systemarchitektur des Floating-Car-Data-Systems [LINAUER 2005]

Sinnvoll wäre eine Zusammenfassung mehrerer Flotten, um noch bessere Ergebnisse zu erzielen. Taxiflotten haben generell den Nachteil, daß sie gewisse Strecken kaum benutzen (z. B. Autobahnen) bzw. gewisse Sonderrechte im Straßennetz haben (z. B. Mitbenutzung von Busspuren oder Ausnahmen von Fahrverboten). Diese sind eventuell im Modell zu berücksichtigen.

3.3 Reisezeitschätzung

Es konnte zwar zu einigen Reiseschätzungsmodellen Literatur gefunden werden, für die großmaßstäbige Anwendung erscheint, vieles aber ungeeignet oder noch nicht ausgereift. Da diese für Floating Car Data nicht gebraucht wird und das Hauptaugenmerk der vorliegenden Arbeit auf die Tourenalgorithmen gelegt wird, wird das Thema an dieser Stelle nicht weiter verfolgt. Hier besteht für künftige Arbeiten noch eingehender Forschungsbedarf.

4 CLEARINGSTELLEN FÜR VERKEHRSDATEN

Derzeit gibt es – zumindest in Österreich – noch keine Ansätze für die Einrichtung von Clearingstellen für die Datenweitergabe von Verkehrstelematikdaten. Ein solcher Ansatz in Deutschland steckt ebenfalls erst in den Kinderschuhen. Für andere Länder wurde die Ausstattung mit derartigen Stellen nicht überprüft. Mit zunehmender Nutzung verkehrstelematischer Daten durch Verkehrsteilnehmer (und Logistikoptimierungen im Vorfeld) wird die Einrichtung solcher Stellen rasch notwendig werden. Solange nur wenige Dateneigentümer den Markt bestimmen, können übergangsweise mit diesen noch Einzelverträge geschlossen werden.

5 DYNAMISCHE TOURENOPTIMIERUNGEN

Tourenoptimierungen sind ***NP***-schwere kombinatorische Probleme. Nachdem exakte Lösungen größerer Datenmengen daher mit vertretbarer Rechenzeit kaum möglich sind, werden üblicherweise heuristische Verfahren eingesetzt, von denen zahlreiche Varianten zur Verfügung stehen. Die meisten hiervon gehen von statischen Daten aus. Die Varianz der Ergebnisqualität bewegt sich im einstelligen Prozentbereich, wobei die meisten Verfahren hauptsächlich auf akademischem Boden, vielfach vermutlich nur mit – wenn auch entsprechend großen – (euklidischen) Testdatensets, getestet wurden. Einige Modelle beziehen auch stochastische Einflüsse ein, die eventuell durch empirische Daten ersetzt werden könnten. Die Einbeziehung dynamischer Daten steckt nach umfangreichen Recherchen scheinbar noch in den Kinderschuhen. An dieser Stelle besteht also noch massiver Forschungsbedarf. Technisch ebenfalls noch ausständig sind leistungsfähige Datenbanken, die raum-zeitliche Abfragen zulassen. Aufbauend auf den Ansätzen von

Car, Stückelberger und Hasselberg lassen sich vermutlich Kürzeste-Wege-Matrizen (oder aber Savingslisten) aufbauen, die dynamisch verändert werden können. Insbesondere mit der Sensitivitätsanalyse von Hasselberg erscheint in diesem Bereich eine Optimierung der Neuberechnungen mit deutlich geringerem Rechenzeitbedarf möglich.

5.1 Savingsalgorithmus

Für die eigentliche Tourenoptimierung stehen sehr viele heuristische Verfahren zur Verfügung, wobei für eine erste Annäherung vermutlich ein tageszeitabhängiges Savingsverfahren gute Ergebnisse liefern sollte. Das Savingsverfahren beruht auf der Idee, daß die Ersparnis (Saving) einfach errechnet werden kann, wenn man statt Einzelzustelltouren jeweils zwei (und in der Folge mehrere) Ziele zu einer größeren Tour zusammenfügt. Bereits in dieser sehr einfach zu programmierenden Variante liefert dieser Algorithmus sehr gute Ergebnisse, die nur knapp hinter jenen zurückliegen, die der jeweils beste Algorithmus derzeit liefert. Nach einer eigenen beschriebenen Idee sollte der Savingsalgorithmus noch um eine tageszeitabhängige Variante erweitert werden.

5.2 Ameisensysteme

Obwohl nur 2 % der in der Natur vorkommenden Insektenarten sozial sind, umfassen diese weltweit mehr als 50 % der gesamten insektoiden Biomasse. Mit sozial ist gemeint, daß diese Insekten – inklusive aller Ameisen und Termiten sowie einigen Subspecies der Bienen und Wespen – in Kolonien vieler interagierender Individuen leben. Insektenkolonien sind fähig, eine Anzahl von Optimierungsproblemen zu lösen, das keines der Individuen selbst lösen könnte. Einige Beispiele finden den kürzesten Weg bei der Futtersuche, Aufgabenzuweisung bei der Verteilung der Arbeit an die Arbeitskräfte und Clusterung bei der Organisation der Brutkammern. Lauter Probleme, die auch in der realen Welt Gegenstücke haben. Insektenkolonien haben mehr als 100 Millionen Jahre Erfahrung bei der Lösung solcher Probleme, möglicherweise hat dies sogar einen evolutionären Vorteil gegenüber der humanen Species, die erst seit rund 50000 Jahren existiert. Um einem Schwarm die Möglichkeit der Kooperation zu geben, ist eine Form der Kommunikation notwendig. Ein Beispiel für diese Kommunikation ist das Legen von Pheromonspuren, wie dies einige bestimmte Species der Ameisen tun. Eine auf Futtersuche befindliche Ameise wird den Weg, den sie dorthin genommen hat, markieren indem sie entlang des Weges dorthin eine bestimmte Menge von Pheromon versprüht, welche die anderen Ameisen auf Futtersuche ermutigt (aber nicht zwingt) diesem Weg ebenfalls zu folgen.
Die Vorzüge der Selbstorganisation als Basis für die Problemlösung zeigen sich vor allem in ihrem verteilten und robusten Charakter. Tatsächlich kann eine Ameisenkolonie ein sinnvolles Verhalten bewahren, auch wenn ein Großteil der Ameisen für eine zeitlang ausfällt.
Ameisensysteme sind heuristische Suchverfahren, die sich an dem Verhalten von Ameisen bei der Futtersuche orientieren. 1991 entwickelten Mailänder Wissenschafter unter Führung von Marco Dorigo Algorithmen, die auf dem Verhalten der Ameisen basieren. Die Besonderheit dieses Verfahrens ist vor allem die Dynamik des Optimierungsprozesses. So wird der Prozeß auf Grund der gewonnenen Erfahrungswerte ständig angepaßt. Er profitiert von gewonnenen Erkenntnissen.

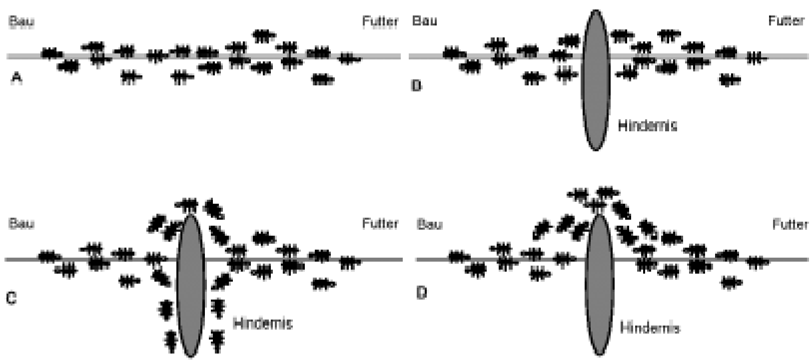


Abbildung 15: Ameisensysteme – die grundlegende Idee [KLEIN 2001]

Zwar haben Ameisen Augen, doch schon auf Grund ihrer bodennahen Position ist jeder Grashalm ein unüberschaubares Hindernis für sie. Ameisen besitzen eine Drüse am Hinterleib, über die sie den chemischen Lockstoff Pheromon auf ihrem Weg hinterlassen können. Nachfolgende Ameisen orientieren sich am Pheromon ihrer Vorgänger und wählen mit höherer Wahrscheinlichkeit den am stärksten markierten Weg. Dieses Verhalten wird dabei aufgrund von Erkenntnissen über eine reale Ameisen-Species (Linepithaeme humile), die praktisch blind ist, beschrieben.
Die grundlegende Funktion kann an folgenden Illustrationen erklärt werden:
Das Beispiel geht von Ameisen aus, die einen Weg zwischen ihrem Ameisenhaufen und einer Futterquelle suchen.

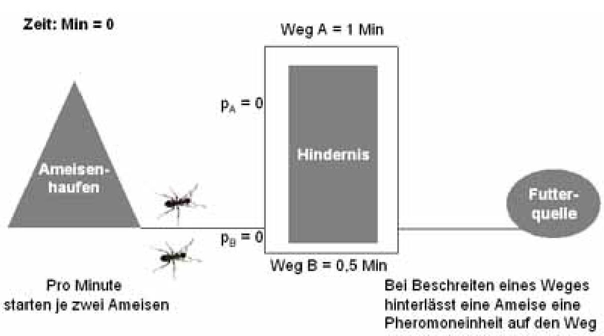


Abbildung 16: Ameisensysteme – Beispiel zum Zeitpunkt t = 0 [HANSMANN 2004]

Dabei bestehen zwei Wegalternativen um ein Hindernis, wobei der längere Weg A doppelt so lang sei wie der kürzere Weg B. Weiterhin sollen pro Minute jeweils zwei Ameisen vom Nest aus starten. In Minute 0 starten somit zwei Ameisen und finden noch keinen der Wege markiert vor. Da sie das Hindernis nicht übersehen können und auch die Pheromon-Duftspuren keinen Hinweis geben, sei unterstellt, daß eine Ameise den längeren Weg A und eine den kürzeren Weg B einschlagen wird.

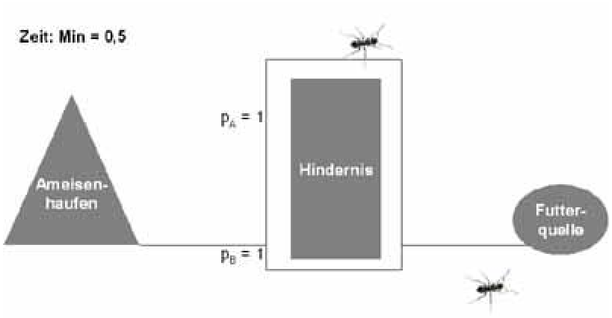


Abbildung 17: Ameisensysteme – Beispiel zum Zeitpunkt t = 0.5 [HANSMANN 2004]

Nach einer halben Minute hat die Ameise, die Weg A eingeschlagen hat, gerade den halben Weg zurückgelegt. Die Ameise auf dem kürzeren Weg hat aber die Futterquelle schon erreicht und macht sich bereits auf den Rückweg. Nach einer Minute hat sich das Bild wie folgt verändert:

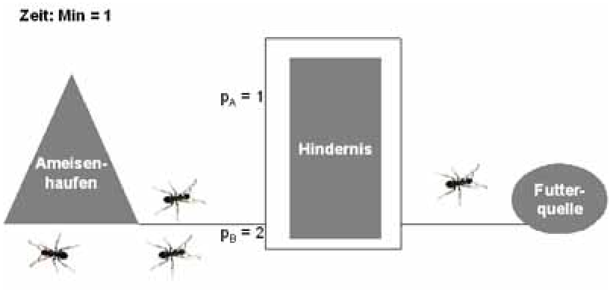


Abbildung 18: Ameisensysteme – Beispiel zum Zeitpunkt t = 1 [HANSMANN 2004]

Während die Ameise auf dem längeren Weg gerade die Futterquelle erreicht, kehrt die auf dem kürzeren bereits ins Nest zurück. Starten zwei weitere Ameisen, so finden sie auf ihren alternativen Wegen bereits Informationen ihrer Vorgänger vor. Der untere Weg ist bereits mit zwei Pheromoneinheiten markiert, während sie auf dem oberen Weg lediglich eine Einheit vorfinden. Sie werden somit mit höherer Wahrscheinlichkeit den kürzeren Weg B einschlagen. Dadurch steigert sich wiederum die Anziehungskraft des Weges für weitere Nachfolger, so daß nach einiger Zeit eine Ameisenstraße auf dem kürzeren Weg B entsteht:

Abbildung 19: Ameisensysteme – Beispiel zum Zeitpunkt t = 10 [HANSMANN 2004]

Vom Beispiel losgelöst, kann also festgestellt werden: Ein kürzerer Weg kann von den Ameisen deswegen gefunden werden, weil dieser im Vergleich zu einem längeren Weg im gleichen Zeitraum von mehr Ameisen durchlaufen werden kann als der längere. Diese vielleicht sehr kleine Präferenz lockt nunmehr im nächsten Zeitraum wieder ein wenig mehr Ameisen auf diesen Weg. Dieser Anziehungseffekt wird langsam immer stärker, bis fast alle Ameisen dem kürzeren Weg folgen. Das Pheromon hält somit die Erfahrungen der Ameisen auf der Wegsuche fest und kann mit einer Art kollektivem Gedächtnis (Gehirn) der Kolonie verglichen werden.

Dabei ist es ein wichtiger Mechanismus, daß die Ameisen lediglich eine mit der Stärke der Markierung korrespondierende Wahrscheinlichkeitsauswahl treffen und nicht immer dem stärker markierten Weg folgen. In diesem Fall könnte die anfänglich zufällige Wegsuche der Ameisen die Präferenz auf einen schlechten Weg locken, der nicht auf Grund seiner Güte zur Straße wird, sondern weil er am stärksten markiert ist. Weichen manche Ameisen vom Weg ab, so werden weitere Wege untersucht, die eventuell Abkürzungen darstellen. Der Erfolg dieser Abkürzungen wird via Pheromon zurückgemeldet und weitere Ameisen werden folgen.

Eine Ameisenstraße auf dem kürzesten Weg entsteht.

Allerdings sei an dieser Stelle angemerkt, daß die Computer-Ameisen genau wie ihre natürlichen Vorbilder nicht in jedem Fall die optimale Lösung finden. Jedoch sind die Lösungen stets nahe am Optimum.

Die Lösung eines Traveling Salesman Problems (TSP) mit einem Ameisensystem zeigt Hansmann anschaulich an einer online verfügbaren Simulation unter http://www.ameisenalgorithmus.de/appletantstour.htm.
Bullnheimer leitet die ersten Tourenplanungsversionen des Ameisenalgorithmus von TSP-Versionen ab, d. h. mit anderen Algorithmen zusammengestellte Touren werden mit Hilfe der Ameisen weiter optimiert. Spätere Ansätze liefern weitere Varianten. Abweichend von den natürlichen Ameisen, wird im nachgebauten Algorithmus kein Pheromon verwendet, sondern man behilft sich mit Gleitkommazahlen, welche die Präferenzen für eine bestimmte Strecke ausdrücken. An einer Weggabelung stehend erfolgt die Auswahl, welcher Weg eingeschlagen wird durch die künstlichen Ameisen z. B. durch eine Zufallsauswahl nach dem Monte-Carlo-Verfahren. Die Pheromonablage erfolgt allerdings etwas anders als bei ihren lebendigen Vorbildern erst am Ende der Berechnung. Mehrere Iterationen bilden nachkommende Ameisen ab. Die Vorbelegung erfolgt im Allgemeinen mit konstanten Werten. Das Verduften wird durch eine Halbwertszeit abgebildet, mit dem hohe Pheromonwerte früher Iterationen immer weiter abgeschwächt werden.
Eine andere Variante ist, nur die beste Lösung für das Pheromonupdate heranzuziehen. Es wurde herausgefunden, daß diese Updating Strategie die effizientere als jene in frühen Ameisensystemen ist, in der alle konstruierten Lösungen benutzt wurden, um die Pheromone upzudaten. In späteren Ansätzen wird beides kombiniert; die besten Ergebnisse werden dabei in Form der „elitären Ameisen“ als Zusatz zu den laufenden Pheromonspuren einbezogen.
Reale Ameisen haben eine implizite Lösungsqualität: bereits das Aufspüren der Pheromonspuren zieht bereits die Lösung nach sich, indem damit mehr Ameisen den kürzeren Weg benutzen. Bei künstlichen Ameisen ist dies nicht in allen Fällen so. Abhängig von der Problemstellung aber auch der Implementation wird diese implizite Lösung nachgebildet oder auch nicht. Auf Ameisensystemen beruhende Routinglösungen können z. B. auf diesem impliziten Mechanismus aufbauen, während statische Optimierungsprobleme davon nicht profitieren. Dieser Zusammenhang entsteht durch die Proportionalität zwischen der Ameisen- und der Lösungsgeschwindigkeit.
Zahlreiche Anwendungen der Ameisensysteme haben in unterschiedlichen Problemstellungen erwiesen, daß Ameisenalgorithmen gute Lösungen (nahe am Optimum) in einer angemessenen Rechenzeit finden können.
Während die Rechenzeit bei den meisten anderen heuristischen Ansätzen eine wichtige Größe ist, kann dies bei den Ameisensystemen gut in Griff gebracht werden, weil die Ameisenheuristik üblicherweise eine vordefinierte Anzahl an Iterationen durchläuft.
Neben Routenproblemen wurden Ameisenalgorithmen bereits für zahlreiche andere Optimierungsprobleme erfolgreich eingesetzt, z. B. Bemalungsprobleme, Optimierung von Industrierobotern etc.

5.3 Systemkombinationen

Weiters sind in der Arbeit Verbesserungen des Savingsalgorithmus beschrieben, die auf den Ameisensystemen beruhen. Wie bei natürlichen Ameisen wird der kürzeste Weg durch mit der Zeit verduftende Pheromonspuren gefunden. Dort, wo bereits die meisten Ameisen vorbeigegangen sind, ist der Duft am stärksten, und der Weg entlang dieser wird daher am wahrscheinlichsten eingeschlagen. Analog zu den SavingsAnts (der meines Erachtens einfachsten und wirkungsvollsten Kombination des Savingsalgorithmus mit den Ameisensystemen) und eventuell einer zusätzlichen Kombination mit genetischen Algorithmen im Bereich der Vorgabevariablen lassen sich damit wahrscheinlich noch weitere Annäherungen an die Realität erzielen.

6 LÖSUNGSANSATZ

Unter den untersuchten Algorithmen erscheinen – wie bereits zuvor angeführt – besonders die Savings-Verfahren, die mit Ameisenalgorithmen kombiniert werden, gut für dynamische Daten weiterentwickelbar. Auch die Kombination der Ameisensysteme mit genetischen Algorithmen erscheint als Weiterentwicklung interessant.
Zielführend erscheint mir für einen ersten Arbeitsansatz folgende Lösung:

1. Man errechne für jedes Zeitintervall (z. B. stündlich oder halbstündlich) eine eigene KW-Matrix und berechne die dazugehörigen Savings für diese Zeitperioden.
   - Grundsätzlich kann von einer Start-KW-Matrix ausgegangen werden, die auf einem Straßennetz mit vollkommen freiem Verkehrsfluß beruht.
   - Weiters kann davon ausgegangen werden, daß dynamische Verkehrsdaten nur für die wichtigsten Straßen vorliegen, daher kann sich die Neuberechnung der KW-Matrix auf Strecken beschränken, die Hauptstraßen benutzen; schließlich ist ja davon auszugehen, daß keine Strecken aus dem reinen Nebenstraßenbereich ins Hauptstraßennetz verlegt werden, wenn dort die Geschwindigkeiten sinken; wenn zusätzlich auch noch die Region bekannt ist, innerhalb derer sich die Geschwindigkeiten geändert haben, kann so die Anzahl der zu berechneten Matrixelemente zusätzlich verringert werden. Alternativ ist noch zu prüfen, ob nicht Algorithmen, die ganze KW-Matrizen in einem Durchgang errechnen, wie z. B. der Floyd-Algorithmus, die Neuberechnung der gesamten KW-Matrix rascher bewältigen als die oben beschriebenen Methoden.
2. Man beginne mit dem größten Saving s_{ijt} (also der Ersparnis beim Zusammenlegen der Touren zu Ziel i und Ziel j in der Zeitscheibe t), und verbinde zwei Einzeltouren miteinander, wobei stets darauf zu achten ist, ob aufgrund der aufzusummierenden Fahrzeiten nicht das nächste Saving aus der benachbarten Zeitperiode zu entnehmen ist. Durch sequentielle Abarbeitung der Savings werden Touren zusammengesetzt.

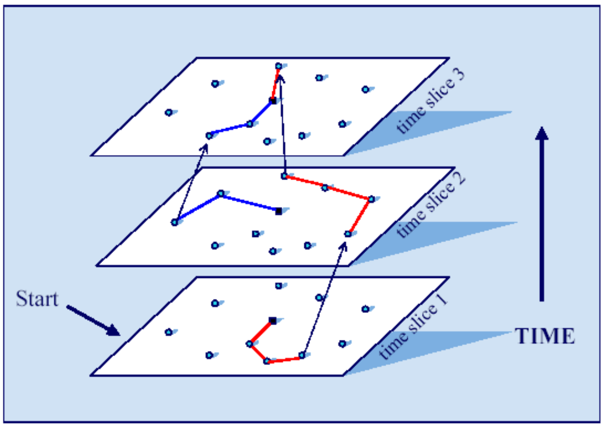


Abbildung 20: Die Aufteilung des Modellraums in Zeitscheiben und der Routingprozess zweier Touren durch die Zeit [DONATI 2003]

Alternativ kann auch mit Zielen mit hohem Ladevolumen begonnen werden bzw. diese bevorzugt werden; dadurch lassen sich bei sehr unterschiedlichen Liefermengen – mit Einschränkungen – auf einfachem Wege Touren einsparen.

3. Da diese extrem suboptimal sein könnten, wird einerseits versucht, diese mit einem TSP-Algorithmus nachzubearbeiten (wobei natürlich ebenfalls auf die tageszeitabhängigen Reisezeiten zu achten ist), andererseits durch Iterationen nach dem Vorbild der Ameisensysteme und genetischen Algorithmen das Ergebnis zu verbessern.
   Durch Vergleiche mit tatsächlich gefahrenen Touren kann die Lösungsqualität aufgezeigt werden.

7 ZUSAMMENFASSUNG UND AUSBLICK

Zusammenfassend kann also gesagt werden, daß sowohl passende dynamische Daten verfügbar sind, als auch grundlegende Algorithmen. Im Bereich der Datenerfassung als auch der Clearingstellen sind noch einige organisatorische Verbesserungen möglich, die einem solchen Projekt zum Erfolg verhelfen könnten. Die dynamischen Tourenalgorithmen stehen zwar im Prinzip bereits zur Verfügung, bedürfen jedoch noch eingehender Weiterentwicklung. Es kann jedoch eine weitgehende Optimierungsmöglichkeit erwartet werden.

In den nächsten Monaten sollen die Forschungen erweitert werden und eine Versuchsanordnung errichtet werden, mit der Rechenergebnisse mit realen Flotten verglichen werden können.

8 LITERATUR

ASFINAG 2003; Das österreichische Mautsystem. Informationsfolder, Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschaft (Hrsg.), Wien 2003

BELL 1994; A stochastic user equilibrium (S. U. E.) path flow estimator for urban road networks, Michael G. H. Bell und Caroline M. Shield, in: How to control mobility - les cahiers du MET collection Trafics novembre 1994, Namur (B) 1994 (http://www.met.be/metpub/src/trafic06/p21.html)

BOCK 2004; Einsatz wechselseitig asynchron und synchron kommunizierender Agenten in der Transportplanung, Stefan Bock, Wilhelm Dangelmaier und Hubertus Franke, Paderborn 2004 (http://wwwhni.uni-paderborn.de/ publikationen/download.php3?id=1704&filename=paper.pdf&paper=BDF2004.pdf&parent=%2Fprojekte%2Fprojekt.php3%3Fid%3D71)

BOYSEN 2004; Schwarmintelligenz und das Hochzeitsproblem - Ameisenalgorithmen zur Lösung kombinatorischer Optimierungsprobleme, Nils Boysen, Hamburg 2004 (http://www.ameisenalgorithmus.de/downloads/ hochzeitsproblem.pdf)

BOYSEN 2004a; Ameisenalgorithmen, Nils Boysen, Hamburg 2004 (http://www.ameisenalgorithmus.de/downloads/ ameisenalgorithmen.pdf)

BULLNHEIMER 1997; Applying the Ant System to the Vehicle Routing Problem, Bernd Bullnheimer, Richard F. Hartl und Christine Strauss, 2nd international Conference on Metaheuristics – MIC 97, Sophia-Antipolis (F) 1997 (http://osiris.tuwien.ac.at/ ~wgarn/VehicleRouting/neo/data/articles/bullnheimer97AS.pdf)

BULLNHEIMER 1999; An improved Ant system Algorithm for the Vehicle Routing Problem, Bernd Bullnheimer, Richard F. Hartl, Christine Strauss, 6th Viennese workshop on Optimal Control, 1997, publiziert in Annals of Operations Research 89 (Dawid, Feichtinger und Hartl (Hrsg.)): Nonlinear Economic Dynamics and Control, S. 319-328, 1999

CAR 1993; Hierarchisches Straßennetz – Konzept für effiziente Wegesuche, Adrijana Car, in Norbert Bartelme (Hrsg.): Grazer Geoinformatiktage 93, Mitteilungen der geodätischen Institute der Technischen Universität Graz, Folge 76, Graz 1993

DIJKSTRA 1959; A note on two problems in connexion with graphs, E. W. Dijkstra, Numer. Math., 1:269–271, 1959

DOERNER 2002; SavingAnts for the Vehicle Routing Problem, Karl Doerner, Manfred Gronalt, Richard F. Hartl, Christine Strauss, Michael Stummer, in Proceedings of the EvoWorkshops 2002 EuroGP 2002, Kinsale, Ireland 2002 (http://www.wu-wien.ac.at/am/Download/report63.pdf)

DOMSCHKE 1997; Logistik, Bd. 2 Rundreisen und Touren, Wolfgang Domschke, Verlag Oldenbourg, München 1997

DONATI 2003; Time Dependent Vehicle Routing Problem with a Multi Ant Colony System, Alberto V. Donati, Roberto Montemanni, Norman Casagrande, Andrea E. Rizzoli und Luca M. Gambardella, Manno (CH) 2003 (http://www.idsia.ch/idsiareport/ IDSIA-17-03.pdf)

DORIGO 1996; Ant System: Optimization by a Colony of Cooperating Agents, Marco Dorigo, V. Maniezoo und A. Colorni, IEEE Trans. Sys., Man, Cybernetics 26 (1996) 1, S. 29-41

DORIGO 1997; Ant Colonies for the traveling Salesman Problem, Marco Dorigo und Luca Maria Gambardella, BioSystems 43, S. 73 –81, 1997

FLEISCHMANN 2004; Time-Varying Travel Times in Vehicle Routing, Bernhard Fleischmann, Martin Gietz und Steffen Gnutzmann, Transportation Science 38 (2), S. 160-173, 2004 (http://www.extenza-eps.com/INF/doi/pdf/10.1287/trsc.1030.0062)

FLOYD 1962; Algorithm 97, Shortest path, Robert W. Floyd, Communications of the ACM, 5(6), S. 345, 1962

FUTTER 2000; Internet Mapping mit Business to Business Daten, Nikolaus Futter und Wolfgang W. Wasserburger, in J. Strobl (Hrsg.), Business Geographics, Salzburg 2000

GAMBARDELLA 1999; MACS-VRPTW: A multiple Ant Colony System for Vehicle Routing Problems with Time Windows, Luca Maria Gambardella, Éric Taillard und Giovanni Agazzi, Technical Reports IDSIA 06-99, Lugano (CH) 1999 (http://osiris.tuwien. ac.at/~wgarn/VehicleRouting/neo/data/articles/MACS-VRPTW.pdf)

GHIANI 2003; Real-Time Vehicle Routing: Solution Concepts, Algorithms and Parallel Computing Strategies, Gianpaolo Ghiani, Francesca Guerriero, Gilber Laporte und Roberto Musmanno, Rende (I) 2003 (http://www.hpcc.unical.it/papers/06.01.02.pdf)

GROSSO 2000; Path Flow Estimator, Sergio Grosso, Newcastle upon Tyne 2000 (http://www.staff.ncl.ac.uk/sergio.grosso/ PFE/pfe.html)

HANSMANN 2004; Karl-Werner Hansmann und Nils Boysen, Ameisensysteme, Hamburg 2004 (http://www.ameisenalgo rithmus.de/)

HASELBERGER 2005; Das Projekt VEMA – Stand Jänner 2005, Rainer Haselberger, in: Manfred Schrenk (Hrsg.), 10. Symposium Computergestützte Raumplanung, Wien 2005 (http://mmp-tk1.kosnet.com/corp/archiv/papers/ 2005/CORP2005_ HASELBERGER.pdf)

HASSELBERG 2000; Some results on heuristical algorithms for the shortest path problems in large road networks, Stephan Hasselberg, Köln 2000 (http://www.ub.uni-koeln.de/ediss/archiv/2000/11v3933.pdf)

JUNG 1998; A genetic algorithm for the vehicle routing problem with time-dependent travel times, Soojung Jung und Ali Haghani, Maryland 1998 (http://152.99.129.29/its/cdrom/4139.pdf)

JUNG 2001; Flottenmanagementsysteme – Grundlegende Technologien, Funktionen und Marktüberblick, Jürgen Jung und Bodo L. van Laak, Koblenz 2001

KERBACHE 2004; Planning and Scheduling Transportation Vehicle fleet in a Congested Traffic Environment, Laoucine Kerbache und Tom van Woensel, Paris 2004 (http://www.hec.fr/hec/fr/professeurs_recherche/upload/cahiers/ CR803kerbache.pdf)

KIM 2004; Optimal Vehicle Routing with Real-Time Traffic Information, Seongmoon Kim, Mark E. Lewis und Chelsea C. White III, Michigan 2004 (http://www.orie.cornell.edu/~melewis/pubs/real-time.pdf)

KLEIN 2001; Ameisensysteme, Seminararbeit zu „Moderne Heuristiken“, Arno Klein, Clausthal 2001 (http://www2.student-online.net/Publikationen/680/seminararbeit.pdf)

LINAUER 2005; Generierung streckenbezogener Verkehrsdaten als Basis für den Einsatz in Verkehrstelematiksystemen, Martin Linauer, Wien 2005

RATLIFF 1999; Estimating Traveling Time/Speed, Donald H. Ratliff und Xinglong Zhang, Atlanta 1999 (http://www.isye. gatech.edu/research/files/misc9716.pdf)

SCHÄFER 2005; Neue Ansätze im Verkehrsmonitoring durch Floating Car Daten, Ralf-Peter Schäfer, Astrid Gühnemann, Kai-Uwe Thiessenhusen, 19. Verkehrswissenschaftliche Tage "Mobilität und Verkehrsmanagement in einer vernetzten Welt", 22. bis 23. September 2003, Technische Universität Dresden, Dresden 2005 (http://eprints.vf. ba.dlr.de/191/02/VWT%5FDresden%5F Schaefer.pdf)

SCHECHTNER 2002; Auswirkungen von Verkehrstelematiksystemen auf Stadt- und Regionalräume, Katja Schechtner, in Manfred Schrenk (Hrsg.): Computer gestützte Raumplanung 2002; Wien 2002 (http://www.corp.at/ corp_relaunch/papers_txt_suche/ CORP2002_Schechtner.pdf)

STÜCKLBERGER 1993; GIS und „Multilevel“-Routensuche, Anton Stücklberger und Manfred Wieser, in Norbert Bartelme (Hrsg.): Grazer Geoinformatiktage 93, Mitteilungen der geodätischen Institute der Technischen Universität Graz, Folge 76, Graz 1993

VANDAELE 2000; A queueing based traffic flow model, Nico Vandaele, Tom van Woensel und A Verbruggen, Transportation Research-D: Transport and environment, January, vol. 5 no 2, S. 121-135

van WOENSEL 2003; A vehicle routing problem with stochastic travel times, Tom van Woensel, Laoucine Kerbache, Herbert Peremans und Nico Vandaele, Samos 2003 (http://www.icsd.aegean.gr/aic2003/Papers/vanWoensel-Kerbache.pdf)

Verkehrs- und Raumplanung – Wirkungssimulation – Information: Praxis und Vision

Thomas HAUPT

Dipl.-Ing. Thomas Haupt, PTV AG, Abteilung Verkehrsmodelle, Stumpfstr. 1, D-76131 Karlsruhe, Thomas.Haupt@ptv.de, www.ptv-vision.de

1 EINFÜHRUNG

Die Entwicklung der Informationstechnologie mit GIS, Navigation und Intra- bzw. Internet eröffnet der Verkehrs- und Raumplanung neue Möglichkeiten. Die Vision ist nicht der gläserne Bürger, sondern Transparenz bei der Analyse und Wirkungsprognose von Entwicklungen und planerischen Maßnahmen.

Mit dem EU-Beitritt von zuletzt 10 neuen Mitgliedsländern und weiteren geplanten Beitritten müssen die Verkehrsnetze zu Lande, zu Wasser und in der Luft auch in diesen Ländern und in diese Länder hinein ausgebaut werden. Durch den Aufbau geeigneter Analyse-, Prognose- und Informationssysteme können die anstehenden Aufgaben besser und effizienter bewältigt werden.

Dabei kommt es nicht nur darauf an, einmal für einen planerischen Zweck eine Studie zu erstellen und dann danach zu handeln, sondern Planung, Auf- bzw. Umbau und Betrieb von Infrastruktur als Prozess zu begreifen und zu gestalten. Als dafür geeignete Planungswerkzeuge werden Verkehrsmodelle angesehen.

Die IT-Systeme (Software und Hardware) und Datengrundlagen dafür gibt es. Am Methoden-Know-how der Planer und vor allem der Erfahrung damit fehlt es jedoch häufig. In diesem Beitrag sollen wesentliche Grundsätze beim Aufbau von Verkehrsmodellen dargestellt und einige Beispiele etwas näher betrachtet werden. Der Anspruch, eine von den subjektiven Erfahrungen des Autors unabhängige Analyse des Status quo vorzunehmen, besteht nicht.

Die subjektive Ausgangsthese dabei ist, dass wir unsere Zukunft gestalten können und dass es hilft, wenn wir dabei in der Lage sind, die Wirkungen von geplanten Maßnahmen vorauszusehen.

2 DAS VERKEHRSMODELL ALS PLANUNGS- UND MODELLIERUNGSSYSTEM FÜR RAUM UND VERKEHR

Der Planungsprozess der Verkehrs- und Raumplanung ist prinzipiell sehr klar und einleuchtend definiert und besteht aus den Schritten Mängel-Analyse, Lösungsentwicklung, Wirkungssimulation und Bewertung. Verkehrsmodelle helfen bei Analyse und Prognose, der Wirkungsermittlung und der Bewertung von Planungsvarianten. Im Folgenden soll dargestellt werden, dass sich auf diesen Modellansätzen aufbauend universelle Analyse- und Simulationssysteme mit Raumbezug aufbauen lassen.

Kern der Herangehensweise ist es, dass eine Modelldatenbasis aus weitgehend vorhandenen Daten erstellt wird oder eine vorhandene benutzt wird. Diese Datenbasis enthält Angebots- und Nachfragedaten sowie weitere Daten, die vielfältig genutzt werden können und damit eine universelle Basis für Analyse, Simulation und Visualisierungen darstellen.

Wenn man die Datensituation in Europa bzw. speziell in Deutschland mit derjenigen in den USA vergleicht, fällt die Freizügigkeit und Selbstverständlichkeit auf, mit der die amerikanischen Verkehrs- und Raumplaner hinsichtlich der Daten umgehen. Im Allgemeinen werden diese Daten zum Download von den Planungsbehörden vorgehalten und tragen so dazu bei, Qualität und Vergleichbarkeit von Planungen zu verbessern und deren Kosten zu senken.

In Deutschland und Österreich ist die Datenbeschaffung vergleichsweise aufwändig. I.A. empfiehlt sich daher für Planungsträger und Dienstleister der Aufbau einer Datenbasis aus kommerziellen, öffentlichen und eigenen Quellen. Bei kommerziellen Daten ist darauf zu achten, dass im Hinblick auf Lizenzart und -umfang die geeigneten Lizenzen erworben werden. In jedem Fall sind auch die Folgekosten für die Aktualisierung im Auge zu behalten. Dabei ist es normalerweise günstiger, Daten zu lizenzieren und Update-Kosten zu tragen bzw. Wartungsverträge abzuschließen, als die Daten selbst zu erheben. Dies gilt insbesondere für Navigationsnetzdaten.

2.1 Wegenetze

Die Daten des Straßennetzes können aus Navigationsnetzen komfortabel abgeleitet und programmgestützt an die Bedürfnisse der Verkehrs- und Raumplanung angepasst werden.

Die digitalen Navigationsdaten bieten mehrere Vorteile:

Professionelle Erhebung: Es wird ein durchgehender Qualitätsstandard gewährleistet, der durch regelmäßige Befahrungen sichergestellt wird.

Tiefendigitalisiert: Es sind sämtliche Straßen bis zu Anliegerwegen und Fußgängerzonen enthalten. Richtungsgetrennte Fahrbahnen werden grundsätzlich als zwei Strecken abgebildet.

Routingfähigkeit: Zuverlässige Erhebung von Einbahnstraßen und Abbiegeverboten.

Aktualität: Vierteljährliche Updates werden zur Verfügung gestellt. Der Bezug zur letzten Version wird über eine permanente ID weitgehend gesichert.

Für die Zwecke der Verkehrs- und Raumplanung sind die Daten räumlich und teilweise auch inhaltlich an den Planungsraum und die Modellierungsaufgabe anzupassen. Werden hierzu einfache GIS-Systeme eingesetzt ist es u.U. sehr schwer, die sogenannte Routingfähigkeit sicher zu stellen. Verkehrsplanungsprogramme hingegen können dies normalerweise leisten. Wichtig ist dann, dass die Daten leicht und verlustfrei in und aus einem solchen System importiert und exportiert werden können.

2.2 Netz- und Fahrplandaten für liniengebundene Verkehre

Aus Auskunft- und Betriebsplanungssystemen können Verbindungs- und Lagedaten von Haltestellen übernommen oder generiert und mit den Straßennetzdaten verbunden werden. Durch die richtige semantische Verbindung dieser Daten entstehen schließlich integrierte Netze, die die Linienverläufe lagegenau erfassen und räumlich differenzierte Auswertungen ermöglichen.

Abb. 1: Integrierte Netzabbildung von ÖV und MIV in einem rechenfähigen Planungssystem: Straßengrundnetz, Haltestellen und Points of Interest für eine Multi-Level Studie Tourismus und Verkehr (Quelle PTV AG, VISUM)

Eine Datenformatbeschreibung in Form von ER-Diagrammen oder Datenbankschemata kann hier nicht gegeben werden. So umfasst das Weißbuch zu INTREST bzw. das darauf aufbauende PTV AGF Format ca. 250 Seiten. Öffentlich zugängliche Beschreibungen zu INTREST findet man unter http://www.intrest.org/ Einen Überblicksvortrag zum AGF Format der PTV AG findet man unter http://intergeo.de/deutsch/page/kongress/downloads/archiv/2004/Vortisch.pdf..

2.3 Points of Interest, Verkehrszellen, Struktur- und Aufkommensdaten

Unter Points of Interest (POI) werden für den Nutzer interessante (Zusatz)Information mit einer Punkt-Koordinate verstanden, die oft durch weitere Datensätze näher beschrieben werden. Solche Daten stehen teilweise frei verfügbar im Internet, da Anbieter von Waren und Dienstleistungen sich über Adressangaben und zusätzliche kartografische Informationen bekannt machen. Außerdem werden POIs von Navigationsdatenlieferanten angeboten. Mit Hilfe von Geocodierung können aber auch zu Adressangaben Koordinaten ermittelt und diese dann als POI in Verkehrsmodelle eingebaut werden.

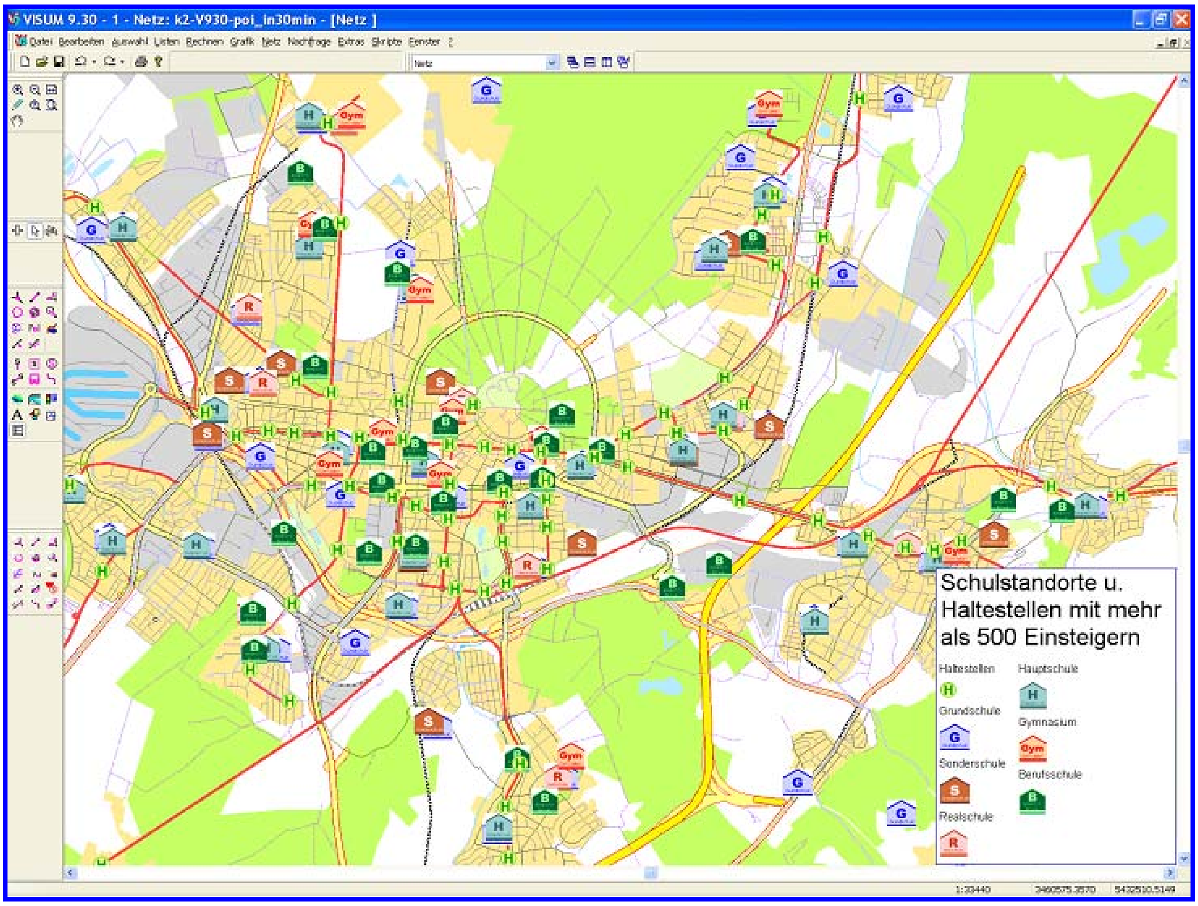


Abb.2: Ausschnitt aus einem Netzgraph mit Straßennetz, Schulstandorte als POI und Haltestellen (Quelle: PTV, VISUM)

Auf einer höheren Abstraktionsebene werden in Verkehrsmodellen Verkehrszellen als räumliche Aggregate und Träger von Strukturdaten verwendet. Durch Verschneideoperationen ist es möglich, Daten aus POI-Informationen auf Verkehrszellen zu aggregieren.
Übliche Raumeinteilungssysteme in Verkehrsmodellen orientieren sich an Raumordnungssystemen und berücksichtigen Landes-, Bezirks-, Kreis-, Gemeindegrenzen sowie innergemeindliche Abgrenzungen, wie z.B. Zähl- oder Wahlbezirke oder statistische Bezirke.

Auf Europäischer Ebene werden neben den länderspezifischen administrativen Einteilungen die sogenannten NUTS-Einteilungen 0 bis 5 verwendet. NUTS 0 entspricht den Ländergrenzen und NUTS 5 den Gemeindegrenzen. Im Europa der 25 gibt es 112119 Gemeinden (Gebietsstand von 2003, Quelle: http://europa.eu.int/comm/eurostat/ramon/nuts/introannex_regions_en.html). Beispielhaft für die EU der 15 ist die räumliche Einteilung in Abb. 3 angegeben.

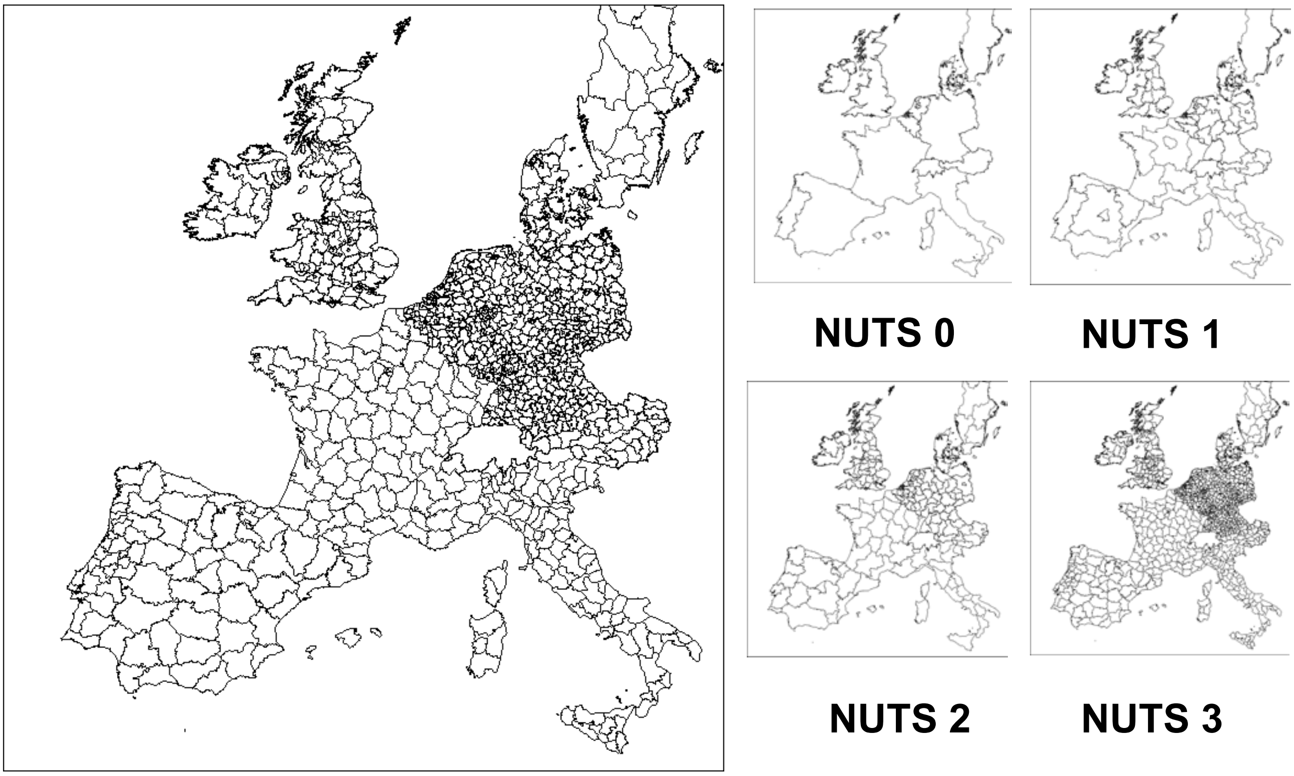


Abb. 3: Gliederungsebenen der EU 15 (Quelle Eurostat)

Für europäische Verkehrsmodelle wird man auch die EFTA Länder Schweiz und Norwegen, sowie die zum 1.5.2004 hinzugekommenen 10 Beitrittsländer, sowie weitere europäische Länder und Beitrittkandidaten dazunehmen. Die Verkehrszelleneinteilung in einem Verkehrsmodell ist u.a. vom Anwendungszweck, der angestrebten räumlichen Auflösung und der Datenverfügbarkeit abhängig und liegt in der Verantwortung des Modellierer bzw. seines Auftraggebers. Da Verkehrszellengrenzen und zugehörige Sachdaten auf verschiedenen Abstraktionsebenen (auch konkurrierend und übergreifend) gehalten und gepflegt werden können, kann man hier heute mehr Großzügigkeit walten lassen als dies früher üblich war. I.A. wird man sich aber auch heute noch an bekannten administrativen Grenzen orientieren und diese dann ggf. weiter unterteilen. Verkehrszellengrenzen und ihre Sachdaten können additiv zu einem Verkehrsnetz dazu gelesen werden und programmgestützt (teil- oder vollautomatisch) an das Verkehrsnetz angebunden werden.

Für viele Anwendungen interessant ist auch der Zugriff auf statistische Daten aus kommerziellen Quellen, die teilweise aus den anonymisierten Auswertungen von Drittdaten stammen. So gibt es z.B. ein umfassendes System sogenannter Marktzellen (für Deutschland etwa 85.000 Zellen) mit sehr differenzierten Daten zur Wohnbevölkerung, Bebauung, Kaufkraft etc. (http://www.spatial-data.de/html/geo.frame.html)

In Bezug auf Aufkommens- und Verflechtungsdaten der Verkehrsnachfrage (Matrizen) sind Ansätze von Interesse, diese Daten aus vorhandenen Quellen wie der Volkszählung oder der Arbeitspendlerstatistik oder aus dem Betrieb von E-Ticketing oder Mauterfassungen (in anonymisierter Form) abzuleiten. Für Prognosen der Verkehrsverflechtungen werden in komplexen Verkehrsmodellen die Wahlentscheidungen der Verkehrsteilnehmer wie z.B. die Verkehrsziel oder Verkehrsmittelwahl (Modal Split) nachgebildet. Weitere Differenzierungen wie Abfahrtszeit und Fahrtzweck können hinzukommen.

2.4 Multi-modale Netzberechnungen

Mit dem Verkehrsmodell bestehend aus Netz, POIs, Fahrplan und Linienführungen, sowie ggf. weiteren Daten zur Verkehrserzeugungs- und Modal Split Berechnung steht das Analyseinstrument bereit. Von besonderem Interesse dabei ist, dass der Bezug zu den Navigationsdatenbeständen und den Fahrplandaten des öffentlichen Verkehrs bei entsprechender Modellierung gewahrt bleibt. So können die Fahrplandaten eines Verkehrsverbundes oder die aktuellen Netzmodifikationen in einer Verkehrsmanagementzentrale genutzt und mit dem Verkehrsmodell auch fortgeschrieben werden. Unten stehende Abbildungen 4 und 5 zeigen multi-modale Berechnungsergebnisse die mit einem regionalen Verkehrsmodell erzeugt wurden.

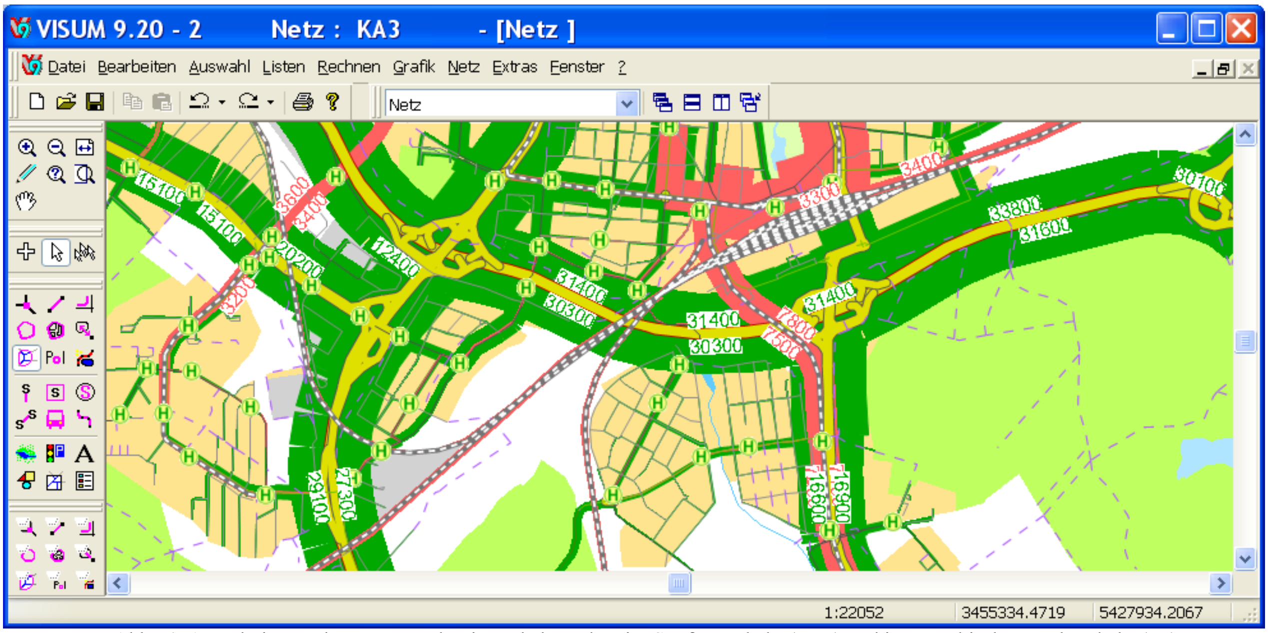


Abb. 4: Ausschnitt aus dem Netzgraph mit Verkehrstärken im Straßenverkehr (grün) und innerstädtischem Nahverkehr (rot) (Quelle: PTV, VISUM)

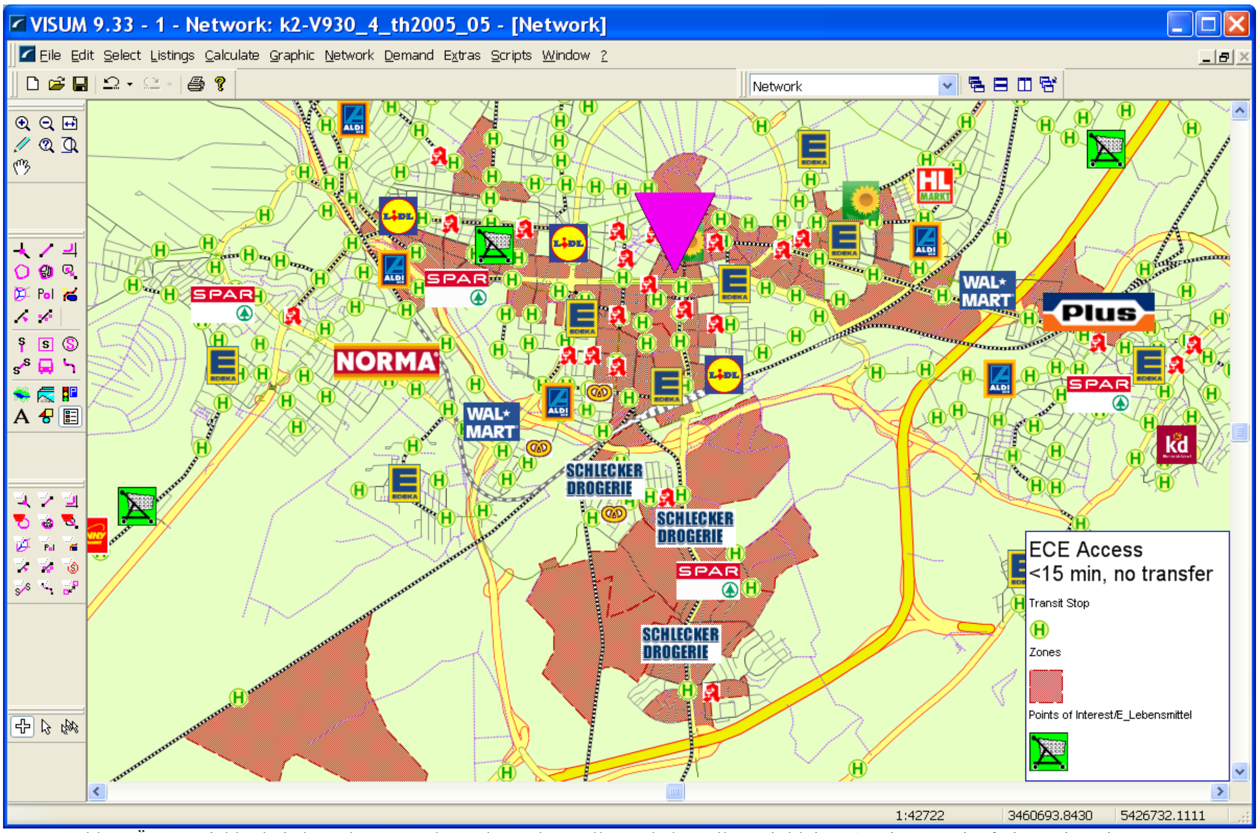


Abb.5: ÖV-Erreichbarkeitsberechnung und Wettbewerber: Alle Verkehrszellen mit kleiner 15min umsteigefreier Reisezeit zum neuen Einzelhandelstandort ECE

Sämtliche Eingaben, Netzprüfungen und Berechnungen sowie Darstellungen können innerhalb des Systems Verkehrsmodell durchgeführt werden. Dies dient vor allem dazu das System Netz und Nutzungen konsistent zu halten. Ein Berechnungslauf speichert alle Ergebnisse während Inputdaten additiv verwaltet und zur Erzeugung von Szenarien und Planfällen sowie für Elastizitätsuntersuchungen genutzt werden können.

Um ungeübten Nutzern einen sicheren Zugang zum Gesamtsystem oder Teilen zu gewähren, kann das System auch in einen Web-Service eingebunden oder mit anderen Programmen verbunden werden. Verkehrsmodelle von PTV, die auf VISUM ab 9.3 aufbauen können mit Python (einer OPEN SOURCE Scipt-Sprache mit programmierbaren Menüs) gesteuert oder funktional ergänzt werden und verfügen über Entry- und Re-Entry Möglichkeiten bei der Ablaufsteuerung. Die Ausgabe von SVG-Grafiken (http://www.adobe.com/svg/viewer/install/main.html) ermöglicht es die Grafiken für Webseiten zu erzeugen. (vgl. Ausführungen von Friderich, T. zum Baustelleninformationssystem in Leipzig, CORP2006).

3 PLANUNGSBEISPIELE MIT VERKEHRSMODELLEN

In dem folgenden Kapitel sollen einige Beispiele für modellgestützte Projektarbeiten mit Schwerpunkten in der Verkehrsplanung dargestellt werden. Hieraus soll der Einsatzbereich der Methoden deutlich werden.

3.1 Berliner Hauptbahnhof

Der neue Berliner Hauptbahnhof („Lehrter Bahnhof“) ist ein zentrales Entwicklungsprojekt für Berlin. Auf einer Verkehrsfläche von etwa 400 mal 400 Meter werden ab Ende Mai 2006 pro Tag etwa 1 170 Züge im Nah- und Fernverkehr halten. Damit soll sich der Bahnhof zur zentralen Drehscheibe für den Nah- und Fernverkehr entwickeln. Wegen seiner Lage am Regierungsviertel und den neu errichteten Nutzungen für Büro, Wohnen und Versorgung soll er auch selbst ein Magnet von Besucherströmen sein.

Auf rund 15 000 Quadratmetern Einzelhandelsfläche sollen die Ansprüche und Bedürfnisse von Privat- und Geschäftsreisenden, Berlin-Besuchern sowie Einwohnern befriedigt werden. Dabei setzt die Bahn sowohl auf überregionale Filialisten als auch auf lokale Einzelhändler, die im Bahnhof ihr Geschäft betreiben. Ein weiterer Schwerpunkt liegt auf einem breiten Dienstleistungsangebot von Autovermietung, Friseur, Post und Reisebüro bis zu Wellnessangeboten – Service steht im Mittelpunkt.

In 15 Meter Tiefe, auf der Ebene -2, liegen an vier Bahnsteigen die acht Gleise der Nord-Süd-Verbindung. Direkt nebenan befindet sich die U-Bahnstation der U 55. Auf der darüber liegenden Ebene 1 befinden sich zahlreiche Geschäfte, Gastronomie- und Serviceeinrichtungen und die Verbindung zum Parkhaus mit circa 900 Stellplätzen. Auf den Ebenen 0 und 1 werden den Kunden weitere Einkaufsmöglichkeiten, gastronomische Einrichtungen und Dienstleistungen geboten. Auf der darüber liegenden Ebene verkehrt heute bereits auf sechs Gleisen der S-Bahn-, Regional- und Fernverkehr in Ost-West-Richtung.

In der Studie aus dem Jahr 2003/04 über die zu erwartenden Reisenden- und Besucherströme waren die bisherigen Plandaten zu überprüfen und zu aktualisieren. Dabei wurden auch die Abhängigkeiten und Einflüsse der geplanten Nutzungen und deren Einbindung in den Hauptbahnhof sowie deren Wirkungen auf die Verkehrsströme durch Szenarien und Varianten simuliert. Ziel der Studie war somit auch die Schaffung einer Grundlage für Verhandlungen mit potenziellen Mietern der Gewerbeflächen und eine Optimierung der Nutzungszuordnungen. Durch die Praxis der sogenannten Umsatzmiete ist heute auch der Vermieter sehr an einer nachhaltigen und erfolgreichen Belegung der Mietflächen interessiert.

3.1.1 Vorgehensweise

Auf der Basis von Netz- und Verkehrserzeugungsmodellen werden die Verkehrsverflechtungen und Kanten-belastungen für die verschiedenen Nutzergruppen errechnet. Die Modelle haben im Innenbereich des Bahnhofs eine Auflösung von ca. 1-2 Meter und verwenden Gebäudepläne um die Quell- und Zielbereiche der Fußgänger (Einkäufer, Besucher, Reisende) zu identifizieren. Durch Befragungen wurden durchschnittliche Ausgaben je Nutzergruppe ermittelt und diese mit den absoluten Zahlen aus den Netz- und Erzeugungsmodellen hochgerechnet und auf die Netzelemente umgelegt. Abhängigkeiten und Einflüsse der geplanten Nutzungen und deren Einbindung in den Hauptbahnhof sowie deren Wirkungen auf die Verkehrsströme waren neu zu definieren und durch Szenarien und Varianten (bis zum Jahr 2015) abzubilden. Auch die Zuordnung der Nutzungen zu den Geschossen sowie die durch die Nutzungen induzierten Verkehrsströme wurden in Form von Planungsvarianten untersucht.

Das von der PTV (NL Berlin) ausgeführte Projekt umfasste folgende Arbeitsschritte:

Erstellen eines Netzmodells für den Nahbereich des Bahnhofs, zur Ermittlung des fußläufigen Einzugsbereiches (wird hier nicht behandelt)

Erstellen eines Netzmodells mit den Nutzungen innerhalb des Bahnhofes zur Ermittlung der Ströme innerhalb des Bahnhofs (siehe Abbildung 1); Aufkommens- und Verteilungsrechnung der Verkehrströme und der Ausgaben der Besucher; die geplanten Nutzungen und die Umsatzzahlen je Besuchergruppe wurde von der DB Station&Service vorgegeben. Hierzu wurden Reisenden- und Besucherbefragungen (u.a. in Leipzig, Frankfurt, Berlin Zoo) durchgeführt.

Übernahme eines Netzmodells für den Nah- und Fernverkehr der Senatsverwaltung und Anpassung an die aktuellen Planungen; Ermittlung der Personenströme im Nahverkehr und im Fernverkehr für drei Szenarien (wird hier nicht behandelt)

Ermittlung der Verflechtungsmatrizen innerhalb des Bahnhofes für verschiedene Varianten

Ermittlung der „Geldströme“ (d.h. der mit ihren Ausgaben gewichteten Besucherströme) und Wegebelegungen unter Berücksichtigung der Nutzungsangebote im Bahnhof (Abb. 8)

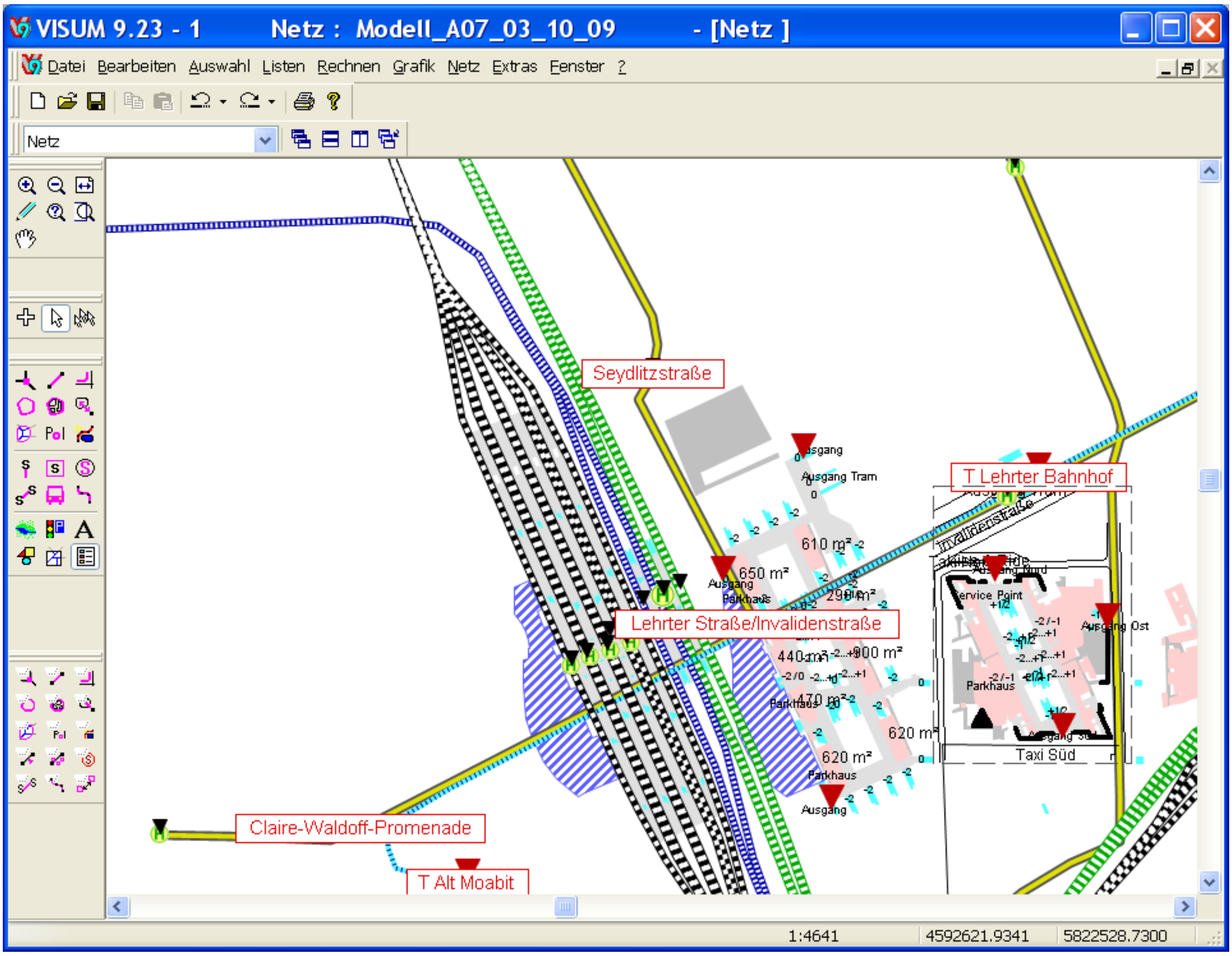


Abb. 6: Ausschnitt aus dem Netzgraph mit dem ÖV-Angebot, einigen Nutzungszuordnungen und den Gebäudeanbindungen (Die Ebenen werden der Übersichtlichkeit nebeneinander dargestellt.)

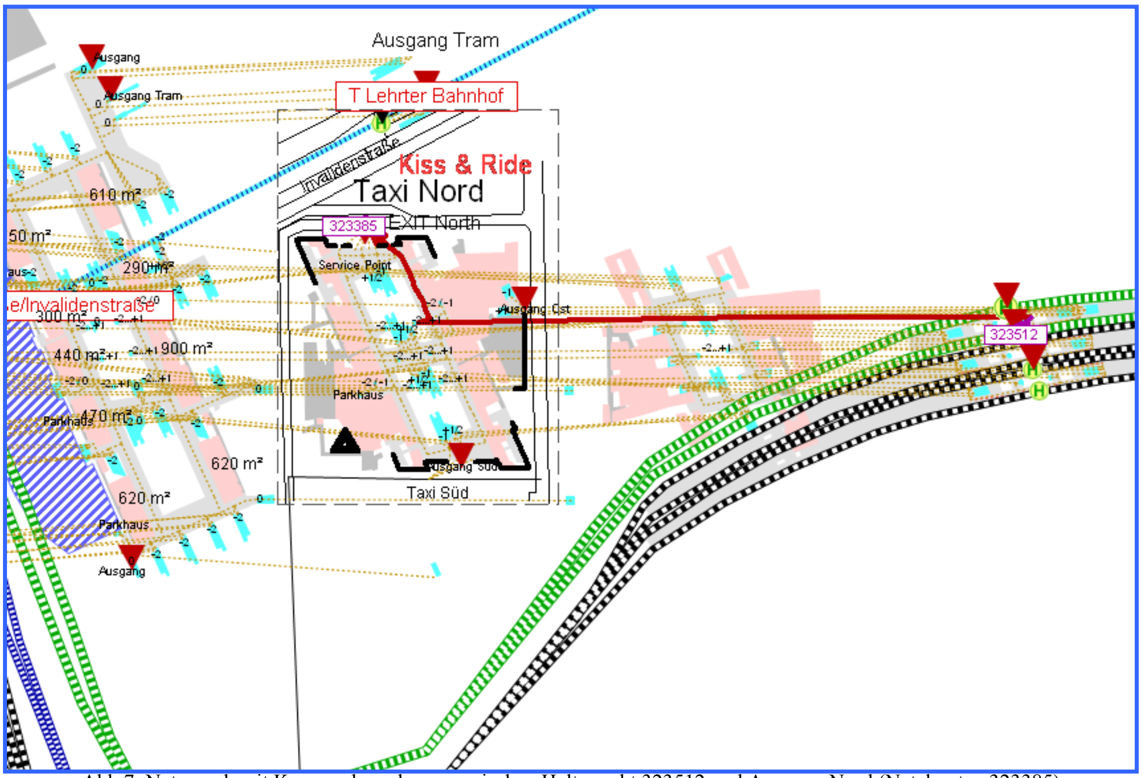


Abb.7: Netzgraph mit Kurzwegberechnung zwischen Haltepunkt 323512 und Ausgang Nord (Netzknoten 323385)

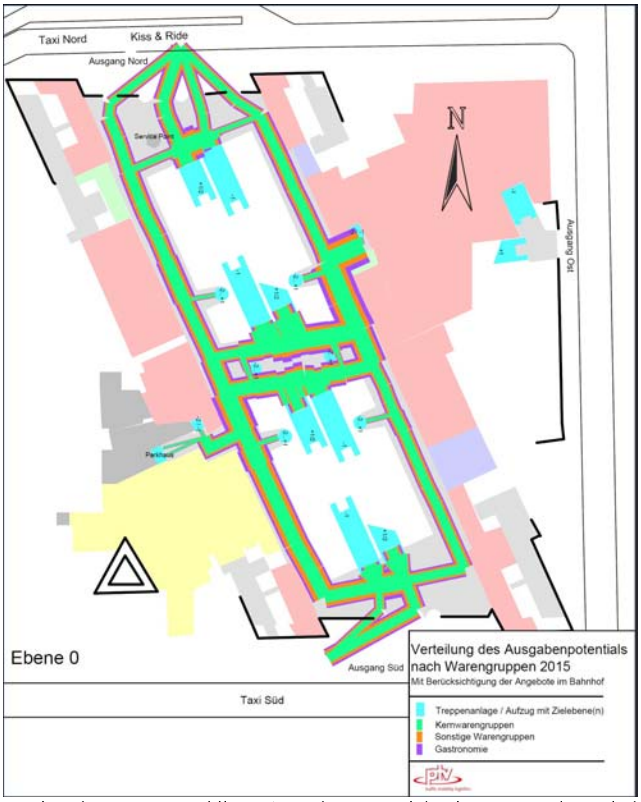


Abb.8: Berechnungsergebnis mit den Reisendenströmen und ihren Ausgabenpotenzialen im Inneren des Bahnhofs (Balkenbreite der „Geldströme“ beispielhaft)

3.1.2 Resümee

Die Zusammenarbeit mit den Projektentwicklern, Real Estate Consultern und Marktanalysten war äußerst fruchtbar. Mit den netzmodellbezogenen Ansätzen wurde in dieser Branche Neuland beschritten. Die Chancen, die sich durch eine derartige interdisziplinäre Zusammenarbeit auf tun, können kaum überschätzt werden:

Übernahme der Grunddaten wie Verkehrsnetz und Nutzungspläne in das Verkehrsmodell

Abbildung der Verkehrserzeugungsstruktur und Möglichkeit Ergebnisse mit anerkannten Methoden zu berechnen (z.B. Mehrwegverfahren bei der Berechnung von Fußwegen, aktivitätenorientierte Verkehrsberechnung)

Konsequente Umsetzung der Annahmen und Hochrechnung zu einem Gesamtbild

Rechenfähige Version des Gesamtmodells und einfache Anpassung an neue Kenntnisse und Planungsvorgaben; Cetris paribus-Berechnungen und Elastizitätsuntersuchungen

Veranschaulichung der Ergebnisse und damit Hilfestellung bei Verhandlungen mit Mietern und der Entscheidungsfindung bei der Funktionszuordnung

3.2 Planungsmodell der ÖBB: SUPERNOVA

Aufbauend auf den Daten aus Navigationssystemen, dem Verkehrsmodell des Verkehrsministeriums, eigenen Nachfragedaten und der Fahrplanauskunft hat der ÖBB-Personenverkehr ein landesweites Verkehrsmodell erstellt, das in seiner Detaildichte einmalig ist. Das Modell ist unter dem Namen SUPERNOVA (vgl. FRÖHLICH, POSCH 2005) bekannt. Inzwischen wird das Modell auch für die konzerninterne Einnahmenaufteilung eingesetzt und ist zu einem festen Bestandteil der Optimierung des Fahrplanangebots der ÖBB geworden.

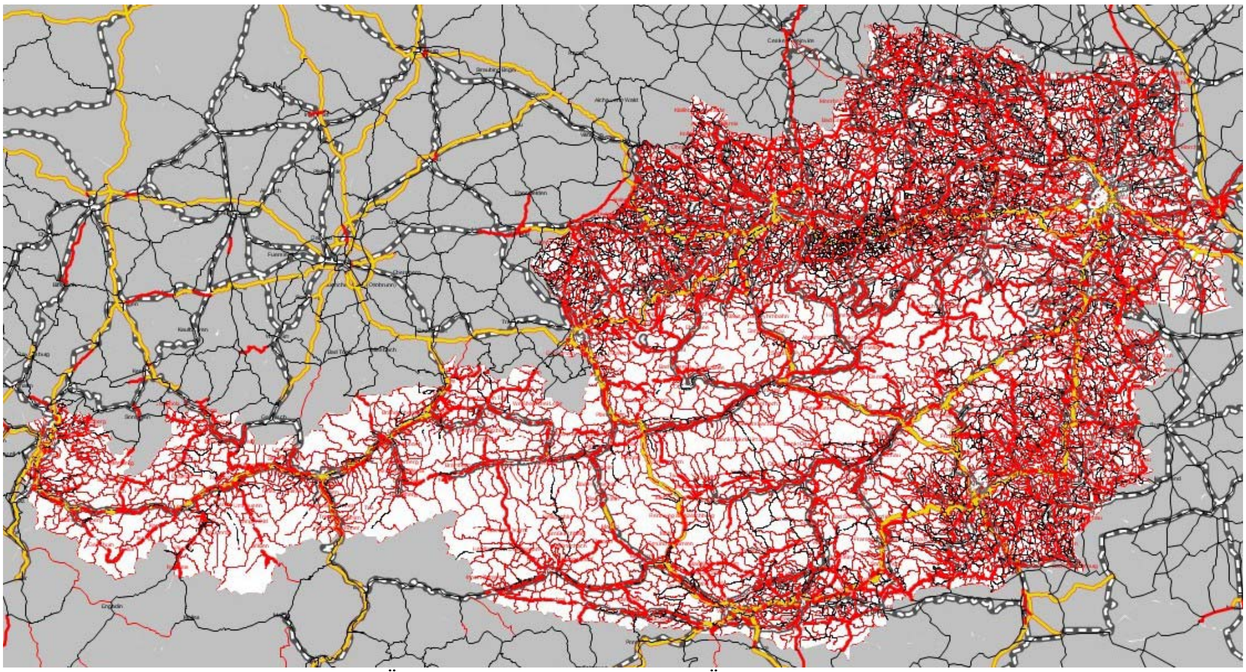


Abb.9: Österreichweites Netzmodell der ÖBB für Schiene und Straße

3.3 Seattle Circulation and Bellevue Downtown Mall Study: PTV America

In Nordamerika setzten die "Metropolitan Planning Organisations" (MPOs) seit den 60er Jahren Verkehrsmodelle ein. Aufgrund bundersweiter Gesetze sind die Planungsbehörden verpflichtet regionale Planungen im Bereich Siedlung und Verkehr durch Verkehrsmodelle in ihren Wirkungen entsprechen dem Stand der Technik zu überprüfen. Seit Anfang 2005 werden von PTV America Netzdaten von NavTeq im VISUM-Format flächendeckend in Teilmodellen bereit gehalten und Kunden zur Verfügung gestellt. Die Lizenzkosten dafür werden nutzerfreundlich mit den Softwarelizenzen abgerechnet. Die attributierten Straßennetzdaten sind routingfähig und hochgenau. Sie werden von den Planern bei Bedarf ergänzt und bspw. mit strukturellen oder verkehrlichen Daten aus anderen GIS-System angereichert..

Bei Detailuntersuchungen zum Verkehrsablauf wird im allgemeinen ein Nachfragemodell auf Makro-Ebene erstellt und dann verfeinert. Für beide hier aufgeführten Anwendungen in der Region Seattle im Staate Washington wurden die Systeme VISUM und VISSIM eingesetzt.

3.3.1 Vorgehensweise

Ziel der Studie ist es den Verkehrsablauf für den Individualverkehr und den öffentlich Verkehr auch unter Berücksichtigung von weiteren Ansiedlungen und Gewerbeentwicklungen zu optimieren. Dabei werden Szenarien der Verkehrsnachfrageentwicklung für die Jahre 2004, 2010 und 2030 betrachtet. Aus dem makroskopischen Gesamtmodell mit Nachfrage (Abb. 8) werden für die Detailuntersuchungen Teilmodelle räumlich abgegrenzt (Abb. 9) und weiter aufbereitet. Für diese werden sehr detaillierte Netzkonfigurationen inkl. der Rampen und der Art der Signalsteuerung entwickelt und bewertet. Die Tests für den erreichbaren Level of Service (Verkehrsqualität gemessen in 5 Stufen) werden entsprechend dem amerikanischen Highway Capacity Manual (HCM) durchgeführt. Die dazu vergleichbare deutsche Richtlinie ist das Handbuch für die Bemessung von Verkehrsstärken, kurz HBS (HBS 2001, http://www.ruhr-uni-bochum.de/verkehrswesen/vk/deutsch/Forschung/hbs.htm). Wer einen umfassenden Einblick in das amerikanische HCM nehmen möchte, sei auf die Webseite der Dowling Inc. (http://www.dowlinginc.com/hcm1997.php) verwiesen. Das von Dowling Inc. entwickelte TRAFFIX System zur Berechnung der HCM Kenngrößen ist in VISUM ab Version 9 enthalten.

Die „besten" Lösungen in den Brennpunkten des Verkehrsablaufs werden dann mit der Mikrosimulation weiter untersucht. Der Verkehrsfluss wird auf der Ebene von Einzelfahrzeugen untersucht. Alle praktisch vorkommenden Steuerungsverfahren und Knotentopologien können im Detail betrachtet und simuliert werden. Hierzu gehören auch verkehrsabhängige Verkehrssteuerungsverfahren. Eine ansprechende 4d-Visualisierung ermöglicht es die entwickelten Lösungen anschaulich zu präsentieren und weiter zu analysieren (Abb. 10).

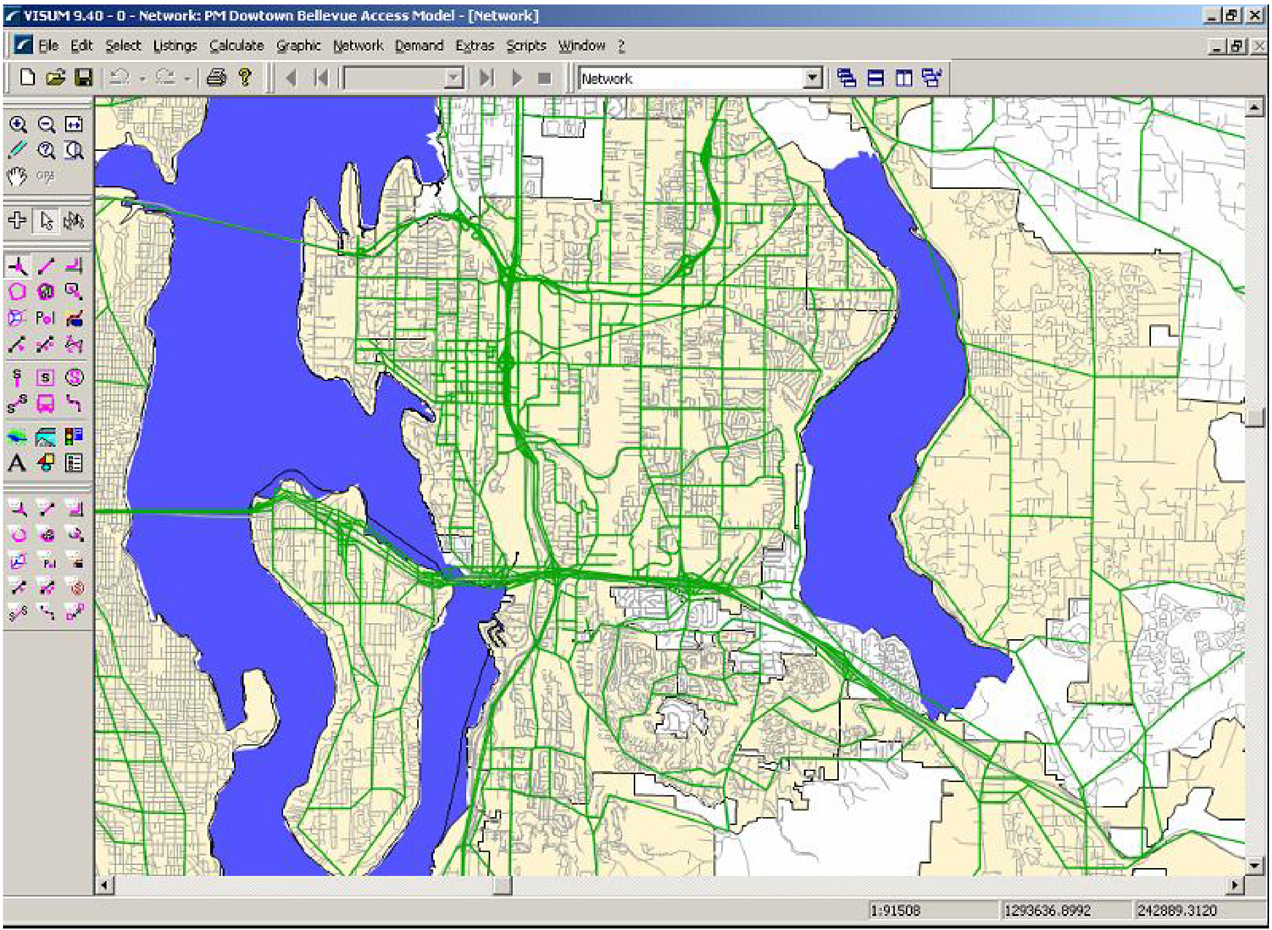


Abb.10: City von Bellevue mit Modellstrecken und lokalen Straßennetz (Quelle: PTV America)

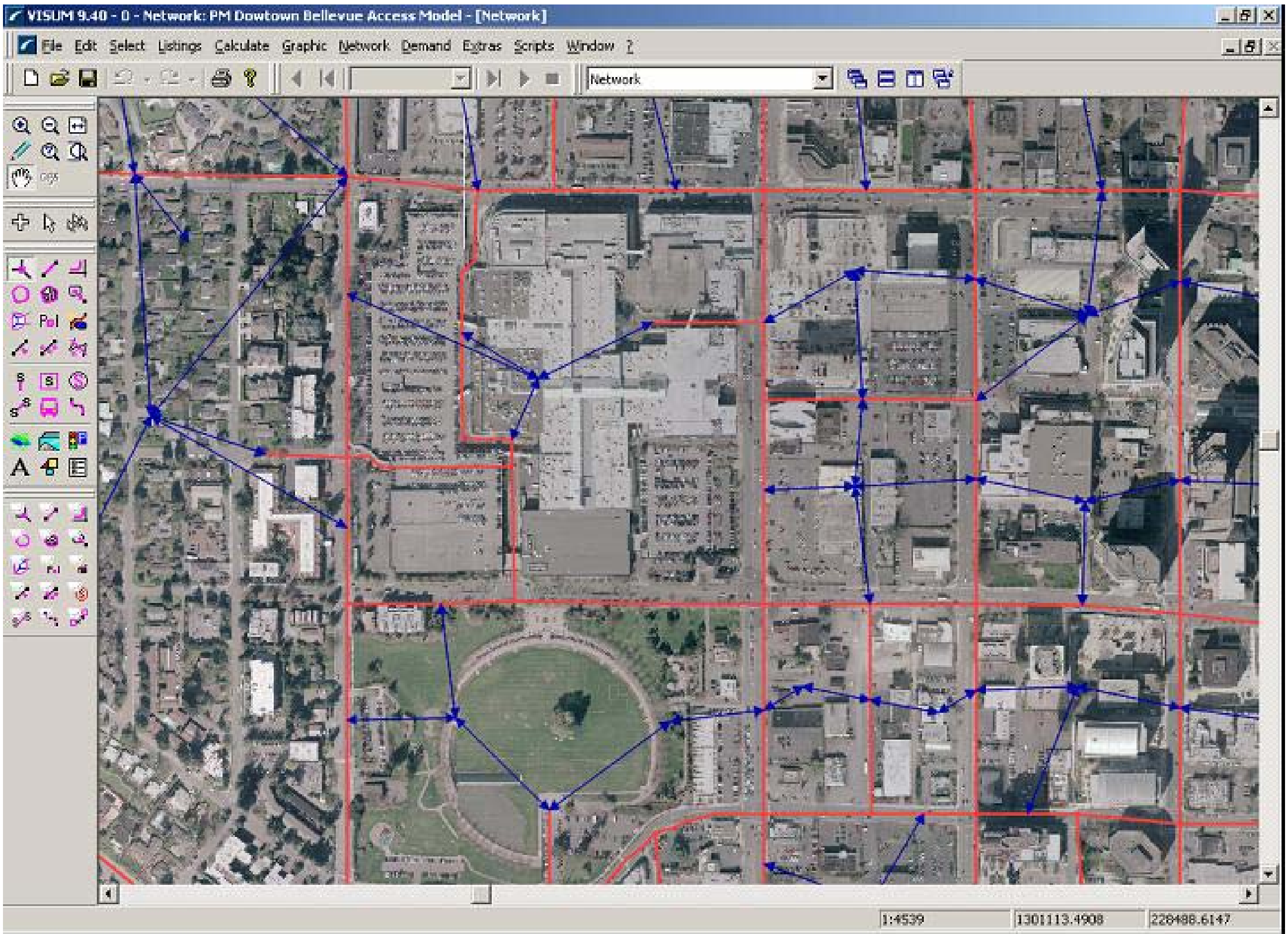


Abb.11: Bellevue Square (Standort der geplanten Mall) mit Netzstrecken und Anbindungen

3.3.2 Resümee

Die amerikanischen Verkehrs- und Raumplanungskollegen setzten in weit höherem Umfang Verkehrs- und Raumplanungsmodelle ein als dies in Europa der Fall ist. Ein Grund hierfür ist die landesweit einheitliche Anwendung von Standards wie sie bspw. im Highway Capacity Manual (HCM) dokumentiert ist. Darüber hinaus spielen auch Land Use Modelle in der amerikanischen Planungskultur eine weitaus größere Rolle als in Europa (z.B. http://www.urbansim.org/). Im Zuge aktueller Förderprogramme wie z.B. dem Travel Model Improvement Program TMIP http://tmip.fhwa.dot.gov/) und dem Next Generation Simulation NGSIM http://ngsim.fhwa.dot.gov/ werden Millionenbeträge in die Verbesserung der Datengrundlagen und Werkzeuge der Raum- und Verkehrsplanung investiert. Die Einbindung von GIS-basierten Informationen in Verkehrsmodelle ist state of the art.

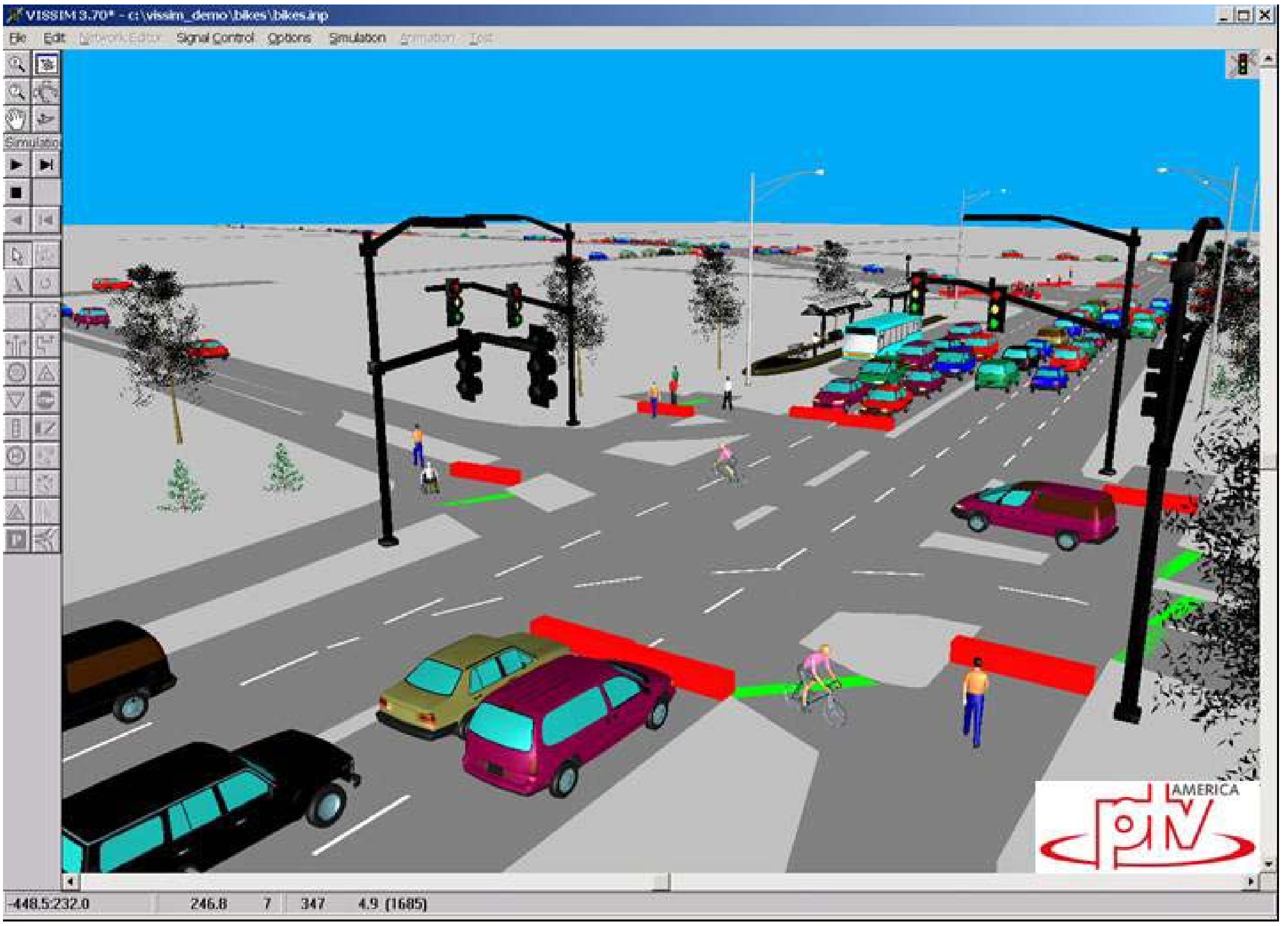


Abb.12: Veranschaulichung der Berechnungsergebnisse durch 4d-Simulation mit VISSIM (Quelle: PTV America)

4 SCHLUSSFOLGERUNGEN UND AUSBLICK

Verkehrsmodelle sind die natürliche Basis für die Integration von Raum- und Verkehrsdaten für Analyse- und Prognosezwecke. Dabei können Verkehrsmodelle sowohl Szenarien der Raumplanung auf strategischer Ebene beinhalten als auch operative Elemente des Betriebs von Verkehrsanlagen und Verkehrsinformationssystemen. Der Vorteil, diese Daten in einem – u.U. auch virtuellen System –zusammenzufassen, besteht darin, dass alle Daten auf der Basis gemeinsamer Raumeinheiten miteinander verknüpft, konsistent gehalten und sehr anschaulich dargestellt werden können. Annahmen über künftige Entwicklungen werden in einem System zusammengefasst und damit leichter plausibilisierbar. Negative Verkehrswirkungen von Ansiedlungen können mit dem Verkehrsmodell unmittelbar errechnet und durch konkrete Netzplanungen entschärft oder auch durch raumplanerische Änderungen "an der Wurzel bekämpft". Umsetzungen von Planungen in betriebliche Lösungen (z.B. Signalzeitenpläne oder Fahrpläne) innerhalb eines Systems oder einer Systemfamilie werden möglich und last not least können Information für die Nutzer der Infrastruktur erstellt und weitergeben werden. (vol die Ausführungen von FRIDERICH, 2006 zum Baustelleninformationssystem in Leipzig)
Die Vision einer Wirkungskette mit den Elementen Planung, Wirkungssimulation, Optimierung, Betrieb und Information wird allmählich real. Dies gilt auch für die Raum- und Ansiedlungsplanung.
Dabei ist es bemerkenswert, dass schon heute viele dieser Planungsaufgaben nicht mehr alleine durch die öffentliche Hand, sondern durch private Investoren und Betreiber wahrgenommen werden.

Um der Vision der Einheit von Planung und Betrieb in der Raum- und Verkehrsplanung näher zu kommen, sollten folgende Gesichtspunkte beim Aufbau von Verkehrsmodellen berücksichtigt werden:
Raumbezug aller verortbaren Projekt (X-,Y-Koordinate) und Angabe der Projektion
Zeitbezug in Form von Zeitstempeln oder Fahrplänen (Von-bis-Angaben) bei Netzobjekten und Sachdaten
Realisierungsbezug (z.B. Analyse_2005, Planung_2007, Szenario_XY_2010 ...) der Rauminformation und der Verhaltensannahmen
Analysedaten möglichst präzise einpflegen, z.B. jede Schule als POI einer Kategorie mit Sachattributen wie z.B. der Schülerzahl je Jahrgangsstufe.
Netzdaten mit Bezug zu genauen Navigationsnetzen

Routingfähigkeit des (multi-modalen) Verkehrsnetzes
Rechenfähige Version des Gesamtmodells und einfache Anpassung an neue Kenntnisse und Planungsvorgaben
Die Möglichkeiten, mit der gleichen Datenbasis verschiedene Levels von Planung und Information gleichzeitig zu bedienen, setzt voraus, dass man heute verfügbare Daten möglichst feinkörnig in die Datenbasis aufnimmt. Abstraktionen sind dann immer mehr eine Leistung des Systems (und nicht des Anwenders beim Dateninput) und werden möglichst spät in Berechnungs- oder Ergebnisaufbereitungsschritten vorgenommen.
Die Vision dabei ist es, Planung als lebensqualitätsverbessernden Prozess zu begreifen und diesen mit IT-Systemen zu unterstützen und parallel dazu, die Fortschreibung von Planung- und Qualitätsmessung zu dokumentieren.

5 LITERATURVERZEICHNIS

FRÖHLICH, M.; POSCH, T.: SUPERNOVA – Simulationsmodell zur Untersuchung der Personenverkehrsnachfrage bei Optimierung des Verkehrsangebots; CORP 2005, 2005
Forschungsgesellschaft für Straßen und Verkehrswesen, Köln: Handbuch für die Bemessung von Straßenverkehrsanlagen (HBS 2001), Januar 2002
Friderich, T.: Baustelleninformationssystem in Leipzig, CORP2006, 2006

6 ABFRAGE VON WEBSEITEN

DDS Digital Data Services GmbH, Karlsruhe : Marktzellendaten, http://www.spatial-data.de/html/geo.frame.html, Abfrage am 10.01.2006
Deutscher Verein für Vermessungswesen e.V. (DVW) - Gesellschaft für Geodäsie, Geoinformation und Landmanagement, Örtlich Vorbereitender Ausschuss der Intergeo 2005, Düsseldorf, Hinte GmbH, Karlsruhe: Überblicksvortrag zum AGF, Format der PTV AG, Vortisch, P., Intergeo 2005 , http://intergeo.de/deutsch/page/kongress/downloads/archiv/2004/Vortisch.pdf, Abfrage am 10.01.2006
Dowling Inc.: Amerikanisches Highway Capacity Manual (HCM), http://www.dowlinginc.com/hcm1997.php, Abfrage am 10.01.2006
European Communities, 1995-2005: Gemeindegrenzen, Gebietsstand von 2003, http://europa.eu.int/comm/eurostat/ramon/nuts/introannex_regions_en.html), Abfrage am 10.01.2006
Oberste Baubehörde im Bayerischen Staatsministerium Innern, München: Beschreibungen zu INTREST, http://www.intrest.org/, Abfrage am 10.01.2006
Ruhr-Universität Bochum: Handbuch für die Bemessung von Verkehrsstärken, HBS (HBS 2001, http://www.ruhr-uni-bochum.de/verkehrswesen/vk/deutsch/info.htm. Abfrage am 10.01.2006
United States Department of Transportation: Förderprogramm Travel Model Improvement Program TMIP http://tmip.fhwa.dot.gov, Abfrage am 10.01.2006
United States Department of Transportation, Federal Highway Administration: Förderprogramm Next Generation Simulation NGSIM http://ngsim.fhwa.dot.gov/, Abfrage am 10.01.2006
University of Washington, Seattle, Land Use Modelle in der amerikanischen Planungskultur, http://www.urbansim.org/). Abfrage am 10.01.2006

Xeismobil Web-GIS www.xeismobil.at
Interaktives Verkehrsinformationssystem zur Förderung des ÖV in der Region Gesäuse

Gerhard TRIEBNIG, Lukas MADL, Stefan MEISSL, Clemens BEYER, Manfred SCHRENK

(Dr. Gerhard Triebnig, Mag. Lukas Madl, DI Stefan Meissl, gerhard.triebnig@arcs.ac.at, lukas.madl@arcs.ac.at, stefan.meissl@arcs.ac.at
ARC Seibersdorf Research Ges.m.b.H., Intelligent Infrastructures and Space Applications Department, A-2444 Seibersdorf;
DI Clemens Beyer, DI Manfred Schrenk, multimediaplan.at, Baumgasse 28, A-1030 Wien; cb@multimediaplan.at; ms@multimediaplan.at)

1 ABSTRACT

In der Region des steirischen Gesäuses drohte durch Einstellung einiger Angebote die weitere Ausdünnung des Öffentlichen Personennahverkehrs (ÖPNV). Xeismobil ist ein Verkehrsprojekt, in dem sich 16 Gemeinden mit dem Ziel zusammengeschlossen haben, den ÖPNV in der Erlebnisregion Gesäuse (Xeis) / Eisenwurzen / Erzbergland zu erhalten.
Ein wesentlicher Bestandteil des Gesamtprojektes ist die Einrichtung eines Mobilitäts-Informationssystemes für die Region, zentrales Element darin ist eine webbasierte GIS-Anwendung zur umfassenden raumbezogenen Information über das ÖV-Angebot.
Das Konsortium MULTIMEDIAPLAN.AT und ARC Seibersdorf Research GmbH ist mit der Umsetzung der Web-GIS-Applikation für das Infoportal Xeismobil betraut und hat eine Lösung entwickelt, die eine optimale Information über das ÖV-Angebot liefern soll.
Die Umsetzung erfolgt zur Gänze auf Open-Source-Komponenten basierend.

2 AUSGANSSITUATION UND ZIELSETZUNG

Im der Region Steirisches Gesäuse (Xeis) drohte die weitere Ausdünnung des Angebotes im Öffentlichen Personennahverkehr (ÖPNV). Um dieser Entwicklung entgegen zu wirken wurde das Projekt Xeismobil lanciert, das die Erhaltung des ÖPNV in der Region sowohl für die einheimische Bevölkerung aber auch für den Tourismus zum Ziel hat.
Zu Xeismobil und damit zum sanften Tourismus mit umweltschonenden öffentlichen Verkehrsmitteln haben sich 16 Gemeinden der Erlebnisregion zwischen Gesäuse und Hochschwab zusammengeschlossen. Alle diese Gemeinden bieten auch spezielle Mobilitäts- und Erlebnisangebote.
Im Mittelpunkt der regionalen Identität steht die unverfälschte Natur der Region, aber auch Kultur, Brauchtum und Industriegeschichte sind Alleinstellungsmerkmale.

Abbildung 21: Die Xeismobil-Region

Durch die Integration des Projektes Xeismobil in das Interreg-IIIB-Projekt „Mobilalp“ ist ein starkes Konsortium entstanden, das die Entwicklung mustergültiger Verkehrslösungen in der Xeisregion ermöglicht.
Die Mobilitätspartner von Xeismobil sind ÖBB, ÖBB-Postbus und regionale Rufbusanbieter. Nachdem Xeismobil eines von zwei österreichischen Projekten im Rahmen von „Mobilalp“ ist, wird das Projekt außer von den 16 steirischen Gemeinden und dem Land Steiermark auch mit Mitteln des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Lebensministerium) und des Bundesministeriums für Verkehr, Innovation und Technologie (BMVIT) unterstützt.
Abgewickelt wird das Projekt Xeismobil durch den Regionalen Entwicklungsverband Eisenerz – Radmer – Hieflau (REVE), das Projektmanagement erfolgt durch das Büro „Der Knotenpunkt“ – Technisches Büro für Verkehrswesen, DI Markus Hauser.
Als unabdingbare Voraussetzung für die Förderung des ÖV in der Region wurde die Einrichtung eines Mobilitäts-Informationssystemes erkannt, zentrales Element darin ist eine webbasierte GIS-Anwendung zur umfassenden raumbezogenen Information über das ÖV-Angebot.

3 INFOPORTAL WWW.XEISMOBIL.AT MIT WEB-GIS-APPLIKATION

Auf www.xeismobil.at wird ein umfassendes Infoportal aufgebaut, das einerseits Touristen über Verkehrsverbindungen in die Region und dortige Angebote informieren soll, vor allem aber für die Bevölkerung der Region einen umfassenden Nutzen bringen soll.
Das Konsortium MULTIMEDIAPLAN.AT und ARC Seibersdorf Research GmbH ist mit der Umsetzung der Web-GIS-Applikation für das Infoportal Xeismobil betraut und hat eine Lösung entwickelt, die eine optimale Information über das ÖV-Angebot liefern soll.
Bei der Konzeption und Umsetzung standen zwei Grundsätze im Mittelpunkt:

- Konsequente Beachtung von Standards, um Offenheit und Erweiterbarkeit sowie Kompatibilität und Interoperabilität mit anderen Informationsdiensten zu gewährleisten
- Wo immer bereits ein gesichertes Web-Service besteht, das die gewünschte Information liefern kann, wird auf dieses Angebot zurückgegriffen, um Doppelgleisigkeiten zu vermeiden – der Endbenutzer greift also über eine Benutzeroberfläche auf verschiedenste Services, u.a. kaskadierte Web-Map-Server, zu, ohne dies in der Benutzung zu merken.

Die Umsetzung erfolgt zur Gänze auf Basis von Open-Source-Komponenten.

4 TECHNISCHES KONZEPT

4.1 Service Übersicht

Abbildung 22 zeigt das GISinfo Xeismobil Service und seine Schnittstellen zum Benutzer, zu „Verlinkten Services“ und zu „Back-end Services“.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

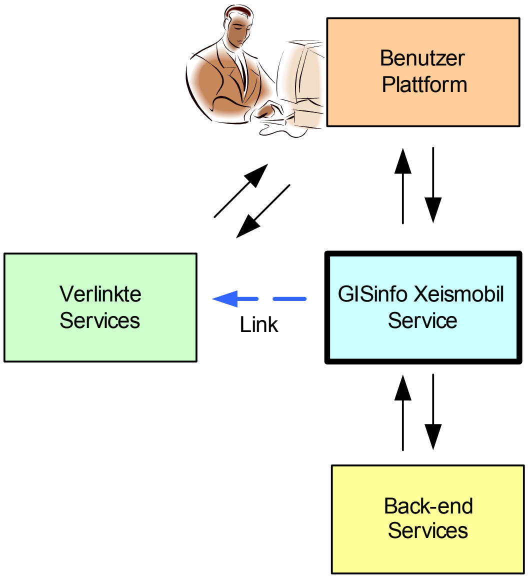


Abbildung 22 GISinfo Xeismobil Service-Kontext

Als **Benutzer Plattform** dient ein Web-Browser.
Das **GISinfo Xeismobil Service** liefert die primäre Schnittstelle zur Informationsdarstellung an den Benutzer. Dazu gehören Adressuche und Anzeigen von interaktiven Karten mit diversen Informationsinhalten, darunter auch weiterführende Links.
Verlinkte Services beinhalten Informationen, welche mit den Inhalten des Xeismobil Services in Beziehung stehen. Die Verlinkung kann ein einfacher Aufruf einer Home Page sein, aber auch eine komplizierte Verknüpfung, welche eine Parameterübermittlung aus dem GISinfo Xeismobil Service zu dem Verlinkten Service durchführt (z.B. Übergabe eines Reiseziels an das Service der Fahrplanauskunft).
Back-end Services dienen der direkten Funktionsunterstützung des GISinfo Xeismobil Services während des on-line Betriebs. Insbesondere liefern die Back-end Services Datensätze über standardisierte Schnittstellen, welche nach Verarbeitung in GISinfo Xeismobil zur Informationsdarstellung verwendet werden (kartographische Daten und Bildmaterial).

4.2 System Übersicht

Abbildung 23 zeigt eine logische Systemarchitektur. Darin ist die GISinfo Xeismobil Plattform als Träger der Services in der Zeichnung blau hervorgehoben. Das Bild zeigt zudem die identifizierten Plattformen für verlinkte Services (grün), für Back-end Services (gelb) und für die Benutzer (braun).
In der Systemübersicht in Abbildung 23 sind die folgenden internen logischen Komponenten der **GISinfo Xeismobil Plattform** gezeigt:

- **Web-Portal** erreichbar über die Adresse www.xeismobil.at/GISinfo/
- Interne **Datenbanken** für Service und System und die zugehörigen Datenbankmanagementfunktionen
- **Back-end Service Manage**r mit eingebautem Web Map Server (WMS), Gateway für Google Earth und Smart Phone Client sowie Schnittstellen zu EFA.
- **Platform Operations Manager** mit den Einrichtungen und Werkzeugen für den Xeismobil Operator

Wie in der Abbildung ersichtlich weist die GISinfo Xeismobil Plattform neben den online Schnittstellen zu Benutzer- und Back-end Systemen auch eine Austauschschnittstelle mit der **BusBahnBim Plattform des Steirischen Verkehrsverbundes** auf. Über diese Schnittstelle tauschen die Operatoren beider Plattformen hauptsächlich Daten über Haltestellen und „Wichtige Punkte“ (BusBahnBim Terminologie) aus.
Mittels Service-Tools ist es dem Xeismobil Operator möglich, Verlinkungen zu externen Services wie z.B. ÖBB, Straßenroutenplanern, Adress- und Telefonverzeichnissen, etc. herzustellen.

Die Anbindung von Back-end Systemen ist eine Systemkonfigurationsaufgabe, die von sachverständigem Installationspersonal durchgeführt wird. Dazu sind System-Tools vorgesehen. Es ist davon auszugehen, dass abgesicherte Einvernehmen mit den Betreibern der **Cascading Web Map Server** (WMS) Plattformen hergestellt werden müssen, um einerseits die Serververbindung zu sichern und andererseits die Abdeckung mit qualitätsvollem Content.

Der **Gateway** Komponente stellt einerseits die Funktionalität „kml2wms“ zur Verfügung, welche benötigt wird, um Linen und Flächendaten aus den Web Map Servern via Google Earth Protokoll (KML Keyhole Markup Langange) anzubieten. Andereseits bietet der Gateway die Möglichkeit, WMS Services direkt für den Smart Phone Client bereit zu halten.

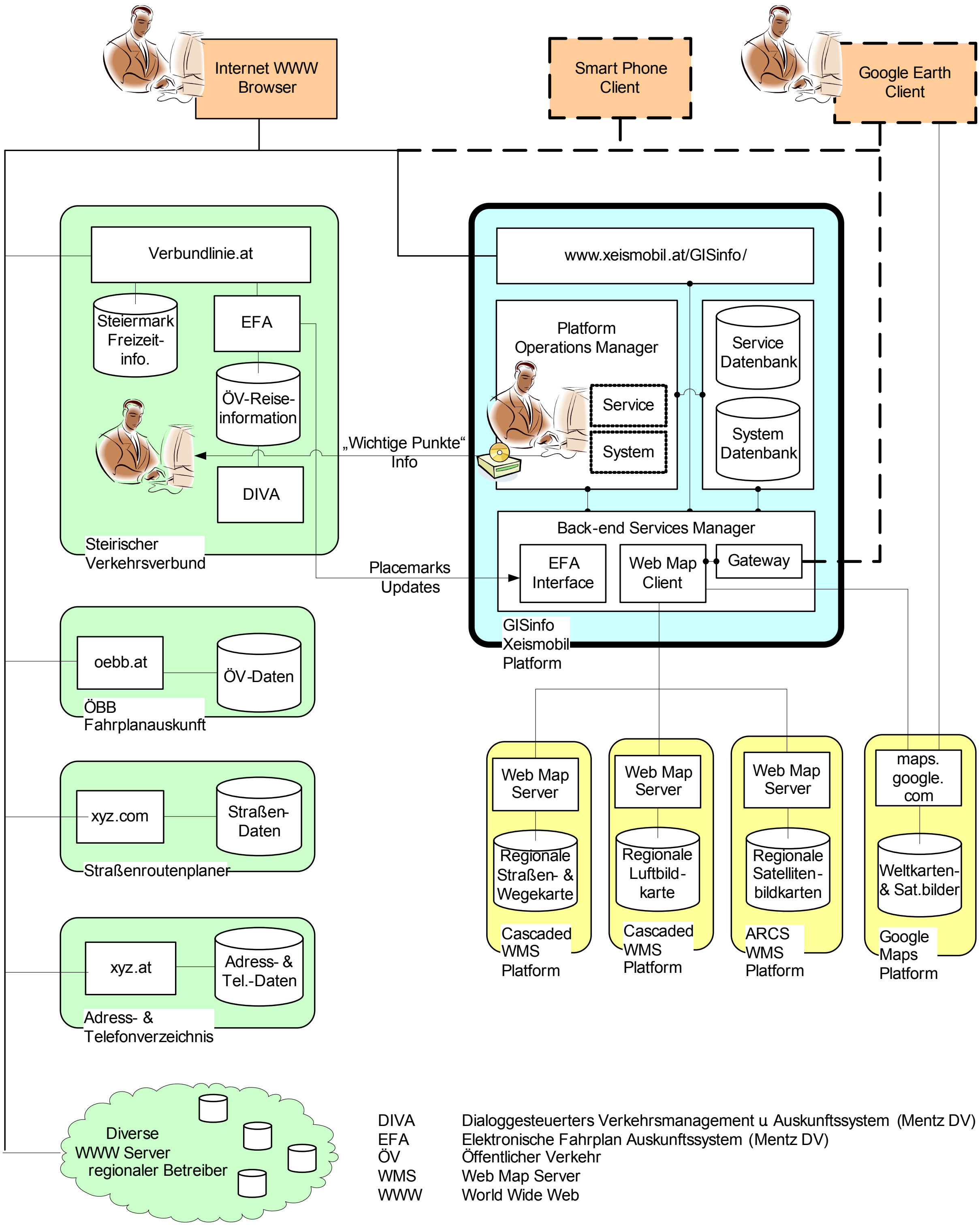


Abbildung 23 GISInfo Xeismobil Systemarchitektur und Backend Systeme

4.3 Informationsinhalte (Contents)

4.3.1 Placemarks, Polylines, Rasters

In GISinfo Xeismobil werden - wie in jedem Geographischen Informationssystem - folgende Content-Typen verwaltet und dem Benutzer zur Anzeige gebracht:

- Placemarks: Informationen zu einem Punkt (Adresse, Haltestelle, etc.)
- Polylines: Linienhafte Information (Straße, ÖV-Linienführung, Gemeindegrenze, etc.)
- Rasters: durch Pixel abgedeckte Flächen (Luftbild, digitales Höhenmodell, etc.)

4.3.2 GISinfo Xeismobil Placemarks

Aus konzeptuellen und betrieblichen Gründen werden die **Placemarks** für GISinfo Xeismobil speziell in folgende Untergruppen eingeteilt:

- ÖV-Haltestellen (Bus- oder Straßenbahnhaltestelle, Bahnhof, Schiffstation, etc.)
- BusBahnBim „Wichtige Punkte"
- Xeismobil „Points-of-Interests" (POIs)

BusBahnBim ist die Bezeichnung des Routenplaners für den Öffentlichen Verkehr, welcher vom Steirischen Verkehrsverbund (www.verbundlinie.at) online betrieben wird. Fahrpläne zu den **Haltestellen** werden vorgehalten. Weiters ist eine ÖV-Beauskunftung zu **Adressen** im Verbundgebiet und zu vom Verkehrsverbund festgelegten **„Wichtigen Punkten"** möglich.
Zur Erweiterung des Destinationen-Vorrats strebt der Xeismobil Betreiber die Beauskunftung zusätzlicher touristischer Punkte an. Die im Verantwortungsbereich des Xeismobil Betreibers liegenden Punktinformationen werden als Xeismobil **„Points-of-Interest"** bezeichnet.

Tabelle 1 ist eine Übersicht der in GISinfo Xeismobil verwendeten Kategorien von Placemarks.

Verkehr	**Gastronomie**	**Öffentl. Gebäude**	xeismobil
Bergbahn	Bar	Kirche	Business
Bus	Café	Polizei	Tourist-Info
Rufbus	Hotel	Schule/Uni	Sportiv
Flughafen	Restaurant	Spital	Natur
Parkhaus		Verwaltung	Family
Parkplatz	**Kultur/Freizeit**		Kultur
Park & Ride	Kino	**Shopping/Service**	Kreativ
Schiff	Museum	Arzt/Apotheke	
Straßenbahn	Sightseeing	Geldautomat	
U-Bahn	Sport	Post	
Zug	Theater	Shop	
Fahrradverleih	WebCam	Tankstelle	

Tabelle 1 GISinfo Xeismobil Placemarks

Im vorliegenden Einteilungssystem sind auch zukünftige Anforderungen bereits berücksichtigt. Insbesondere wurde auf die Kompaktheit der Kategorien geachtet. Die Einteilung berücksichtigt auch die Notwendigkeit des konsistenen Datenmanagements über Betreibergrenzen hinweg. So besteht die Möglichkeit die speziellen Xeismobil Points-of-Interest von allgemeinen auch in anderen Regionen gültigen Placemark-Kategorien (Verkehr, Gastronomie, etc.) klar unterscheidbar darzustellen.

4.3.3 ÖV-Haltestellen Datensätze

Die Referenz für Haltestelleninformation des Öffentlichen Verkehrs liegt beim Steirischen Verkehrsverbund. Der ÖV-Haltestellen Datensatz der Xeismobil Region wird periodisch in die Xeismobil Service Umgebung übertragen.

4.3.4 BusBahnBim „Wichtige Punkte"

Im BusBahnBim Service des Verkehrsverbunds sind so genannte "Wichtige Punkte" definiert. Derzeit findet man folgende Kategorien dafür:

- Schulen
- Sonstige Bildungseinrichtungen
- Ämter, Behörden & Öffentliche Einrichtungen
- Sehenswürdigkeiten
- Kulturelle Einrichtungen
- Veranstaltungs- und Ausstellungsorte
- Kirchen und Friedhöfe
- Freizeit, Sport & Wellness
- Krankenhäuser
- Verkehr

4.3.5 Xeismobil „Points-of-Interest"

Laut Ausschreibung besteht die Absicht des Xeismobil Betreibers über das GISinfo Xeismobil Portal so genannte „Funtools" zur Verfügung zu stellen. Ein Schritt in diese Richtung ist die Einführung von Xeismobil Points-of-Interest als eigene Placemark Kategorie.

Funtools sollen folgende Aspekte mit Servicefunktionen unterstützen:

- Xeismobil sportiv: Klettern, Wandern, Touren aller Arten, Ausgangspunkte
- Natürliches Xeismobil: Erzberg, Nationalpark etc.

- Xeismobil Family: Wasserspielpark, Funcars, das größte und kleinste Taxi der Welt, etc.
- Xeismobil belebt den Geist: Kultur, Kunst, Geschichte, Museen
- Xeismobil bleiben, auch wenn es regnet

Die GISinfo Xeismobil Service Datenbank beinhalten die Referenzinformation für diese Kategorie. Aus Gründen der Konsistenz sollte vermieden werden, ÖV-Haltestellen und wichtige Punkte mit der Points-of-Interest Kategorie zu vermengen.

4.3.6 ÖV-Routeninformation

Die Komfort-Auskunft von BusBahnBim bietet die Möglichkeit eine reine ÖV-Route von Haltestelle zu Haltestelle zu planen und darzustellen oder eine intermodale Route (mit Autoanteil, Fußweg, OV-Weg). Alle dazu erforderlichen Service-Funktionen werden von BusBahnBim bereitgestellt, inklusive der Kartendartendarstellung (in PDF-Format) von Teilstrecken dieser Route.

4.3.7 GISinfo Xeismobil Polylines

Diverse Polylines (Linienvektoren) können in GISInfo Xeismobil zur Darstellung gebracht werden. Dazu wird u. a. der in der GISinfo Xeismobil Plattform eingebaute MapServer verwendet

4.3.8 GISinfo Xeismobil Rasters

Die Darstellung von Landnutzungs- bzw. Flächennutzungsdaten könnte auch im Rasterformat realisiert werden. Die GISinfo Xeismobil Konzeption berücksichtigt dies durch die Bereitstellung des MapServers als Teil der GISinfo Xeismobil Plattform. Damit könnten etwa Corinne Landnutzungsdaten aus nationalen oder europäischen Beständen eingebunden werden.

4.3.9 Werbeeinschaltungen

Das GISinfo Xeismobil Portal ermöglicht die Anzeige von kostenpflichtigen Einschaltungen (Banner-Werbung) zur direkten Bewerbung von Placemarks. Derartige Werbeeinschaltungen könne einzelnen Placemarks von der Kategorie Xeismobil Points-of-Interest zugeordnet werden.

4.4 GISinfo Xeismobil Plattform

Es werden vier Architektur-Ebenen unterschieden:
(1) Plattform oder System, (2) Komponente, (3) Element, (4) Modul.

Die **GISinfo Xeismobil Plattform** besteht wie schon dargestellt aus folgenden Komponenten:
- **Web-Portal** erreichbar über die Adresse www.xeismobil.at/GISinfo/.
- Interne **Datenbanken** für Service und System und die zugehörigen Datenbankmanagementfunktionen.
- **Back-end Service Manage**r mit eingebautem Web Map Server (WMS), Gateway für Google Earth Gateway und Smart Phone Client sowie Schnittstellen zu EFA.
- **Platform Operations Manager** mit den Einrichtungen und Werkzeugen für den Xeismobil Operator.

4.4.1 WWW Portal

Die WWW Portal Komponente beinhaltet folgende Elemente:
- **Web Server** verarbeitet vom WWW Browser kommende HTTP Requests und antwortet mit HTML und Java Script Output, weiters erledigt der Web Server die Aufrufe für Serverseitiges Processing.
- **User Authentification Manager** zur Abfrage von Username und Passwort und Vergleich mit der Datenbank im Datenbankmanagementsystem.

4.4.2 Datenbankmanagementsystem

Die Datenbankmanagementsystem (DBMS) Komponente beinhaltet folgende Elemente:
- Objekt-orientiertes, relationales **Datenbankmanagementsystem** und Datenbank zur Verwaltung der Plattform-internen Service Daten (primär Placemarks), System- und Benutzer-Daten.
- **Gazetteer** Element zur Übersetzung von Adressen (Straßenname, Hausnummer, etc.) in Geographische Koordinaten (bei Adresssuche benötigt).

4.4.3 Back-end Services Manager

Die Back-end Services Manager Komponente beinhaltet folgende Elemente:
- **MapServer** dient einerseits als OGC WMS Client für die Kaskadierung der Back-end WMS-Systeme, wie andererseits auch als Server für die lokal in der GISinfo Xeismobil Plattform vorgehaltenen Service Daten (Polylines und Raster). Der lokale WMS verwendet die DBMS Komponente zur Verwaltung seiner Service Daten (z.B. Verwaltung und Auslesen über geographischen Parameter aus einem Stapel von Bildern mit gleicher regionaler Abdeckung jedoch unterschiedlicher Auflösung oder Zoomstufe).
- **EFA Interface** enthält Funktionen zum Parsen von XML-Output, welcher direkt aus dem EFA 9 System bezogen werden kann. In erster Linie sind dies Haltestellen-Daten und Wichtige-Punkte-Daten aus dem BusBahnBim Service. Das Interface kann auch für zukünftige Erweiterungen, beispielsweise der Synchronisierung von Adress-Datenbeständen in EFA und GISinfo Xeismobil, verwendet werden.
- **Gateway** stellt einerseits die Funktionalität „kml2wms" zur Verfügung, welche benötigt wird, um Linen und Flächendaten aus den Back-end WMS und dem lokalen WMS via Google Earth Protokoll (KML Keyhole Markup Langange) anzubieten. Andererseits bietet der Gateway die Möglichkeit, WMS Services direkt für den Smart Phone Client bereit zu

halten. Dies geschieht entweder direkt über das WMS-Protokoll an WMS Smart Phone Clients oder als OSML (Open-SPIRIT Markup Langague) für Open-SPIRIT Smart Phone Clients.

4.4.4 Platform Operations Manager

Die Platform Operations Manager Komponente beinhaltet folgende Elemente:

- **Service Management Tools** für den Xeismobil Operator, darin der Web-gestützte **Datenbank Editor** (bedient sich des Web Servers).

4.4.5 Software

Die im Rahmen des Projekts eigens entwickelte Software wird als

„OMGeo - Offene Mobilitäts- und Geoinformationsplattform *"

bezeichnet. Neben OMGeo besteht die GISinfo Xeismobil Plattform aus mehreren Open Source Software-Produkte (MapServer (OGC WMS, WFS, WCS), GDAL libaries, Proj.4 libaries, PostgreSQL Datenbankmanagementsystem, PostGIS, PHP scripting language, Apache Web Server).

Ein wichtiges Design-Ziel für die GISinfo Xeismobil Plattform ist die Berücksichtigung offener Standards, insbesondere solche des **Open Geospatial Consortium (OGC)**.

4.5 Back-end Services

4.5.1 Cascading Web Map Server

GISinfo Xeismobil implementiert den Web Server Standard des Open Geospatial Consortium (OGC WMS) um Kartendarstellungen aus seiner lokalen Datenbank bereitzustellen. Ein wichtiges Prinzip des OGC Standards ist das über mehrere verteilte Server-Betreiber verteilte Dantenmanagement. Die WMS Software erlaubt nämlich, dass ein Server seine eigenen (lokalen) Informations-Layer mit den Layern von anderen WMS im Back-end kombiniert und im Front-end den Benutzern zur Verfügung stellt. Bei Anwendung dieser Möglichkeit entsteht eine „Kaskade" von WMS, wobei die Einhaltung des Standards sicherstellt, dass die zusammengeführten Informationsebenen passgenau übereinander zu liegen kommen. Es lassen sich auf diese Weise Placemarks, Polylines und Raster aus unterschiedlichen Quellen zusammenführen.
Mit dem HTTP-Request „GetCapabilities" bezieht der in der Kaskade übergeordnete Server Daten über vorhandenen Layer, Service-URL, unterstützte Formate etc. und mit „GetMap" holt er die ausgewählten Karten und bindet sie in die eigene Kartendarstellung ein. Dies erfolgt online zum Zeitpunkt der Kartenanforderung durch den Benutzer.
Auf diese Weise bleibt die Verantwortung und der Aufwand für das Vorhalten von Kartendaten beim jeweiligen Server-Betreiber und Doppelgleisigkeiten können vermieden werden. Klarerweise müssen Vereinbarungen zwischen den Server-Betreibern hinsichtlich des gesicherten Servicebetriebs getroffen werden.
In GISinfo Xeismobil werden Polylines und Rasterdaten von kaskadierten Web Map Servern eingebunden.

4.5.2 Google Maps

Für die Verwendung im nicht-kommerziellen Bereich werden weltweit Satellitenbilddaten (Landsat und Ikonos) kostenlos über das Service **Google Maps** im Internet angeboten (http://maps.google.com). Die Konzeption des GISinfo Xeismobil Services sieht ein „Durchschleusen" des Google Maps Service in der GISinfo Xeismobil Kartenansicht vor, sobald der Benutzer ein Wegzoomen über die Region hinaus vornimmt.
Die Technische Lösung dazu wird mit über das Applications Programmers Interface (API) realisiert, welches für den Google Maps Server angeboten wird. Dieses erlaubt generell die Einbindung von Google Karten-Anzeigen in Webseiten. Google Maps ist derzeit noch im Beta-Testbetrieb. Im Rahmen von GISinfo Xeismobil wird die Integration mit Google Maps als ein Hinweis für „Think Global – Act Local" verstanden, und löst außerdem ein Anschlussproblem der Kartendarstellung hin zu über Österreich hinausgehenden Zoomstufen. Eine Informationsdarstellung auf der Karte des „Wo befindet sich die Xeis-Region in Europa" wird dadurch vorbereitet, etwa interessant zur Information von ausländischen Touristen.

4.6 Verlinkte Services

Verlinkte Services beinhalten Informationen, welche mit den Inhalten des Xeismobil Services in Beziehung stehen. Die Verlinkung kann ein einfacher Aufruf einer Home Page sein, aber auch eine komplizierte Verknüpfung, welche eine Parameterübermittlung aus dem GISinfo Xeismobil Service zu dem Verlinkten Service durchführt (z.B. Übergabe eines Reiseziels an das Service der Fahrplanauskunft).
Folgende Services sind verlinkt bzw. sind zur Verlinkung vorgesehen:

- BusBahnBim Elektronische Fahrplanauskunft
- ÖBB - Österreichische Bundesbahnen
- (Straßenroutenplaner)
- Diverse WWW Services wie
    - Adressenverzeichnis, Telefonbuch (Post, Herold, etc.)
    - WebCam-Verzeichnis (z.B. Feratel)
    - Zimmerreservierungs-Services (z.B. TisCover).

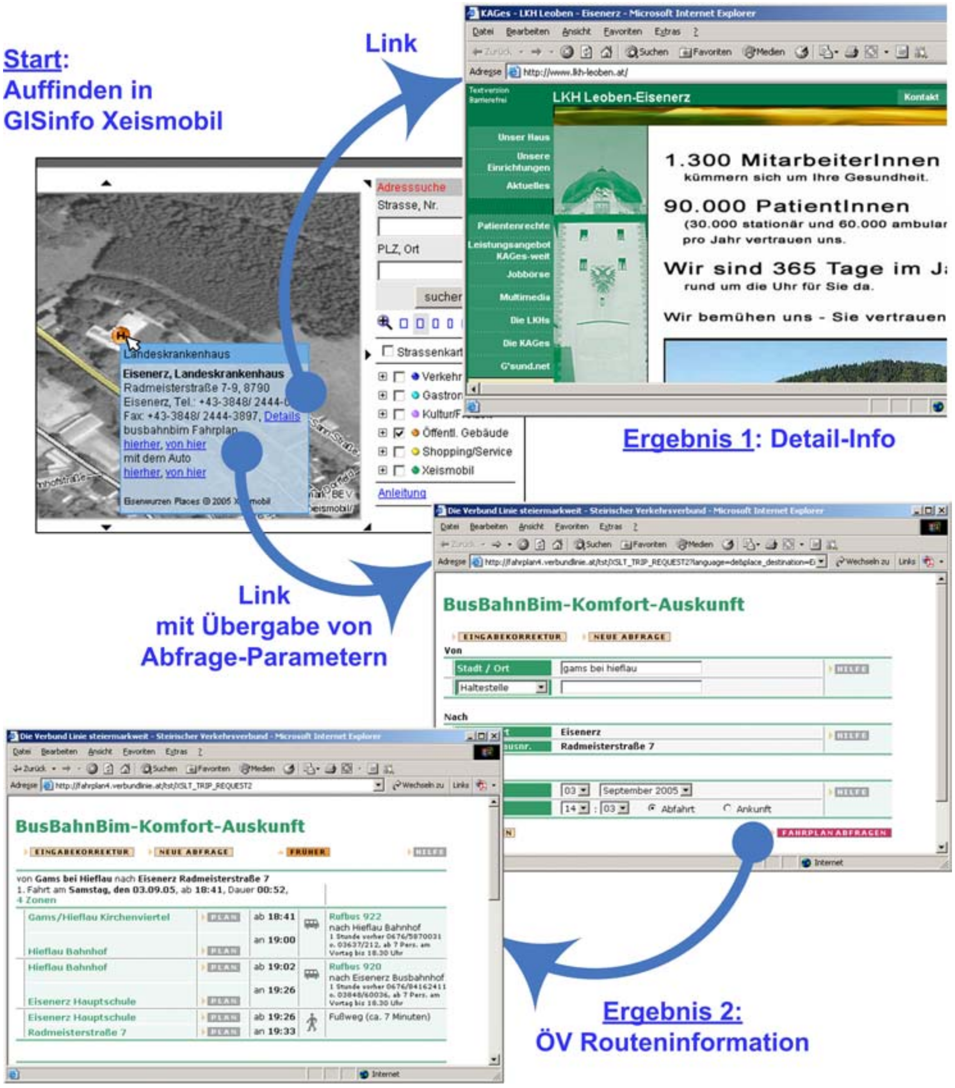


Abbildung 24 Link Beispiele des GISinfo Xeismobil Systems

4.7 Web-Darstellung, Zoom-Stufen

Es werden alle gängigen WWW Browser auf Linux und Microsoft Windows Plattformen unterstützt, wobei geringfügige Unterschiede in der Darstellung von Informationsinhalten auftreten können.
In der Browser-Einstellung muss für die Ausführung von JavaScript Funktionen aktiviert sein.

Abbildung 25 GISinfo Xeismobil Startseite

Anzeige im Modus „Hybrid“ (Starteinstellung)
In dieser Anzeigeform wird der Karteninhalt aus Luft- bzw. Satellitenbildern (naturähnlicher Kartenhintergrund), Placemarks und Polylinien aufgebaut.

Tabelle 2 Informationsinhalte der Karte im Hybridmodus

Zoomstufe	Inhalt der Kartenanzeige
0	• Satellitenbild mit niederer Auflösung (Abdeckung: Österreich) • Landehauptstädte (Symbol, Bezeichnung) • Regionsabgrenzung Xeismobil • Bahnnetz
1	• Satellitenbild mit mittlerer Auflösung (Abdeckung: Xeismobil Region) • Hauptorte (Symbol, Bezeichnung), • Hauptverkehrswege (Straße, Schiene)
2	• Satellitenbild mit mittlerer Auflösung • Hauptorte (Symbol, Bezeichnung) • Mittelgroße Orte (Symbol, Bezeichnung) • Hauptverkehrswege (Straße, Schiene)
3 (Einstellung bei Start und nach „Karte Zurücksetzen)	• Satellitenbild (z.B. Landsat-Auflösung 12 m) • Hauptorte (Symbol, Bezeichnung) • Mittelgroße Orte (Symbol, Bezeichnung) • Hauptverkehrswege (Straße, Schiene) • Mittlere Verkehrswege
4	• Satellitenbild mit sehr guter Auflösung (3 m) oder Luftbild • Hauptorte (Symbol, Bezeichnung) • Mittelgroße Orte (Symbol, Bezeichnung) • Hauptverkehrswege (Straße, Schiene) • Mittlere Verkehrswege • Landschaftsbezeichnungen
5	• Satellitenbild mit sehr guter Auflösung (1 m oder besser) oder Luftbild • Hauptorte (Symbol, Bezeichnung) • Mittelgroße Orte (Symbol, Bezeichnung) • Hauptverkehrswege (Straße, Schiene) • Mittlere Verkehrswege • Hervorhebungen der Streckenführungen des Öffentlichen Verkehrs (Polylinien) • Landschaftsbezeichnungen • Points-of-Interest „Verkehr“
6	• Luftbild mit sehr guter Auflösung (0,5 m) • Hauptorte (Symbol, Bezeichnung) • Mittelgroße Orte (Symbol, Bezeichnung) • Hauptverkehrswege (Straße, Schiene) • Mittlere Verkehrswege • Hervorhebungen der Streckenführungen des Öffentlichen Verkehrs (Polylinien) • Landschaftsbezeichnungen • Alle Points-of-Interest

Die Grundeinstellung der Karte ist immer wählbar durch Navigationshilfe „Karte zurücksetzen“:

Anzeige im Modus (Straßenkarte)
Dieser Modus wird vom Benutzer im entsprechenden Kästchen eingeschaltet. In dieser Anzeigeform wird der Karteninhalt aus Placemarks und Polylinien aufgebaut. Es besteht prinzipiell auch die Möglichkeit Rasterbilder zur Symbolisierung der Landnutzung als Hintergrund anzuzeigen.

Anzeige von Zoomstufe „-1“
Die Konzeption des GISinfo Xeismobil Services sieht ein „Durchschleusen“ des Google Maps Service in der GISinfo Xeismobil Kartenansicht vor, sobald der Benutzer ein Wegzoomen über die Zoomstufe 0 hinaus vornimmt. Abbildung 26 zeigt die zugehörige Ansicht der GISinfo Xeismobil Seite. Der Benutzer sieht einen Hinweis, dass er die Google Maps Navigations Funktionen verwenden muss und wie eine Rückkehr zu der Startanzeige erfolgen kann. In dieser Ansicht können keine Symbole bzw. Placemarks angezeigt werden.

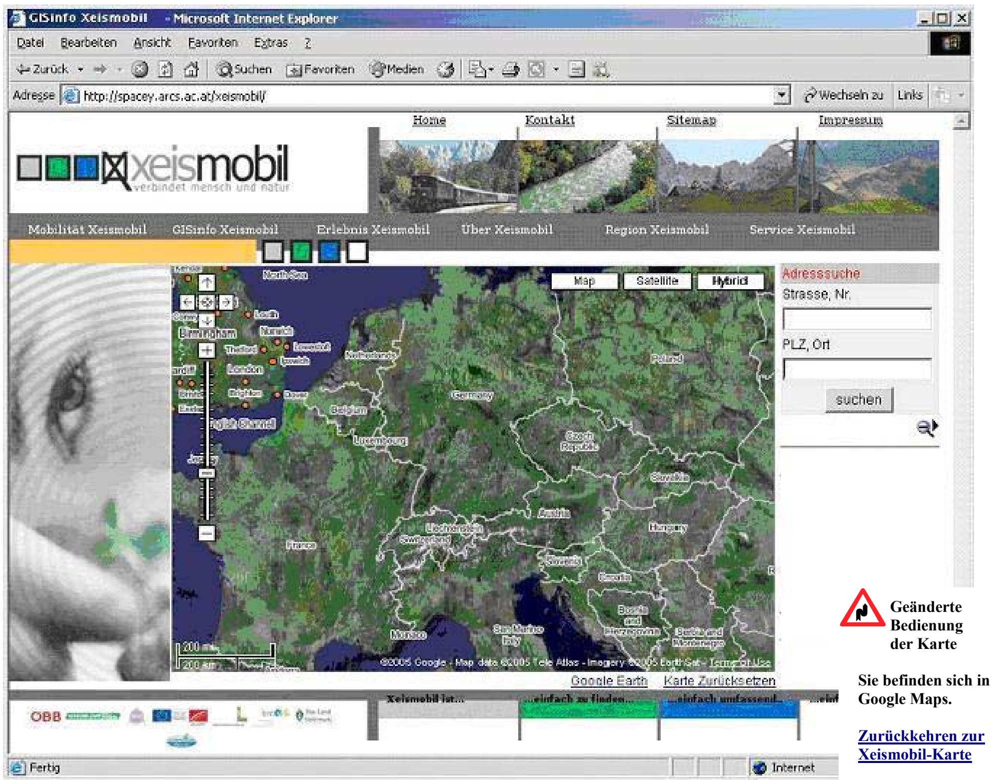


Abbildung 26 Kartendartellung mit Google Maps bei Zoomstufe -1

4.8 3D-Darstellung, Zugang mit Google Earth Browser

Die Implementierung des GISinfo Xeismobil Systems unterstützt auch den Google Earth Client (früher als Keyhole Client bekannt). Damit wird zeitgemäße 3D-Visualisierungs- und Navigationsfunktionalität über ein unabhängiges Tool realisiert. Es wird eine Sammlung von „Placemarks" und ein „Network Link" zum Web Map Server von GISinfo Xeismobil bereitgestellt (siehe Link „Google Earth" auf der GISinfo Xeismobil Web-Seite). Diese Daten werden nach download im Google Earth Client unter „Temporary Places" geladen und automatisch ein Zoom auf die Xeis-Region vorgenommen.

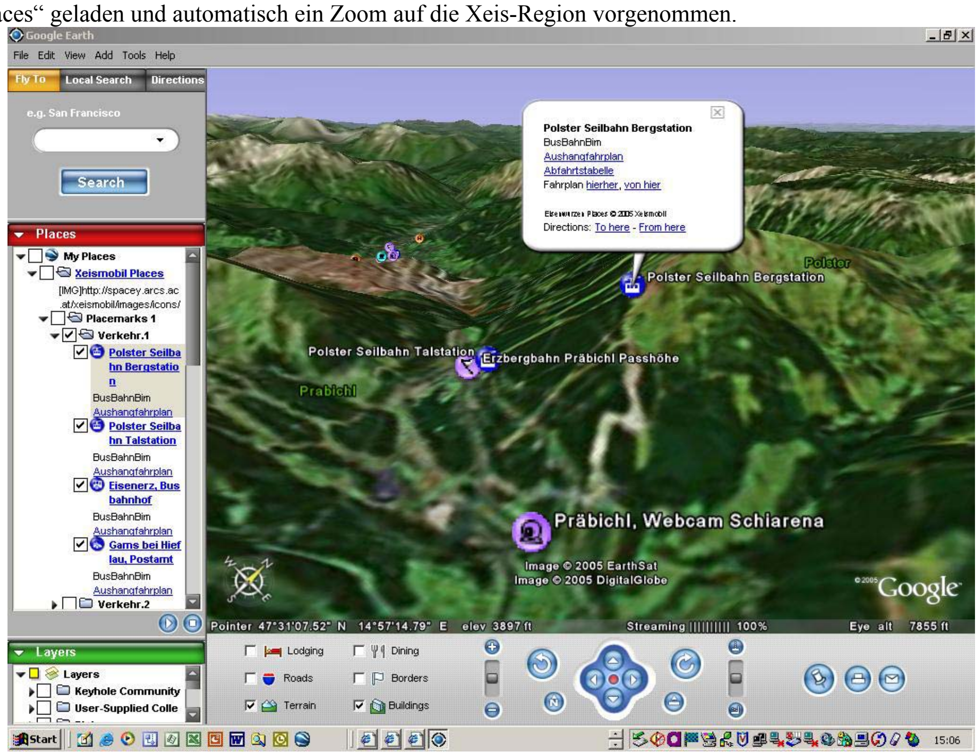


Abbildung 27 GISinfo Xeismobil Placemarks dargestellt mit Google Earth

5 ZUKUNFTSPERSPEKTIVEN

Als eine wesentliche künftige Erweiterung der Xeismobil-Plattform wird der Zugang mittels mobiler Endgeräte angesehen, wodurch der praktische Nutzen bei Reisen in der Region noch deutlich gesteigert würde.

🏆 reviewed paper

Innere Sicherheit, Sicherheitstechnologien und Urbanität

Holger FLOETING

(Dipl.-Geogr. Holger Floeting, Deutsches Institut für Urbanistik, Arbeitsbereich Wirtschaft und Finanzen,
Straße des 17. Juni 112, 10623 Berlin, floeting@difu.de)

1 EINFÜHRUNG

Nach dem Terroranschlag vom 11. September 2001 in den USA und den Anschlägen in Madrid und London ist die Verwundbarkeit von Städten mit ihren konzentrierten Baumassen und Großinfrastrukturen stärker in das Bewusstsein der Öffentlichkeit gerückt. Die Bedrohung von Städten durch terroristische Anschläge ist allerdings keine neue Entwicklung, wie ein Blick nach Lateinamerika, Asien oder in den Nahen Osten zeigt. Seit den 1990er Jahren gab es allerdings eine Zunahme von Terroranschlägen in Städten (Savitch 2005) und auch zukünftig werden Städte mit dieser Bedrohung umgehen müssen. In einer fiktiven Rede zum zehnten Jahrestag des 11. September malt Richard A. Clarke – bis 2003 nationaler Koordinator für Sicherheit, Infrastrukturschutz und Antiterrorpolitik beim US-amerikanischen Präsidenten – ein Bild der Bedrohung gerade von Städten durch Terrorismus, das völlig neue Sicherheitskonzepte nötig mache. Seien doch nicht nur die kritischen Infrastrukturen bedroht, sondern auch Casinos und Themenparks, Hotels, Einkaufszentren, U-Bahnen und andere Nahverkehrseinrichtungen, Eisenbahnen usw. (Clarke 2005).

Je größer die Bedrohung, desto eher setzt man auf technische Problemlösungen: „Intelligente" Überwachungskameras sollen in Clarke's Szenario „an allen öffentlichen Plätzen" installiert, die Videoüberwachung „mit einem zentralen Notfallmanagement" vernetzt werden, „mit Hilfe elaborierter Softwareprogramme sollten Polizeibeamte verdächtige Aktivitäten entlang der Hauptverkehrsadern aufspüren" und für die Benutzung des öffentlichen Personennahverkehrs werden „Security Identity Cards" notwendig (Clarke 2005).

Tatsächliche oder vermeintliche Bedrohungen gehen aber nicht nur von singulären Schadensereignissen aus, die „global cities" und Megametropolen betreffen, sondern auch von alltäglicher Kriminalität. Sicherheitstechnik soll diese Gefahren verhindern oder zumindest den Umgang mit ihnen erleichtern. Dass Sicherheitsfragen von Städten in der Öffentlichkeit stärker diskutiert werden, führt manchmal zu dem Kurzschluss, dass die Städte selbst unsicher seien. Dabei gibt es einige Mythen zu dekonstruieren. So ist beispielsweise „die Kriminalitätsfurcht weniger durch die ‚objektive' Kriminalitätslage als vielmehr durch soziale Problemlagen im Wohnquartier beeinflusst" (Oberwittler 2003: 31). Mittlerweile befürchten rund 40% der Detschen einen deutlichen Anstieg der Kriminalitätsrate und fühlen sich unbehaglich angesichts wachsenden Vandalismus (rund 30%), von Graffittis (20% der Westdeutschen und 29% der Ostdeutschen) oder Bettlern (18% der Westdeutschen und 21% der Ostdeutschen) (Opaschowski 2005, zit. n. Stegemann 2005). Auch die Zunahme privater Sicherheitsdienste ist nicht zwangsläufig ein Ausdruck für eine höhere Unsicherheit in den Städten, sondern „verdankt sich zumindest teilweise einem statistischen Artefakt, das sich durch den wachsenden Umfang von Outsourcing-Prozessen erklären lässt" (Siebel/Wehrheim 2003: 24). Genauso wenig wie aus der Zunahme der „Verkaufszahlen von CCTV-Anlagen … automatisch auf die Überwachung in den Städten geschlossen werden kann. Oft werden Kameras tatsächlich nur für die Regulierung des Verkehrsflusses … eingesetzt" (Ebenda).

Die wissenschaftliche Auseinandersetzung mit Fragen des Zusammenspiels von Innerer Sicherheit und der Entwicklung von Städten, wurde bisher kaum und wenn, dann meist unter historischer Perspektive geführt.[1]

Zum Umgang mit Bedrohungen bedarf es jedoch der realistischen Einschätzung, der Prävention – soweit dies möglich ist – und dem sicheren Handeln, sobald Schadensfälle eintreten. Sicherheitstechnik soll den Umgang mit Gefahrensituationen und Schadensereignissen in zunehmendem Maß unterstützen. Über die Zusammenhänge des Einsatzes von Sicherheitstechnik, der Entwicklung der Inneren Sicherheit und der Stadtentwicklung wird dabei bisher wenig diskutiert.

2 SICHERHEIT ALS ÖFFENTLICHE AUFGABE

2.1 Aufgaben und Zuständigkeiten

Zu den öffentlichen Aufgaben von herausragender Bedeutung gehört „der Schutz der Bevölkerung vor besonderen Gefahren, die nicht aus eigener Kraft abzuwehren sind" (Weber 2004: 1) und „die Gewährleistung der Sicherheit und Ordnung" (DST 2004: 1). Der zivile Bevölkerungsschutz ist in Deutschland vertikal gegliedert, Bund und Länder arbeiten zusammen. Aufgaben des Zivilschutzes werden auf nationaler Ebene wahrgenommen, auf die Länder entfällt die Verantwortung für den Katastrophenschutz. Der zivile Bevölkerungsschutz in Deutschland stützt sich in hohem Maß auf ein Sicherheits- und Hilfeleistungssystem, das auf ehrenamtlichen und Freiwilligenorganisationen beruht (freiwillige Feuerwehren, DLRG, DRK, ASB usw.). Die kommunale Ebene nimmt in Deutschland vor allem Aufgaben zur Gewährleistung der Sicherheit und Ordnung war. „Seit die Stadtmauern ihre Funktion verloren haben, ist die äußere Sicherheit … keine kommunale Angelegenheit mehr, und seit 1975 die Münchner Polizei als letzte der nach 1945 wieder eingerichteten Großstadtpolizeien verstaatlicht worden ist (Lange 1998:83), ist auch die innere Sicherheit endgültig zur staatlichen Aufgabe geworden" (v. Kodolitsch 2003: 5). Die kommunalen Aufgaben in Bezug auf die Sicherheit in der Stadt konzentrieren sich im wesentlichen auf die Aufgaben der Gefahrenabwehr (Erteilung und Entziehung von Gewerbeerlaubnissen für Gaststätten, Spielhallen usw., Festlegung von Sperrbezirken, Überwachung von Ausländervereinen usw., Unterbringung von Obdachlosen, Regelung der Polizeistunde, Umgang mit Jugendschutz und Versammlungsrecht usw.), Maßnahmen der Städtebaupolitik (Festlegung von Nutzungsstrukturen, Vermeidung von städtebaulichen Angsträumen usw.) und die Gestaltung von Rahmenbedingungen zur Kriminalprävention (Sozial- Jugend-, Familien-, Wohnungs-, Bildungs-, Kultur-, Beschäftigungspolitik usw.). „Was dabei an sicherheitsspezifischen und kriminalpräventiven Wirkungen entsteht, wurde jedoch von der kommunalen Praxis über lange Zeit, von wenigen Teilbereichen abgesehen, keineswegs ausdrücklich angestrebt, oft genug nicht einmal als Nebenwirkung der eigentlichen Aufgabenerfüllung zur Kenntnis genommen" (v. Kodolitsch 2003: 6).

1 Bisher wurde die „auf den Raum, auf die Bevölkerung und auf die Versorgungssysteme von Städten gerichtete … organisierte politische Gewalt in den kritischen sozialwissenschaftlichen Debatten über Städte und Urbanisierung beharrlich vernachlässigt" (Graham 2004: 58). Die moderne Stadtforschung tendiere „seit dem Zweiten Weltkrieg dazu, der Behandlung … auszuweichen, weil die vollständige Zerstörung von Städten in Konflikt zur aufklärerischen Vorstellung von Fortschritt, Ordnung und Modernisierung steht" (Graham 2004: 59).

Erst seit Beginn der 1990er Jahre haben die Kommunen Sicherheit als Querschnittsaufgabe entdeckt und integrierte Ansätze zum Umgang mit dem Thema Sicherheit entwickelt, die meist unter dem Leitbegriff „kommunale Kriminalprävention“ zusammengefasst werden (vgl. DST 2004: 2 ff.). Zu den neueren Instrumenten kommunaler Sicherheitspolitik (vgl. DST 2004: 2 ff.) zählen z.B.

Ordnungs- und Sicherheitspartnerschaften zwischen Polizei und Stadt sollen der Tendenz entgegenwirken „die alleinige Verantwortung für die Sicherheit bei der Polizei, für die öffentliche Ordnung aber bei den Städten anzusiedeln“ (DST 2004: 2).

Kriminalpräventive Räte sollen bürgerschaftliches Engagement einbinden und zur Entwicklung kleinteiliger Lösungen beitragen.

Kommunale Ordnungsdienste übernehmen Ordnungsaufgaben, die von der Polizei aufgrund von Sparzwängen in den Landeshaushalten nicht mehr wahrgenommen werden bzw. von den Städten nicht mehr anderweitig erledigt werden (z.B. Kontrollaufgaben, die früher durch Parkwächter, Schaffner usw. erledigt wurden).

Städte werden immer wieder als Brennpunkte der Kriminalität dargestellt. Zunehmende Kriminalitätsfurcht bestimmt die Argumentation oft in stärkerem Maß als die tatsächliche Kriminalitätsentwicklung. Die Sicherheitslage in den deutschen Verdichtungsräumen ist aber „weit weniger kritisch als in den meisten Städten Europas und der Welt“ (DST 2004: 1). Gerade im Bereich der Metropolregionen gibt es aber „klare Signale dafür, dass unser Sicherheitssystem weiterentwickelt und ausgebaut werden muss“ (DST 2004: 1), um neuen Sicherheitsanforderungen gerecht zu werden. Zu den neuen Problemlagen werden beispielsweise gezählt:

Organisierte Kriminalität und Korruption,

neue Sicherheitsprobleme in Gebieten mit negativer demographischer Entwicklung,

eine gewachsene Erwartungshaltung der Bürgerinnen und Bürger im Bereich der öffentlichen Ordnung und der allgemeinen Gefahrenabwehr (DST 2004: 1).

In zunehmendem Maß wird aber auch die Bedrohung durch terroristische Aktionen im Rahmen der Sicherheitsüberlegungen von Städten thematisiert. Gerade in den Metroploregionen, im Zusammenhang mit der Durchführung von Großveranstaltungen und im Kontext des Infrastrukturausbaus spielt dies eine wichtige Rolle.

2.2 Neuorientierung im Politikfeld „Innere Sicherheit“

Der Zuschnitt staatlicher Sicherheitspolitik in Deutschland hat sich nach 2001 erheblich verändert: „Waren in Zeiten des Kalten Krieges innere und äußere Sicherheit aufgrund der damals geltenden internationalen sicherheitspolitischen Paradigmen nicht nur politisch, sondern vor allem auch verfassungsrechtlich streng getrennt, haben die Terroranschläge vom 11. September 2001 und deren weitreichende Folgen zu einer tendenziellen Überschneidung in den Anforderungen an die beiden Teilbereiche staatlicher Sicherheitspolitik geführt. … Aktuelle Bedrohungs- und Gefährdungsanalysen und aus ihnen abzuleitende kurz-, mittel- und langfristige Maßnahmen müssen von allen Organen der Gefahrenabwehr, d.h. den Nachrichtendiensten, den Polizeibehörden, dem staatlichen Bevölkerungsschutz und den Streitkräften in enger Kooperation erfolgen“(Weber 2004: 2).

Unter dem Eindruck einer veränderten Bedrohungs- und Gefahrensituation sind Bürger eher bereit Einschränkungen persönlicher Freiheit in Kauf zu nehmen. So befürworten beispielsweise mittlerweile 90 Prozent der Briten die Kameraüberwachung auf öffentlichen Plätzen, 44 Prozent der Deutschen reichen die Sicherheitsvorkehrungen gegen Terroranschläge nicht aus und über 60 Prozent würden die Bundeswehr gern auch für Polizei- und Grenzschutzaufgaben im Innern eingesetzt sehen (BPB 2004: 2). Maßnahmen der Inneren Sicherheit greifen in deutschen Städten auf unterschiedlichen Ebenen und führen zu neuen Sicherheitsregimes. Die Maßnahmen umfassen rechtliche Veränderungen (Novellierung der Sicherheits- und Ordnungsgesetze, Gefahrenabwehrverordnungen), organisatorische Eingriffe (Ersatz informeller Organisationsformen durch staatliche bzw. privatwirtschaftliche) und die symbolisch-materielle Gestaltung der Stadt (Schließung von Räumen, Herstellung von Einsehbarkeit, Ästhetisierung) (Wehrheim 2004). Ein zentraler Bereich der Umsetzung von Maßnahmen der Inneren Sicherheit in den Städten ist die technische Aufrüstung.

3 SICHERHEITSTECHNIK ALS PROBLEMLÖSER

Sicherheitstechnik kann die Gefahrenabwehr und Maßnahmen zur Herstellung von Sicherheit und Ordnung in allen Phasen unterstützen:

Sie kann zur Analyse von Gefahren- und Bedrohungssituationen eingesetzt werden,

- sie kann der Prävention dienen,
- die Lagebeurteilung kann durch technische Systeme erleichtert werden,
- die Komplexität von Intervention und Management bei Schadensereignissen kann handhabbarer gemacht werden und
- bei der Rehabilitation von Schadensräumen wirkt Sicherheitstechnik unterstützend.

Der komplexen Aufgabe entsprechend bietet die Industrie eine breite Palette von sicherheitstechnischen Produkten, die im kommunalen Bereich bereits Anwendung finden oder zukünftig in Anwendung kommen könnten. Als Vorteile des Einsatzes von Sicherheitstechnik werden immer wieder genannt (vgl. u.a. DStGB 2003: 17)

Die Programmier- und Parametrierbarkeit von Sicherheitstechnik und damit die Zuverlässigkeit des Funktionierens,

die Effizienz von Sicherheitstechnik aufgrund der hohen Verfügbarkeit, Dauerhaftigkeit, technischen Wirksamkeit und Genauigkeit,

die Innovationsorientierung von Sicherheitstechnik,

die Kosten-Nutzen-Effizienz, die insbesondere unter Berücksichtigung von potenziellen verhinderten Schäden, verminderten Versicherungskosten usw. bewertet werden muss.

Demgegenüber stehen Befürchtungen hinsichtlich allgegenwärtiger technischer Überwachung und Ausgrenzung und Skepsis gegenüber Sicherheitsversprechen. Zudem ist die ökonomische Bedeutung der „Sicherheitsindustrie“ nicht zu unterschätzen. Sicherheit ist ein wachsender Markt. In den USA hat allein das Heimatschutzministerium ein Budget von rund 40 Milliarden Dollar. In Deutschland wenden Bund, Länder und Kommunen etwa 30 Milliarden Euro jährlich für Innere Sicherheit auf. Seit den Anschlägen in New York sei „der Markt für Zutrittskontrollen und Videoüberwachungsanlagen um ein Drittel gewachsen“ (v. Landenberg 2004).

4 BEISPIELE FÜR DEN EINSATZ VON SICHERHEITSTECHNIK IN DEUTSCHEN STÄDTEN

An dieser Stelle können nur einige wenige Beispiele für die Anwendung neuer Sicherheitstechnik im kommunalen Bereich ausgeführt werden. Die Ausführungen konzentrieren sich auf „sichtbare“ Frontend-Anwendungen. Sie zeigen wie alltäglich Sicherheitstechnologien bereits heute eingesetzt werden in Bereichen, die nicht zwangsläufig zum Aufgabenbereich „Innere Sicherheit“ gehören. Über diese Beispiele hinaus lassen sich Anwendungsfelder beispielsweise auch in folgenden Bereichen identifizieren:

Informationssysteme (für Akteure und Bürger)

Expertensysteme (zur Entscheidungsunterstützung)

Vorgangsbearbeitungssysteme (zur Kooperation bei extrem heterogener Akteursstruktur)

Auskunftssysteme (für Akteure und Bürger)

Messnetze (zur Informationsgewinnung und Alarmierung)

Geodaten-basierte Anwendungen (zur räumlichen Analyse und Prognose potenzieller und tatsächlicher Schadensereignisse)

Data Mining (zur Erstellung umfassender Profile)

Augmented Reality (zur Unterstützung von Helfern und Entscheidern)

Ubiquitous Computing (zur umfassenden Vernetzung)

4.1 Videoüberwachung

Mit dem Thema Videoüberwachung befassen sich die Kommunen schon seit längerer Zeit. Videoüberwachung wird als „die bedeutendste Neuerung auf dem Feld der Inneren Sicherheit in Städten“ (Wehrheim 2004: 23) angesehen. Im Rahmen der Verkehrsüberwachung sind Kamerasysteme bereits weit verbreitet. Auch zur Gebäudesicherung (z.B. Behörden, Fußballstadien, im öffentlichen Personennahverkehr usw.) sind Kamerasysteme mittlerweile ein gängiges Mittel der technischen Unterstützung. Seit einer Reihe von Jahren werden Videoüberwachungssysteme auch im Rahmen der Kriminalprävention auf öffentlichen Plätzen und Straßen eingesetzt, z.B. zur Kontrolle der Drogenkriminalität. Vorreiter dieser Entwicklung waren Kommunen in Großbritannien, die Videotechnik mittlerweile z.T. flächendeckend in Geschäftsstraßen, an zentralen öffentlichen Plätzen usw. einsetzen und damit z.T. auch eine videotechnische Verfolgung von Einzelpersonen in größeren Stadtbereichen ermöglichen.

Neuere technische Entwicklungen erlauben gestützt auf biometrische und Verhaltensmerkmale eine Automatisierung dieser Überwachung. So besteht beispielsweise die Möglichkeit anhand spezifischer Bewegungsmuster Verdachtspersonen „auszufiltern“ von denen angenommen wird, sie werden eine Sachbeschädigung (z.B. das Anbringen von Graffitti) begehen.

Neben ortsfesten Anlagen schreitet auch der Einsatz mobiler Videoüberwachung voran. In Großbritannien haben „zahlreiche Kommunen … inzwischen sogenannte "CCTV-Vans" eingeführt, die mit Digitalkameras und Kontrollräumen ausgestattet sind. Auch in Deutschland sollen mobile Systeme zukünftig stärker eingesetzt werden, so etwa in Baden-Württemberg und Bayern.

In Deutschland ist die Überwachung öffentlicher Straßen und Plätze durch Änderung der Polizeigesetze der Länder erst seit den 2000er Jahren möglich. Eine flächendeckende Überwachung nach britischem Muster wird aber nicht angestrebt. Die Zahl der stationierten Videokameras wird auf 500.000 geschätzt (Wehrheim 2004: 23). Die Terroranschläge in London haben aber die Diskussion um eine erhebliche Ausweitung der Videoüberwachung erneut angefacht.

Da eine ständige Überwachung von öffentlichen Plätzen mit tiefen Eingriffen in die Persönlichkeitsrechte (Recht am eigenen Bild, Recht auf informationelle Selbstbestimmung) des einzelnen verbunden sein kann, sind die Einsatzmöglichkeiten begrenzt. So ist etwa die Überwachung öffentlicher Plätze durch Private eingeschränkt, die Speicherung von Daten zeitlich begrenzt und die heimliche Videoüberwachung ist untersagt, die Überwachung muss deutlich angezeigt werden. Dennoch ergeben sich immer wieder Grenzfälle, Überschreitungen und Skurrilitäten, die zu heftigen öffentlichen Diskussionen der Videoüberwachung führen.[2] Immer wieder werden auch Grenzfälle der Nutzung von Überwachungsdaten thematisiert.[3]

Über die Effektivität von Videoüberwachung hinsichtlich ihrer kriminalpräventiven Wirkung gibt es sehr unterschiedliche Aussagen. Die präventive Wirkung an Kriminalitätsschwerpunkten wird häufig als positiver Effekt genannt ebenso wie die Unterstützung der Strafverfolgung. Messbare Rückgänge der Zahl von Straftaten in videoüberwachten Bereichen sind z.T. aber auch mit Verdrängungsprozessen in andere Stadtbereiche verbunden.

Ohne Zweifel hat die Überwachungsintensität in den letzten Jahren erheblich zugenommen und wird mittelfristig weiter zunehmen. Dabei geht es nicht nur um die zunehmende Zahl der Kameras im öffentlichen Raum, sondern auch um die technische Verknüpfung unterschiedlicher Überwachungstechniken und die organisatorische Vernetzung von privaten und öffentlichen Sicherheitsmaßnahmen z.B. im Rahmen von Sicherheitspartnerschaften (vgl. Hempel 2003).

4.2 Biometrische Zugangssysteme

Im Zuge der Diskussion um die Terrorabwehr wurde in den letzten Jahren häufig über die Nutzung von biometrischen Merkmalen im Rahmen neuer Sicherheitskonzepte diskutiert. Dabei geht es einerseits um die Integration von biometrischen Merkmalen in Personaldokumente, andererseits um deren Nutzung im Rahmen von Identitäts- und Zugangskontrollen. Die Zahl der eingesetzten Biometrie gestützten Systeme in Europa ist von rund 8.500 (1996) auf mehr als 150.000 (2004) gestiegen (Horvath 2005). Erhebliche Wachstumsraten für die „Biometrieindustrie“ werden vorausgesagt. So soll deren Umsatz von 600 Millionen Dollar (2002) auf 4 Milliarden Dollar (2007) steigen. Biometrie-Technologien werden als die „wichtigsten Innovationen in der IT-Industrie in den

[2] Beispiele aus dem kommunalen Bereich dafür sind etwa die wieder aufgegebene Videoüberwachung der Männerumkleidebereiche in einem Freiburger Schwimmbad (Badische Zeitung 8.11.2003) oder die Videoüberwachung von Müllsammelstellen im Rahmen der Kampagne „Unser sauberes Braunschweig“ (taz Nord 15. März 2004).

[3] So z.B. die Nutzung der Videoüberwachung der DB AG durch den BGS auf Bahnhöfen und in Bahnhofsbereichen (Bundesdatenschutzbeauftragter 2005: 63).

nächsten Jahren“ (BITE 2005) angesehen. Bisher getestete Systeme setzen Gesicht, Finger und Iris als biometrische Merkmale ein. In der Forensik werden daneben DNA-Merkmale zur Identifizierung genutzt.
Es besteht noch eine Reihe weitgehend ungelöster Probleme. So können einige Personen grundsätzlich von derartigen Systemen nicht erfasst werden (bei Fingerabdruck-, Iriserkennung), mit dem Alter der zu erkennenden Person nimmt die Erkennungsleistung ab und für bestimmte Berufsgruppen ist sie eingeschränkt (Fingerabdruckerkennung). Darüber hinaus können umgebungsbedingte Erkennungsschwierigkeiten (z.B. aufgrund bestimmter Lichtverhältnisse bei der Gesichtserkennung) die Systeme behindern. Schließlich wird die geringe Überwindungssicherheit (Fingerabdruckerkennung) derartiger Systeme bemängelt (Bundesdatenschutzbeauftragter 2005: 47/48). Darüber hinaus gibt es bisher kein eindeutiges bioethisches Bezugssystem für die Entwicklung und Nutzung biometrischer Technologien. Diskussionen über die Akzeptanz biometrischer Technologien konzentrieren sich bisher vor allem auf Kosten-Nutzen-Aspekte und Sicherheitsfragen (BITE 2005).
Wer bisher gedacht hat, derartige Zugangssysteme seien beschränkt auf Hochsicherheitsbereiche und Grenzübertritte, irrt, wie das Beispiel des Zugangssystems für Dauerkartenbesitzer des Zoos Hannover – einem als GmbH organisierten Unternehmen der Region Hannover zeigt. Wer für den Zoo Hannover eine Dauerkarte erwerben will, muss zunächst seine Personalien zur Aufnahme in ein Ticketing-System angeben. Beim ersten Zoobesuch wird ein digitales Foto des Kartenbesitzers aufgenommen und gespeichert. Bei weiteren Besuchen wird an der Zugangskontrolle erneut ein digitales Bild erstellt und mit den gespeicherten Daten verglichen. Ein Zugang ist nur nach positiver Prüfung möglich. Für die Beantragung von Familien-Karten benötigt man zusätzlich einen Familiennachweis (Kindergeldnachweis, Auszug aus dem Stammbuch, amtlicher Ausweis, Krankenkassenkarte). Mit mehr als 71.000 Dauerkarten handelt es sich um die größte biometrische Anwendung im sog. Convenience-Bereich in Deutschland (DStGB 2003, Glitza 2004, Schiffhauer 2004). Der erste Versuch biometrische Merkmale – den Fingerabdruck zur Zugangskontrolle zu nutzen, war zuvor daran gescheitert, dass hygienische Bedenken das System ebenso aushebelten wie die schlechte Erkennungsrate bei Kindern und der langsame Durchgang sowie die mangelnde Wetterfestigkeit des Systems sich als Problem erwiesen (vgl. Glitza 2004, Schiffhauer 2004). Mögliche weitere kommunale Einsatzfelder von Zugangssystemen mit biometrischen Merkmalen sind Museen oder Sporteinrichtungen usw. Darüber hinaus lassen sich natürlich zahlreiche Anwendungen in sicherheitsrelevanten Bereichen vorstellen.

4.3 RFID

Hinter der Abkürzung RFID (Radio Frequency Identification) verbirgt sich Mikrochiptechnologie zur kontaktlosen Speicherung von Daten. Die Datenabfrage erfolgt unter Nutzung von Funkübertragungstechnik. Angewendet wird die Technik bisher vor allem im Bereich des Handels und in der Logistik.
In zunehmendem Maß finden Anwendungen aber auch Eingang im öffentlichen Personennahverkehr. Für die Nahverkehrsunternehmen sind RFID interessant, entfallen doch etwa ein Fünftel der Ticketkosten auf das Management des Ticketverkaufs. Vom Einsatz von RFID-Chips verspricht man sich erhebliche Kostenvorteile und Verbesserungen im Transportablauf. 1994 gab es rund 1 Mio. kontaktlose Chipkarten, vier Jahre später waren es schon 100 Mio. Das erste Chipkarten-Projekt im ÖPNV gab es in Deutschland zu Beginn der 1990er Jahre in Köln, das erste Projekt mit kontaktlosen Karten Mitte der 1990er Jahre (Cap 2005). RFID sind nicht nur im ÖPNV, sondern auch in anderen Bereichen der Zugangskontrolle und Überwachung einsetzbar.
Durch den Einsatz von RFID besteht grundsätzlich die Möglichkeit der Erstellung von Bewegungsprofilen, beim Einsatz im Einzelhandel von Kaufprofilen. Die Datenschutzproblematik im ÖPNV ist eng verknüpft mit dem gewählten Tarifmodell. Einheitspreismodelle sind weitgehend unkritisch im Bezug auf die Erstellung von Bewegungsprofilen. Aus Sicht des Datenschutzes bedürfen dagegen Check in-/Check out und Best Price-Modelle einer kritischen Prüfung.
Insgesamt ist die RFID-Technik mit der Gefahr der Verarbeitung personenbeziehbarer Daten ohne ausreichende Transparenz der Verarbeitungsvorgänge verbunden. Bei einigen Systemen ist der Zugriff bis auf einige Meter Entfernung möglich. Sowohl RFID als auch Lesegeräte können unerkannt in alltägliche Gegenstände eingearbeitet werden. Die aus datenschutzrechtlicher Sicht kritischen Potenziale werden auch daran deutlich, dass „ein Personenbezug, z.B. bis hin zur Kopplung mit Videokameras, … bereits Gegenstand von Feldversuchen im Handel“ war (Bundesdatenschutzbeauftragter 2005: 46). Es besteht weiterhin eine Reihe von technischen Problemen und Problemen mit der Alltagstauglichkeit der Systeme.[4]
Die Verbreitung von RFID-Chips schreitet weiter voran. Was in der Computerzeitschrift „c't“ im Frühjahr 2004 noch als Aprilscherz „durchging“ – die angebliche Ausstattung von TÜV-Prüfplaketten mit RFID-Chips – soll in Großbritannien gut ein Jahr später Realität werden. Um das Fälschen von Nummernschildern zu erschweren, sollen sie mit RFID-Chips ausgerüstet werden. Als Nebeneffekt oder „Kollateralschaden“ – je nach Ansicht – würde damit die Aufzeichnung von Bewegungsprofilen möglich (vgl. Spiegel Online 11.8.2005). Ein weiteres Beispiel für die breite Anwendung von RFID-Technologien ist die südkoreanische Stadt New Songdo, 40 Meilen südwestlich von Seoul: Eine als Freihandelszone konzipierte großflächige Immobilienentwicklung (1500 acres), in der 65.000 Menschen wohnen und 300.000 Menschen arbeiten sollen, in der Englisch die Verkehrssprache sein soll und unterschiedliche internationale Währungen in Gebrauch sind.[5] Teil des Entwicklungskonzepts ist die Vernetzung und der Datenaustausch zwischen allen wesentlichen Informationssystemen. Datenschutzprobleme werden dabei kaum thematisiert, Skepsis vor dem „Überwachungsstaat“ scheint den Entwicklern völlig fremd zu sein. Das Projekt wird vielmehr als Möglichkeit gesehen, technologische Führerschaft zu beweisen und ausländische Investitionen anzuziehen (O'Connell 2005)[6].

4 So war ein Problem bei der Eingangskontrolle zu den Spielen des Confederation Cup in Deutschland 2005 (Generalprobe für die Fußballweltmeisterschaft 2006) die Angewohnheit von Fans Eintrittskarten an der Pinnwand zu befestigen und damit zum Teil die RFID-Chips zu zerstören. Vor dem Knicken der Eintrittskarten war auf den Karten gewarnt worden, an die „Pinnwand-Falle“ dachte keiner (vgl. http://www.heise.de/newsticker/meldung/61251; 31.8.2005)

5 Eine ausführlichere Darstellung der Entwickler findet sich in: http://www.new-songdocity.co.kr/; 7.11.2005.

6 Mögliche Anwendungen wären beispielsweise: „public recycling bins that use radio-frequency identification technology to credit recyclers every time they toss in a bottle; pressure-sensitive floors in the homes of older people that can detect the impact of a fall and immediately contact help; cellphones that store health records and can be used to pay for prescriptions“ (O'Connell 2005).

4.4 Technische und organisatorische Konvergenz der Sicherheitstechnologien

Eine Vielzahl von Anwendungsmöglichkeiten in den Städten ist denkbar. Gerade die Kombination unterschiedlicher Sicherheitstechniken wie die Videoüberwachung, die Nutzung biometrischer Merkmale für die Identifikation und die kontaktlose Datenübermittlung ermöglichen die Entwicklung komplexer Identifikations-, Zugangs- und Überwachungssysteme, die zur Regelung der Zugänglichkeit bestimmter Stadtbereiche (Innenstädte, ÖPNV, Botschaften, Ministerien, Behörden usw.) eingesetzt werden können und die Überwachung größerer Stadtbereiche und deren individueller Nutzung ermöglichen. Schon heute werden derartige konvergente Technologien genutzt. Einerseits besteht das Bedürfnis die technischen Möglichkeiten zur Gefahrenabwehr umfassend zu nutzen, andererseits entstehen mit zunehmender Erfassung von personenbezogenen oder personenbeziehbaren Daten in ihrer stadträumlichen Differenzierung und den Möglichkeiten der Verknüpfung von Einzeldaten völlig neue Potenziale der Überwachung. Neben der technischen Konvergenz spielt in diesem Zusammenhang die organisatorische Konvergenz eine besondere Rolle. Mit der zunehmenden Vermischung von Aufgaben der Gefahrenabwehr der inneren und der äußeren Sicherheit und dem Wunsch einer möglichst umfassenden informationsbasierten Lagebeurteilung kann die Verknüpfung von Einzelinformationen verbunden sein, die sich zu einem umfassenden individuellen Datenprofil verdichten lassen. Ohne gleich das monströse Bild des „gläsernen Menschen" zu zeichnen, entsteht doch durch die technischen und organisatorischen Konvergenzprozesse eine bisher nie vorhandene Möglichkeit umfassende Informationen über den einzelnen zu gewinnen.

5 URBANITÄT UNTER VERÄNDERTEN SICHERHEITSBEDINGUNGEN

Die Nutzung von IuK-gestützter Sicherheitstechnik ist mit Potenzialen und Gefahren verbunden, die es gilt gegeneinander abzuwägen. So bietet beispielsweise der Einsatz von Überwachungstechnologien grundsätzlich den Vorteil einer möglichen präventiven Wirkung, da das Entdeckungsrisiko (z.B. von Ordnungswidrigkeiten oder Straftaten) bzw. die Entdeckungswahrscheinlichkeit (von Gefahrensituationen) steigt und damit die Möglichkeit einer frühzeitigen Intervention, da die Informationsbasis über spezifische Sicherheitslagen sich vergrößert. Demgegenüber stehen die Gefahren von übermäßiger punktueller Überwachung, die z.B. mit Ausgrenzungs- oder Verdrängungsprozessen verbunden sein kann.

Die Nutzung von IuK-gestützten Sicherheitstechniken kann die Zugänglichkeit der Stadt verbessern, wenn beispielsweise bauliche Sicherheitsmaßnahmen wie Zäune, Sicherheitsabstände und Verbauungen durch technische Kontrollsysteme und temporäre Intervention ersetzt werden können. Sie kann die Zugänglichkeit von bestimmten Bereichen der Stadt aber auch verringern, wenn über technische Systeme Zugangsrestriktionen durchgesetzt werden und sie kann in erheblichem Maß sozial selektiv eingesetzt werden.

Technik ist immer ambivalent. Auch Sicherheitstechnik muss dabei immer in ihrem Einsatzkontext betrachtet werden. Der zunehmende Einsatz von Sicherheitstechnik muss auch vor dem Hintergrund tatsächlicher oder vermeintlicher Bedrohungen und des damit in Zusammenhang stehenden Sicherheitsregimes betrachtet werden.[7]

Mit einer veränderten Gefahrensituation, der Zunahme des Einsatzes von Sicherheitstechnik in bestimmten Räumen der Städte und dem Bedeutungsgewinn von Sicherheitsfragen für das Leben in den Städten sind eine Reihe möglicher Entwicklungen verbunden. Zu erwarten sind sowohl grundsätzliche Veränderungen von Einstellungen gegenüber Städten, langfristige Veränderungen der baulich-räumlichen Strukturen als auch Veränderungen in der Nutzung von Stadträumen:

Städte könnten zunehmend als unsichere Orte wahrgenommen werden. Damit würde einer neuen „Stadtfeindlichkeit" Vorschub geleistet. Grundsätzlich sind Städte vergleichsweise „unübersichtliche Orte" und könnten damit unter den Generalverdacht geraten, Versteck für alle möglichen Formen von Sicherheitsbedrohung zu sein. Schon jetzt werden diese Befürchtungen in der internationalen Stadtforschungsliteratur geäußert.[8] Sind wir also auf dem Rückweg in die befestigten Städte und die sicherheitspolitisch beherrschbaren Hausmann'schen Boulevards?

Die zunehmende oder lang anhaltende Bedrohung könnte mit einer verstärkten „Aufrüstung" mit Sicherheitsmaßnahmen, -technologien und –architekturen verbunden sein. Die „Aufrüstung" zeigt sich als schleichender Prozess der „Befestigung" von Städten. Zunächst nimmt die Aufmerksamkeit für die Geschehnisse im öffentlichen Raum zu und eine informelle Überwachung etabliert sich. Die sicherheitstechnische Ausrüstung wird verbessert. Regelungen, die den Aufenthalt in öffentlichen Räumen regulieren, werden verschärft. Bauliche Veränderungen wie die Errichtung von Zäunen und Wällen, Zugangstoren und die Entwicklung „wehrhafter Architekturen" finden Einzug in die Städte.[9] Unter Sicherheitsgesichtspunkten spricht man vom „target hardening" (Oc/Tiesdell 2000).

Vermeintliche „Archipele der Sicherheit" wie Shopping Malls, Bahnhöfe, innerstädtische Plätze, Business Improvement Districts, Gated Communities könnten entstehen (vgl. Wehrheim 2002). Wörtlich genommen wird ein derartiges „Archipel der Sicherheit" beispielsweise gerade auf der 62 ha großen Ayers-Insel im US-Bundesstaat Maine errichtet, wo eine „intelligente Insel" entwickelt werden soll, „deren Ziel es ist, die gesamte Insel mitsamt allen Gebäuden mit Sensoren so abzudecken, dass ‚jede verdächtige Bewegung' erfasst werden kann" (Rötzer 2004).

Stadträume könnten nach ihrem Sicherheitsstatus unterschiedlich bewertet werden. Folge wäre eine Polarisierung in sichere und unsichere Räume, wobei gerade die in Zukunft z.B. aufgrund der demographischen Entwicklung und des fortschreitenden technologisch-ökonomischen Strukturwandels zunehmenden Zwischennutzungen auf „ungeordneten Flächen" als unsichere Flächen wahrgenommen werden könnten. „Ethnic profiling" ist eine der Sicherheitsinstrumente zur Prävention von Anschlägen besonders, wenn vorhergehende Anschläge bestimmten ethnischen Gruppen zugeordnet werden konnten (vgl. Savitchev 2005). Damit geraten Wohnquartiere spezifischer ethnischer Gruppen in das sicherheitspolitische Visier. Auch die Diskussion um die Bedrohung durch vermeintliche Parallelgesellschaften, die bei einer engen räumlichen Konzentration einzelner ethnischer Gruppen

7 „Das Fatale ist, dass sich Überwachung an vielen Stellen ausbreitet, die erst einmal mit dem ‚Großen Bruder' nichts zu tun haben, aber doch eine Infrastruktur herstellen, die leicht anzueignen wäre" (Rötzer 2004).

8 „Cities are especially well suited for furnishing terrorists with anonymity, safe houses and supply depots in order to prepare attacks as well as gain access to potential targets. … Terrorists can more easily become invisible in overcrowded neighborhoods; they can hide weapons and explosives in obscure places and they can freely conduct themselves in a maze of twisting streets" (Savitch 2005: 362).

9 Oc und Tiesdell entwickeln die Vorstellung eines gestuften Prozesses der Stadtbefestigung und bezeichnen diese Stufen der Entwicklung als animated presence, panoptic devices, regulatory measures, fortress construction (Oc/Tiesdell 2000).

in den Städten entstünden, und Instrumente wie kleinräumige Zuzugssperren bekämmen unter sicherheitspolitischen Erwägungen einen verschärften Zungenschlag. Als eher sicher gelten dagegen suburbane Räume.[10] Nach Clarke's eingangs vorgestelltem Szenario müsste man sich von diesem Gedanken aber vermutlich ebenfalls verabschieden.

Zwischen unerwünschten Nachbarschaften könnten „Kontrollzonen“ oder „Sicherheitszonen“ entstehen.[11] In den Großstädten entstünde ein Inselsystem von sich überlagernden Milieus (die ortsgebundenen Armutsmilieus, die Arbeits-, Freizeit- und Wohnorte der Lebensstilgruppen und das Milieu international orientierter, hoch qualifizierter Arbeitskräfte), die bestrebt sind sich mit tiefer gehender sozialer Spaltung kontrolliert von einander abzugrenzen (vgl. Wehrheim 2004: 26). „Sicherheitszonen“ um „gefährdete Einrichtungen“ könnten entstehen, die über das bisher gekannte Maß hinausgehen, z.B. auch Wohngebäude betreffen[12]. Je nach gewünschtem Sicherheitsstatus könnten – temporär begrenzbare Zugangsbeschränkungen für bestimmte Stadtbereiche ausgesprochen und technisch überwacht werden. Schon heute werden solche temporären Aufenthaltsbeschränkungen vorgenommen, die von polizeilichen Anordnungen (wie dem Platzverweis) über Sperrmaßnahmen (z.B. bei Veranstaltungen) bis hin zu Aufenthaltsverboten reichen.[13] Mit technischer Überwachung ließen sich derartige Zugangsbeschränkungen erheblich ausweiten.

Öffentliche Räume würden ihren Charakter durch zunehmende technische Überwachung verändern bis hin zum Verlust von öffentlichen Räumen und zur Vermischung von öffentlichen und privaten Räumen. Befürchtet wird beispielsweise, dass öffentliche Räume „zu privatrechtlich sanktionierten Enklaven des gehobenen Konsums“ werden (vgl. Hamedinger 2005).

Neue Sicherheitsregimes könnten Auswirkungen auf die Infrastrukturplanung haben, z.B. könnte es für notwendig angesehen werden, die Gestaltung von Zugangsbereichen der Verkehrsinfrastruktur zu verändern (wie im Bereich der Flughäfen mittlerweile schon z. T. umgesetzt) und Einschränkungen bei der Verknüpfung von Verkehrsträgern vorzunehmen. Der Aufbau von Schleusensystemen mit Detektoren für Sprengstoff oder Sensoren, die versteckten Sprengstoff auch aus der Entfernung erkennen können, würde eine völlige Umgestaltung von Verkehrsinfrastruktur mit sich bringen.[14] Letztlich kommt die Frage auf, ob Megainfrastrukturen wie Großflughäfen, Großbahnhöfe mit angegliederten Shopping- und Bürokomplexen überhaupt zu sichern wären und ob nicht dezentrale Einrichtungen aus Sicherheitsüberlegungen sinnvoller wären. Die Desintegration von Einkaufs- und Verkehrseinrichtungen (z.B. bei Flug- oder Bahnhöfen) und Größenbeschränkungen oder Konzentrationen (abhängig von der besseren Zugänglichkeit für Kontrollmaßnahmen) könnten die Folgen sein.

Die städtebauliche Gestaltung könnte erheblich von den Sicherheitsüberlegungen zumindest an exponierten Standorten – geprägt werden, mit erheblichen Auswirkungen auf die Stadtgestalt in Zentren, in denen sich derartige Standorte konzentrieren (z.B. Berlin oder Frankfurt a. M.).[15]

Umfassende stadträumliche Sicherheitskonzepte könnten implementiert werden. Am Londoner Beispiel lassen sich diese Entwicklungen schon heute teilweise ablesen. Nach den IRA-Anschlägen in der Londoner City in der ersten Hälfte der 1990er Jahre hatte man sich entschlossen, dem Belfaster Beispiel folgend einen „ring of steel“ zu bilden, indem die Zahl der Zugangsmöglichkeiten in den Finanzdistrikt begrenzt und Barrieren aufgebaut wurden, die temporäre Zugangssperren möglich machen sollten. Es wurden Tausende von Videokameras installiert, Sicherheitspläne der Finanzinstitutionen überarbeitet und empfohlen die Zahl der Zugänge zu einzelnen Gebäuden von Finanzinstitutionen zu begrenzen. Die Gebäude wurden sicherheitstechnisch verstärkt und „back-up sites“ aufgebaut, die im Notfall die Funktion der ursprünglichen Standorte übernehmen sollten. Die Polizeipräsenz wurde massiv verstärkt (vgl. Coaffee 2003).

Veränderte Sicherheitsbedingungen haben auch Auswirkungen auf die Umsetzbarkeit von Großereignissen, die zu einem gern eingesetzten Instrument neuerer Stadtentwicklungspolitik im Rahmen der Inszenierung von Räumen geworden sind. So führen erhöhte Sicherheitsanforderungen dazu, dass der Einlass zu Großveranstaltungen in zunehmendem Maß nur mit personalisierten Tickets

10 „Many of the more secure places resemble the protected spaces of suburban malls as well as lower-density, suburban housing complexes” (Savitch 2005: 383).

11 Der Entwurf des neuen Anti-Terror-Gesetzes in Frankreich sieht beispielsweise die automatisierte Überwachung von Autonummernschildern und Insassen in „Risikozonen“ vor. Auf Anordnung des Polizeichefs könnten bei „konkretem Verdacht“ überall, ohne richterliche Anordnung, bis zu vier Monate Kameras installiert werden (Streck 2005).

12 Beispielhaft dafür ist der Fall eines Diplomatenwohnhauses in Wien (vgl. Jänicke 2004).

13 Ein besonders krasses Beispiel für derartige Zugangsbeschränkungen ist das Zutrittsverbot, das zur Prostitutionsbekämpfung für den Stadtteil Colonia Marconi de Villaverde in Madrid ausgesprochen wurde. Der Zugang zu diesem Stadtteil ist in der Zeit von 23 bis 6 Uhr nur mit einer der ausgegebenen 3000 Zugangskarten möglich (Streck 2005).

14 „Sollte eine solche Maßnahme nützlich sein, müsste wie in einem Flughafen jeder Zugang mit solchen Schleusen und zusätzlich mit Personal ausgestattet sein. Abgesehen von den Kosten würde dies im Berufsverkehr unweigerlich zum Chaos führen. Lange Schlangen bilden, wie im Irak deutlich sichtbar, überdies gute Ziele für Anschläge“ (Rötzer 2005). In der Londoner U-Bahn sollen angeblich „zur Beruhigung oder zum Testen einige dieser ‚Passive Millimetre-wave Scanner' im Eingangsbereich der U-Bahn [aufgebaut werden], die die Kleidung der Passanten durchleuchten und versteckte Gegenstände sichtbar machen können“ (Rötzer 2005).

15 Wie sich Sicherheitsüberlegungen auf die Gestaltung von Architektur auswirken, zeigt sich besonders deutlich am Beispiel des Wiederaufbaus am „Ground Zero“ in New York. Der „Freedom Tower“ soll spezifische Sicherheitskriterien erfüllen, die über das Maß der üblichen Gebäudesicherheit erheblich hinausgehen. So soll „das Betonpodest, eine Stahl-Titan-Mischung, … einen Meter dick und in schimmerndes Metall gekleidet sein …, auf den von der Strasse aus gerechnet ersten 10 Metern Höhe ganz und gar fensterlos [sein]“. Die Konstruktion „ geht … auf die Furcht vor Auto- und LKW-Bombenanschlägen zurück. Sicherheitsexperten der Polizei hatten darauf bestanden, dass der Turm nach Kriterien errichtet werden sollte, die auch für Bundesgebäude gelten, etwa für US-Botschaften oder das Pentagon. Darüber hinaus wurden mindestens 30 Meter Abstand von der nächsten befahrenen Strasse angemahnt. Natürlich gibt es chemische und biologische Filter, massive Vorkehrungen für Brandschutz, extra breite Treppen, viele verbundene Ausgänge und besonders geschützte Lifte“ (Böhnel 2005).

möglich ist, was zu erheblichen Unbequemlichkeiten für Ticketinhaber führen kann.[16] Umfangreiche Sicherheitsmaßnahmen (Straßensperrungen, Sperrungen des Luftraums usw.) können darüber hinaus große Teile der Stadt beeinträchtigen.

In letzter Konsequenz könnte das subjektive Unsicherheitsgefühl mit einer Verlagerung von Aktivitäten in den virtuellen Raum verbunden sein. So beschreibt beispielsweise Clarke in seinem Szenario die Verlagerung von Einkäufen ins Internet nach Anschlägen auf Einkaufszentren (Clarke 2005).

Schließlich stellt sich die Frage wie Städte aussehen, die bei sinkenden finanziellen Mitteln zunehmende Anteile für Sicherheitsinfrastruktur investieren müssen oder wollen.[17] Die Gefahr besteht, dass sich die baulichen, technischen und regulatorischen Sicherheitsmaßnahmen in den Städten als wirksam gegen Bedrohungen erweisen und dennoch dafür sorgen, dass urbanes Lebensräume zerstört und städtisches Leben behindert wird und damit ein Ziel des Terrors gegen Städte erreicht wird.

6 FAZIT

Es kann ebenso wenig darum gehen Sicherheitstechnik grundsätzlich zu verteufeln wie sie unkritisch als Problemlöser für alle Sicherheitsaufgaben in den Städten anzusehen. Viel mehr müssen die Potenziale, aber auch die Risiken, die mit dem Einsatz von Sicherheitstechnologien verbunden sind, im Anwendungskontext kritisch bewertet werden. Städte werden sich in Zukunft in stärkerem Maß mit Sicherheitsfragen auseinandersetzen müssen. Dabei darf es nicht nur um die unmittelbar handlungsleitenden Fragen des Umgangs mit Gefahren-, Bedrohungssituationen und Schadensereignissen gehen. Darüber hinaus geht es um eine Auseinandersetzung mit den langfristigen Folgen der Eingriffe von Maßnahmen der Inneren Sicherheit für das Leben in den Städten. Fragen, denen sich Stadtforschung und und Technologiefolgenforschung ebenso stellen sollten wie Anwender und Entwickler.

7 LITERATUR

BITE – Biometric Information Technology Ethics: Press Release, January 2005.

Böhnel, M.: Hochsicherheitsklotz statt Freiheitsturm; Telepolis, 6.7.2005, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=20459&mode=print; 26.8.2005.

Braunschweig im Putzwahn; taz Nord vom 15.3.2004.

Briten testen funkende Autokennzeichen; Spiegel Online, 11. August 2005; http://www.spiegel.de/netzwelt/technologie/0,1518,369248,00.html 26.8.2005.

Cap, C. H.: Anwendungen von RFID Identifikation; Folien zur Vorlesung „Smart Cards, Smart Labels, Smart Devices", Lehrstuhl für Informations- und Kommunikationsdienste der Universität Rostock, http://wwwiuk.informatik.uni-rostock.de/sites/lehre/lehrveranstaltungen/vl_smartx/rfid-applications.pdf, 9.5.2005.

Clarke, R. A.: Zehn Jahre danach. Vortragsmanuskript zum zehnten Jahrestag des 11. September 2001; Frankfurter Allgemeine Sonntagszeitung, 6. März 2005.

Deutscher Städtetag: Positionspapier Sicherheit und Ordnung in der Stadt, Februar 2004.

Deutscher Städte- und Gemeindebund: Pressemeldung vom 1.7.2002.

Glitza, K. H.: Mundwasser gegen einen Hauch von Toll Collect. CD Sicherheitsmanagement 4/2004, S. 125-129.

Graham, St.: Postmortem City. Plädoyer für eine Geopolitik des Urbanen; Informationen zur modernen Stadtgeschichte, 2/2004, S. 54-71.

Hamedinger, A.: Privatisierung und soziale Kontrolle öffentlicher Räume in „sicheren Städten"; Manfred Schrenk (Hrsg.): CORP 2005 & Geomultimedia05, Proceedings/Tagungsband. Wien 2005, S. 547-554.

Hempel, L.: Verdrängen statt Vorbeugen; Telepolis, 15.1.2003, http://www.heise.de/tp/r4/artikel/13/13928/1.html; 9.5.2005.

Jänicke, E.: Sicherheitszone für US-Bürger in Wien; Telepolis 15.8.2004 (http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?mode=html&artikelnr=18121; 9.5.2005).

v. Kodolitsch, P.: Einführung: Sicherheit in der Stadt; Deutsche Zeitschrift für Kommunalwissenschaften I/2003, S. 5-10.

v. Landenberg, M.: Mit Sicherheit mehr Jobs; Stern Spezial Campus & Karriere, 1.10.2004, S. 42-44.

Oberwittler, D.: Die Entwicklung von Kriminalität und Kriminalitätsfurcht in Deutschland – Konsequenzen für die Kriminalprävention; Deutsche Zeitschrift für Kommunalwissenschaften, I/2003, S. 31-52.

Oc, T., Tiesdell, S.: Urban design approaches to safer city centers: the fortress, the panoptic, the regulatory and the animated.; J.R. Gold, G. Revill (Hg.), Landscapes of Defense, S. 188-208, Upper Saddle River 2000.

O'Connell, P.: Korea's High-Tech Utopia, Where Everything Is Observed, New York Times, 05.10.2005.

Rötzer, F.: Insel der Überwachung; Telepolis, 2.6.2004, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=17451&mode=print; 9.5.2005.

Rötzer, F.: Politiker fordern mehr Überwachung zur Verhinderung von Terror; Telepolis, 11.7.2005, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=20490&mode=print; 26.8.2005.

Savitch, H. V.: An Anatomy of Urban Terror: Lessons from Jerusalem and Elsewhere; Urban Studies, Vol. 42, No. 3, S. 361-395, March 2005.

Schiffhauer, N., Hinter dem Spiegel geht's weiter; GIT Sicherheit + Management 12/2004, S. 12/13.

Siebel, W.; Wehrheim, J.: Sicherheit und urbane Öffentlichkeit; Deutsche Zeitschrift für Kommunalwissenschaften, I/2003, S. 11-30.

SMS-Fahndung floppt.; Spiegel Online, 28.12.2004, http://www.spiegel.de/netzwelt/politik/0,1518,334577,00.html; 9.5.2005).

Stegemann, Th.: Auf der Suche nach der Stadt der Zukunft; Telepolis, 19.10.2005, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=21143&mode=print, 4.11.2005.

Streck, R.: Eingangsverbote statt Ausgangssperre; Telepolis, 9.8.2005; http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=20689&mode=print; 26.8.2005).

Streck, R.: Volle Überwachung in Frankreich; Telepolis, 27.10.2005, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=21229&mode=print, 4.11.2005.

Videoüberwachung überraschend gestoppt; Badische Zeitung vom 8.11.2003.

Weber, W.: Die neue Sicherheitsarchitektur Deutschlands – Neue Strategie von Bund und Ländern zum Schutz der Bevölkerung. Vortrag anlässlich der Fachkonferenz des DStGB „Mehr Sicherheit für lebenswerte Städte und Gemeinden" am 4.03.2004 in Mainz.

Wehrheim, J.: Die überwachte Stadt. Sicherheit, Segregation und Ausgrenzung. Opladen 2002.

Wehrheim, J.: Städte im Blickpunkt Innerer Sicherheit; Aus Politik und Zeitgeschichte, B44/2004, S. 21-27.

Winsemann, B.: Alles, was noch krauchen kann, muss persönlich ins Stadion; Telepolis, 22.10.2005, http://www.heise.de/bin/tp/issue/r4/dl-artikel2.cgi?artikelnr=21189&mode=print, 4.11.2005.

WM-Tickets bitte nicht knicken; http://www.heise.de/newsticker/meldung/61251; 31.8.2005.

16 So können etwa die personalisierten Tickets für die Fußballweltmeisterschaft 2006 in Deutschland nur dann z.B. wegen Erkrankung an einen anderen Nutzer weitergegeben werden, wenn eine Vollmacht des eigentlichen Ticketinhabers mit Ausweiskopie und ein Dokument, das die Erkrankung nachweist (ärztliches Attest) vorliegen (Winsemann 2005).

17 Allein für die Ausstattung mit "Passive Millimetre-wave Scanner" würden „pro Station … bis zu drei Millionen Euro erforderlich sein" (Rötzer 2005).

🏆 reviewed paper

Besuchererfassungstechnologien als Beitrag für eine nachhaltige Erholungsgebiets- und Stadtentwicklung

Arne ARNBERGER, Christiane BRANDENBURG, Andreas MUHAR

(DI Dr. Arne Arnberger, DI Dr. Christiane Brandenburg, Ao.Prof. DI Dr. Andreas Muhar; Universität für Bodenkultur, Department für Raum, Landschaft und Infrastruktur, Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung, Peter Jordan-Strasse 82, 1190 Wien, arne.arnberger@boku.ac.at)

1 KURZFASSUNG

Erholungsgebiete sind elementar für ein attraktives Lebensumfeld im urbanen Raum. Trotzdem wird kaum eine Gebietsverwaltung in der Lage sein, Auskünfte über Besucheranzahl und Besucherstrukturen in ihren Erholungsgebieten zu geben. Mit der Dokumentation von Besucherzahlen kann die Wichtigkeit von suburbanen und urbanen Parkanlagen politischen wie städtebaulichen Entscheidungsträgern aufgezeigt werden. Gleichzeitig werden Grundlagen für die Planung von Siedlungsgebieten und Grünanlagen geschaffen. Voraussetzung für den Einsatz eines Besuchermonitorings ist die genaue Kenntnis der jeweiligen Vor- und Nachteile von Besuchererfassungstechnologien. Eine Vielzahl an Methoden und Messgeräten zur Registrierung von Besucherströmen steht zur Verfügung. Werden diese Methoden über einen längeren Zeitraum und standardisiert eingesetzt, so können Vergleiche hinsichtlich der Besucherintensitäten und Besucherstrukturen von Erholungsgebieten gezogen werden, die eine tiefergehende Analyse der Erholungsnutzung erlauben. Die Vor- und Nachteile von Besuchererfassungstechnologien werden in dem Beitrag anhand von Besuchermonitoringstudien in und um Wien vorgestellt. Inwieweit die gewonnenen Erkenntnisse über die Erholungsnutzung als Beitrag für ein nachhaltiges Gebietsmanagement und für eine nachhaltige Stadtentwicklung dienen können, wird diskutiert.

2 EINLEITUNG

2.1 Der Bedarf von Besucherzahlen für eine nachhaltige Erholungsgebiets- und Stadtentwicklung

Erholungsgebiete sind elementar für ein attraktives Lebensumfeld im urbanen Raum. Sie stellen für die Stadtbevölkerung Orte des Aufenthalts dar, ermöglichen soziale Kontakte, dienen der psychischen und physischen Regeneration und bieten Naturerlebnisse. Während ein Großteil von touristischen Destinationen und Einrichtungen ihre Besucherfrequenzen als Nachweis für ihre Attraktivität dokumentieren (siehe TourMIS; Wöber 2005), wird kaum eine städtische Verwaltung in der Lage sein, statistisch abgesicherte Auskünfte über Besucherzahlen und Besucherstrukturen ihrer Erholungs- und Schutzgebiete zu geben. Dabei stellen die Besucher eigentlich die fiktive „Einnahmequelle“ der Gebietsverwaltungen dar. Da aber die Nutzung öffentlicher Grünflächen unentgeltlich ist, stehen Nachweise z.B. in Form von verkauften Eintrittskarten nicht zur Verfügung.

Mit der Erhebung und somit Dokumentation von Besucherzahlen und der vielfältigen Nutzerstrukturen wird die Wichtigkeit urbaner Erholungsgebiete politischen wie städtebaulichen Entscheidungsträgern aufgezeigt (More 1997). Viele Gebietsverwaltungen benötigen Besucherzahlen über die Inanspruchnahme ihrer Einrichtungen, um den Einsatz öffentlicher Mittel rechtfertigen zu können. Besucherdaten stellen Grundlagen für die Planung von Siedlungsgebieten und Grünanlagen und deren Erholungsinfrastrukturbedarf dar. Die Kenntnis über Nutzermengen und Nutzerstrukturen und deren zeitliche Verteilung bilden wichtige Entscheidungsgrundlagen für das Management von Erholungs- und Schutzgebieten in sozialer wie ökologischer Hinsicht. So führen die intensive Nutzung sowie neue Individualsportarten zu einer Belastung von urbanen und suburbanen Schutzgebieten. Ein Beitrag zur Konfliktentschärfung zwischen Naturschutz und Erholungsnutzung wird in der Erstellung von Besucherlenkungskonzepten gesehen. Entscheidend für die Effizienz derartiger Maßnahmen sind aber konkrete Kenntnisse über die Besucherfrequenz und Besucherstruktur.

Nur in einigen Städten wie Budapest (Nagy 2002) oder Cleveland (Mowen 2002) werden urbane Erholungsgebiete einem permanenten Besuchermonitoring unterzogen. In Japan werden seit 1966, insbesondere in Tokyo (Uchiyama 2000, Aoki et al. 2002) regelmäßige Besucherzählungen und Besucherbefragungen in städtischen Parkanlagen durchgeführt. In Wien fanden 1966 größer angelegte Erhebungen über den Besuch öffentlicher Erholungsflächen statt (Kirchner 2000). In den letzten Jahren allerdings wurden in Wien einige umfassende Besucherstudien durchgeführt, die ein steigendes Interesse an dem Thema Erholungsnutzung (peri)urbaner Erholungs- und Schutzgebiete dokumentieren (s. Tabelle 1).

Gebiet	Jahr	Quelle
Marchfeldkanal, Wien XXI und Niederöstereich	1993-1995	Muhar et al. 1995
Lobau, Nationalpark Donau-Auen, Wien XXII	1998-1999	Arnberger et al. 2000
Niederösterreichischer Anteil des Nationalpark Donau-Auen, Wien XXII	2000-2001	Arnberger & Brandenburg 2002
Lainzer Tiergarten	Nahezu jedes Jahr	Weidinger 2002
Erholungsgebiet Wienerberg, Wien X	2002-2003	Arnberger 2004
Ottakringer Wald, Wien XVI	2003-2004	Arnberger 2005

Tabelle 1: Übersicht über Besuchererfassungsstudien in und um Wien der letzten Jahre

2.2 Voraussetzungen für ein Besuchermonitoring

Ausgangspunkt für jedes Besuchermonitoring ist eine genaue Definition der Problemstellung. Danach ist zu entscheiden, wer mit dem Besuchermonitoring erfasst werden soll, um mit den Erholungsnutzungsdaten zur Problemlösung beizutragen. So ist zu klären, ob alle Besucher innerhalb eines Jahres erfasst werden sollen, nur eine bestimmte Nutzergruppen wie Radfahrer, oder die Erhebungen nur über einen bestimmten Zeitraum laufen sollen.

Nach der Entscheidung wer erfasst werden soll, stellt sich die Frage nach dem wie. Voraussetzung für den Einsatz eines Besuchermonitorings ist die genaue Kenntnis der jeweiligen Vor- und Nachteile von Besuchererfassungstechnologien hinsichtlich Datengenauigkeit, Zuverlässigkeit, Kosten, Betreuungsaufwand, Datenschutz und Vandalismusanfälligkeit. Eine Vielzahl an Methoden und Messgeräten zur Registrierung von Besucherströmen steht inzwischen zur Verfügung (Cessford & Muhar 2003, Coch & Hirnschall 1998, Eagles & Hornback 1999, Watson et al. 2000). Oftmals haben aber die fehlenden Kenntnisse über Erfassungsmethoden und ihre Anwendungsbereiche die Durchführung einer Besuchererhebung verhindert (Arnberger 2002).

Nach der Auswahl der Methode ist die entsprechende Samplingstrategie festzulegen, da die Daten in einer standardisierten Vorgehensweise erhoben werden sollen. Damit wird entschieden, wann, wie lange und wie oft und an welchen Stellen die Besucherströme erfasst werden müssen. Gerade mit Langzeitbeobachtungen können gesichert Besucherzahlen eines Jahres, Tagesgänge nach Saison, Spitzennutzungszeiten, zeitlich-räumliche Verteilung von Nutzergruppen, Daten über unerwünschte Verhaltensweisen wie das Nichtanleinen des Hundes etc. gewonnen werden.
Für ein umfassendes Verständnis des Freizeit- und Erholungsgeschehens in einem Gebiet hat sich der Einsatz von Methodenkombinationen als effizient erwiesen. Beispielsweise können Langzeitbeobachtungen mit kurzfristigen Zählungen, mit offenen und verdeckten Erhebungen, mit Befragungsergebnissen oder qualitativen Daten kombiniert werden. Werden Besuchermonitoringmethoden standardisiert eingesetzt, so können Vergleiche hinsichtlich der Besucherintensitäten und Besucherstrukturen von mehreren Erholungsgebieten gezogen werden, die eine tiefergehende Analyse der Erholungsnutzung urbaner Räume erlauben.

3 BESUCHERERFASSUNGSTECHNOLOGIEN

3.1 Bildgestützte Erfassungsgeräte

Zu den bildgestützten Erfassungsgeräten gehören Luftbildkameras, Handkameras and die Videobeobachtung (Tabelle 2). Luft- und Satellitenbilder eignen sich zwar sehr gut für die momentane Erfassung beispielsweise der Badenutzung an Seen oder von Bergwanderern über der Baumgrenze, Aussagen über die Erholungsnutzung in Waldgebieten sind damit aber kaum möglich. Zusätzlich beschränken die hohen Flugkosten, allfällige Fluggenehmigungen, die gerade für städtische Bereiche sehr schwer erhältlich sind, und das Flugwetter die Verfügbarkeit von Erholungsnutzungsdaten gewonnen über Luftbilder. Gesamtbesucherzahlen innerhalb eines Jahres oder eines Zeitraumes bzw. Tagesgänge der Erholungsnutzung sind damit nicht erfassbar. Darüber hinaus können über diese Momentaufnahmen Langzeiteffekte der Erholungsnutzung auf Fauna und Flora schwerlich abgeleitet werden.
Vorteilhaft erweisen sich Luftbilder in schwer überblickbaren Erholungs(teil)gebieten, wenn die räumliche Verteilung der Erholungsnutzung zu Spitzenbesuchszeiten erfasst werden soll. Werden stereoskopische Bilder eingesetzt, so könnte unter Umständen die Bewegungsrichtung festgestellt und mit Hilfe des Schattenwurfs Radfahrer von Fußgänger unterschieden werden. Um zu solchen Detailaussagen zu kommen, ist allerdings der Arbeitsaufwand bei der Auswertung von Luftbildern sehr hoch. Mit zusätzlichen Datenerhebungen, beispielsweise mit Besucherzählungen an Eingangsbereichen, können über Korrelationen von Besucherzahlen auch Aussagen über die Momentaufnahme hinausgehend erfolgen. Hochauflösende Satellitenbilder sind meist kostspielig. Tagesgänge der Erholungsnutzung können daraus nicht generiert werden, da die Umlaufbahn der Satelliten dies nicht zulässt.
Fotoaufnahmen, ausgelöst durch einen Bewegungsmelder, in bestimmten Intervallen oder permanente Aufnahmen liefern hingegen detaillierte Informationen über das Erholungsgeschehen. So wurde vielfach mit Fotoapparaten, die mit einem Sensor verbunden waren, in entlegenen Schutzgebieten gearbeitet (Watson et al. 2000). Für städtische Erholungsgebiete eignet sich diese Methode allerdings kaum, da die Besucherzahlen sehr hoch und damit die Filmkapazität bzw. bei digitalen Kameras die Speicherkapazität schnell erschöpft sind. Daher müsste permanent das Speichermedium gewechselt werden, wodurch hohe Manipulationskosten entstehen.
Als effektiv haben sich Zeitraffer- (Time lapse-) Videoaufnahmen erwiesen, welche in Intervallen von einigen Sekunden durchgeführt werden (Arnberger et al. 2005, Cessford & Muhar 2003, Muhar et al. 1995). Durch die im Vergleich zu normalen Videos weitaus geringere Bildfrequenz können auf einem Videoband Daten von mehreren Wochen aufgezeichnet werden. Voraussetzung für den Einsatz der Videotechnik ist meist eine Stromversorgung. Durch den Fortschritt in den Bereichen Digitalvideo und Photovoltaik ist es jedoch mittlerweile möglich, Aufnahmestationen in entlegenen Gebieten zu errichten, welche über Solarpanele mit Strom versorgt werden. Über UMTS-Mobiltelefonie lassen sich Videodaten auch ohne direkte Anbindung an Strom- und Datennetze übertragen (siehe www.visit.com). Die Videostationen selbst bestehen aus jeweils einer SW- oder Farbvideokamera und einem Time-lapse-Videorekorder, wobei in einem Zeitintervall von zumeist ein bis zwei Sekunden jeweils ein Bild aufgenommen wird, abhängig vom Kamerablickwinkel, Besuchsintensität und Nutzungsarten. Die Kameras können dabei in Vogelhäuschen integriert werden, um sowohl verdeckte Beobachtungen durchzuführen als auch vor Vandalismus geschützt zu sein.
Gerade für städtische Erholungsgebiete eignet sich die Videobeobachtung sehr gut, da damit einerseits die vielfältige Nutzung dieser Gebiete abgebildet wird, andererseits der hohe Besucherdruck über einen langen Zeitraum sehr genau erfasst werden kann (Arnberger et al. 2005). Mit den Daten der Videobeobachtung werden somit Jahres-, Saison-, Wochen- und Tagesgänge (Grafik 1), Jahresmaxima, Tagesmaxima, -mittelwerte und -minima der Besuche ermittelt. Die zeitliche Verteilung des Besuchsaufkommens kann in Hinblick auf Nutzerarten wie Radfahrer, Fußgänger, Skater, Langläufer, mitgeführte Hunde, motorisierter Individualverkehr usw. ausgewertet werden. Für jeden Zeitpunkt und für jede Beobachtungsstation kann somit die Anzahl der jeweiligen Nutzerarten ermittelt und darauf basierend deren jeweiliger Anteil am Gesamtbesucheraufkommen errechnet werden. Weitere Informationen über Besucherverhalten, Nutzerkonflikte oder über neue Trendsportarten können gewonnen werden.
Nachteil der Time lapse-Videoaufnahmen ist der hohe Auswertungsaufwand. Da das Erholungsgeschehen permanent aufgenommen wird, werden auch „Leerzeiten" der Erholungsnutzung, vor allem an den Tagesrandzeiten, erfasst. Dies könnte mit in die Kamera/Videorecorder integrierten Bewegungssensoren oder in Kombination mit elektrischen Zählgeräten wie Lichtschranken erfolgen (Janowksy & Becker 2003). Allerdings wird dadurch die Wahrscheinlichkeiten von Fehlzählungen erhöht (siehe 3.2). Neuere Entwicklungen der automatischen Bildinterpretation lassen künftig auch eine kostengünstige Auswertung des bildlich aufgenommenen Erholungsgeschehens zu (Muhar et al. 1995). Ein weiterer Nachteil ist die fehlende Erfassung der Nachtnutzung, die vor allem für städtische Parkanlagen von Bedeutung ist. Aber auch hier haben inzwischen neueste Entwicklungen in Form von Nachtsicht- und Wärmebildkameras Abhilfe geschaffen.

Erfassungsgeräte	Besuchszahl	Aktivitätsart	Bewegungsrichtung	Gruppengröße	Besuchereigenschaften (z.B. Alter, Geschlecht)	Besuchereigenschaften dr. mitgeführte Utensilien	Besucherverhalten	Jahresgänge	Tages- und Wochengänge	Nutzerkonflikte	Langzeiterfassungen möglich
Bildgestützte Erfassungsgeräte											
Handkameras	✓	✓	✓	✓	(✓)	(✓)	✓		(✓)		
Videobeobachtung	✓	✓	✓	✓	(✓)	(✓)	✓	✓	✓	✓	✓
Luftbildkameras	✓	(✓)	(✓)	(✓)							
Elektronische Zählgeräte											
Lichtschranken	✓		(✓)	(✓)				✓	✓		✓
Bewegungsmelder	✓							✓	✓		
Wärmesensoren	✓		(✓)	(✓)				✓	✓		
Drucksensoren	✓		(✓)	(✓)				✓	✓		✓
Pneumatische Schläuche	✓		(✓)	(✓)				✓	✓		✓
Radar	✓	(✓)	(✓)	(✓)				✓	✓		✓
Magnetische Sensoren	✓		(✓)	(✓)				✓	✓		✓
Mechanische Zählgeräte											
Drehkreuze	✓		(✓)					(✓)	(✓)		✓
Drehtüren	✓		(✓)					(✓)	(✓)		✓
Türverriegelungen	✓							(✓)	(✓)		✓

Tabelle 2: Übersicht über Besuchererfassungstechnologien und ihre Informationsgehalte

Bildgestützte Erfassungsgeräte werfen ethische Aspekte auf. Die Videobeobachtung ist in urbanen Freiräumen (Parkplätze, Stadtplätze) weit verbreitet und dort offenbar auch von einer Mehrheit der Bevölkerung akzeptiert (Helten & Fischer 2004). Anders stellt sich die Situation in Erholungsgebieten abseits der Ballungszonen dar. Dort erwarten sich die Besucher einen Freiraum außerhalb sozialer Kontrolle. Prinzipiell sind Stationen mit Videokameras so einzurichten, dass auf den Bildern keine Personen oder Autokennzeichen identifiziert werden können. Die Brennweite des Objektivs und das Blickfeld wird so gewählt, dass zwar Radfahrer von Fußgängern unterschieden werden können, eine weitere Identifizierung aber nicht möglich ist. Außerdem sind stets ortsfremde Auswertepersonen einzusetzen.

3.2 Elektronische Zählvorrichtungen

Über optische, elektromagnetische, pneumatische, druck- und wärmeempfindliche Sensoren, sowie Radarstrahlen, die mit Datenspeichergeräten kombiniert sind, werden Besucherzahlen erfasst (Gasvoda 1999, Rauhala et al. 2002, Watson et al. 2000). Gleichzeitig wird die Uhrzeit, Datum, eventuell die Gehrichtung und unter Umständen auch die Gruppengröße registriert. Teilweise kann sogar der Nutzertyp aufgrund der Geschwindigkeit festgestellt werden (Radar). Die Energieversorgung erfolgt zumeist über Batterien, teilweise auch über Solarpanele.

Vorteile dieser Methoden liegen in ihrer Stromunabhängigkeit, der Möglichkeit von Langzeiterfassungen und der direkten und langfristigen Registrierung der Daten in digitaler Form. Neuere Entwicklungen erlauben überdies das automatisch Downloaden der Daten (Melville & Ruohonen 2004). Weiters können weitere Daten wie die Temperatur automatisch miterfasst werden. Die Aufnahmen können rund um die Uhr erfolgen. Beispielsweise wurden mittels Zählschranken die Besuchsfrequenzen in weniger genutzten Bereichen des Nationalparks Donau-Auen ganzjährig und über 24 Stunden aufgenommen. Es zeigte sich, dass in der Nacht an siedlungsfernen und habitatreichen Waldbereichen überproportionale Auslösungen, (höchstwahrscheinlich) hervorgerufen durch Rehe und Hirsche, registriert wurden (Tabelle 3).

Fotos: Links: Beschädigte Lichtschranke im Nationalpark Donau-Auen; Rechts: Einbau einer Druckmatte (Fotos Arnberger)

Nachteilig sind das Fehlen jeglicher Informationen über Nutzerart und Besucherverhalten sowie Fehlzählungen, insbesondere bei Lichtschranken, aufgrund von Wildtieren, unterschiedlichen Geschwindigkeiten der Nutzergruppen, herab fallenden Ästen oder Wettereinflüssen. Personen, die nebeneinander gehen, werden oft nur als eine Person registriert. Da Druckmatten eingegraben werden müssen, können sie nicht bei asphaltierten Wegen eingesetzt werden. Sie eignen sich eher für schmale Wanderwege und Trampelpfade. Besucher, die allerdings nicht direkt über die Druckmatten gehen, werden nicht erfasst. Druckmatten zeigen bei gefrorenem oder sehr lehmigen Boden Fehlzählungen. Größere Wildtiere wie Hirsche oder schnell laufende, größere Hunde führen ebenfalls zu Fehlzählungen.
Magnetische Sensoren sprechen bei Metall an. Diese Auslösungen können von Fahrrädern, aber auch von Hundehalsbändern oder Hufeisen von Pferden stammen. Daher kommt der richtigen Auswahl des Standortes bei elektrischen Zählgeräten höchste Bedeutung zu. Idealerweise sollte der Weg möglichst nur von einer Nutzergruppe genutzt werden. Die Einrichtung und der Betrieb der Zählstationen kann relativ teuer werden, da einerseits die Geräte für jeden Standort kalibriert werden müssen (vor allem bei einer gleichzeitigen Nutzung von Radfahrern und Fußgängern), andererseits solche Stationen sehr anfällig gegenüber Vandalismus sind (siehe Foto). Daher ist eine versteckte Anordnung sämtlicher Teile zwingend erforderlich.

Lichtschrankenstationen	Tag und Nacht	Relativer Anteil der Nachtfrequenzen
Siedlungsnah/sehr geringe Habitatqualität	48.090	7%
Siedlungsnah/geringe Habitatqualität	44.290	7%
Siedlungsnah/ geringe Habitatqualität	16.680	8%
Siedlungsfern/mittlere Habitatqualität/Einfluss durch Gastronomiebetrieb	51.880	15%
Siedlungsfern/mittlere Habitatqualität	29.260	15%
Siedlungsfern/hohe Habitatqualität	12.280	17%
Gesamt	202.480	11%

Tabelle 3. Anzahl der Auslösungen je Lichtschrankenstation innerhalb eines Jahres sowie relativer Anteil der nächtlichen Frequenzen (Arnberger & Brandenburg 2002)

3.3 Mechanische Zählvorrichtungen

Drehkreuze werden in vielen Naturparken, Badegebieten oder Skigebieten zur Erfassung von Besucherzahlen eingesetzt. Mechanische Zählvorrichtungen können beispielsweise in Türen eingebaut werden. Jede Betätigung der Türverriegelung wird erfasst. So hat der finnische Forest Service diese an Toilettentüren angebracht (Rauhala et al. 2002). Tatsächlich ist die Zuverlässigkeit solcher Vorrichtungen gering, da unbeaufsichtigte Drehkreuze insbesondere Kinder zum Spielen verleiten, und somit für den Einsatz in städtischen Gebieten weniger geeignet sind. Informationen über verschiedene Nutzergruppen werden nicht geliefert. Nachteilig ist auch die fehlende Möglichkeit über mechanische Zählvorrichtugen die Uhrzeit mit zu erfassen. Ist eine zeitliche Erfassung der Erholungsnutzung erforderlich, so müssen die Daten beispielsweise am Ende jeden Tages ausgelesen werden. Drehtüren sind relativ häufig in städtischen Parkanlagen zu finden, werden jedoch kaum für Besucherzählungen genützt.

4 DATEN VON BESUCHERERFASSUNGSGERÄTEN ALS BEITRAG FÜR EINE NACHHALTIGE ERHOLUNGSGEBIETS- UND STADTENTWICKLUNG

4.1 Gesamtbesucherzahlen

Statistisch abgesicherte Gesamtbesucherzahlen zeugen von der Beliebtheit und somit Notwendigkeit von Erholungsgebieten. Die Lage im städtebaulichen Gefüge, aber auch die touristische Nutzung beeinflussen dabei im starken Masse die Besuchsfrequenzen. In Tabelle 4 sind von einigen Wiener Erholungsgebieten Gesamtbesucherzahlen und die Besucherzahl pro Hektar und Tag angeführt. Während bei international bekannten Tourismusdestination, wie der Park des Schlosses Schönbrunn, die gleichzeitig auch als Naherholungsgebiet und als Teil des täglich aufgesuchten Wohnumfeldes dienen, die Besuchsdichten bei 100 bis 300 Besuchen pro Hektar und Tag liegen, ist in größeren städtischen Erholungsbieten ohne touristische Nutzung mit Besuchsdichten von rund 30 Besuchen pro Hektar und Tag zu rechnen. In weniger gut erreichbaren Erholungsgebieten am Stadtrand liegen die Besuchsdichten bei unter einem Besuch, in Erholungsgebieten außerhalb städtischer Agglomeration deutlich darunter.

Gebiet	**Besuche im Jahr**	**Besuche pro ha und Tag**	**Erfassungsmethoden**	**Quellen**
Schloss Belvedere, Wien IV	2.000.000	317	Eintritte, Zählungen und Schätzung	Österreich Werbung (2000)
Schloss Schönbrunn inkl. Zoo, Wien XIII	5.200.000	118	Eintritte, Zählungen und Schätzung	www.schönbrunn.at
Erholungsgebiet Wienerberg, Wien X	1.243.000	28	Zählungen und Videoerfassung	Arnberger (2004)
Lobau/Nationalpark Donau-Auen, Wien XXII	600.000	0,7	Zählungen und Videoerfassung	Arnberger et al. (2000)
Lainzer Tiergarten, Wien XIII	500.000	0,6	Zählungen	Weidinger (2002)
Nationalpark Donau-Auen, Niederösterreich	390.000	0,2	Zählungen und Videoerfassung	Arnberger et al. 2000

Tabelle 4. Jahresbesucherzahlen von Erholungsgebieten in und um Wien

Seitens der World Tourism Organisation (WTO in König 1998) wurden einige Standards bezüglich der Raumnutzung für touristische Zwecke zusammengestellt. Die maximale Besucheranzahl von Wäldern, beispielsweise, wird bei 15, bei Vorstadtparks zwischen 15 und 70 Besuchen pro Hektar und Tag angegeben. Die Erholungsnutzung des Erholungsgebietes Wienerberg im X. Wiener

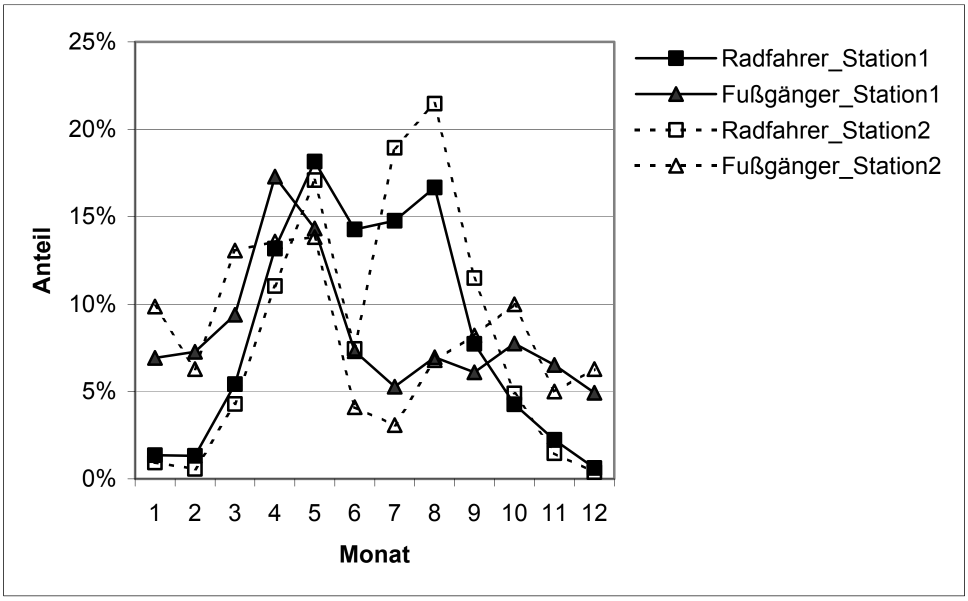
Gemeindebezirk mit durchschnittlich 28 Besuchen pro Hektar und Tag befindet sich somit im mittleren Bereich dieses festgelegten Standards, an 1,5 % der Tage im Jahr wird dieser allerdings überschritten (Arnberger 2003).
Erholungsgebiete, deren soziale und oder ökologische Tragfähigkeiten überschritten sind, können beispielsweise durch eine bessere Ausnutzung der Morphologie, Trennung von Nutzergruppen wie Radfahrer von Fußgängern und durch die Anlage neuer Wege aufnahmefähiger gestaltet werden. Kann die Kapazität des Erholungsgebietes nicht erhöht werden, dann sind zusätzlich nutzbare Freiräume im Umfeld bereitzustellen. Ist allerdings die Anlage neuer Erholungsgebiete nicht möglich, dann ist von einer weiteren Verdichtung umliegender Wohnflächen, aber auch von einer Bewerbung des Gebietes Abstand zu nehmen. Eine weitere Strategie wäre das langfristige Ausdünnen von Anwohnern in der Umgebung beispielsweise durch die Zusammenlegung von Wohneinheiten oder gar ein gefördertes Absiedeln über finanzielle Anreize und attraktive Wohnstandortalternativen. Eine indirekte Besucherlenkungsmaßnahmen stellt die Verschlechterung der Erreichbarkeit dar, die vor allem die Besucherinnen und Besucher aus entfernteren Siedlungsbereichen trifft. Beispiele dafür wären eine wenig attraktive Anbindung an den Öffentlichen Nahverkehr oder eine Reduktion der PKW-Stellplätze.
Hingegen könnten in Erholungsgebieten, deren soziale Tragfähigkeitsgrenzen noch lange nicht erreicht sind, neue Nutzergruppen untergebracht werden, um andere, überfüllte Erholungsgebiete zu entlasten (Arnberger 2003). Überdies kann eine Verdichtung der umliegenden Siedlungsgebiete erfolgen. Gerade bei Siedlungen, die an attraktive Erholungsgebiete grenzen, ist mit höheren Renditen für die Errichter und Betreiber von Wohnbauten zu rechnen (Tyrväinen & Väänänen 1998). Allerdings sollten der Erholungsgebietsverwaltung Teile der Renditen zu gute kommen, schließlich verursacht der erhöhte Besucherdruck auch einen gesteigerten Managementaufwand. Bei diesen Überlegungen sind die jeweiligen Ziele der Gebietsverwaltung miteinzubeziehen. So werden Schutzgebiete schon bei viel geringeren Besucherfrequenzen ihre Belastungsgrenze erreichen als innerstädtische Parkanlagen.

4.2 Nutzergruppenanteile

Bildgestützte Besuchererfassungstechnologien, insbesondere die Video-Beobachtung, erlauben eine Differenzierung in Nutzergruppen. Gerade für das Management städtischer Erholungsgebiete ist dies aufgrund der Vielzahl verschiedener Nutzergruppen eine grundlegende Information. Mit der Identifikation von Nutzergruppen kann überprüft werden, ob die gewünschte Zielgruppe das Gebiet aufsucht. Gleichzeitig werden Nutzungen, die nicht erlaubt sind wie motorisierte Nutzungen, erfasst und quantifiziert. Mit der Feststellung von Besuchergruppen kann auch das Potenzial von Nutzerkonflikten abgeschätzt werden. Ebenso dienen diese Daten der Gestaltung, Ausstattung und Dimensionierung der Erholungsinfrastruktur, beispielsweise für die Anlage von Radwegen, der Anzahl von Radständern, Rastmöglichkeiten, Spielbereichen etc. Bildgestützte Erfassungstechnologien können das Auftreten neuer Nutzergruppen dokumentieren, wie beispielsweise die Nordic Walker (Arnberger 2005).
Gerade im urbanen Bereich können die in einer Parkanlage getätigten Besuchermanagementmaßnahmen zu Änderungen in der Besucherstruktur und Besuchermenge einer anderen Parkanlage im positiven wie negativen Sinne führen. Mittels mehrjähriger Erhebungen über bildgestützte Besuchererfassungstechnologien werden diese Änderungen des Besuchsaufkommens erfasst. Damit kann das Management überprüfen, ob die Maßnahmen erfolgreich sind bzw. rechtzeitig lenkend eingreifen, sollten die Änderungen in eine nicht erwünschte Richtung laufen.

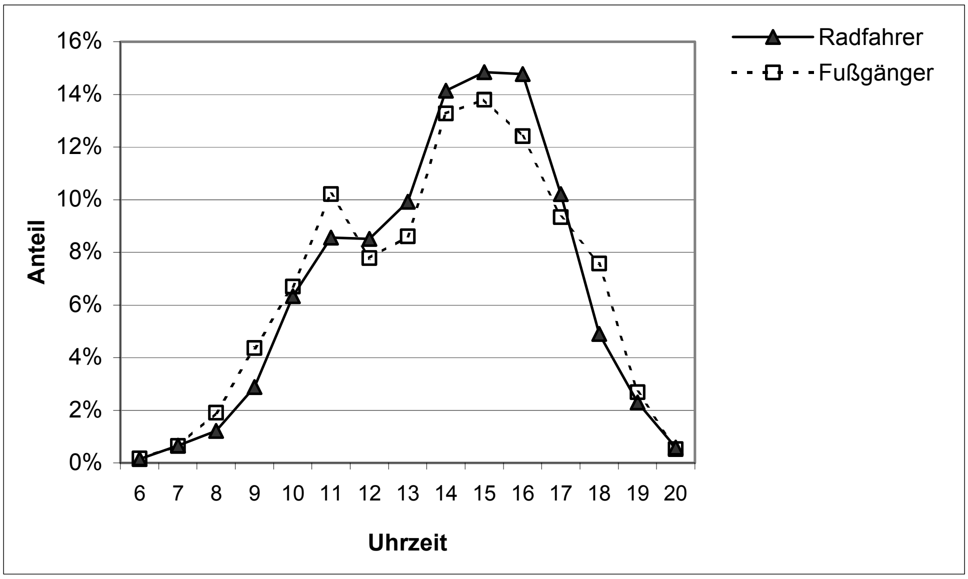
4.3 Zeitliche Verteilung von Besucherströmen

Mit der Kenntnis über die zeitliche Verteilung von Besucherströmen und insbesondere von einzelnen Nutzergruppen wie Radfahrern und Fußgängern werden Grundlagen für viele Entscheidungen und Maßnahmen im Rahmen des Besucher- und Gebietsmanagements geschaffen. Diese Daten können unter anderem für die Erstellung räumlich-zeitlicher Einsatzpläne von Pflege- und Informationspersonal, für die Planung und Wartung des Wegenetzes, für die Berechnung von Parkplatzkapazitäten, für eine zielgerichtete Besucherinformation über unerwünschten Verhaltensweisen etc. eingesetzt werden.
Von einem Besuchermonitoring wird erwartet, dass es Daten zur Minimierung von Konflikten zwischen Erholungsnutzung und Naturschutz und anderen Nutzungsansprüchen, wie beispielsweise Landwirtschaft, Forstwirtschaft oder Jagd, sowie auch zur Minimierung von Konflikten zwischen verschiedenen Formen der Erholungsnutzung bereitstellt. Mit der Darstellung der zeitlichen Überlagerung von Nutzergruppen können solche Problembereiche identifiziert werden. So können über Langzeitbeobachtungen zeitliche „hot spots" in der Erholungsnutzung, bedingt beispielsweise durch die Überlagerung von hohen Besucherströmen mit ökologisch sensiblen Zeiträumen (z.B. Brutzeiten), unerlaubten Besucherverhalten und sich langsam und schnell fortbewegenden Nutzergruppen identifiziert werden.
Grafik 1 zeigt so eine starke Überlappung der Auftretensmuster von Radfahrern und Fußgängern im April und Mai an zwei Videostationen im Wiener Anteil des Nationalpark Donau-Auen. Dies ist ein Hinweis für ein erhöhtes Konfliktpotenzial in diesen Monaten zwischen beiden Nutzergruppen. Erst mit der Zuziehung der Nutzergruppenanzahl sind allerdings Aussagen über das Konfliktpotenzial wirklich möglich. So sind an der Station 1 die Besucherzahlen um ca. 40% höher als an der Station 2. An der Station 2 waren nur 7% aller erfassten Besucher Fußgänger (mit und ohne Hund) und Jogger, während bei Station 1 über 40% aller Nutzer Fußgänger und Jogger waren. So ist das Konfliktpotenzial an der Station 2 zwischen Radfahrern und Fußgängern relativ gering und bedarf nur eines geringen Managementaufwandes.



Grafik 1: Jahresgang von Radfahrern und Fußgängern an zwei Videostationen in der Lobau, Nationalpark Donau-Auen (Arnberger et al. 2000); Anmerkung: im Juni war an der Station 2 ein mehrtägiger Datenausfall aufgrund technischer Defekte der Aufnahmegeräte zu verzeichnen

Um das Konfliktpotenzial an der Station 1 stärker zeitlich einzugrenzen, wurden die Tagesgänge der Erholungsnutzung in den beiden Monaten April und Mai herangezogen. An den Tagen desWochenendes, inklusive Feiertagen, waren rund vier Mal so viele Radfahrer und Fußgänger an dieser Station unterwegs wie an den Tagen unter der Woche. Daher wurden die Tagesgänge an den Wochenenden der beiden Monate analysiert (Grafik 2). Hier zeigte es sich, dass die Spitzenzeiten von Radfahrern und Fußgängern zwischen 14 und 17 Uhr zusammenfallen. Auf diesen Zeitraum wird folglich das Hauptaugenmerk des Managements liegen, um allfällige Nutzerkonflikte zu vermeiden.



Grafik 2: Tagesgang von Radfahrern und Fußgängern an der Station 1 an den Wochenenden im April und Mai in der Lobau, Nationalpark Donau-Auen (Arnberger et al. 2000); Anmerkung: 6 Uhr bedeutet 6:00 bis 6:59.

4.4 Besucherverhalten

In vielen Erholungs- und Schutzgebieten gibt es Einschränkungen für die Erholungsnutzung, deren Einhaltung mit Hilfe eines Monitoringprogramms überprüft werden kann. Solche Einschränkungen können sich auf bestimmte Gebiete beziehen, welche nicht betreten werden sollen, oder auf bestimmte Nutzungen, wie etwa motorisierte Sportarten oder auch auf das Anleingebot für Hunde.

Anhand der Videodaten kann die Anzahl und Anleinrate mitgeführter Hunde dokumentiert werden. Diese wurde für mehrere Wiener Erholungsgebiete erfasst (Arnberger et al. 2000, Arnberger 2004). Im Nationalpark Donau-Auen, wie auch in allen öffentlichen Grünflächen Wiens, besteht Anleinpflicht. Von den jährlich 50.000 in die Lobau mitgeführten Hunden waren laut Videobeobachtung aber 66% der Hunde nicht angeleint. Gerade für Naturschutzgebiete stellen Hunde, die nicht an der Leine sind, eine potenzielle Gefährdung des Naturraumes und der Besucher dar. Verglichen allerdings mit dem Erholungsgebiet Wienerberg ist der Einfluss unangeleinter Hunde auf die Besucher deutlich geringer. Hier waren nur 22% der über die Videobeobachtung erfassten Hunde an der Leine. Problematisch ist dies insofern, als in diesem relativ kleinen Erholungsgebiet knapp 200.000 Hunde im Jahr hinein geführt werden und die Bessucherdichte ca. 40-mal größer ist als in der Lobau (Tabelle 4). Über die Videobeobachtung können nun jene Zeiträume identifiziert werden, in denen der Anteil unangeleinter Hunde besonders groß ist, um Aufsichtspersonal zu diesen Zeitpunkten vor Ort zu haben.

5 RESÜMEE

Mit der Erfassung von Besucherströmen werden Grundlagen für viele Entscheidungen und Maßnahmen im Rahmen des Besucher- und Gebietsmanagements geschaffen (Arnberger 2002). Beispiele sind Personaleinsatzpläne, Planung und Management des Wegenetzes, eine verfeinerte Ausweisung von Schutzzonen, eine zielgerichtete Besucherinformation, das Vorgehen gegenüber unerwünschten Verhaltensweisen, oder die Abstimmung von Marketingmaßnahmen auf die erwünschte Zielgruppe. Die Daten eines Besuchermonitoring können dazu beitragen, Zonen und Zeiten auszuweisen, in welchen spezifischer Handlungsbedarf gegeben ist, beispielsweise durch Übernutzung oder durch Fehlverhalten. Ebenso dienen diese Daten der Gestaltung, Ausstattung und Dimensionierung der Erholungsinfrastruktur. Daten, gewonnen in standardisierter Weise, erlauben überdies auch Vergleiche zwischen einzelnen Erhebungsstationen innerhalb eines Gebietes und zwischen Gebieten, auf regionaler, nationaler und internationaler Ebene. Besucherlenkungskonzepte und -maßnahmen basierend auf einem Besuchermonitoring sollen bei Konflikten zwischen und innerhalb von Nutzergruppen Abhilfe schaffen. Maßnahmen, untermauert mit nachvollziehbaren und plausiblen Besucherdaten, gewonnen in einer systematischen und nachvollziehbaren Weise, führen zu einer erhöhten Akzeptanz bei den Betroffenen.

Die gewonnenen Erholungsnutzungsdaten dienen aber nicht nur dem Gebietsmanagement selbst, sondern liefern Beiträge für viele raum-, landschafts-, wie auch verkehrsplanerische Fragestellungen und Maßnahmen im Umfeld des Untersuchungsgebietes. So verursachen hohe Besucherzahlen auch ein hohes Verkehrsaufkommen. Maßnahmen der Verkehrslenkung können basierend auf der Kenntnis über die Anzahl und das zeitliche Aufkommen der Besucher rechtzeitig entwickelt werden. Quantitative Informationen stellen Grundlagen für eine verbesserte Anbindung des öffentlichen Verkehrs, für die Anlage und Dimensionierung von regionalen und lokalen Radrouten oder für die Anlage und Dimensionierung von Parkplätzen dar. Auch die lokale Gastronomie und die Fremdenverkehrswirtschaft insgesamt profitieren von den Erholungsnutzungsdaten.

Durch die immer größer werdende Mobilität, stärkere Flexibilisierung der Arbeitszeiten, durch vermehrten Stress, höhere Lärmbelastungen und Reizüberflutung ist mit einem Steigen der Besucherzahlen in attraktiven Erholungsgebieten zu rechnen. Gesellschaftliche Trends, wie Wellness und ein erhöhtes Gesundheitsbewußtsein, tragen ebenfalls zu einer verstärkten Nutzung von Erholungsgebieten bei. Bedingt durch fehlende, aber auch überbesuchte und unattraktive städtische Erholungsgebiete, wird der Erholungsdruck auf landschaftlich abwechslungsreiche und ruhige Erholungs- und Schutzgebiete im städtischen Nahbereich steigen. Die allwochenendliche Flucht ins Grüne wird weitergehen, und damit auch die Verkehrsbelastung. Gerade aber der hohe Anteil des Freizeitverkehrs am Gesamtverkehr verursacht Schadstoffbelastungen und ist ein Mitverursacher des Klimawandels. Daher sollte es eine Zielsetzung städtischer Verwaltungen sein, als Beitrag für eine nachhaltige Stadtentwicklung, ihre Bürger durch attraktive Erholungsgebiete in der Stadt zu halten. Die Erfassung und Prognose von Besucherströmen wird somit künftig eine immer wichtiger werdende Rolle in der Planung und dem Management von urbanen Schutz- und Erholungsgebieten einnehmen.

Aufgrund der hohen Informationsgehalte (Anzahl, zeitlich-räumliche Verteilung der Besucher, Identifikation von Besuchertypen etc.) kann mit bildgestützten Langzeit-Erfassungstechnologien wie der Videobeobachtung ein genaues Bild von der Erholungsnutzung eines Gebietes gewonnen werden. Künftige Entwicklungen in der Erholungsnutzung basierend auf diesen Daten können über Vorhersagemodelle abgeschätzt werden (Brandenburg 2001). Je präziser die erhaltenen Daten über die Besucherstruktur und ihre zeitlich-räumliche Verteilung sind, umso höher ist die Akzeptanz, Effektivität und damit Nachhaltigkeit des Erholungsgebietsmanagements. Neue Techniken, wie der automatische Datentransfer von der Messstelle zum Auswerteplatz, werden künftig das Erheben von Besucherdaten erleichtern.

Ist ein Besuchermonitoring zielgerichtet ausgelegt, dann sind die erhaltenen besucherbezogenen Daten niemals „unnütze Datenberge", sondern genau jene Daten und Ergebnisse, die für das Management erforderlich sind. Die Einsatzgebiete von Besucherdaten sind äußerst vielschichtig und werden oft erst im Laufe langjähriger Aktivitäten der Gebietsverwaltung ersichtlich, wo dann auf die Daten des Besuchermonitorings zurückgegriffen werden kann, um Besuchertrends abzuleiten. Gerade mit der Verbindung von längerfristigen Zähldaten und Befragungsergebnissen können detaillierte Daten für weitreichendere Aussagen gewonnen werden, um die Bedürfnisse der Stadtbevölkerung bestmöglich zu befriedigen. Vielfach werden die hohen Kosten eines Besuchermonitorings als Grund angeführt, dieses nicht durchzuführen. Tatsache ist, dass ein Besuchermonitoring Geld kostet. Doch welche Kosten treten erst auf, wenn falsche Maßnahmen aufgrund fehlender oder unzuverlässiger Besucherdaten getroffen worden sind? Tatsache ist, dass ein aktives, statt reaktives, Besuchermanagement viele Konfliktbereiche im Vorhinein vermeidet und Erholungsgebiete langfristig zur Zufriedenheit der Besucher erhält.

6 DANKSAGUNG

Das Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung an der Universität für Bodenkultur wurde von der Magistratsabteilung 49, Forstamt der Stadt Wien, und von der Nationalpark Donau-Auen GmbH beauftragt, Daten über die Erholungsnutzung zu erheben.

7 LITERATURVERZEICHNIS

Aoki, Y., Fujita, H., Aoki, K.: Measurement and Analysis of Congestion at the Traditional Japanese Garden "Korakuen". In: Arnberger A., Brandenburg C., Muhar A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings.BOKU - University of Natural Resources and Applied Life Sciences: Vienna, 264-270, 2002.

Arnberger, A., Brandenburg, C., Cermak, P., Hinterberger, B.: Besucherstromanalyse für den Wiener Anteil am Nationalpark Donau-Auen, Bereich Lobau. Forschungsbericht, im Auftrag des Mag. d. Stadt Wien, MA 49 / Forstamt der Stadt Wien- Forstverwaltung Lobau.

Arnberger, A., Brandenburg, C.: Der Nationalpark als Wohnumfeld und Naherholungsgebiet - Ergebnisse der Besucherstromanalyse im Wiener Anteil des Nationalparks Donau-Auen. Naturschutz und Landschaftsplanung, 33/5: 157-161, 2001.

Arnberger, A.: Besuchermonitoring und Besuchermanagement. In: Tiroler Nationalparksfond Hohe Tauern / Föderation Europarc (Hrsg.) Europarc 2001. Tagungsband. Matrei/Osttirol. S. 70 – 73, 2002.

Arnberger, A. Brandenburg, C.: Visitor Structure of a Heavily Used Conservation Area: The Danube Floodplains National Park, Lower Austria. In: Arnberger A., Brandenburg C., Muhar A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings. Institute for Landscape Architecture and Landscape Management, BOKU - University of Natural Resources and Applied Life Sciences Vienna: 7-13, 2002.

Arnberger, A.: Modellierung sozialer Tragfähigkeitsgrenzen von Erholungsgebieten. Dargestellt am Erholungsgebiet Wienerberg. Dissertation. Universität für Bodenkultur Wien, 2003.

Arnberger, A.: Besuchermonitoring im Erholungsgebiet Wienerberg. Projektbericht im Auftrag der MA49, Forstamt der Stadt Wien. Institut für Freiraumgestaltung und Landschaftspflege, Universität für Bodenkultur Wien, 2004.

Arnberger, A. Haider, W., Brandenburg, C.: Evaluating visitor monitoring techniques: A comparison of counting and video observation data. Environmental Management, 36, 4, 317-327, 2005.

Arnberger A.: Besuchermonitoring im Ottakringer Wald: Im Auftrag der Magistratsabteilung 49, Forstamt der Stadt Wien.

Brandenburg, C.: Erfassung und Modellierung von Besuchsfrequenzen in Erholungs- und Schutzgebieten – Anwendungsbeispiel Nationalpark Donau-Auen, Teilgebiet Lobau. Dissertation. Universität für Bodenkultur Wien, 2001.

Cessford, G., Muhar, A.: Monitoring options for visitor numbers in national parks and natural areas. Journal for Nature Conservation, 11(4), 240-250, 2003.

Coch, T., Hirnschall, J.: Besucherlenkungskonzepte in Schutzgebieten. Überlegungen zur methodischen Vorgangsweise der Erarbeitung. Naturschutz und Landschaftsplanung, 30(12): 382-388, 1998.

Eagles, P.F.J., Hornback, K.E.: Guidelines for Public Use Measurement and Reporting at Parks and Protected Areas. Cambridge: IUCN Publication Services Unit, 1999.

English, D.B.K., Kocis, S.M., Zarnoch, S.J., Arnold, J.R. (2002): Forest service national visitor use monitoring process: Research method documentation. General Technical Report SRS-54, USDA Forest Service, Southern Research Station. Asheville, NC.

Gasvoda, D.: Trail traffic counters: Update. Report 9923-2835-MTDC. USDA Forest Service, Missoula Technology and Development Centre, Missoula, MN., 1999.

Helten, F., Fischer, B.: What do People Think about CCTV? Findings from a Berlin Survey. Urban Eye Working Paper 13. http://www.urbaneye.net/results/ue_wp13.pdf, 2004.

Janowsky, J. von, Becker, G.: Characteristics and needs of different user groups in the urban forest of Stuttgart. Journal for Nature Conservation, 11(3-4), 251-259, 2003.

Kirchner, W.: Besucherzählung und Besucherbefragung in Wiener Grünanlagen. In Aoki Y. (Ed.): Investigation Methods for Recreational Use of Natural Landscape. Research Report from the National Institute for Environmental Studies, No. 155, R-155-2000, Japan: 85-90, 2000.

König, N.: Besuchermanagement als Instrument einer nachhaltigen Tourismusentwicklung in Destinationen. Diplomarbeit an der Technischen Universität Dresden, 1998.

Melville, S., Ruohonen, J.: The development of a remote-download system for visitor counting. In: Sievänen, T., Erkkonen, J., Jokimäki, J., Saarinen, J., Tuulentie, S., Virtanen, E. (Eds.), Policies, Methods and Tools for Visitor Management. Proceedings of the Second Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Rovaniemi, Finland, 37-43, 2004.

More, T.A.: Personal Benefits of Public Open Space: A Case Study in Boston`s Arnold Arboretum. Proceedings of the 1997 Northeastern Recreation Research Symposium, Bolton Landing, New York. USDA General Technical Report NE-241: 51-55,1997.

Mowen, A.: Estimating Visitor Occasions and Recreational Visits at an Urban Park District. In: Arnberger A., Brandenburg C., Muhar A. (Eds.). Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings. Institute for Landscape Architecture and Landscape Management, Bodenkultur University: Vienna, 436-438, 2002.

Muhar, A., Zemann, R., Lengauer, M.: Permanent Time-lapse Video Recording for the Quantification of Recreational Activities. Proceedings Decision Support-2001 Volume 1, Bethesda, Maryland: 219-229, 1995.

Nagy, K.: Public Use of the Public Parks and Protected Areas of Budapest. In Arnberger A., Brandenburg C., Muhar M. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas, Conference Proceedings, BOKU - University of Natural Resources and Applied Life Sciences Vienna: 271-276, 2002.

Rauhala, J., Erkkonen, J., Iisalo, H.: Standardisation of visitor counting – Experiences from Finland. In A. Arnberger, C. Brandenburg and A. Muhar (eds.) Proceedings of the First Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas. BOKU - University of Natural Resources and Applied Life Sciences, Vienna, 258-263, 2002.

Tyrväinen, L., Väänänen, H.: The economic value of urban forest amenities: an application of the contingent valuation method. Landscape and Urban Planning, 43, 105-118, 1998.

Uchiyama, K.: Data from Recent Park Studies by the Tokyo Metropolitan Government. In Aoki Y. (Ed.): Investigation Methods for Recreational Use of Natural Landscape. Research Report from the National Institute for Environmental Studies, No. 155, R-155-2000, Japan: 95-100, 2000.

Watson, A.E., Cole, David N., Turner, David L. & Reynolds, Penny S.: Wilderness Recreation Use Estimation: A Handbook of Methods and Systems. Ogden: USFS General Technical Report RMRS-GTR-56, http://www.fs.fed.us/rm/pubs/rmrs_gtr56.html, 2002.

Weidinger, H.: Recreational Forest Management: Sustainably Protecting and Improving the Recreational Function of the Vienna Woods. In: Arnberger A., Brandenburg C., Muhar A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings. BOKU - University of Natural Resources and Applied Life Sciences: Vienna, 302-305, 2002.

Wöber, K.: Entwicklung der Nachfrage im Tourismus dargestellt im touristischen Marketinginformationssystem TourMIS. Kurzfassung des Vortrags im Rahmen der Schönbrunner Tourimsugespräche am 23.09.2005. http://www.schoenbrunn.at/de/site/publicdir/res/246378_58604_Kurztext%20W%F6ber%20(2).pdf

🏆 **reviewed paper**

Instrumente für die partizipative, nachhaltige Siedlungsentwicklung – Unterstützung von Zielanforderungen nachhaltiger Siedlungsplanung und Erfahrungen aus der Anwendung im europäischen Kontext

Robin GESSMANN; Markus PETER

(Dipl.-Ing. Markus Peter, Institut für Industrielle Bauproduktion, Universität Karlsruhe (TH), Englerstr. 7, 76128 Karlsruhe, markus.peter@web.de)

1 KOOPERATIVE FORMULIERUNG VON ZIELEN UND ANFORDERUNGEN

Der vorliegende Beitrag befaßt sich mit der Entwickung von netzbasierten Abstimmungs- und Moderationssytemen zur Unterstützung von partizipativen Planungsprozessen. Grundlage dafür sind europäische Forschungsprojekte, die weitreichende Übereinstimmung über die Ziele nachhaltiger Raum- und Siedlungsplanung erzielt haben. Es wurden Instrumente entwickelt die eine weitreichende Integration künftiger Nutzer ermöglichen. Dies basiert auf den Erfahrungen die aus der Entwicklung kooperativer netzbasierter Planungsinstrumente kommen. Diese unterstützten bereits seit geraumer Zeit die Kommunikationsanforderungen, führen diese Plattformen unter dem Anspruch eines weitreichendes Dokumentenmanagement zusammen und eröffnen so die Möglichkeit des zeitlich und räumlich getrenntem Arbeitens.

Über die wesentlichen Ziele nachhaltiger Siedlungsentwicklung besteht weitreichend Einigkeit und auch bei den Indikatoren zur Messung der erreichten Qualität kann auf eine große Anzahl von Forschungsprojekten zurückgegriffen werden[1][2][3][4].

Abbildung 1: Kooperierende, partizipative Planung [5]

Die Ziele der Planung nachhaltiger Gebäude- und Siedlungsstrukturen unterliegen komplexen und teilweise gegensätzlichen Zielanforderungen. Auf Ebene der Gebäude werden die Anforderungen einer Nachhaltigkeit meist mit denen des komsumptiven Energie und Medienverbrauchs gleichgesetzt. Wird der Betrachtungs- und Planungsrahmen auf eine nachhaltige Siedlungsentwicklung ausgedehnt, müssen eine ungleich größere Anzahl von Zielen nachhaltiger Siedlungsentwicklung im Kontext der städtischen Rahmenbedingungen integriert werden. Sollen die künftigen Bewohner umfassend an einem solchen Planunggegenstand partizipieren, bedarf es also Instrumente, die in der Lage sind, nicht nur das gegenwärtige Spektrum des Wissens nachhaltiger Siedlungsentwicklung zu präsentieren, sondern auch darüber hinaus einen solchen komplexen partizipativen Planungsprozess zu unterstützen und zu dokumentieren. Im vorliegenden Projekt sollten deshalb aufbauend auf den Erkenntnissen kooperativer Planungsplattformen internetbasierte Instrumente entwickelt und integriert werden, die in der Lage sind partizipative Planungsprozesse professionell zu unterstützen.

---

1 [1]

2 [2]

3 [3]

4 http://crisp.cstb.fr/default.htm

5 SINTEF Civil and Environmental Engineering, Architecture and Building Technology

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

2 ZIEL- UND ANFORDERUNGSMODELL

Im vorliegenden Projekt wird in Kooperation mit verscheidenen europäischen Partner gezielt die Ziel- und Anforderungsproblematik in Planungsvorhaben für die Anforderungen nachhaltiger Gebäude untersucht. Die kooperative netzbasierte Festlegung der Anforderungen und Präferenzen nachhaltiger Gebäude- und Siedlungsstrukturen kann damit auf alle Stufen des Planungsprozesses übertragen werden und ist für alle Beteiligten nachvollziehbar und rückverfolgbar. Hierbei ist die Erkenntnis maßgebend, dass eine detaillierte Erfassung der Ziele und Anforderungen und ihre Einbindung in ein Zielsystem, das auch die Anforderungen des übergeordneten Systems (z.B. energetische und ökologische Aspekte) berücksichtigt, eine entscheidende Grundlage jeglicher Planungsarbeit darstellt. Es wurde untersucht inwieweit die Zielplanung die Aufgabe erfüllen kann, Chancen und Lösungen, die sich aus der Planung ergeben, auf die funktionale Eignung, wirtschaftliche und ökologische Machbarkeit und nicht zuletzt auf die Akzeptanz im partizipativen Planungsansatz zu prüfen.

Schwerpunkt dieses Vorhabens ist die Erarbeitung einer Systematik zur Entwicklung und strukturierten Verwaltung eines Ziel- und Aufgabensystems und dessen informationslogistische Umsetzung auf einer internetbasierten, prozessorientierten Kooperationsplattform. Die Plattform dient im folgenden gleichzeitig, jeweils angepasst an die örtlichen Planungsvorgaben und die involvierten Experten und deren Anforderungen, als Entscheidungsmedium mit weit reichendem Einblick in die Datengrundlage und die sich daraus ergebenden Konsequenzen und Zwänge.

Hierzu werden Strukturierungsregeln inhaltlicher und zeitlicher Art entwickelt. So soll die Erarbeitung verschiedener Zielbereiche, deren Gewichtung und entsprechend klassifizierte Einordnung in das Zielsystem unterstützt werden. Erreicht wird dadurch eine hohe Transparenz hinsichtlich der unterschiedlichen anzustrebenden planungsrelevanten Zielsetzungen, zudem wird eine zielbezogene Verwaltung von Planungsdaten möglich [6].

3 INSTRUMENTE ZUR PARTIZIPATION

Um tragfähige Ergebnisse im Hinblick auf eine spätere nachhaltige Nutzung gewährleisten zu können, liegt hierbei das Hauptaugenmerk auf der Einbeziehung der zukünftigen Bewohner in den Zielfindungsprozess. Im Ergebnis werden also Instrumente präsentiert, die den komplexen Zusammenhang von Zielen und Indikatoren nachvollziehbar erläutern und präsentieren und zugleich einen weit reichenden partizipativen Ansatz für die Planung von Gebäuden Siedlungen und Stadtteilen ermöglichen. Die Basis dafür ist eine Datenbank, die über weit reichende Informationen zu Zielen nachhaltiger Planung, Indikatoren und in der Folge einem großen Pool von „Guidlines" für den weiteren Planungsverlauf verfügt. Diese Datenbank stützt sich auf einem Datenstand der für das jeweilige Anwendungsprojekt individuell angepasst wird. Entscheidend dabei ist, dass im Vorfeld der Planung der partizipative Planungsprozess individuell an die gewünschte oder sinnvolle Tiefe der Diskussion angepasst werden kann.

Es bestehen bereits weitreichende Erfahrungen bei Entwicklungen von kooperativen, geographisch und zeitlich getrennten Kooperations-Plattformen.[7][8]. Durch sie werden Kommunikationsabläufe organisiert und dokumentiert und planungsrelevante Dokumente vorgehalten[9][10]. Diese werden nun durch Instrumente zur Unterstützung nachhaltiger, partizipativer Siedlungsplanung erweitert, die internetbasiert strukturierte Ziele der Nachhaltigkeit, zugehörige Indikatorensystemen sowie technische Anforderungen und Richtlinien zur Umsetzung zur Verfügung stellen und so den individuellen Planungsprozesses als ein nachvollziehbares System für alle Beteiligten dokumentieren. Das Instrument soll es ermöglichen innerhalb eines kooperativen Planungsprozesses die Beteiligten bei der Festlegung auf eine überschaubarer Anzahl von Zielen zu unterstützen. Als Ergebnis können die sich daraus ableitenden zu beachtenden Anforderungen, Leitlinien und technischen Voraussetzungen als auch die zugehörigen Indikatorensysteme dokumentiert und für den späteren Zugriff gespeichert werden.

Kooperative Planungsteams verfügen damit auf allen Stufen der Integration über Instrumente, die es ihnen ermöglichen schon in frühen Planungsphasen die Auswirkungen einzelner Zielfindung leicht verständlich und übersichtlich zu dokumentieren. Das System wird überdies durch die Möglichkeit komplettiert, durch eine professionelle Vorauswahl eine reduzierte Anzahl von „Globalzielen" zu formulieren, die nach Auswahl in definierte Prozesse überführt werden. Die Instrumente wurden im Rahmen des Forschungsprojektes an zwei Anwendungsprojekten der Siedlungsplanung in Trondheim (Norwegen) und Montreuil (Frankreich) angewendet. Die Ergebnisse daraus werden präsentiert.

4 VORBEREITUNG DER ZIEL – INHALTE

Eines der Hauptprobleme bestehender Ziel- und Anforderungensysteme zur Unterstützung nachhaltiger Gebäude und Siedlungskonzepte ist die Tatsache das es als Ergebnis neben der Vermischung von Ziel- und Indikatorensystem es sehr häufig zu einer zu hohen Anzahl formulierter Ziele kommt. Diese Systeme sind zumeist in sich widersprüchlich, sollen Handlunganweisung und Leitbild für eine idealisierte Nachhaltigkeitsanforderung sein und enden dann zumeist in sehr langen Anforderungskatalogen, von denen nur sehr wenige Argumente konsequent weiterverfolgt werden können. Darüberhinaus wird vielfach vergessen dass die Umsetzung der Nachhaltigkeitziele bis in den Lebenszyklus der Gebäude und Siedlungen hinein eine professionelle Begleitung bzw. Moderierung benötigt, die auf der Grundlage dieser Entscheidungsprozesse aufbaut. Sehr große inhomogene Entscheidungsträger führen außerdem zu sehr schwer steuerbaren Zielprofilen. Beispielhaft wird der hier verwendete Partizipationsansatz dargestellt:

6 [4]
7 [5]
8 [6]
9 http://www.rz.uni-karlsruhe.de/rz/specials/nukath
10 http://www.netzentwurf.de/

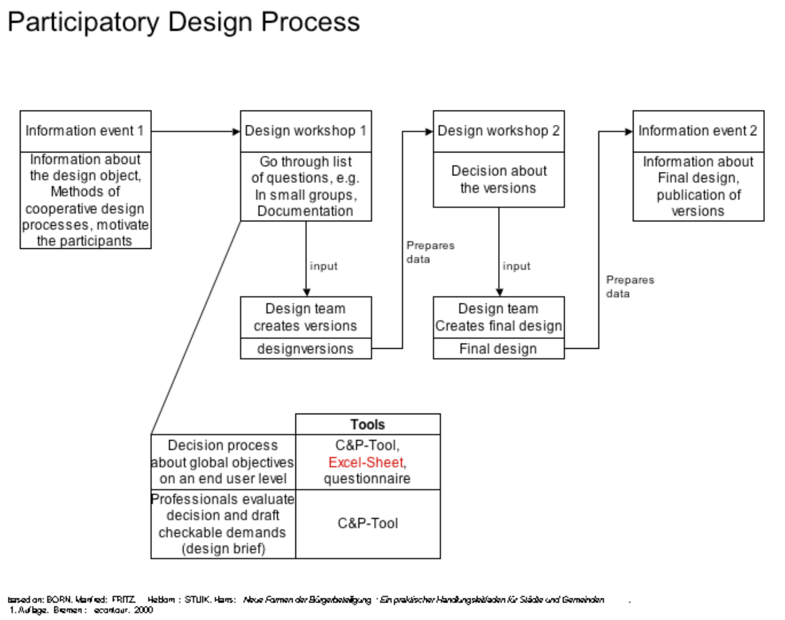


Abbildung 2: Ablaufschema für den verwendeten Partizipationsprozess, nach Born[11][12]

Die Vorbereitung von derartigen Abstimmungsprozessen stellt deshalb eine wichtige Voraussetzung für eine erfolgversprechende Umsetzung der vereinbarten Nachhaltigkeitsanforderungen dar.
Dazu wurden Instrumente entwickelt die neben den bestehenden Ansätzen kooperativer Planung und Dokumentenvorhaltung einen Prozess zur Festlegung von Zielen nachhaltiger Gebäude- und Siedlungsplanung auf der Basis von in einer Datenbank vorgehaltenen Informationen ermöglicht. Diese Instrumente (C&P tool) wurden in vorhandene Plattformen zu kooperativen Arbeiten integriert und können somit zeitlicher räumlich verteilt repräsentiert werden. Diese wurden im Rahmen europäischer Forschungsprojekte bei der Entwicklung von zwei Stadtteilen/ Siedlungen in ihrer Anwendung überprüft.
Alle Zielanfordererungen werden den vier Dimensionen nachhaltiger Entwicklung zugeordnet. Im Rahmen der vorliegenden Instrumente wurden die in der Struktur der viergliedrigen Nachhaltigkeitbäume verteilten Ziele (Objective) jeweils übergeordneten „Global Objectives“ zugeordnet. Außerdem werden den Zielanforderungen die jeweiligen Indikatoren zugeordnet. Künftige Bewohner entscheiden innerhalb dieses Systems ausschließlich über Zielanforderungen, nicht aber über die zugehörigen Inikatoren. Mithilfe dieser übergeordneten Struktur können auf der Basis von Fachwissen begleitende professionelle Entscheidungsvorlagen erstellt werden, die es ermöglichen Teilnehmer unterschiedlichen Wissensstandes in den Abstimmungsprozessen integrieren. „Global Objectives“ verfügen damit über folgende Vorteile:

Reduzierung Nachhaltigkeitziele auf eine überschaubares Maß
Überwindung von Verständnisschwierigkeiten durch Bündelung bei Zielen die ausschließlich über ausreichende Einblicke in die Systemzusammenhänge verständlich sind
Verringerung von Komplexität und Erhöhung der Verständlichkeit durch Formulierungen die die Ziele aus reichen beschreiben
wahlweise Veränderung für unterschiedliche Adressaten mit unterschiedlichen Interessen und Intensität
Vereinfachungen des Abstimmungsverhaltens
Spielraumerhaltung bei der Problemlösung für die Planer

---

[1] Tarja Häkkinen, Tarja, Huovila, Pekka, Bourdeau, Luc, and Sylviane Nibel. CRISP Network on Construction and City related Sustainability Indicators: Structuring of Indicators and status of work. Oslo.
[2] Giuseppe Munda. Indicators and Evaluation Tools for the Assessment of Urban Sustainability. Barcelona.
[3] Innes, J. E., and D. E. Booher. "Indicators for Sustainable Communities: A Strategy Building on Complexity Theory and Distributed Intelligence." Planning Theory and Practice 1.2 (2000): 173-186.
[4] Both, Petra von. Lebenszyklusbezogene Einbindung der Zielplanung und des Zielcontrolling in den Integralen Planungsprozess. Karlsruhe.
[5] Schink, Claus-Jürgen, Koch, Volker. Interdisciplinary Cooperation Modules in Mobile Networks. Karlsruhe.
[6] Elger, Dietrich and Russell, Peter. "Net-based Architectural Design: The Difficult Path from the Presentation of Architectural Design in the World Wide Web to Teamwork in Virtual Planning Offices: A Field Report." 19th eCAADe Conference Proceedings (2001): 371-375.
[7] Born, Manfred. Neue Formen der Bürgerbeteiligung: Ein praktischer Handlungsleitfaden fu¨r Sta¨dte und Gemeinden. Positionen / Econtur -< Internationale Agentur für Nachhaltige Projekte GmbH. Vol. 7, Bremen: Econtur - Internationale Agentur für nachhaltige Projekte, 94 S.

Abbildung 3: Kooperative Planungsplattform mit Integration der Ziele nachhaltiger Planung

5 ABSTIMMUNGSPROZESS

Als Grund-Datenstock liegen, nach unterschiedlichen Quellen strukturiert, eine große Anzahl von Zielen nachhaltiger Gebäude- und Siedlungsplanung sowie eine noch größere Anzahl für den Siedlungsbau relevanter Indikatoren in der MySQL gestützten Datenbank vor. Diese werden für logisch zwingende und individuell veränderbare Zusammenhänge und Abhängigkeiten in der Form verknüpft, dass sie für den konkreten Abstimmungsprozess auf der Ebene der Web-Applikation zur Verfügung stehen. Alle Web-Repräsentationen.werden durch die Skriptsprache php servergestützt individuell und dynamisch generiert.
Damit besteht die Möglichkeit den Zugang zur Datenbank dieser nachhaltigen Anforderungsprofile sowohl zeitlich und örtlich unabhängig über das Internet zu realisieren als auch für den realen Moderationsprozess vor Ort zu verwenden. Es besteht also die Möglichkeit über allgemeine Ziele internetbasiert zu informieren und Abstimmungen zu organisieren. Die Inhalte werden jeweils zu Beginn des jeweiligen Prozesses von fachlicher Seite konfiguriert und damit in der nötigen Tiefe und Komplexität repräsentiert. Dafür stehen Konfigurationswerkzeuge zur Verfügung.

Als Ausgabe und Ergebnis stehen zunächst vollständige Listen und damit ein Status über die vereinbarten Ziele zum jeweiligen Zeitpunkt zur Verfügung. Damit lässt sich auch in der Zukunft der Planungsprozesses in Bezug auf seine evolutionären Veränderungen wirkungsvoll zurückverfolgen. Alle Ziele der nachhaltigen Planungen werden dann übergeordneten „Global Objetives“ zusammengefasst und auf diese Weise die Anzahl der Aspekte nachhaltiger Planung über die kollektiv entschieden werden muss drastisch reduziert. Erst dies ermöglicht einen realistischen kooperativen und im positiven Sinne gelenkten Entscheidungsprozess. Zu allen Zielen die gewährt werden können, stehen weitergehende Informationen zur Verfügung (Schriftform und Internet-Links). Auch diese können an das jeweilige Vorhaben angepasst werden. Die Zusammenhänge und Abhängigkeiten können zu jedem Zeitpunkt aufgezeigt werden und einzelne Schritte sind wiederholbar. Die Ergebnisse werden in die Datenbank geschrieben und stehen zu jedem Zeitpunkt mit allen Metainformationen zur Verfügung. Im Anschluss werden die einzelnen Ziele nachhaltiger Planung gewichtet und mit einer Reihenfolge versehen und so eine zusätzliche Rückkopplung der Wahrnehmung der Teilnehmer gefordert.

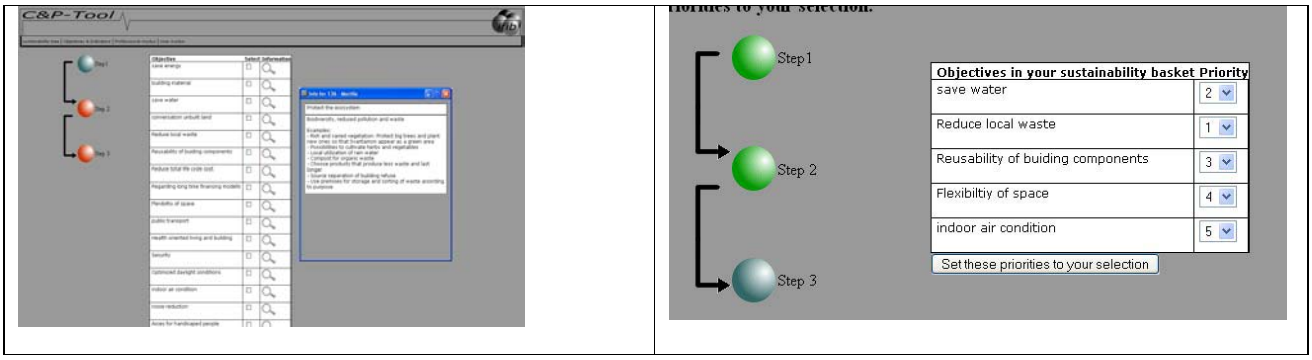


Abbildung 4: Abstimmungsinstrument, Erläuterungen, und Bewertung

6 ERGEBNISSE

Im Zusammenhang mit der Anwendung der Instrumente im Rahmen der Entwicklung von zwei Siedlungen in Trondheim (Norwegen) und Montreuil (Frankfreich) wurden die Instrumente in praktischen Anforderungen und Fragen künftiger Bewohner angepasst. Davon wird in diesem Zusammenhang berichtet. Die Zusammenfassung von Zielen in übergeordneten Zielen, sog. „GobalObjectives", zunächst als praktisches Datenverwaltungsinstrument gedacht, erwies sich in diesen Fällen als sehr effizientes Mittel um komplexe Sachverhalte zu vereinfachen und vor allen Dingen eine große Anzahl von unterschiedlichen Meinungen und Wissensständen zusammenführen zu können. Die großen Vorteile dieses Instruments erweisen sich vor allen Dingen in der eindeutigen Dokumentierbarkeit längerer Planungs- und Partizipationsprozesse sowie dem Anspruch nach und nach einem vollständigen Pool nachhaltiger Entscheidungskriterien und relevanter Zusammenhänge zu etablieren. Das Instrument kann durch diese Eigenschaften in allen Ebenen der Planung verwendet werden. Zunächst nur für den Rahmen der Siedlungsplanung entwickelt sind auch Anwendungen auf regionaler Ebene denkbar. Alle Ansätze auf Ebene der Gebäude münden außerdem in der Anbindung von Unterhaltskriterien für die erstellten Gebäude und Siedlungen als auch speziell auf den Planungsgegenstand nachhaltiger Entwicklung abgestimmten Richtlinien für die Lebenszyklus bezogene Ausführung der einmal festgelegten Ziele. Auch diese sind auf die raumbezogenen Planungsprozesse anpassbar.

Abbildung 5: Kooperative Planungsansätze bei der Entwicklung einer Siedlung in Trondheim, Norwegen

Wieviel Energie (ver)braucht eine innovative Gemeinde?
e5 – Programm für energieeffiziente Gemeinden

Josef MATHIS, Irene RUBITZKI

(Josef Mathis, Bürgermeister der Gemeinde Zwischenwasser, Hauptstraße 14, 6832 Zwischenwasser, bgm@zwischenwasser.at)
(Dipl.-Ing. Irene Rubitzki, Geschäftsstelle e5 Österreich, Österreichische Energieagentur - Austrian Energy Agency, Otto-Bauer-Gasse 6, 1060 Wien, irene.rubitzki@energyagency.at)

ZUSAMMENFASSUNG

Seit einigen Jahren steht das e5-Programm für herausragende Erfolge im Energiebereich auf kommunaler Ebene. Kaum eine andere Initiative kann auf Gemeindeebene einen ähnlich erfolgreichen wie umfassenden und konsequenten Ansatz vorweisen. Mit e5 erhalten die am Programm teilnehmenden Gemeinden Hilfsmittel und Unterstützung um ihre Energie- und Klimaschutzziele festzulegen und zu erreichen. Der folgende Beitrag beschreibt das e5 Programm und stellt anhand der Gemeinde Zwischenwasser das Programm im Detail vor. Zwischenwasser nimmt seit dem Programmstart, 1998, an e5 teil und kann größte Erfolge vorweisen. Im Herbst 2004 wurde die Kommune mit „eeeee“, der höchsten Auszeichnungsstufe für energieeffiziente Gemeinden, ausgezeichnet.

1.0. EINLEITUNG

1.1 Klimawandel auf internationaler und nationaler Ebene

Weltweite Beobachtungen von Klimaforschern haben gezeigt, dass die menschlichen Eingriffe in die Natur Klimaveränderungen verursachen. Durch den vermehrten Ausstoß von so genannten Treibhausgasen, insbesondere von CO2, hat sich das Temperaturmittel der Erde in den vergangenen 150 Jahren um 0,6 bis 0,8 Grad Celsius erhöht. Experten warnen, dass die Erdtemperatur durch diese globale Erwärmung bis zum Jahr 2100 um 1,4 bis 5,8 Grad steigen könnte, was unter anderem das teilweise Abschmelzen der Gletscher und der Polkappen und damit einen Anstieg des Meeresspiegels um acht bis 88 Zentimeter zur Folge hätte. Mit dem von der internationalen Staatengemeinde initiierten Klimaschutzprogramm soll der Ausstoß der Treibhausgase reduziert und die Klimaveränderung gebremst werden.

Um den vom Menschen verursachten Ausstoß von Treibhausgasen in der Atmosphäre zu stabilisieren wurde beim Umweltgipfel der Vereinten Nationen in Rio de Janeiro im Juni 1992 das UNFCCC Rahmenübereinkommen über Klimaveränderung (United Nations Framework Convention on Climate Changes) beschlossen. Als wichtigstes kurzfristiges Ziel wurde dabei festgelegt, den Ausstoß der Treibhausgase bis zum Jahr 2000 auf dem Niveau von 1990 zu halten oder wieder darauf zu reduzieren. Seit 1995 finden jährlich internationale Klimaschutzkonferenzen statt. 1997 kam es bei der dritten internationalen Klimakonferenz in der japanischen Stadt Kyoto zu einem Durchbruch in der weltweiten Klimapolitik. Das bei der Konferenz verabschiedete Kyoto-Protokoll ist eine völkerrechtlich verbindliche Vereinbarung, in der sich die unterzeichnenden Staaten zu konkreten Reduktionen ihrer Treibhausgasemissionen von 2008 bis 2012 verpflichten. Insgesamt soll eine Reduzierung um durchschnittlich 5,2 Prozent gegenüber dem Niveau von 1990 erreicht werden.

2002 hat der Bund gemeinsam mit den Ländern eine nationale Klimastrategie für Österreich ausgearbeitet. Ihre Umsetzung soll garantieren, dass Österreich seine Treibhausgasemissionen in dem im Kyoto-Klimaschutzprotokoll vereinbarten Umfang reduzieren wird. Österreich muss in den kommenden Jahren seinen Ausstoß an Treibhausgasen um 13 Prozent unter den Wert von 1990 senken. Die Klimastrategie ist ein Paket von emissionsverringernden Maßnahmen für die Sektoren Energieerzeugung, Verkehr, Raumwärme, Industrie, Land-, Forst- und Abfallwirtschaft. Ein wesentlicher Beitrag ist die Nutzung und Förderung neuer Technologien, die den Ausstoß von Treibhausgasen reduzieren. Trotz aller Anstrengungen konnte Österreich dem Kyoto-Ziel bisher nicht näher kommen. 2003 lagen die Emissionen 13 Millionen Tonnen über dem Basisjahr 1990 und um 23,2 Millionen Tonnen über dem Kyoto Ziel. Das bedeutet einen Anstieg der Treibhausgasemissionen von 16,6 Prozent seit 1990.

Die Klimaschutzinitiative **klima**:aktiv, eine Initiative des Lebensministeriums, unterstützt und ergänzt die in der österreichischen Klimastrategie vorgesehenen Maßnahmen. 23 zielgruppen- und themenspezifische Programme werden derzeit von der österreichischen Energieagentur koordiniert, wobei e5 Österreich eines dieser Programme ist [1].

2.2 Was ist e5? Woher kommt die Idee?

e5 ist ein Qualifizierungs- und Auszeichnungsprogramm für besonders innovative und engagierte Gemeinden, die durch einen kontinuierlichen Bürgerbeteiligungs-Prozess den Energiehaushalt der Gemeinde positiv beeinflussen wollen. Diese Idee stammt ursprünglich aus der Schweiz (www.energiestadt.ch) [3] und wurde 1998 von den Bundesländern Vorarlberg, Tirol und Salzburg übernommen und geringfügig adaptiert. Gemeinden in diesen drei Bundesländern können seither an diesem Landesprogramm teilnehmen. Aufgrund des großen Erfolges wurde im Rahmen von **klima**:aktiv eine österreichweite Koordinationsstelle geschaffen, deren Aufgabe es einerseits ist die Idee von e5 in weitere Bundesländer zu tragen und Gemeinden zu motivieren an diesem Programm teil zu nehmen sowie andererseits Österreich auf der europäische Ebene zu vertreten.

2.0. DIE KERNELEMENTE VON e5

2.1 Energiesparen in der Gemeinde: von Einzelprojekten hin zu einer strukturierten und kontinuierlichen Arbeit in der Gemeinde

Ziel von e5 ist, alle Bereiche der Gemeindeverwaltung nach Energiesparpotentialen zu durchleuchten und schrittweise die Einsparungspotentiale der Ist-Analyse zu realisieren und diese Erfolge zu dokumentieren und zu evaluieren. Das heißt, nicht das Einzelprojekt steht im Vordergrund, sondern das jährlich neu adaptierte Arbeitsprogramm, das eine Vielzahl von unterschiedlichen Maßnahmen und Projekte enthält.

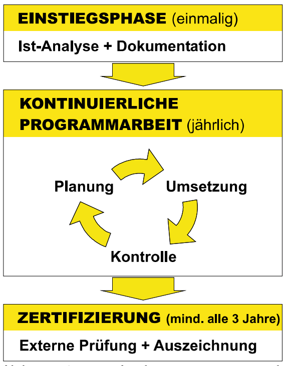


Abbildung 1: Typischer Programmablauf

Während der Einstiegsphase unterzeichnet die Gemeinde eine Basisvereinbarung mit dem e5-Programmträger, in der sie sich zu den Grundsätzen und "Spielregeln" des Programms bekennt. Im Gegenzug erhält die Gemeinde fachliche und organisatorische Unterstützung vom e5-Programmträger, einen professionellen Energieberater, der von Landesebene unterstützt wird. Das Energieteam der Gemeinde (bestehend aus VertreterInnen von Verwaltung, Politik, Initiativen sowie engagierten BürgerInnen und EnergieexpertInnen) zeichnet für die Prozesssteuerung und Programmumsetzung verantwortlich. In einem ersten Prozessschritt erfolgt eine Ist-Analyse mit Hilfe der vom e5-Programm zur Verfügung gestellten Werkzeuge. Damit erhält die Gemeinde einen ersten Überblick über den Status der Energieeffizienz in ihrem Handlungsbereich und gleichzeitig ein Stärken-Schwäche-Profil, das bei der Erstellung eines energiepolitischen Arbeitsprogramms hilft.

Nach Abschluss der Einstiegsphase folgt die kontinuierliche Programmarbeit, der Schwerpunkt der energiepolitischen Arbeit. Das e5-Team sorgt dafür, dass konkrete Projekte geplant, vom politisch zuständigen Gremium beschlossen und schließlich umgesetzt werden. Zudem wird im Jahresrhythmus Bilanz über die Programmarbeit gezogen. Im Zuge dessen wird auch das energiepolitische Arbeitsprogramm überprüft und gegebenenfalls um neue Projekte erweitert.

Mindestens alle drei Jahre unterziehen sich die e5-Gemeinden einer Bewertung durch eine unabhängige Kommission. So wie Restaurants mit Hauben ausgezeichnet werden, bekommen erfolgreiche e5-Gemeinden dabei - je nach Umsetzungsgrad der möglichen Energieeffizienzmaßnahmen - ein bis fünf "e" verliehen. Ab einem Umsetzungsgrad von 50 Prozent ("eee") haben sich die Gemeinden zusätzlich für die europäische Auszeichnung European Energy Award® qualifiziert und können sich mit anderen europäischen Städten und Gemeinden messen. Erreicht eine Gemeinde "eeeee" (mehr 75 Prozent Umsetzungsgrad), kann sie sich um den European Energy Award® in Gold bewerben und rückt damit in die Liga der europäischen Energiechampions auf.

4. EUROPÄISCHE EBENE: FORUM EUROPEAN ENGERY AWARD®

Im Jahr 2002 einigten sich VertreterInnen der Programme e5 (Österreich) und Energiestadt (Schweiz) sowie Projektpartner aus Deutschland und Polen auf ein harmonisiertes Programm "European Energy Award®", das über weite Strecken auf seinen Vorgängerprogrammen Energiestadt und e5 basiert.
In Österreich und der Schweiz arbeitet man bereits seit 2003 mit dem neuen europaweit einheitlichen System European Energy Award, man hat sich aber dazu entschlossen, die bereits gut etablierten Marken e5 bzw. Energiestadt beizubehalten. In Deutschland sind derzeit etwa 45 Städte Mitglied beim European Energy Award. Darüber hinaus implementieren derzeit Pilotgemeinden aus sechs weiteren europäischen Regionen das Programm im Rahmen eines EU Projektes (Baskenland, Frankreich, Irland, Ligurien, Litauen, Slowakei).
Ein internationaler Dachverband (Forum European Energy Award) zeichnet für die Einheitlichkeit des Programms in allen Mitgliedsregionen verantwortlich. Durch die adaptive Gestaltung des European Energy Awards werden bei der jeweiligen Bewertung der Gemeinden Faktoren wie die nationale Gesetzeslage, unterschiedliche Kompetenzen, die Gemeindegröße etc. ausgleichend berücksichtigt.

5. DIE AUSZEICHNUNG„EUROPEAN ENERGY AWARD®“

Ebenso wie im e5-Programm werden Gemeinden – je nach Umsetzungsgrad der möglichen Energieeffizienzmaßnahmen – ausgezeichnet. Das europäische System ist im Gegensatz zu e5 zweistufig:
Den European Energy Award® erhalten Gemeinden, wenn sie mindestens die Hälfte der möglichen Maßnahmen umgesetzt haben. Das entspricht der e5-Auszeichnung „eee“.
Um den European Energy Award® Gold zu erreichen, müssen in einer Gemeinde – ebenso wie für die Ereichung von „eeeee“ – mindestens 75 Prozent der möglichen energierelevanten Maßnahmen umgesetzt sein, die in einem Maßnahmenkatalog aufgelistet sind. 2004 wurden die European Energy Awards erstmals in Österreich verliehen: der European Energy Award® Gold ging an die Gemeinde Langenegg (Vorarlberg) und European Energy Awards® wurde an etwa 15 Gemeinden aus Vorarlberg, Tirol und Salzburg vergeben. Die Gemeinden Mäder und Zwischenwasser konnten beim e5-Audit im Herbst 2005 „eeeee“ erreichen und werden bei der kommenden EEA-Veranstaltung mit dem European Energy Award® Gold ausgezeichnet, weitere 7 Gemeinden werden mit dem European Energy Awards® für Ihre intensives Engagement belohnt.

6. DIE WESENTLICHEN PROGRAMMELEMENTE VON E5

In Österreich gibt es derzeit über 50 e5-Gemeinden in den Bundesländern Vorarlberg, Tirol und Salzburg, die seit 1998 dieses Programm durchführen sowie in Kärnten, das 2004 dem Programm beigetreten ist. Besonders erfreulich ist, dass die Steiermark seit Herbst 2005 ebenfalls Mitglied bei e5 wurde. Nachdem die Länder die Kommunen finanziell unterstützen, kommt den Ländern eine besondere Bedeutung zu. Die Abwicklung in den einzelnen Bundesländern erfolgt mittels Landesträger, das sind professionelle Energieberater, die den e5-Teams in den Gemeinden für Fragen und mit Unterstützung zu Verfügung stehen. Die Handlungsfelder von e5 umfassen die Bereiche Raumplanung, Verkehrsplanung, kommunale Gebäude und Anlagen, Ver- und Entsorgung, interne Organisation der Gemeinde, Kommunikation und Kooperation. Im so genannten Maßnahmenkatalog ist eine Vielzahl von möglichen Maßnahmen in den jeweiligen Handlungsfeldern aufgelistet. Das e5-Team kann somit aus einer Vielzahl von Maßnahmen frei wählen, welche für sie die effizientste Maßnahmen sind, die als nächstes umgesetzt werden.

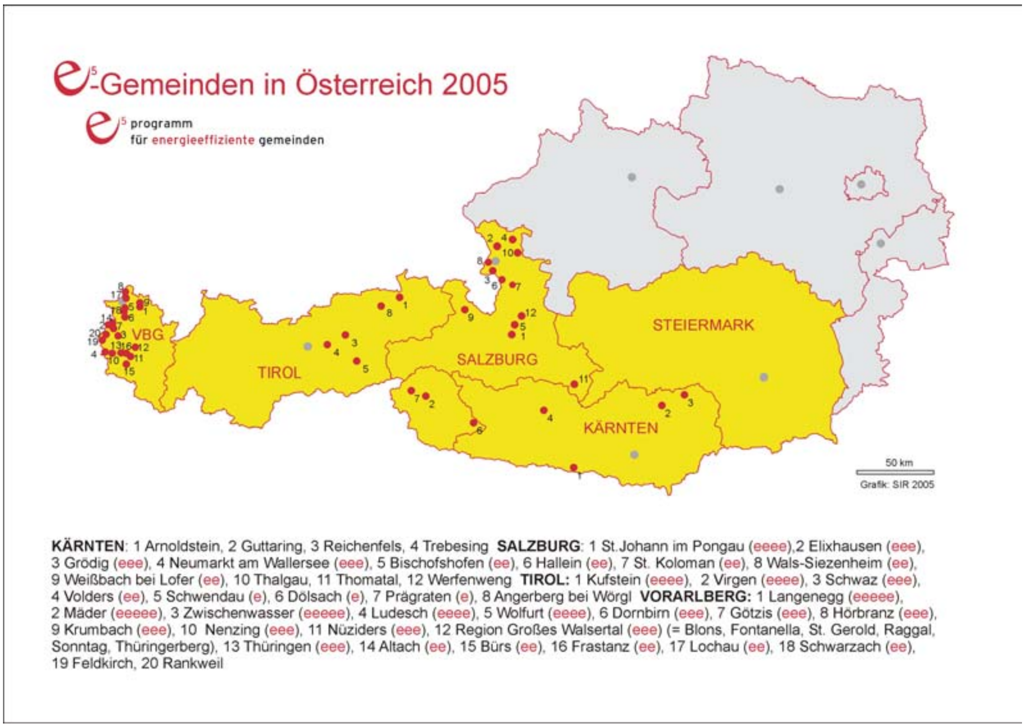


Abbildung 2: e5 Gemeinden und Bundesländer in denen e5 angeboten wird

Angelehnt an Qualitätsmanagementsysteme der Wirtschaft, ist das e5-Programm als ein Prozess zu verstehen, in dem Schritt für Schritt:

Schwachstellen aufgedeckt und Verbesserungspotentiale identifiziert werden,

eine kontinuierlicher Verbesserungsprozess in Gang gesetzt wird,

Strukturen und Abläufe zur erfolgreichen Umsetzung von Energieprojekten aufbaut oder verstärkt werden,

die Mitwirkung der Bevölkerung an energiepolitischen Entscheidungen und Aktivitäten ermöglicht wird.

Wesentliche Programmelemente von e5 sind dabei:

die Berücksichtigung aller energierelevanten Handlungsfelder von Gemeinden (kommunale Gebäude und Anlagen, Ver- und Entsorgung, Mobilität, Entwicklungsplanung, interne Organisation, Kommunikation, Kooperation);

die schrittweise Verbesserung der Energieperformance durch klar identifizierbare Teilziele;

der Aufbau von Strukturen und die Vernetzung von Akteuren innerhalb der Gemeinde (Politik, Verwaltung, BürgerInnen, Betriebe, Initiativen etc.) sowie der Erfahrungsaustausch zwischen den Gemeinden;

die Qualifizierung und Unterstützung kommunaler Akteure bei Planung und Umsetzung von Maßnahmen durch das e5-Beraternetzwerk;

regelmäßige interne und externe Erfolgskontrolle sowie die Auszeichnung der Gemeinden entsprechend ihrem Erfolg.

7. NUTZEN UND CHANCEN FÜR GEMEINDEN

Eine Mitgliedschaft im e5-Programm bietet für die Gemeinde und deren BürgerInnen vielfältigen Nutzen:

Kontinuierliche Steigerung der Energieeffizienz und eine damit verbundene Kosteneinsparung

Umsetzung einer zukunftsverträglichen Energiepolitik und damit ein Beitrag zur Erfüllung internationaler Verpflichtungen zum Klimaschutz

Befähigung engagierter BürgerInnen zur Eigeninitiative und Eigenverantwortung durch aktive Bürgerbeteiligung

Qualifizierung von GemeindemitarbeiterInnen und Unterstützung durch das e5-Beraternetzwerk bei der Planung und Umsetzung von Maßnahmen

Optimierung gemeindeinterner Strukturen und Prozesse in energierelevanten Bereichen (Planung – Umsetzung – Evaluierung)

Vergleichsmöglichkeit mit anderen engagierten Gemeinden (Benchmarking)

Zugriff auf das Know-how von Energie-Mustergemeinden (regional, national und europaweit)

Klima- und Umweltschutz bedeutet erhöhte Lebensqualität für BürgerInnen

Imagegewinn durch eine verantwortungsbewusste Energie- und Klimaschutzpolitik

Die Gemeinde hat gegenüber dem Programmträger auch einige verbindliche Zusagen zu tätigen, um die Chancen nutzen zu können:
Zusage, sich in der Gemeinde und darüber hinaus aktiv für die Verwirklichung der Ziele des e5-Programms einzusetzen
Bereitstellung von personellen und budgetären Mittel für die Arbeit des e5-Teams
Formulierung und Umsetzung eines energiepolitischen Arbeitsprogramms
Bezahlung eines jährlichen Programmbeitrags zur Sicherstellung der fachlichen und organisatorischen Betreuung (abhängig vom jeweiligen Bundesland und der Gemeindegröße)
Teilnahme an e5-Veranstaltungen und Weiterbildungen
Weitergabe von Erfahrungen und Know-how an interessierte e5-Partnergemeinden
Durchführung des jährlichen internen Audits
Regelmäßige Teilnahme an einem externen Audit (Evaluierung mindestens alle 3 Jahre)

8. DIE VORALBERGER GEMEINDE ZWISCHENWASSER ERKLIMMT DEN E5-OLYMP

Zwischenwasser, liegt an einem sonnigen südwestlich gelegenen Rheintalhang auf einer Seehöhe von 500 bis 2000 m, mitten im „Garten Vorarlbergs". Die Ortschaften Batschuns, Dafins und Muntlix zusammen bilden die Gemeinde Zwischenwasser, die 3056 EW zählt. Die Besonderheit: Keine der 3 Ortschaften trägt den Gemeindenamen. Dieser leitet sich aus den natürlichen Grenzen zwischen den „Wassern der Frutz und Frödisch" ab. Die Seehöhe der einzelnen Ortschaften ist sehr unterschiedlich und erschwert die Erreichbarkeit.
Im Herbst 2005 konnte Zwischenwasser mit „eeeee", der höchsten Ehrung im e5 Programm, ausgezeichnet werden. Das Engagement des gesamten e5-Teams, das seit 1998 intensiv an Verbesserungsmaßnahmen in allen 6 Energiebereichen umfassend aktiv ist, wurde somit belohnt.

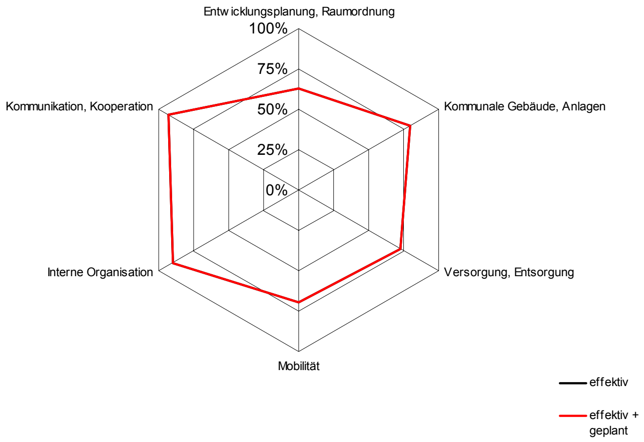


Abbildung 3: Energiepolitisches Profil der Gemeinde Zwischenwasser

Einerseits liegt die Idee von e5 auf der Hand: das vorbildliches Verhalten von einzelnen Kommunen soll andere Gemeinden dazu anregen ebenfalls energieeffiziente Projekte abzuwickeln und verstärkt auf erneuerbare Energieträger zu setzen. Gleichzeitig hat die Gemeinde aber auch eine Vorbildfunktion gegenüber ihren BürgerInnen wahr zu nehmen, damit diese ebenso zu einem energiesparenden Verhalten angeregt werden. Beim „Tag der offenen Kellertüre" zeigen Nachbarn ihre neuesten Heizkessel und Heizformen her und informieren über ihre individuellen Erfahrungen mit dem neuen Heizgerät. Eine Information vom Nachbarn bzw. Kunden zum künftigen Kunden ist glaubwürdig und eine wesentliche Entscheidungshilfe, wenn auf eine neue Heizform umgestellt wird. Wenn mehrere Kommunen an einem Themenbereich arbeiten, ist das effizient und für die Weiterentwicklung von Ideen hilfreich.

Alle Projekte der Gemeinde Zwischenwasser aufzuzählen würde hier den Rahmen bei weitem sprengen, darum werden einige Projekte erwähnt, wobei in dieser Aufzählung der Schwerpunkt auch auf die Bereiche Raumplanung und Verkehr gelegt wird:

1984: Korrektur des Flächenwidmungsplanes: 6 ha Bauerwartungsland wurde in Freifläche Landwirtschaft rückgewidmet. Eigentümer-Beschwerden wurden vom Verfassungsgericht abgewiesen
1988 zweite Korrektur des FWP: zirka 18 ha Bauerwartungsland wurden rückgewidmet
1991: Rückwidmung von 8,4 ha Bauland (58 Grundeigentümer) in Freiflächen Landwirtschaft mit großen Anstrengungen und Verhandlungen bis zum obersten Gerichtshof
1992: Installation eines Fachbeirates für Architektur und Gemeindeentwicklung (in einer Gemeinde mit rund 3.000 EW!), wobei energetische Kriterien wesentlicher Bestandteil der Beurteilung sind
1993: Errichtung eines 60 ha großen Naturschutzgebietes
1995: Beitritt zum „Klimabündnis"
1997: Beitritt „ARGE ALP"
2001: Beschluss einer „Lokalen Agenda 21" mit ambitionierten Zielen als erste Gemeinde Österreichs.
2001: Im Rahmen des ARGE ALP Projektes „Energiebewusste Gemeinde 2000" wurde eine Energiebilanz der privaten Haushalte der ganzen Gemeinde erstellt und 2002 aktualisiert.
Umsetzung der Grundsätze und Zielvorgaben der LA21 bei den durchgeführten Bauprojekten der Gemeinde: Schule Muntlix, Sennerei Dafins, Musik-Probelokal, Friedhofserweiterung)

2003: Gründung der Projektgruppe „Verkehr“ zur Planung und Umsetzung von Maßnahmen zur Verkehrsberuhigung.
2004: Umsetzung von „Tempo 30“ auf dem gesamten Gemeindegebiet, ausgenommen Hauptdurchzugsstraßen.
2005: Digitale Karte für erneuerbare Energie auf der Homepage der Gemeinde

Im Bereich Mobilität wurden folgende Maßnahmen gesetzt:
In den letzten Jahren wurden die Ortszentren der Ortsteile Dafins, Oberbatschuns und Suldis neu gestaltet. Dabei wurden verkehrsberuhigende Maßnahmen umgesetzt und Gehsteige verlängert.
2003: Gründung der Projektgruppe „Verkehr“. Daraus entstand das Projekt „LUS“ (=Langsam, umweltfreundlich, sicher). Mit Unterstützung des Kuratoriums für Verkehrssicherheit wurde dann im Herbst 2004 „Tempo 30“ mit einer Reihe von Begleitmaßnahmen eingeführt. Mit einem Fahrsicherheitstraining für die Bevölkerung und geförderten Intensivtrainingskursen wurde bei der Bevölkerung und bei Mitgliedern der freiwilligen Feuerwehr das Bewusstsein für Geschwindigkeit geschaffen.
Aufgrund der Berglage der Gemeinde mit verschiedenen Ortsteilen ist die Begünstigung von Fußgängern und Radfahrern nur eingeschränkt möglich beziehungsweise zielführend. Unter anderem wurde aber die Fahrradmitnahme im ÖPNV durchgesetzt, einladende Fahrradabstellplätze errichtet sowie Fuß- und Radwegverbindungen neu geschaffen.
ÖPNV Angebotsverbesserung: Einführung des Sammeltaxis „YOYO“ und des Gratis-Schibus nach Laterns . Derzeit laufen Bemühungen zur Parkraumbewirtschaftung bei der „Alpe Furx“ mit gleichzeitiger Erschließung durch den ÖPNV sowie die Installation einer Mitfahrzentrale. Auch stellt die Gemeinde den Stellplatz für ein Car-Sharing Auto zur Verfügung und schreibt den Mitarbeitern die Benutzung vor.
Neben dem obligatorischen Aktionstag „autofrei“, der in Kooperation mit den Vorderland-Gemeinden durchgeführt wird, erfolgt eine regelmäßige Bewerbung alternativer Mobilität in den Gemeindenachrichten, in eigenen Aussendungen und in Tourismusprospekten.

Abbildung 4: Gemeinde Zwischenwasser bei der Überreichung der „eeeee“ Auszeichnung

9. AUSBLICK UND ZIELE IN NAHER ZUKUNFT

Die herausragenden Erfolge der über 50 Gemeinden, die sich an dem Programm derzeit schon beteiligen, insbesondere die Gemeinde Zwischenwasser mit ihren Herausragenden Projekten, sind die beste Referenz zur Motivation weiterer Kommunen in Österreich an e5 teil zu nehmen.
Darüber hinaus sollen weitere Bundesländer gefunden werden, die ebenfalls an diesem Programm partizipieren. Auf europäischer Ebene gilt es die guten Beziehungen mit den Partnern zu festigen und weitere Entscheidungsträger in Europa von der Relevanz des Projektes zu überzeugen.

10. QUELLEN

[1] www.klimaaktiv.at
[2] www.e5-gemeinden.at
[3] www.energiestadt.ch

Forschungsschwerpunkte Nachhaltig Wirtschaften - Ziele und strategische Ausrichtung 2006

Theresia VOGEL-LAHNER

DI Theresia VOGEL-LAHNER, FFG Österreichische Forschungsförderungsges. MbH, theresia.vogel@ffg.at

1. DAS IMPULSPROGRAMM NACHHALTIG WIRTSCHAFTEN

Nachhaltigkeit als gesellschaftliches und unternehmerisches Leitprinzip ist nicht erst mit der UN Dekade zur Bildung für Nachhaltigkeit[1] ein Thema, sondern wurde in Österreich bereits vor rund 10 Jahren als wichtiger Themenschwerpunkt erkannt und erste Aktivitäten gesetzt. Auf Anregung des Rats für Forschung und Technologieentwicklung wurde von den befassten Ministerien letztlich die FORNE-Initiative[2] gegründet und eine programmübergreifende Strategie für Österreich entwickelt.
Nachhaltig Wirtschaften, das Impulsprogramm des Bundesministeriums für Verkehr, Innovation und Technologie hat eine zentrale Rolle in dieser Strategie und verfolgt das Anliegen die Wettbewerbsfähigkeit des Wissenschaftsstandortes Österreich zu erhöhen und gleichzeitig die Lebens- und Umweltbedingungen zu verbessern.
Es werden richtungsweisende Forschungs- und Entwicklungsarbeiten sowie die Umsetzung von Demonstrationsvorhaben unterstützt. Die Erforschung und Entwicklung zukunfts- und marktfähiger Technologien steht dabei im Mittelpunkt, ergänzt durch Begleit- und Diffusionsmaßnahmen.
Nachhaltig Wirtschaften in der bestehenden Form ist über zehn Jahre, insgesamt bis ins Jahr 2009 konzipiert. Das Programm begann 1999 mit der Linie ***Haus der Zukunft***, 2000 erfolgte die Ergänzung um die Linie ***Fabrik der Zukunft*** und 2003 wurde in der Linie ***Energiesysteme der Zukunft*** die erste Ausschreibung initiiert.
Seither sind rd. 1.100 Anträge behandelt worden, davon etwas weniger als die Hälfte wurden gefördert, durchschnittlich steht ein jährliches Budget von etwa 15 Millionen Euro zur Verfügung.

a. Haus der Zukunft

Mit der Programmlinie ***Haus der Zukunft*** wird auf bestehenden Erkenntnissen im Bereich des solaren und energieeffizienten Bauens aufgebaut und zu deren Entwicklung beigetragen. An Demonstrationsgebäuden und mit innovativen Produkten soll höchsten Ansprüchen bezüglich Energieeffizienz, des Einsatzes von nachwachsenden Rohstoffen und erneuerbaren Energieträgern und den Prinzipien des ökologischen Bauens genügt werden.
In bisher 5 Ausschreibungen wurden zahlreiche Demonstrationsobjekte gefördert und bereits einige eröffnet, zusätzlich konnten auch Bauprodukte wie Fensterkonstruktionen, Wandaufbauten und Dämmstoffe aus nachwachsenden Materialien entwickelt werden. Neben dem Innovationsgehalt sind auch konkurrenzfähige Kosten und eine hohe Qualität wesentliches Anforderungskriterium an die entstehenden Innovationen.

Obwohl der Bauwerksbestand in Österreich jährlich um bis zu 3 % wächst [3] ist neben dem Neubau auch die Sanierung bestehender Bausubstanz ein Förderungsschwerpunkt, berücksichtigend die reale Situation des vorhandenen Bauwerkslagers.
Haus der Zukunft hat sich in der aktuellen Ausschreibung auch verstärkte dem Thema Begleitforschung und Dissipation von Forschungsergebnissen verschrieben. Dies kommt den strukturellen Rahmenbedingungen der österreichischen Bauwirtschaft mit zahlreichen kleinen und mittleren unternehmen entgegen und trägt zur Erhöhung von deren Marktchancen bei.

b. Fabrik der Zukunft

Die Entwicklung beispielhafter Technologien, Produkte und Dienstleistungen in Unternehmen ist primäres Ziel der Programmlinie ***Fabrik der Zukunft***. Die Kriterien für die Förderwürdigkeit gehen deutlich über den Ansatz des Umweltschutzes hinaus und zielen auf die Berücksichtigung aller Dimensionen der Nachhaltigkeit ab. Innovationen in ***Fabrik der Zukunft*** haben vielfach „immateriellen" Charakter, berücksichtigen verstärkt Aspekte des Wissenstransfers und der Entmaterialisierung. Zukunftsweisende Ansätze zeigen Optionen für den Einsatz nachwachsender Materialien in zahlreichen Produktionsbereichen auf, optimieren Technologien sowie Prozesse und ermöglichen den Ersatz von Produkten durch Dienstleistungen.
Die Betrachtung der Produktion als Teil eines Wertschöpfungssystems, eingebettet in die regionalen Rahmenbedingungen, eröffnet neue Möglichkeiten einer komplexen Betrachtung des Themas Nachhaltigkeit. In der aktuellen 4. Ausschreibung wird daher insbesondere die Bedeutung des Marktes, d.h. der KonsumentInnen als ein Schwerpunkt gesetzt.
Fabrik der Zukunft ist dabei wenn internationale Trends generiert werden und erhöht dadurch die Innovationsfähigkeit österreichischer Betriebe indem innovative Technologien mit hohem Marktpotenzial realisiert werden.

c. Energiesysteme der Zukunft

Den Einsatz erneuerbarer Energieträger voranzutreiben und die Entwicklung von energieeffizienten und flexiblen Energiesystemen die langfristig in der Lage sind unseren Energiebedarf zu decken – das sind die Ziele der Programmlinie ***Energiesysteme der***

[1] Die Vereinten Nationen haben die Jahre **2005 bis 2014** zur **Weltdekade** Bildung für nachhaltige Entwicklung erklärt.

[2] FORNE – **For**schung für **N**achhaltige **E**ntwicklung

[3] Vogel-Lahner, T., Stark,W.: Management von Baurestmassen. Ressourcen- und abfallwirtschaftliche Erkenntnisse aus der Studie ABASG 2 – Bauwerk Österreich. In: Österreichische Wasser- und Abfallwirtschaft. Heft 11-12. Springer Verlag. 2004.

Zukunft. In einem umfassenden Ansatz wird das gezielte Zusammenwirken von Technologien, Akteuren und Maßnahmen berücksichtigt und gefördert.
Im Bereich Biogastechnologie konnte Österreichs Spitzenposition ausgebaut werden. Die entwickelten Technologien zur Biogasaufbereitung setzen internationale Maßstäbe und treten vermehrt in transnationalen und europäischen Projekten in den Vordergrund.
Aufgrund der jüngsten Entwicklung der Erdgaspreise hat das Thema Biogas höchste Aktualität erhalten und die Beantwortung der Fragen zur Netzeinspeisung werden zunehmend dringlicher. Neben den rechtlichen und technologischen Herausforderungen die es zu bewältigen gilt, stellen sich für die österreichische Landwirtschaft neue Potentiale der Wertschöpfung dar.
Im Rahmen der laufenden 2.Ausschreibung werden derzeit Modellsysteme und Modellregionen intensiv untersucht, die als Keimzellen für zukunftsweisende Konzepte gesehen werden. Dabei werden sowohl reale als auch „virtuelle" Systeme (siehe auch Pkt. 2.1) zwecks Erkenntnisgewinn betrachtet.
Mit seinen Aktivitäten setzt ***EdZ*** nicht zuletzt wesentliche Vorarbeiten für die Entwicklung eines neuen nationalen, strategisch und langfristig ausgerichteten Energieprogramms - derzeit unter dem Arbeitstitel ***e2050*** beim BMVIT in Entwicklung[4]. Dringlich ist ein derartiges Programm nicht allein deswegen, da sich die zwischen 19973- 1995 erfolgreiche Entkoppelung von Wirtschaftswachstum und Energieverbrauch seit rund 10 Jahren wieder „relinkt" hat, eine Entwicklungscharakteristik die in Europa ansonsten unüblich ist.[5]

d. Erfolgsfaktoren des Programms

Das Programm ***Nachhaltig Wirtschaften*** ist mehrjährig konzipiert, mittelfristig und stark operativ ausgerichtet. Es setzt die intensive Zusammenarbeit von Wissenschaft und Wirtschaft - bedingt durch die einzureichenden Förderformate - voraus. Die geplante Programmdauer bis 2009 ermöglicht eine Kontinuität in der konsequenten Themenentwicklung für die teilnehmenden Betriebe und Institutionen.
Mit der angestrebten Abfolge von Grundlagenstudie über kooperations-unterstützende Konzepte hin zu wirtschaftsbezogenen Grundlagenforschungen sowie Technologie- und Komponentenentwicklungen wird die Basis für richtungsweisende Demonstrationsprojekte erarbeitet. Damit einher geht eine zunehmende thematische Verdichtung und stetige qualitative Verbesserung der einzelnen Projekte.
Eine risikogerechte Förderung bzw. der optimale „Fördermix" garantieren die bestmögliche Unterstützung der einreichenden Betriebe und Institutionen.
Zu den ausgeschriebenen Fragestellungen werden im Rahmen von internationalen Jurierungen und unter wettbewerblichen Rahmenbedingungen die am besten geeigneten Projekte ausgewählt und weiterverfolgt. Positive „Nebeneffekte" sind die damit einher gehende internationale Bekanntheit und die internationale Positionierung des Programms sowie der damit initiierte Austausch mit anderen Programmträgern.
Ergänzend zu den einzelnen Projekten werden die Ergebnisse aus den Programmlinien themenspezifisch aufbereitet und zielgruppengerecht verbreitet. Dies garantiert eine weitest mögliche Verbreitung der Projektergebnisse und der gewonnenen Erkenntnisse.

2. REGIONEN IM FOKUS

Die Region als funktional zusammenhängendes Gebiet, unter Vernachlässigung politischer Grenzen bildet die begriffliche Grundlage der folgenden Darstellungen. Die Region kann dabei unterschiedliche geografische Größenordnungen annehmen, wie z.B. die Versorgungsregion oder der politische Bezirk oder das Bundesland usw.

e. *EdZ*: Die virtuelle Welt der Energie – Energieregionen als Modelle

4 Virtuelle Kraft- und Netzwerke

Zahlreiche Fragestellungen der Energiegeneration können bereits mit Modellen beantwortete werden. International beschäftigen sich derzeit noch einige wenige Forscherteams intensiv mit virtuellen Kraft- und Netzwerken und entwickeln optimierte Modelle zur Lastabdeckung. Das dahinter stehende Prinzip ist es, sich in der Energieproduktion nicht mehr ausschließlich auf einzelne Großkraftwerke zu stützen, sondern auch zahlreiche kleine Kraftwerke in einem Netz zusammen zu schließen, entsprechend einer Art „energetisches Inter-Net". Als Energielieferanten kommen dabei neben den traditionellen Energieversorgern prinzipiell auch kleine Einheiten wie Betriebe oder Haushalte in Frage. Die Steuerung wird dzt. an Mikro-Netzen entwickelt und erprobt.
Energieproduktion in kleinstem Maßstab sind heute möglich. Experten gehen daher davon aus, dass langfristig für die Investitionsentscheidung nicht alleine Rentabilitätsüberlegungen sein werden, sondern zunehmend Technologieentscheidungen und „Versorgungssicherheit" an Bedeutung gewinnen.[6]

5 Am Weg zur regionalen Energieautarkie – Polygeneration

Die Generation von Energie aus unterschiedlichen Prozessen zur gleichzeitigen Abdeckung des Bedarfs für Heizen, Kühlen und Strom sowie zur Abdeckung unterschiedlicher Lastsituationen ist ein zunehmend bedeutendes Thema - insbesondere für die Energieversorgung verschiedenartiger Zielgruppen wie etwa Industriebetriebe, Verwaltungseinheiten und Haushalte. Wird zusätzlich bei der Energiegeneration auf nicht leitungsgebundene Energieträger abgestellt so kommt Fragen der bedarfsgesteuerten Energieproduktion und -speicherung besondere Bedeutung zu.

[4] Paula, M., zitiert in: Energiegeladene Konzepte. Austria Innovativ 6/2005.
[5] Schleicher, St. bei der Veranstaltung e2050 am 24.11.2005 in Wien.
[6] Schleicher, St. bei der Veranstaltung e2050 am 24.11.2005 in Wien.

Erste Erfahrungen aus österreichischen „Energieregionen" und aus Pilotprojekten liegen vor und bilden die Grundlage für weitere Forschungsaktivitäten. Der Schwerpunkt liegt dabei bei der Einbindung von regionalen Energieversorgern, von regionalen Leitbetrieben und den Haushalten u. a. in Form partizipativer Entwicklungsmodelle in die Projektkonsortien.

f. *FdZ*: Regionen als Rohstofflieferanten

Die Region als Rohstofflieferant erzeugt eine win-win Situation für Produzenten und Lieferanten. Entlang der Wertschöpfungskette wird Bewusstsein für die gegenseitigen Anforderungen geschaffen – Abnahmegarantien und Versorgungssicherheit stehen dabei im Zentrum der Untersuchungen.
Für Rohstoff-Lieferanten ist die gesicherte Abnahme von Interesse, für die abnehmenden und weiterverarbeitenden Produzenten steht die qualitative und quantitative Absicherung im Vordergrund. Das Bewusstsein für die natürlich bedingten, qualitativen Schwankungen der nachwachsenden Rohstoffe, der Umgang mit diesen sowie die Definition naturstoffgerechter Qualitätsanforderungen sind wesentliche Eckpunkte einer erfolgreichen Kooperation.
In allen Programmlinien wurden nachwachsende Rohstoffe oder Erneuerbare Energieträger als Substitut für solche aus fossiler Herkunft erfolgreich angewendet, in Produkten oder Prozessen eingesetzt und die Anforderungen an Materialien und Prozesse definiert.
Die Erfassung nachfrageseitiger Aspekte erfolgt im Rahmen der aktuellen Ausschreibung durch thematische Schwerpunkte betreffend Produkt-Dienstleistungssysteme und Erhebung von Konsumtypologien.

g. *HdZ*: Demonstrationsgebäude als regionale Leuchttürme

Regional bedingte Bauweisen sind an sich keine Neuigkeit, denn seit Jahrhunderten wurde das Wissen um die lokal vorhandenen Baumaterialen gezielt eingesetzt und mündete in optimierten traditionellen Bauformen. Neu hinzugekommen sind forcierte Anforderungen an die Energieeffizienz der Gebäude bei gleichzeitig steigendem Bedarf. Die dahinter stehende Vision hat sich in den vergangenen Jahrzehnten gewandelt. Stand ursprünglich die bloße Minderung des Energiebedarfs von Wohnbauten im Vordergrund, so wurde daraus bald die Forderung nach Energieautarkie des Haushaltes. Zusätzlich wurde der Fokus erweitert und auf Verwaltungsgebäude sowie auf Gewerbeobjekte erweitert.
HdZ verfolgt das Ziel sowohl energetisch als auch architektonisch richtungsweisende Demonstrationsgebäude zu errichten. Die Anzahl der fertig gestellten Objekte nimmt stetig zu, mit Ende 2006 werden es an die 20 sein.
Möglicherweise architektonisch weniger spektakulär, dafür aber technisch äußerst anspruchsvoll ist die energetische Optimierung der vorhandenen Bausubstanz. Insbesondere dann sind hier neue Ansätze gefragt, wenn es sich um denkmalgeschützte Objekte handelt, an deren Fassaden nahezu keine Veränderungen zugelassen werden, gleichzeitig aber zeitgemäße Bedürfnisse der NutzerInnen abgedeckt werden sollen.
Neben der Durchführung von Demonstrationsprojekten ist deren ex-post Evaluierung ein wesentlicher Bestandteil der Programmlinie. Die vielfältige Ergebnisse werden laufend in Wissenschaft und Wirtschaft verbreitet und tragen so zur technologischen Weiterentwicklung der beteiligten Branchen bei.

3. AUSBLICK 2006

h. Nationale Aktivitäten

In allen drei Programmlinien werden die laufenden Ausschreibungen 2006 weiter geführt. Generelles Ziel ist es programmspezifische „Leuchttürme" zu entwickeln, die das Potential haben, richtungsweisende und zukunftsorientierte Beispiele zu setzen.
Daher wird die Kooperation von ***Nachhaltig Wirtschaften*** mit der Umweltförderung (Kommunalkredit KKPC) auch 2006 weiter geführt. Dies kommt jenen Demonstrationsprojekten zugute, die neben den innovationsbedingten Mehrkosten auch deutliche umweltrelevante erhöhte Investitionskosten aufweisen.
Ebenfalls generelles Ziel ist es KMUen verstärkt für eine Programmbeteiligung zu gewinnen.

i. Transnationale Aktivitäten

Nachhaltig Wirtschaften ist an insgesamt fünf ERA-NETs beteiligt:

- ERA-NET SUSPRISE
- ERABUILD
- PV-ERA-NET
- ERA-NET HYCO
- ERA-NET BIOENERGY

Alle Programmlinien werden im Rahmen der laufenden ERA NET Aktivitäten weiterhin international vernetzt und am Erfahrungsaustausch intensiv teilnehmen.
Transnationale Calls und Ausschreibungen als Alternative zu europäischen Projekten für Konsortien mit wenigen (internationalen) Partnern sind ein neuer Schwerpunkt für das Jahr 2006.
Dabei wird die Kooperationen von Förderstellen in Österreich mit Förderstellen in zunächst wenigen anderen europäischen Ländern ein erster Schritt für die gemeinsame Abwicklung von umsetzungsorientierten Projekten (vor allem Wirtschaftsbezogene Grundlagenforschung und Technologie- und Komponentenentwicklung) sein.

j. Die Ausschreibungen 2006

Auch 2006 stehen wieder mehrere Termine für die Einreichung zur Verfügung:

Impulsprogramm Nachhaltig Wirtschaften						
Linie	**EdZ**		**FdZ**		**HdZ**	
Schwer-punkte	Entwicklung von Demonstrationsprojekten, Energiedienstleistungssysteme, Modellregionen, Energienetze, transnationale Projekte		Entwicklung von Demonstrationsprojekten, Markteinführung von FdZ-Produkten und Verfahren, Identifikation von Konsumtypologien, transnationale Projekte		Demonstrationsvorhaben Sanierung, Dissipation vorhandener Ergebnisse, wissenschaftliche Begleitmaßnahmen, transnationale Projekte; Implementierung europäischer Themen	
aktuell	**2. Ausschreibung**		**4. Ausschreibung**		**5. Ausschreibung**	
Projektarten und Termine	Grundlagenstudien	**24. Juli und 13.November 2006**	Grundlagenstudien	**27. Februar 2006**	Demonstrations-vorhaben Eigenheim-sanierung	**13. April 2006**
	Konzepte	**24. Juli 2006**	Konzepte	**27. Februar 2006**	Demonstrations-vorhaben Sanierung Wohn/Dienst-leistungsbau	**28.September 2006**
	Demonstrations-projekte	**18. April und 4.September 2006**	Demonstrations-projekte	**18. April und 4.September 2006**	Begleit-maßnahmen Transferphase Strategische Projekte	**13. April und 28. September 2006**
	WGF und TKE	**laufend**	WGF und TKE	**laufend**	TKE	**laufend**

4. KONTAKTAUFNAHME UND INFORMATIONEN

Programmverantwortung:
Bundesministerium für Verkehr, Innovation und Technologie,
Abteilung für Energie- und Umwelttechnologien
Leitung: Dipl.-Ing. Michael Paula
Informationen über Förderformate und Fördersätze unter:
www.nachhaltigwirtschaften.at

Programmträger:
FFG Österreichische Forschungsförderungsgesellschaft mbH
Kärntnerstraße 21 – 23
1015 Wien
Programmleitung:
Dipl.-Ing. Theresia Vogel-Lahner
theresia.vogel@ffg.at
Tel.: 0 5 77 55 - 5011
Detaillierte Antragsberatung:
EdZ: Österreichische Energieagentur office@ENERGIESYSTEMEderZukunft.at
FdZ: Trust Consult office@FABRIKderZukunft.at
HdZ: ÖGUT office@HAUSderZukunft.at

reviewed paper

Einsatz Geoographischer Informationssysteme für die Strategische Umweltprüfung für Hochwasserschutzpläne nach § 31d WHG

Nicole HAUSTEIN

(Universität Kassel, Fachbereich 06: Architektur, Stadt- und Landschaftsplanung, FG Landschaftsplanung, Gottschalkstraße 28, 34109 Kassel, nicole.haustein@uni-kassel.de)

1. EINLEITUNG

Mit Hochwasserschutzplänen werden sowohl technische (Hochwasserrückhaltebecken, Dezentrale Rückhalte) als auch natürliche Maßnahmen des Hochwasserschutzes (Gewässerrenaturierung, Rückhalt in der Fläche usw.) planerisch vorbereitet. In Deutschland ist nach Novellierung des UVPG (Gesetz über die Umweltverträglichkeitsprüfung) im Mai 2005 eine Strategische Umweltprüfung bei der Erarbeitung von Hochwasserschutzplänen durchzuführen (vgl. Anlage 3 UVPG). Aufgabe der Strategischen Umweltprüfung ist es, die negativen und positiven Umweltwirkungen von Hochwasserschutzmaßnahmen frühzeitig als Entscheidungsgrundlage für die Wasserwirtschaft zu ermitteln und zu bewerten. Bei paralleler Erarbeitung von Umweltbericht und Hochwasserschutzplan können über mehrere Bewertungs- und Rückkoppelungsprozesse die Planungen zu Hochwasserschutzmaßnahmen für ein Flusseinzugsgebiet schrittweise optimiert werden. Unter Berücksichtigung umweltplanerischer, raumplanerischer und hydrologischer Aspekte kann ein auf Nachhaltigkeit ausgerichtetes Hochwasserschutzkonzept erarbeitet werden. Negative Umweltwirkungen können bereits auf der vorbereitenden Planungsebene erkannt und vermieden bzw. vermindert werden. Umgekehrt können Synergien mit Zielen der Umwelt- und Raumplanung z.B. durch die planerische Vorbereitung von Maßnahmen des natürlichen Hochwasserschutzes gesucht und für den Hochwasserschutz genutzt werden. Nachhaltige Lösungskonzepte, die eine Vielzahl möglicher Handlungsoptionen des Hochwasserschutzes aufzeigen und berücksichtigen, können gerade für große Flusseinzugsgebiete nur mit Hilfe von Geographischen Informationssystemen effektiv erarbeitet werden.

Strategische Umweltprüfung (SUP) und Hochwasserschutzplanung sind in Deutschland neu eingeführte Planungsinstrumente, für die in der Praxis kaum Erfahrungen zur Umsetzung vorliegen. In einem Forschungsvorhaben „Creating New Landscapes for Flood Risk Management“ wird im Zeitraum von 2003-2006 die Durchführung einer Strategischen Umweltprüfung an der Universität Kassel modellhaft für die Einzugsgebiete von Fulda und Diemel (Hessen, BRD) erprobt. Das Forschungsvorhaben ist Teil eines internationalen Forschungsvorhabens mit den Kurztitel „Floodscape“ (http://www.floodscape.net/newsite/) unter Beteiligung von Forschungspartnern in England, Belgien, Niederlanden und Deutschland. Das Forschungsvorhaben wird finanziert mit Mitteln der Europäischen Union (Programm INTERREG IIIB), Region Nord-West-Europa und dem Hessischen Ministerium für Umwelt, ländlichen Raum und Verbraucherschutz. Im Rahmen des deutschen Teilprojektes wird unter Leitung des Fachgebietes Wasserbau/ Wasserwirtschaft an der Universität Kassel ein Hochwasserschutzplan für die Einzugsgebiete von Fulda und Diemel erarbeitet. Weitere Projektpartner im deutschen Teilprojekt sind die TU Braunschweig (Leichtweiß-Institut für Wasserbau), die Technische Universität Darmstadt (Institut IWAR – FG Umwelt- und Raumplanung), die Universität Kassel (FG Landschaftsplanung/Naturschutz sowie das Wissenschaftliche Zentrum für Umweltsystemforschung). Die Strategische Umweltprüfung zum Hochwasserschutzplan wird durch das Fachgebiet Landschaftsplanung/ Naturschutz an der Universität Kassel bearbeitet.

Zentrale Aufgabe der SUP ist die Ermittlung, Prognose und Bewertung der Umweltwirkungen von Hochwasserschutzplänen. Gegenstand der SUP sind bauliche Maßnahmen des Hochwasserschutzes. Für die Umweltbewertung von Hochwasserschutzmaßnahmen in dem 7415 km^2 großen Untersuchungsgebiet (hess. Teil der Einzugsgebiete) wurde eine GIS-gestützte Bewertungsmethodik entwickelt. Damit können Umweltwirkungen verschiedener Maßnahmentypen des Hochwasserschutzes systematisch bewertet und für die spätere Entscheidung mit Öffentlichkeitsbeteiligung nachvollziehbar dargestellt werden.

Mit dem vorliegenden Beitrag soll am Beispiel der „Strategischen Umweltprüfung zum Hochwasserschutzplan Fulda/ Diemel“ aufgezeigt werden, wie unter Einsatz von GI- Systemen ein umweltverträgliches Hochwasserschutzkonzept erarbeitet werden kann. Im Einzelnen soll dargestellt werden:

Was der Untersuchungsgegenstand der Strategischen Umweltprüfung ist und welche Arbeitsschritte für die Beschreibung der Umweltwirkungen vollzogen wurden.

Welche Datengrundlagen für die Beschreibung der Umwelt und die Darstellung von Umweltwirkungen von Hochwasserschutzmaßnahmen verwendet wurden.

Wie GIS Daten aufbereitet und der Aufgabenstellung entsprechend modifiziert wurden, um eine Beurteilung von Umweltwirkungen zu ermöglichen.

Wie in Anlehnung an die Ökologische Risikoanalyse eine EDV gestützte Bewertung der Umweltwirkungen durchgeführt wird.

Wie im Ergebnis dieser Bewertungen ein optimiertes Hochwasserschutzkonzept erarbeitet wird.

2. ERMITTLUNG, PROGNOSE UND BEWERTUNG VON UMWELTWIRKUNGEN VON HOCHWASSERSCHUTZMAßNAHMEN

2.1 Untersuchungsgenstand und Arbeitsschritte der SUP

Der Untersuchungsraum der SUP erstreckt sich auf den hessischen Teil des Einzugsgebietes von Fulda und Diemel mit einer Gesamtgröße von 7415 km^2. Weitere Teile der Einzugsgebiete (ca 1280 km^2) liegen in Nordrheinwestfalen, Thüringen und Bayern und wurden bei der Bearbeitung der SUP nicht berücksichtigt, da der Hochwasserschutzplan für den hess. Teil des Einzugsgebietes erarbeitet wurde. Die Einzugsgebiete von Fulda und Diemel sind Teileinzugsgebiete der Weser und liegen im deutschen Mittelgebirge. Der Untersuchungsraum umfasst einen überwiegend ländlich geprägten Raum mit Wald und landwirtschaftlich geprägten Offenlandschaften. Größere Städte sind Kassel, Fulda und Bad Hersfeld. Der Untersuchungsraum ist von Sommer- und Winterhochwassern betroffen. Intensive Gewitterereignisse haben in den letzten Jahren im Untersuchungsgebiet bereits zu zwar lokal begrenzten, aber mit hohen Schäden verbundenen Hochwassern geführt.

ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

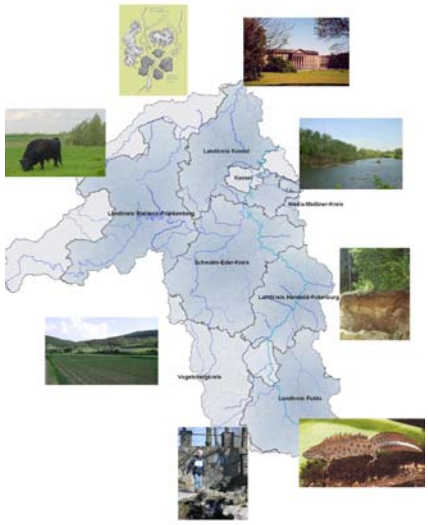


Abb. 1 Untersuchungsraum und Schutzgüter der Strategischen Umweltprüfung

Vor diesem Hintergrund wird ein Hochwasserschutzplan für die beiden Einzugsgebiete im hess. Teil erarbeitet. Aufgabe des Planes ist es, Schadensrisiken und Hochwasserstände zu mindern, sowie Hochwasserbewußtsein und Hochwasserinformation zu verstärken bzw. zu verbessern. Inhalt eines Hochwasserschutzplanes sind folgende Maßnahmen und Instrumente (vgl. Röttcher 2001):

Maßnahmen des natürlichen Hochwasserschutzes: Flächenmaßnahmen, Wasserrückhalt in der Aue und am Gewässer

Maßnahmen des technischen Hochwasserschutezs: Hochwasserrückhaltungen, Lokale Schutzmaßnahmen

Maßnahmen und Instrumente des vorsorgenden Hochwasserschutzes: Flächen-, Bau-, Verhaltens- und Risikovorsorge.

Gegenstand der SUP sind die Maßnahmen des Hochwasserschutzplanes, die raumwirksam sind und positive oder negative Wirkungen auf die Schutzgüter Boden, Wasser, Klima, Biologische Vielfalt, Flora & Fauna, Landschaft, Mensch einschl. menschl. Gesundheit sowie Sach- und Kulturgüter haben. Maßnahmen und Instrumente des vorsorgenden Hochwasserschutzes werden in der SUP nicht berücksichtigt, da von diesen keine erheblichen Wirkungen auf die Umwelt ausgehen. Als erheblich müssen vor allem die Inhalte des Planes angesehen werden, die UVP-pflichtige Vorhaben vorbereiten (Bau von Stauwerken, Deichen oder Dämmen, Baggerungen in Flüssen und Seen zur Gewinnung von Mineralien, Erstaufforstungen). Kernaufgabe der SUP ist es, einen Beitrag zur Entwicklung von Alternativen zu leisten, indem die zu berücksichtigenden Umweltbelange und die durch Maßnahmen entstehenden Umweltfolgen dargestellt werden. Der Beitrag der SUP kann in dem Aufzeigen von Restriktionen einerseits und dem Aufzeigen von Synergien mit Umweltzielen andererseits liegen. Vor diesem Hintergrund kann durch die Wasserwirtschaft ein optimiertes Planungskonzept erarbeitet werden.

Im Forschungsvorhaben werden mehrere Alternativen für einen nachhaltigen und umweltverträglichen Hochwasserschutz aufzeigt. Der Beitrag der SUP zur Alternativenentwicklung und zur Umweltfolgenabschätzung erfolgt in mehrern Arbeitsschritten:

- Beurteilung der derzeitigen Umweltsituation im Einzugsgebiet und Darstellung der möglicherweise durch Hochwasserschutzmaßnahmen betroffenen räumlich konkretisierbaren Umweltziele.
- Entwurf eines Landschaftsszenarios zum „Potentiell natürlichen Zustand" des Einzugsgebietes. Im „Potentiell natürlichen Zustand" wird ein gedachter Zustand des Einzugsgebietes simuliert, in dem keine anthorpogenen Einflüsse auf das Untersuchungsgebiet bestehen. Das Landschaftsszenario dient der Ermittlung des natürlicherweise auftretenden Hochwasserabflusses.
- Ermittlung und Bewertung von Umweltwirkungen für verschiedene fiktive Szenarien des Hochwasserschutzes: kleine und mittlere Hochwasserrückhaltebecken, Retention in der Fläche, Gewässerrenaturierung, Maßnahmen in der Landwirtschaft, Maßnahmen im Bereich potentieller Kiesabbauflächen. Für das gesamte Einzugsgebiet wird angenommen, dass lediglich Maßnahmen eines Types realisiert werden. Die Szenarien sind fiktiv und dienen im Rahmen der SUP dazu, die positiven und negativen Wirkungen bestimmter Maßnahmentypen im Planungsraum systematisch und nachvollziehbar zu erfassen und zu bewerten. Mit Hilfe der Szenarien soll die Auswahl von Maßnahmentypen und Standorten für vernünftige, tatsächlich realisierbare Maßnahmen vorbereitet werden.
- Erarbeitung von Empfehlungen für die Auswahl von Maßnahmentypen und möglichen Standorten auf Grundlage der Szenarien.
- Auswahl von Maßnahmentypen und Standorten für vernünftige, tatsächlich realisierbare Maßnahmenkonzepte, sogenannte „Strategische Alternativen" (STA). In den STA werden in unterschiedlichem Umfang Maßnahmen des natürlichen und des technischen Hochwasserschutzes miteinander kombiniert. Die Zusammenstellung der Maßnahmenkombinationen erfolgt im Forschungsvorhaben aufgrund der für einzelne Maßnahmentypen berechneten hydrologischen Effektivität (Beitrag der Wasserwirtschaft und Hydrologie) unter Berücksichtigung der Ergebnisse der SUP und unter Berücksichtigung der Belange der Raumplanung. Darüber hinaus werden die entstehenden Kosten für Hochwasserschutzmaßnahmen bei der Zusammenstellung von Maßnahmenkombinationen berücksichtigt.
- Abschließende Ermittlung und Bewertung von Umweltwirkungen von drei unterschiedlichen Strategischen Alternativen im Rahmen der SUP.
- Erarbeitung von Hinweisen zu Vermeidungs-, Verminderungs- und Kompensationsmaßnahmen, sowie zu Nachfolgeverfahren (FFH-Verträglichkeitsprüfung, Umweltverträglichkeitsprüfung) und zum Monitoring.

Für die Durchführung der SUP sind umfangreiche Raumanalysen durchzuführen, die nur mit GIS Einsatz zu bewerkstelligen sind. Im Forschungsvorhaben wurde für die Umweltfolgenbewertung ARCGIS 9 der Firma ESRI und Microsoft Excel eingesetzt. Darüber hinaus wird für eine 3D-Visualisierung von Maßnahmentypen des Hochwasserschutzes das Softwarepaket VNS 2 (Visual Nature Studio) verwendet (vgl. dazu auch den CORP Beitrag von Mülder J., Stemmer, B. 2006).

2.2 Datengrundlagen – räumlich konkretisierbare Kriterien für die Umweltfolgenbewertung

Die Umweltwirkungen der Hochwasserschutzmaßnahmen werden in Text und Karten in einem Umweltbericht dargestellt. In diesem werden die voraussichtlichen erheblichen Umweltwirkungen der Durchführung des Plans und die vernünftigen Alternativen ermittelt, beschrieben und bewertet. Aufgrund der Größe des Einzugsgebietes kann zur Beschreibung der Umwelt nur auf vorhandene Datengrundlagen zurückgegriffen werden. Eigene Erhebungen sind auf der Maßstabsebene des Hochwasserschutzplanes für das gesamte Einzugsgebiet nicht möglich. Im Rahmen der Bestandserfassung wurden Datengrundlagen verwendet, die es ermöglichen Aussagen über die Bedeutung von Landschaftsräumen zur Erfüllung bestimmter Umweltfunktionen zu machen. Die Operationalisierung von Umweltfunktionen erfolgte anhand räumlich konkretisierbarer Kriterien, die einzelnen Schutzgütern des UVPG zugeordnet wurden. Es wurden nur solche Kriterien erfasst, für die Wirkungen durch folgende Hochwasserschutzmaßnahmen zu erwarten sind:

- Hochwasserrückhaltebecken,
- Maßnahmen zur Retention in der Fläche (Vorlandwälle, Auwaldanpflanzung, Anlage von Nebengerinnen),
- Gewässerrenaturierung durch Anlage eines Uferstreifens beidseitig des Gewässers,
- Umwandlung von konventioneller landwirtschaftlicher Nutzung in konservierende landwirtschaftliche Nutzung bzw. Umwandlung von Acker in Grünland,
- techn. Maßnahmen zum Rückhalt von Wasser im Bereich potentieller Kiesabbauflächen,
- Dezentrale Rückhalte.

Einen zusammenfassenden Überblick über die in der Umweltfolgenbewertung verwendeten räumlich konkretisierbaren Kriterien gibt Tabelle 1.

Für die Bestandserfassung zur Umweltsituation und für die Ermittlung der Umweltziele im Untersuchungsraum war es von zentraler Bedeutung, dass mit dem „Landschaftsrahmenplan Nordhessen“ (RP Kassel 2000) und dem „Landschaftsrahmenplan Mittelhessen“ (RP Giessen 1998) zwei akutelle Fachplanungen mit Angaben zur Umweltsituation und zu Umweltzielen des Naturschutzes als GIS-Daten vorlagen. Auf dieser Grundlage konnten Flächen mit Bedeutung für die Bereitstellung der nachfolgend genannten Umweltfunktionen im Untersuchungsraum ermittelt werden:

Erholungsfunktionen in der freien Landschaft und im Siedlungsbereich (Schutzgut Mensch),
Bedeutung für Vielfalt, Eigenart und Schönheit der Landschaft (Schutzgut Landschaft),
Biotopverbundfunktion und Lebensraumfunktion von Biotopen bzw. Habitaten (Schutzgut Flora & Fauna, biologische Vielfalt).

Bei der Datenverwendung erwies es sich als problematisch, dass für die Erarbeitung der Landschaftsrahmenpläne keine einheitlichen Standards exisitieren. Die Aufstellung der Landschaftsrahmenpläne wurde in Hessen jeweils für Regierungsbezirke vorgenommen. Das Untersuchungsgebiet erstreckt sich auf Flächen der Regierungsbezirke Kassel und Giessen. Die Planaussagen der beiden Fachplanungen waren inhaltlich z.T. unterschiedlich, so dass zu einigen Themenkomplexen keine Zusammenführung der Daten in eine Datei möglich war. Einige Daten waren zwar inhaltlich vergleichbar, konnten aber aufgrund unterschiedlicher Datenbankstrukturen nicht zusammengefasst werden. Ein weiteres Problem stellte die mangelnde Aktualität der Daten dar. Aufgrund aktueller Schutzgebietsausweisungen, insbesondere im Bereich der FFH-Gebietsmeldungen bei der EU, mussten daher anstelle der in der Landschaftsrahmenplanung dargestellten Schutzgebiete die Datensätze des NATUREG verwendet werden. NATUREG hält als zentrales digitales Naturschutzregister für das Bundesland Hessen aktuelle Sach- und Geodaten zu allen Flächen mit rechtlichen Bindungen (Schutzgebiete, Kompensationsflächen, Investitionsflächen) vor (vgl. HMULV 2005). Der Beitrag der Landschaftsrahmenplanung lag vor allem darin, dass sie aus Umweltsicht bedeutsame Flächen ohne rechtliche Bindungen darstellt. Für eine weitere inhaltliche Qualifizierung der Umweltfolgenbewertung wären Flächenabgrenzungen der besonders schützenswerten Biotope notwendig gewesen. Daten zB. in Form einer selektiven Biotoptypenkartierung lagen für das Untersuchungsgebiet aber nicht vor bzw. waren nicht verfügbar. Für eine weitergehende qualifizierte Bewertung der Wirkungen von Hochwasserschutzmaßnahmen auf Flora & Fauna wären entsprechende Datensätze wünschenswert gewesen.

Bereitstellung von Umweltfunktionen bzw. Gefährdung	Räumlich konkretisierbares Kriterium	Quelle / Datengrundlage
Schutzgut Boden		
Lebensraum Regualtion Naturhaushalt	Böden mit Auendynamik	HLUG: Fachinformationssystem Boden - Bodenkarte Hessen (BDK 50)
Archiv	Geol. Geschütze Objekte	RP Kassel / RP Giessen: Landschaftsrahmenplan
Schadstoffeintrag	Altlastenverdachtsfläche	HLUG: Karten der Altflächen
Schutzgut Wasser		
Wasserdagebot	Trinkwasserschutzzonen	HLUG: Umweltatlas
Lebensraum Naturhaushalt	Gewässerstrukturgüte	HLUG: Umweltatlas
Lebensraum	Zielgewässer und Wandergewässer Lachs	Schwevers: Fischereiökologisches Fachgutachten
Schutzgut Klima		
Klimatischer Ausgleich	Regionalplanerisch bedeutsame Frischluftleitbahn (Regionalplan)	RP Kassel / RP Giessen: Regionalplan
	Überwärmte Siedlungsbereiche (Klimafunktionskarte)	HMULV: Klimagutachten Hessen
Schutzgut Biologische Vielfalft		
Artenvielfalt	FFH-Gebiet	HMULV: NATUREG
	Vogelschutzgebiet	
	Brutgebiet / Rastgebiete mit internationaler, nationaler, regionaler und lokaler Bedeutung	RP Kassel / RP Giessen: Landschaftsrahmenplan
Schutzgut Flora & Fauna		
Lebensraum seltener Arten	Naturschutzgebiet	HMULV: NATUREG
	Nationalpark	
	Biosphärenreservat	
Biotopverbund	Biotopverbund Fließgewässer	RP Kassel / RP Giessen: Landschaftsrahmenplan

	Biotopverbund Magerrasen (nur Maßnahmen Landwirtschaft)	
Schutzgut Landschaft		
Vielfalt, Eigenart und Schönheit der Landschaft	Landschaftsschutzgebiet	HMULV: NATUREG
	Freizuhaltende Fläche aus Gründen des Landschaftsbildes	RP Kassel / RP Giessen : Landschaftsrahmenplan
	Historische Kulturlandschaft	
Schutzgut Mensch		
Erholungsraum	Naturpark	HMULV: NATUREG
	Gebiet für landschaftsbezogene Erholung	RP Kassel / RP Giessen: Landschaftsrahmenplan
	Bedeutsame innerstädtische Grünflächen	
Schutzgut Sach- & Kulturgüter		
Produktion	Ackerflächen	Hess. Landesvermessungsamt ATKIS, HLUG: Natürliche Standorteignung für landbauliche Nutzung

Tab.1 : Räumlich konkretisierbare Kriterien für die Umweltfolgenbewertung

Regional bedeutsame Frischluftleitbahnen wurden auf Grundlage des digital vorliegenden Regionalplans „Nordhessen" (RP Kassel 2000) bzw. „Mittelhessen" (RP Giessen, 1998) erfasst. Überwärmte Siedlungsbereiche konnten aus dem „Klimagutachten Hessen", das als GIS-Datensatz beim HMULV vorlag, übernommen werden. Auf dieser Grundlage konnten im Rahmen der Umweltfolgenbewertung Standorte ermittelt werden, die als besonders empfindlich gegnüber einer Abriegelung von Talquerschnitten (z.B. durch Hochwasserrückhaltebecken oder Auwaldanpflanzung) eingestuft werden müssen.

Eine weitere wichtige Datengrundlage bildete der „Umweltatlas Hessen" (HLUG 2004), der vom Hessischen Ministerium für Umwelt und Geologie (HLUG) geführt wird und umfangreiche GIS-Daten zur Umweltsituation bereithält. Mit den GESIS Daten lagen Informationen zur Gewässerstrukturgüte für 100m Abschnitte aller Fließgewässer im Einzugsgebiet vor. Zum Einsatz kamen zwei Datensätze, da der Bewertungsdatensatz GESIS lediglich die Bewertung der Fließgewässerabschnitte entsprechend der Gewässerstrukturgütekartierung enthält. Der Erfassungsdatensatz GESIS stellt demgegenüber umfangreiche Daten zum Gewässertyp, zur Gewässersohle, zum Gewässerprofil, zur Breitenvarianz, zu Ufergehölzen, Uferverbau, Flächennutzung im Gewässerumfeld usw. zur Verfügung. Für die Beurteilung von Habitatstrukuturen am Uferrandstreifen und im Gewässer ist dieser Datensatz daher viel besser geeignet, als der Bewertungsdatensatz mit aggregierten Bewertungsergebnissen. Auf Basis der GESIS Daten wurden für die Umweltfolgenbewertung Fließgewässerabschnitte ermittelt, für die durch die Anlage von Ufergehölzstreifen eine Verbesserung der Fließgewässerstruktur angestrebt werden sollte.

In analoger Form lagen Angaben zu Ziel- und Wandergewässern für die Wiederansiedlung des Lachses im Wesereinzugsgebiet vor. Da Fulda und Diemel zu den wichtigsten Reproduktionsgewässern für den Lachs im Wesereinzugsgebiet zählen und durch Hochwasserschutzmaßnahmen positive (z.B. durch Renaturierung) aber auch negative Wirkungen (z.B. Unterbrechung der Fließgewässerdurchgängigkeit durch Hochwasserrückhaltebecken) zu erwarten sind, wurden diese Gewässer im GIS dargestellt und bei der Bewertung von Standorten für einzelne Maßnahmentypen des Hochwasserschutzes berücksichtigt. Über eine Berechnung des Fließgewässergefälles in längszonaler Richtung wurde darüber hinaus eine Einteilung der Fließgewässer in Leitfischregionen vorgenommen. Auf dieser Basis konnten im Umweltbericht Aussagen zu Wirkungen von Maßnahmen auf typische Arten der Fischregionen räumlich konkretisiert werden.

Die Daten zu Wasserschutzgebieten (Trinkwasserschutzzonen I-III) dienten dazu, Räume zu konkretisieren, die als besonders empfindlich gegenüber Schadstoffeinträgen im Falle eines Einstaus im Bereich der Hochwasserschutzmaßnahmen eingestuft werden müssen. Ebenso wurde für Standorte mit Altablagerungen und Altstandorte ein erhöhtes Risiko des Schadstoffaustrages angenommen.

Für die Darstellung der Flächennutzung wurden Daten aus dem Amtlichen Topographischen Informationssystem (ATKIS) des Hessischen Landesvermessungsamtes verwendet. Auf dieser Grundlage wurde im Rahmen der SUP die Flächeninanspruchnahme von Hochwasserschutzmaßnahmen berechnet. Da Hochwasserschutzmaßnahmen überwiegend lokal sehr schmale und kleine Flächen beanspruchen, war im Rahmen der Umweltfolgenbewertung eine detaillierte Erfassung der Fließgewässer und der angrenzenden Auebereiche erforderlich. Trotz des Bearbeitungsmaßstabes von 1:100.000 wurden daher sehr genaue Angaben über die Flächennutzung in den Auen benötigt. CORINE Landcover erschien für die Abbildung der Flächennutzung aufgrund des Erfassungsmaßstabes als zu ungenau. Darüber hinaus werden in CORINE verschiedene Flächennutzungen in kleinteilig parzellierten Landschaften in den Objektklassen „Komplexe Parzellenstrukturen" und „Landwirtschaft und natürliche Bodenbedeckung" zusammengefasst. Zudem sind kleinere Fließgewässer in CORINE gar nicht erfasst. Detaillierte Aussagen insbesondere zur Inanspruchnahme landwirtschaftlicher Flächen waren auf dieser Grundlage nicht möglich. ATKIS enthält demgegenüber eine detaillierte räumliche Darstellung und Klassifizierung von Offenlandstrukturen in der Aue.

Als weitere Datengrundlage wurden die Bodendaten aus dem Fachinformationssytem Boden (HLUG 2004) verwendet. Das Fachinformationssystem Boden enthält Angaben zu den Bodentypen und zur Standorteignung für Vegetation. Für die Beurteilung von Bodenfunktionen und für die Abgrenzung der eigentlichen Aue waren die in den Datensätzen enthaltenen Angaben zur Auendynamik der Böden von hoher Bedeutung. Das digitale Geländemodell (DGM im 40x40m-Raster) wurde in Verbindung mit den Daten zu Bodentypen dazu genutzt, einen gedachten Zustand des Einzugsgebietes „Bodenbedeckung ohne anthropogene Einflusse" zu simulieren. Dieser „Potentiell natürliche Zustand des Einzugsgebietes" wurde im Rahmen des Projektes verwendet, um den „natürlichen Hochwasserabfluss" zu berechnen. Es wurde für die Simulation des „Potentiell natürlichen Zustandes" davon ausgegangen, dass sich unter Wegfall aller anthropogener Einflüsse in Abhängigkeit von den Bodentypen, den Klimaverhältnissen und dem Einfluss von Großherbivoren eine überwiegend durch Wald geprägte Landschaft im Einzugsgebiet entwickeln würde. Lediglich in Bereichen mit natürlicher Auendynmaik und häufigeren Hochwasserereignissen, sowie an klimabegünstigten Standorten wurde von einem größeren Einfluss von Großherbivoren bzw. von natürlichen Hochwasserkatastrophen auf die heutige potentiell natürliche Vegetation nach Bohn U. (1996) und Schröder L. (1994) ausgegangen. Im „Potentiell natürlichen Zustand" wird daher ein Wald-Hochstauden-Offenland-Verhältnis von jeweils einem Drittel für Standorte mit natürlicher Auendynamik und einer geringen Hangneigung angenommen, da davon ausgegangen werden kann, daß Herden von Großherbivoren, sowie der Biber im Auenbereich starke Einflüsse auf die Landschaftsgestalt haben (vgl. dazu u.a. Holtmeier, F.K. 2002, Gerken & Schirmherr 1995). Für klimabegünstigte Süd- bzw. Süd-West-Hänge wird ein Offenlandanteil aufgrund der bevorzugten Nutzung durch Großherbivoren insbesondere im Frühjahr vermutet. Mit Hilfe des „Spatial Analyst" wurden diese Süd- und Süd-West-Hänge auf Grundlage des

DGM ermittelt und als Flächen mit einem höheren Offenland- und Hochstaudenanteil ausgewiesen. Auf dieser Grundlage wurde durch die Hydrologie der natürliche Hochwasserabfluss berechnet.

2.3 Umweltwirkungen und Wirkräume von Hochwasserschutzmaßnahmen

Im GIS wurde überprüft, welche Flächen mit welchen Nutzungen und mit welchen Umweltfunktionen für einzelne Maßnahmen des Hochwasserschutzes in Anspruch genommen werden. In den Szenarien wurden folgende Flächen und Maßnahmentypen betrachtet:

Hochwasserrückhaltebecken: Damm und Staubereich der Rückhaltebecken (insgesamt 108 Standorte im gesamten Einzugsgebiet). Vorgesehen werden im Einzugsgebiet kleine und mittlere Hochwasserrückhaltebecken mit einer Dammhöhe von 15 bzw. 6 Metern. Aufgrund der Topographie im Einzugsgebiet können Becken i.d.R. nicht seitlich vom Gewässer gelagert werden und müssen vorwiegend im Hauptschluss realisiert werden.

Gewässerrenaturierung: 5 bzw. 10m breiter Uferstreifen entlang aller Fließgewässer mit erheblichen Sturkturdefiziten (schlechter GW-Strukturgüteklasse III ausserhalb von Ortschaften). Zur Abgrenzung der Wirkräume im GIS wurde ein 5m breiter Puffer beidseitig der Gewässer bis 10m Breite und ein 10m breiter Puffer für Gewässer ab 10m Breite und mit einer Gewässerstrukturgüteklasse schlechter III angelegt.

Landwirtschaft: Umwandlung von konventioneller landwirtschaftlicher Nutzung in konservierende Landwirtschaft bzw. Umwandlung in Grünland. Auf Grundlage der Daten zur Karte „Standorteignung Landwirtschaft- Potentielle Erosionsgefährdung - Bodenerosion“ (HLUG 1999) und der aktuellen Ackernutzung nach ATKIS wurden Flächen ermittelt, für die aufgrund einer Bodenerosionsgefährdung eine Umstellung der landwirtschaftlichen Nutzung angestebt werden sollte. Durch die konservierende Landwirtschaft wird das Rückhaltevermögen der Böden für Wasser erhöht, wenn der Boden nicht gefroren ist oder bereits durch vorherige Niederschläge gesättigt ist.

Retention in der Fläche: Anlage von Auwald bzw. Vorlandwällen in der Aue, sowie Anlage von Nebengerinnen entlang der Fließgewässer in den größeren und flachen Talauen. Durch die Maßnahmen wird die Rauhigkeit der Aue heraufgesetzt und Wasser in der Fläche zurückgehalten.

Nutzung von Kieslagerflächen: Nutzung aller Vorrang- bzw. Vorbehaltsflächen für Kiesabbau (Regionalplan) zum Rückhalt von Wasser in der Fläche. Als Maßnahmen auf diesen Flächen werden vor allem gesteuerte Rückhalte vorgesehen, die seitlich des Gewässers gelagert sind.

Für die Szenarien wurden für alle möglichen Standorte Wirkräume im GIS abgegrenzt. Durch Überlagerung mit den räumlich konkretisierbaren Kriterien (vgl. Tabelle 1) wurde festgestellt, ob Kriterien von der Maßnahme betroffen sind. Darüber hinaus wurden die Inanspruch genommenen Flächennutzungen nach ATKIS ermittelt. Zur Abschätzung von Wirkungen der Maßnahmen auf das Landschaftsbild und zur Visualisierung der Maßnahmentypen im Rahmen einer Öffentlichkeitsbeteiligung wurden einzelne Maßnahmentypen zusätzlich mit Visual Nature Studio visualisiert (vgl. Mülder J., Stemmer, B. 2006).

3. BEWERTUNGSVERFAHREN ZUR BEWERTUNG VON UMWELTWIRKUNGEN

Für die Untersuchung und Bewertung planungsbedingter Umweltfolgen gelten derzeit Ökologische Risikoanalysen und dazu ergänzend die verbal- argumentativen Bewertungsanssätze als die geeignetsten Methoden (vgl. Jacoby 1999. S.403). Die Ökologische Risikoanalyse wurde von Bachfischer (1978) entwickelt und in der Praxis der Umweltverträglichkeitsprüfung ständig weiterentwickelt. Die Methodik ermöglicht es, für eine Vielzahl von Kriterien über mehrere Bewertungs- und Aggregationsschritte Umweltfolgen zusammenfassend zu bewerten. Umweltfolgen werden dabei nicht nur auf der Sachebene erfasst, sondern auch anhand gesellschaftlich festgelegter Normvorstellungen bewertet. Die Ökologische Risikoanalyse konkertisiert sich nach Bachfischer (1978, S.79ff) in den folgenden Arbeitsschritten:

Zerlegung des komplexen Wirkungsgefüges des Systems Mensch-Umwelt in weitgehend unabhängige Teilsysteme

Ermittlung der Intensität der potentiellen Beeinträchtigung

Ermittlung der Empfindlichkeit der Teilsysteme gegnüber Beeinträchtigungen

Einschätzung des Risikos der Beeinträchtigung

Einschätzung des Umweltrisikos unter Berücksichtigung der Bedeutung zur Erfüllung von Umweltfunktionen.

Formalisierte Bewertungsverfahren eigenen sich vor allem für komplexe Planungsaufgaben. Planungsmaßstab und Komplexität der Aufgabe (Zahl der Standorte und möglichen Maßnahmentypen mit unterschiedlichen positiven und negativen Wirkungen der Maßnahmen, Größe des Untersuchungsgebietes, Anzahl der zu berücksichtigenden Kriterien) erfordern für die SUP zum Hochwasserschutzplan die Anwendung eines formalisierten Bewertungsverfahrens. Im Rahmen des Forschungsvorhabens wurde daher eine EDV-gestützte Methodik in Anlehnung die Ökolgosiche Risikoanalyse entwickelt. In der Ökologischen Risikoanalyse werden in der bisherigen Praxis überwiegend negative Umweltwirkungen erfasst. Im vorliegenden Anwendungsfall sind neben negativen Wirkungen auch vielfach positive Wirkungen auf die Schutzgüter des UVPG zu erwarten. Daher wurden z.T. Begriffe der Ökologischen Risikoanalyse neu definiert: Anstelle des Risikobegriffs wird der Begriff „Umweltfolgen“ verwendet. Da durch Hochwasserschutzmaßnahmen auch Synergien mit Umweltzielen entstehen können, wird von „Wirkungen“ anstelle von „Belastungen“ und von „Auswirkungen“ anstelle von „Beeinträchtigungen“ gesprochen (vgl. Abb.2).

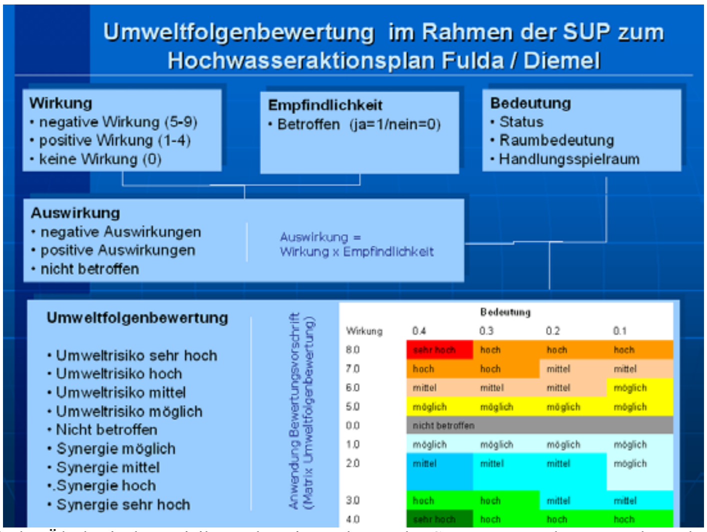


Abb.2: Methodik der Ökologischen Risikoanalyse im Rahmen der SUP zum Hochwasserschutzplan Fulda / Diemel

Im Forschungsvorhaben wurde zunächst die Wirkung eines Maßnahmentypes auf die Schutzgüter des UVPG beschrieben. Dabei wurden für jedes der räumlich konkretisierbaren Kriterien im Planungsraum (vgl. Tabelle 1) Wirkungen von Hochwasserschutzmaßnahmen verbal argumentativ beschrieben. Aufbauend auf dieser verbal argumentativen Darstellung wurden die Wirkungen einer 9-stufigen Ordinalskala zugeordnet. Unterschieden wurde zwischen sehr negativen (Wertstufe 9-5) bis sehr positiven Wirkungen (Wertstufen 1-4) bzw. keinen bzw. geringen Wirkungen auf das Kriterium (0). Die fachliche Wirkungsabschätzung wurde in einer Excel Tabelle dargestellt.

Im GIS wurde ermittelt, inwieweit ein räumlich konkretisierbares Kriterium von einer Maßnahme betroffen ist (betroffen=1, nicht betroffen=0). Dabei wurde davon ausgegangen, dass Räume, die in der Landschaftsrahmenplanung als besonders bedeutsam für die Erfüllung bestimmter Umweltfunktionen eingeschätzt werden, besonders empfindlich gegenüber bestimmten Maßnahmentypen des Hochwasserschutzes eingestuft werden müssen. Weitere Räume mit hoher Empfindlichkeit aufgrund ihrer Bedeutung zur Erfüllung von Umweltfunktionen, die in der Landschaftsrahmenplanung nicht dargestellt werden, wurden durch die Gutachter der SUP räumlich konkretisiert. Im Ergebnis konnten so für alle Schutzgüter Räume ermittelt werden, die aufgrund ihrer Raumausstattung als empfindlich gegenüber Wirkungen von Hochwasserschutzmaßnahmen eingestuft werden müssen. Die weitere Bearbeitung der Umweltfolgenbewertung erfolgte mit Microsoft Excel: Ausgehend von den Ergebnissen der GIS Analyse wurde in Excel durch Multiplikation mit der Empfindlichkeit die Auswirkung für jeden Standort ordinal beschrieben.

Die Bedeutung der räumlich konkretisierbaren Kriterien wurde anhand einer 4stufigen Ordinalskala eingeschätzt (sehr hohe, hohe, mittlere, geringe Bedeutung). Bei der Einstufung wurden Raumbedeutsamkeit (Europa, national, regional, lokal), Status (gesamträumlich abgestimmt, Fachplanung einer Behörde, Fachtgutachten im Auftrag einer Behörde) und gesetzlich festgelegter Handlungsspielraum (sehr gering – hoch) berücksichtigt.

Die Umweltfolgen wurden zunächst für jedes Kriterium einzeln bewertet, indem Auswirkung und Bedeutung über eine Matrix miteinander verknüpft wurden. Für die Gesamtdarstellung wurden diese Ergebnisse für die einzelnen Schutzgüter und für alle Schutzgüter insgesamt aggregiert, indem jeweils die Maximalwerte (höchste negative bzw. positive Wirkung) ausgelesen wurden. Die Bewertungsergebnisse können graphisch in Form von Diagrammen oder durch Import in GIS dargestellt werden. Im Ergebnis wurden auf diese Weise für alle Szenarien Karten zur Umweltfolgenbewertung erarbeitet.

4. ERARBEITUNG EINES OPTIMIERTEN HOCHWASSERSCHUTZKONZEPTES

Für alle Szenarien des Hochwasserschutzes (vgl. Punkt 2.1) wurden die Umweltfolgen für alle möglichen Standorte von Hochwasserschutzmaßnahmen entsprechend der vorangehend beschriebenen Methodik (vgl. Punkt 3) bewertet. Bestimmte Standorte wurden aufgrund der hohen negativen Umweltfolgen für einzelne Maßnahmentypen ausgeschlossen. Von den Partnern im deutschen Forschungsvorhaben wurde eine hydrologische, ökonkonomische (Universität Kassel, FG Wasserbau / Wasserwirtschaft, TU Braunschweig) und raumplanerische Beurteilung (TU Darmstadt) der Maßnahmentypen der Szenarien parallel zur Umweltfolgenbewertung in der SUP vorgenommen. Die Ergebnisse wurden der Umweltfolgenbewertung gegenübergestellt. Einzelne Standorte für Hochwasserrückhaltebecken, die zuvor in der Umweltfolgenbewertung oder in der raumplanerischen Bewertung ausgeschlossen wurden, mussten auf Grund der hydrologischen Notwendigkeit der Standorte (Schutz von Siedlungen vor einem HQ100) erneut diskutiert werden. Aus umwelt- oder raumplanerischer Sicht problematische Standorte, die zum Schutz größerer Siedlungsflächen vor Hochwasserereignissen aus hydrologischer Sicht unbedingt erforderlich erscheinen, wurden im Gelände besichtigt. Dabei stellte sich die Validität der im GIS auf der Maßstabsebene 1:100.000 durchgeführten Analyse und Bewertung heraus: Die im GIS ermittelten Konflikte zwischen raum- und umweltplanerischen Zielen auf der einen Seite und der Notwendigkeit effektiver Maßnahmen zum Rückhalt von Hochwasser auf der anderen Seite, bestätigten sich auch im Gelände. Die entstehenden Zielkonflikte können auf der Ebene der SUP nicht gelöst werden. In den Strategischen Alternativen wurden für einzelne Standorte daher unterschiedliche Maßnahmentypen ausgewählt.

Insgesamt werden für den Planungsraum drei verschiedene sogenannte „Strategische Alternativen“ (STA) erarbeitet. Dabei werden aus den in den Szenarien untersuchten Maßnahmen einzelne Maßnahmentypen ausgewählt. Als Strategische Alternativen werden die folgenden konzeptionellen Lösungsmöglichkeiten vorgeschlagen:

Großflächige und weitgehende Reaktivierung des Retentionsvermögens der gesamten Aue unter Verzicht auf technische Maßnahmen (STA IIa)

Großflächige Reaktivierung des Retentionsvermögens am Gewässer unter weitgehendem Verzicht auf technische Maßnahmen (STA IIb)

Aktivierung des Retentionsvermögens durch punktuelle Maßnahmen am Gewässer und durch technische Maßnahmen (STA III). Darüber hinaus wird die Nullvariante (STA I) dargestellt. Ausgehend von einer Status-Quo Prognose zur zukünftigen Raumentwicklung im Untersuchungsgebiet, wird die Hochwassergefährdung unter Verzicht auf weitere Hochwasserschutzmaßnahmen aufgezeigt. Damit sollen der Wasserwirtschaft und den politischen Akteuren verschiedene Handlungsoptionen und ihre Folgen aufgezeigt werden. Bis Mitte 2006 werden die Strategischen Alternativen im Forschungsvorhaben abschließend im Hinblick auf ihre Umweltfolgen, ihre Verträglichkeit mit Zielen der Raumplanung, ihre hydrologische Wirkung und die durch Maßennahmen entstehenden Kosten bewertet.

5. FAZIT

Die Strategische Umweltprüfung kann bei Vorliegen hinreichend aktueller digitaler Daten effektiv unter EDV Einsatz durchgeführt werden. Wichtig für die Durchführung einer Umweltfolgenbewertung auf der dargestellten Planungsebene ist es, dass auf regionaler Ebene noch nicht abgewogene räumlich konkretisierte Umweltziele für das Planungsgebiet vorliegen. In Deutschland stellt die Landschaftsrahmenplanung in ihren Planwerken einen Großteil der zu berücksichtigenden Umweltziele auf regionaler Ebene räumlich konkretisiert dar. Sie operationalisiert damit gesetzlich oder politisch festgelegte Umweltziele. Die Darstellung von Landschaftsräumen, die zwar keinem rechtlichen Schutzstatus unterliegen, aber dennoch bestimmte Umweltfunktionen mit hoher Empfindlichkeit gegenüber Eingriffen aufweisen, ist für die Durchführung einer fachlich qualifizierten SUP unerlässlich. Landschaftsrahmenpläne müssen daher als Grundlage für die SUP in regelmäßig aktualisierter Form vorliegen. Die Daten müssen dabei in gängigen GIS-Formaten verfügbar sein. Da Untersuchungsräume in der SUP fachlich – inhaltlich festgelegt werden und sich nicht an administrativen Grenzen orientieren, sollten Standards der Datenerfassung und –aufbereitung auch für die Landschaftsplanung erarbeitet werden. Für eine effiziente, kostengünstige und schnelle Bearbeitung einer Umweltfolgenabschätzung ist dies unerlässlich. Aufgrund der länderspezifischen Regelungen zur Landschaftsplanung in Deutschland ist es derzeit allerdings nicht absehbar, dass die Inhalte der Landschaftsplanung in einem semantischen Datenmodell beschrieben werden

Auch bei Vorliegen aktueller Landschaftsrahmenpläne werden in der Umwelftfolgenbewertung neben den Daten der Landschaftsplanung weitere Daten zur Erfassung der abiotoischen Schutzgüter, des Schutzgutes Mensch und der Sach- & Kulturgüter herangezogen werden müssen. Die in Umweltinformationssystemen wie dem Umweltatlas Hessen zur Verfügung stehenden Daten bilden zwar eine gute Grundlage zur Beschreibung der Umweltsituation, müssen aber häufig zunächst hinsichtlich ihrer Bedeutung zur Erfüllung von bestimmten Umweltfunktionen und politisch festgelegten Umweltzielen interpretiert werden.

Die Nutzung von GIS und Datenbanken ist für die Strategische Umweltprüfung auf der Ebene eines größeren Einzugsgebietes mit einer Vielzahl möglicher Standorte und Handlungsoptionen unerläßlich. Im vorliegenden Fallbeispiel wurden überwiegend Geoprozessing – Funktionen im Rahmen der Umweltprüfung genutzt, da Wirkungen auf räumlich konkretisierte Umweltfunktionen abgeprüft wurden.

Zur Bewertung der Umweltfolgen von Maßnahmen des Hochwasserschutzes hat sich im Planungsbeispiel der Einsatz von Datentabellen mit festgelegten Bewertungs- und Aggregationsvorschriften bewährt, da die Vielzahl der in Betracht kommenden Standorte schnell bewertet werden konnte. Die Bewertung der Szenarien der Maßnahmentypen ist dabei transparent und nachvollziehbar. Darüber hinaus ermöglicht die automatisierte Anwendung von Bewertungsvorschriften im Nachhinein eine Überprüfung der Bewertungsergebnisse auch unter Annahme anderer Rahmenbedingungen. So können z.B. Umweltfolgenbewertungen unter Annahme einer höheren oder geringeren Bedeutung eines Kriteriums ohne großen Mehraufwand verändert werden. Dies ist insbesondere dann erforderlich, wenn z.B. durch Änderungen politischer oder gesetzlicher Umweltzielstellungen eine veränderte Einstufung der Bedeutung vorzunehmen ist. Mit der Nutzung von Excel im Forschungsvorhaben war die Anzahl der in einem Schritt zu berücksichtigenden Standorte allerdings auf 61000 limitiert. Die Vielzahl der verwendeten Datenblätter stellte ausserdem bei der hohen Zahl untersuchter Standorte (Datensätze) erhöhte Anforderungen an den Arbeitsspeicher des Rechners.

Im Forschungsvorhaben zeigte sich, dass durch GIS- und EDV-Einsatz die Umweltfolgenbewertung verschiedener Maßnahmentypen des Hochwasserschutzes für eine ganzes Einzugsgebiet effektiv durchgeführt werden kann. Formalisierte Bewertungsverfahren können in Sachdatentabellen transparent und nachvollziehbar umgesetzt werden, wobei Bewertungsergebnisse automatisiert nach zuvor festgelegten Schritten ausgelesen werden können. Die Eingangsparameter und die Einordnung von fachlichen Wirkungsabschätzungen in Ordinalskalen müssen dabei im Text nachvollziehbar erläutert werden. Insgesamt bietet die Arbeit mit einem GIS-/EDV-gestützen Bewertungsverfahren die Möglichkeit eine Vielzahl möglicher Handlungsoptionen zu erfassen und hinsichtlich iherer Umweltfolgen zu prognostizieren und zu bewerten. In Weiterentwicklung zu der im Forschungsvorhaben umgesetzen EDV-gestützten Bewertungsmethodik müssten Bewertungslogarithmen entwickelt werden, die innerhalb einer relationalen GIS Datenbank zur Anwendung kommen können.

6. LITERATUR

Bachfischer, R.: Die ökologische Risikoanalyse – eine Methodde zur Integration natürlicher Umweltfaktoren in die Raumplanung, Diss am Lehrstuhl für Raumforschung, Raumordnung und Landesplanung der TU München, München, 1978

Bohn, U.: Vegetationskarte der Bundesrepublik Deutschland 1:200.000 – Potentielle natürliche Vegetation. In: Schriftenreihe für Vegetationskunde, Heft 15, 2. erw. Auflage, Landwirtschaftsverlag, Bonn Bad Godesberg, 1996

Gerken B., Schimer M.: Die Weser. In: Limnologie Aktuell – Band 6, Gustav Fischer Verlag, 1995

HMULV – Hessisches Ministierium für Umwelt, Landwirtschaft und Verbraucherschutz: Informieren, verwalten, schützen - ditigales Naturschutzregister Hessen, http://www.rp-kassel.de/static/themen/naturschutz/natureg/download/broschuere.pdf, Zugriff 27.11.05

HMULV - Hessisches Ministierium für Umwelt, Landwirtschaft und Verbraucherschutz: Klimagutachten Hessen, unveröffentlichtes Gutachten, Wiesbaden, 2004

HLUG – Hessisches Landesamt für Umwelt und Geologie: Standorteignung Landwirtschaft – Potentielle Erosionsgefährdung – Bodenerosion, 1999

HLUG – Hessisches Landesamt für Umwelt und Geologie: Karten der Altflächen, 2003

HLUG - Hessisches Landesamt für Umwelt und Geologie: Fachinformationssystem Boden - Bodenkarte Hessen (BDK 50), 2004

HLUG Hessisches Landesamt für Umwelt und Geologie: Umweltatlas Hessen, digitale Umweltdaten http://atlas.umwelt.hessen.de/servlet/Frame/atlas/allg_dat/verwalt/verwalt_txt.htm, Zugriff 27.11.05

Holtmeier, F.K.: Tiere in der Landschaft – Einfluss und ökologische Bedeutung. Verlag Eugen Ulmer, Stuttgart, 2002

Jacoby, Ch.: Die Strategische Umweltprüfung (SUP) in der Raumplanung – Instrumente, Methoden und Rechtsgrundlagen für die Bewertung von Standortalternativen in der Stadt- und Regionalplanung. Erich Schmidt Verlag, 1999

LAWA – Länderarbietsgemeinschaft Wasser (Hrsg): Handlungsempfehlung zur Erstellung von Hochwasserschutzplänenn, Eigenvertrieb Umweltministerium Mecklenburg-Vorpommern, Schwerin, 1999

Mülder J., Stemmer, B.: Unterstützung nachhaltiger Planung durch 3D Visualisierung mit World Construction Set und Visual Nature Studio, Wien 2006

Röttcher, K.: Hochwasserschutz für kleine Einzugsgebiete im Mittelgebirge am Beispiel der Bauna. In: Kassler Wasserbau-Mitteilungen (Heft 11), Herkules Verlag, Kassel, 2001

RP Giessen: Landschaftsrahmenplan Mittelhessen, Gutachten im Auftrag des Regierungspräsidiums Giessen, Giessen,1998

RP Kassel: Landschaftsrahmenplan Nordhessen, Gutachten im Auftrag des Regierungspräsidiums Kassel, Kassel, 2000

Schröder, J.: Potentiell natürliche Vegetation Deutschland: Mittel-Westdeutschland. Unveröffentlichte Maunskript-Karte, Bundesamt für Naturschutz, Bonn. 1994

Schwevers, U.; Adam, B.; Engler, O.: Fischerreiökologisches Gutachten (Bd.1). Unveröffentlichte Studie im Auftrag der Oberen Fischereibehörde, Regierungspräsidium Kassel, Kassel 2002

UVPG – Gesetz über die Umweltverträglichkeitsprüfung (UVPG). In der Fassung und Bekanntmachung vom 25.Juni 2005, BGBl I S 1757, zuletzt geändert durch Artikel 2 des Gesetzes vom 24. Juni 2005, BGBl I S.1794

WHG – Gesetz zur Ordnung des Wasserhaushaltes. In der Fassung und Bekanntmachung, zuletzt geändert durch Art. 2 G v. 25. 6.2005 I 1746

🏆 **reviewed paper**

Studie Hochwasserschutz in der Dokumentation der Raumordnung

Michal HADLAC, M. KADLECOVÁ, S. KOVAR

1. PILOTPROJEKT

In den letzten Jahrzehnten hat sich im Gebiet des Pilsner Kreises grundsätzlich die Art und Weise der Nutzung des Gemeindegebietes geändert. In vielen Orten wurden Wohnbaukomplexe und Industriebetriebe in solchen Gebieten gebaut, die irrtümlicherweise für hochwassersicher gehalten wurden. Gleichzeitig wurde der Ausbau von Hochwasserschutzanlagen in den Gemeinden unterschätzt. Es wurde auf große Bauten von Wasserbehältern gesetzt, deren Speichervermögen sich als ungenügend erwiesen hat und bei deren Überflutung standen keine Mittel mehr zur Verfügung, die das Steigen des Wasserspiegels hätten aufhalten können. Dabei hat sich gleichzeitig gezeigt, dass in dem Gebiet zahlreiche physische Barrieren errichtet wurden (Verkehrswege, Brücken, Bauten usw.), die überdies den Abfluss des Hochwassers aus dem Gebiet behindert haben und oft die Ursache einer höheren Verheerungswut der Überschwemmungen waren. Darüber hinaus hat sich der Risikofaktor der Überschwemmungen erhöht, da es in dem Gebiet immer mehr Leitungsnetze gibt, zu deren Beschädigung es natürlich durch die Überflutung kommt.

Einen bedeutenden Faktor, der zum Ausmaß der Überschwemmungen beiträgt, stellt die geringe Wasserkapazität der Landschaft dar, die durch den sinkenden Anteil an zerstreuten Grünanlagen, Entwaldung (Forstnutzung im Nationalpark Šumava/Böhmerwald), Meliorationen, Begradigung von Wasserläufen und vor allem durch ununterbrochene Zunahme von versiegelten Flächen verursacht ist, und die ihrerseits bedingt ist durch chaotische und oft unorganisierte urbane Entwicklung.

Eines der Mittel, die die Raumentwicklung beeinflussen und sogar auch zur Reduktion der oben angeführten negativen Erscheinungen beitragen können, ist die Raumordnung. Dieses Projekt hatte zum Ziel einen Beitrag zu leisten zur Optimierung der Erarbeitung von Raumordnungsplänen in den Gemeinden und anderen großen Gebietskomplexen. Darüber hinaus sollten breitere Zusammenhänge des Hochwasserschutzes im Rahmen sowohl interregionaler und grenzüberschreitender Zusammenarbeit als auch im Rahmen der Erweiterung und Abänderung der jetzigen legislativen Normen Berücksichtigung finden.

2. METHODE DER PROJEKTVERARBEITUNG

Das Projekt wurde in vier Phasen bearbeitet:

- Sammeln von wichtigen Unterlagen, hauptsächlich:
  - Raumordnungspläne von großen Gebietskomplexen im Gebiet des Pilsner Kreises
  - Raumordnungspläne der ausgewählten Gemeinden
  - Studie des Hochwasserschutzes im Pilsner Kreis
  - Digitale Karten von Wasserläufen der hydrologischen Quellengebiete
  - Digitale Grundlagenkarten des Pilsner Kreises
- Analyse der Situation im Hochwasserschutz:
  - Bestimmung des Potenzials der Hochwassergefahr in dem Gebiet
  - Bestimmung der Speicherkraft des Gebietes aus der Sicht des Anteiles an bebauter Fläche und Waldfläche
  - Analyse der Situation der Inkorporation der Informationen über hochwasserbedrohte Gebiete und Hochwasserschutzmaßnahmen in die Raumordnungspläne der ausgewählten Gemeinden
  - Analyse der Hochwasserschutzmaßnahmen in den Raumordnungsplänen der Gemeinden
  - Analyse der Studien der Hochwasserschutzmaßnahmen in den ausgewählten Gemeinden
- Verarbeitung von Schlussfolgerungen und Empfehlungen
  - Kategorisierung der Wasserläufe und Einteilung des Kreisgebiets – aus der Sicht der Hochwasserschutzmaßnahmen
  - Empfehlung auf diesen Gebieten:
    - Erarbeitung von Raumordnungsplänen der Gemeinden und großen Gebietskomplexe
    - Reduzierung von kritischen Durchflüssen an den Grenzen der Gebietskomplexe
    - Finanzielle Mittel zur Motivation der Eigentümer zum Auffangen von Wasser
    - Raumordnungsmittel zur Einschränkung ungeeigneter Bebauung in Bebauungsgebieten
    - Finanzielle Unterstützung von Hochwasserschutzmaßnahmen im Gebiet
  - Vorschläge und Empfehlungen für die ausgewählten Gemeinden aus der Sicht der Situation der Hochwasserschutzmaßnahmen in ihren Raumordnungsplänen
  - Beurteilung der Hochwasserstudien der Gemeinden Švihov und Rokycany aus der Sicht der Ergebnisse dieses Pilotprojektes
  - Vorbereitung der Methodik „Ausgangspunkte der Hochwasserschutzmaßnahmen in der Dokumentation der Raumordnung“
- Vorbereitung von Infomaterialien

3. PILSNER KREIS IN ALLGEMEINEREM ZUSAMMENHANG

In Hinsicht auf das Zuflussgebiet der Elbe befindet sich der Pilsner Kreis im Gebiet der Oberläufe von Flüssen, die in die Elbe durch deren wichtigen Nebenfluss – die Moldau - münden. In dieser Situation kommt dem Pilsener Kreis die besondere Aufgabe zu, Anstrengungen zu unternehmen, die darauf abzielen, möglichst lange Regenwasser in diesem Bereich zurückzuhalten, bzw. Wassermassen aufzustauen, damit so Überschwemmungen verhindert oder zumindest wesentlich vermindert werden.

Im Hinblick auf den Wasserablauf aus dem Pilsner Kreis sind zwei geographische Punkte innerhalb seiner Verwaltungsgrenzen maßgebend. Die Punkte befinden sich an den Flüssen Berounka und Otava, die in die Moldau münden. Das meiste Wasser wird jedoch durch den Fluss Berounka abgeleitet, der kurz vor Prag in die Moldau mündet, sodass sein Wasser die Überschwemmungslage in der Hauptstadt unmittelbar negativ beeinflusst. Auch während der Überschwemmungen im Jahre 2002 hat die Berounka in nicht unerheblichem Maße die Durchflusserhöhung in die Moldau erhöht, was zur Überflutung eines Teiles des Stadtgebietes von Prag führte.

4. ZUSTAND VON RAUMORDNUNG IM PILSNER KREIS

Das Gebiet des Pilsner Kreises ist bezüglich der Raumordnungspläne von den großen Raumeinheiten ziemlich gut erschlossen. Im größten Teil des Kreises sind die Raumordnungspläne bewilligt. Ein Problem besteht noch im Bezirk Klatovy, wo das aktualisierte Konzept vom Jahr 2000 bis jetzt diskutiert wird, sodass der alte, im Jahre 1992 bewilligte Raumordnungsplan von der großen Raumeinheit Böhmerwald bis heute nicht ersetzt werden konnte. Eine Analyse der einzelnen Raumordnungspläne zeigt, dass der derzeitige Entwurf zur Überschwemmungsprävention nur Projekte von neuen Wasserspeichern vorsieht, - die meisten von ihnen jedoch in großem zeitlichen Rahmen. Was den Gebietsschutz betrifft ist kein vollständiger Entwurf in diesen Raumordnungsplänen enthalten.

Die Flächendeckung der Raumordnungspläne ist in den Gemeinden mit dem Zustand in einigen anderen Kreisen, vor allem mährischen Kreisen, in denen die Verbreitung der genehmigten Raumordnungspläne fast 100% erreicht, nicht vergleichbar.

Bewilligter Raumordnungsplan	37 %
Entwurf von Raumordnungsplan	35 %
Ohne Raumordnungsplan	28 %

Deshalb besteht im Pilsner Kreis die gute Gelegenheit, die Lösung der Problematik im Hinblick auf den Überschwemmungsschutz sowohl in den Änderungen zu den bereits bewilligten Plänen, als auch vor allem in den in Arbeit befindlichen und aufgenommenen Raumordnungsplänen zu erweitern.

5. KATEGORISIERUNG DES GEBIETES IM HINBLICK AUF SEINE FUNKTIONEN IM ÜBERSCHWEMMUNGSSCHUTZ-SYSTEM DES GEBIETES

Bezüglich des Entwurfes zur Überschwemmungsvorsorge im Raumordnungsplan der Gemeinde ist von den spezifischen Gegebenheiten innerhalb der einzelnen Gemeinden, sowie von deren Lage im Bereich des Wasserflusses auszugehen.

In vereinfachter Form sind vier Kategorien zu unterscheiden:

Kennzeichnung	**Beschreibung**
I.	Flussbetterweiterungen, Sohlenvertiefungen
II.	Schutzdämme, Wasserumlaufkanale
III.	Speicherung – Polder, Wasserspeicher
IV.	Speicherung – Polder, Wälder

Die Auswahl von diesen Gemeinden wird aufgrund der Analyse der nachfolgenden Kriterien durchgeführt:

kumulierte Zuflussgebiet-Fläche im Bereich der Gemeinde – bearbeitet durch die Karte der hydrologischen Zuflussgebiete der 4. Stufe. Dieses Kriterium zeigt, wieviel Wasser bei dauerhaftem Regen und unter gleich bleibenden Ablaufverhältnissen im jeweiligen Zuflussgebiet gesammelt würde. Dies kann außerdem als Kennziffer für die eventuelle Gefährdung durch Hochwasser dienen.

Bewaldungsverhältnis zwischen den einzelnen Zuflussgebieten – aufgrund des Vergleiches der Flächen von hydrologischen Zuflussgebieten der 4. Stufe und Waldflächen von der Karte 1:25000 wurde für jedes Zuflussgebiet die Kennziffer der Bedeckung durch gewachsene Begrünung festgesetzt;

Verhältnis der bebauten Fläche in einzelnen Zuflussgebieten – aufgrund des Vergleiches der Flächen von hydrologischen Zuflussgebieten der 4. Stufe und Flächen des bebauten Geländes von der Karte 1:25000 wurde für jedes Zuflussgebiet die Kennziffer der Bedeckung durch Bebauung festgesetzt;

angepasste kumulierte Zuflussgebiet-Fläche im Bereich der Gemeinde – gesamtes Kriterium, das sich aus den drei vorangehenden Kriterien ergibt. Im Hinblick auf die Ablauf-Verhältnisse wurden diese drei Koeffizienten festgesetzt:

bewaldete Fläche – 0,5 (diese vermindert die Menge von Ablaufwasser im Mittel auf die Hälfte)
bebautes Gelände – 2,0 (dies verdoppelt die Menge von Ablaufwasser)
anderes Gelände – 1,0 (mittlerer Wert)

Bei der Erstellung der Analyse wurde die Karte für die hydrologischen Zuflussgebiete 1:50000 verwendet.

Für jedes Zuflussgebiet wurde die angepasste Fläche einschließlich aller Zuflussgebiete auf den Wasserflüssen im Bereich dieses Zuflussgebietes zusammengerechnet. Werden die auf diese Weise berechneten Flächen in die Bereiche von Wasserflüssen, die zu den jeweiligen hydrologischen Zuflussgebieten gehören, projiziert, dann ist die Identifizierung und Einordnung der einzeln ausgewählten Gemeinden in die Kategorien einfach durchzuführen.

Bei der Bewertung der Raumordnungspläne von ausgewählten Gemeinden wurden die Rasterzeichnungen verwendet, die in dem zur Zeit bereits (teilweise) im Internet zugänglichen Register der Raumordnungspläne von Gemeinden im Pilsner Kreis zu finden sind. Für jede Gemeinde wurde eine kurze Bewertung der Überschwemmungs-Risiken, sowie Charakterisierung der Gemeindefunktion innerhalb des Überschwemmungsschutz-Systems ihrer Kategorie entsprechend bearbeitet.

6. VERWENDUNG VON GIS

Zur Lösung der Aufgabe wurde das Programm ArcView 9.1 der Firma ESRI und für die Berechnungen wurde die Datenbank Visual FoxPro 8.0 von Microsoft verwendet. Die Analyse wurde mit Hilfe der Vektorkarte der hydrologischen Zuflussgebiete der 4. Stufe erstellt. Der Wert betreffend Bewaldungs- und Bebauungsstufen in den Zuflussgebieten wurde durch die Funktionen im Programm ArcView festgesetzt. Weiter wurden die Vektorkarten von den betreffenden Überschwemmungsgebieten zu Verfügung gestellt. Dabei war es notwendig, diese teilweise durch schriftliche Unterlagen zu ergänzen. Die Raumordnungspläne von den Gemeinden wurden vom Raumordnungspläne-Register des Pilsner Kreises, dessen Betrieb durch das Institut für Regionalinformationen gewährleistet ist, erhalten.

7. BEITRAG FÜR DEN ÜBERSCHWEMMUNGSSCHUTZ DER GEMEINDEN

Das Projekt bringt keine sofortigen Ergebnisse im Bereich des Überschwemmungsschutzes. Aufgrund der Orientierung auf räumliche Planungstätigkeiten ist es jedoch möglich, in Zukunft den Überschwemmungsschutz von Gemeinden wesentlich zu verbessern, wenn Raumordnungspläne erstellt werden, in denen Empfehlungen verarbeitet werden, die sich aus den in diesem Projekt vorgelegten Grundsätzen und Kategorisierung ergeben.

Der wichtige Endergebnis ist der Entwurf betreffend die Gemeinde-Kategorisierung im gelösten betrachteten Gebiet (Pilsner Kreis) im Hinblick auf deren Funktionsfähigkeit im Überschwemmungsschutz-System des Kreises. Diese Kategorisierung ist sowohl bei der Erstellung der Raumordnungspläne von Gemeinden, als auch der Erstellung des Raumordnungsplanes im Rahmen des gesamten Kreises direkt anwendbar.

8. BEITRAG ZUM ÜBERSCHWEMMUNGSSCHUTZ FÜR DEN GESAMTEN KREIS

Im Rahmen der Lösung eines Raumordnungsplanes für den Großraum ist ein Maßnahmenkatalogkatalog vorzulegen, durch den einerseits die Eintrittsmöglichkeit der Überschwemmungslage (höchste Anstrengungen Wasser auf dem jeweiligen Gebiet zu halten) vermindert wird und andererseits Schutz von Objekten während einer bereits eingetretenen Überschwemmung (Hochwasserschutzanlagen) gewährleistet würde. Bestandteile eines solchen Entwurfes wären:

Grundsätze betreffend Erstellung von Raumordnungsplänen für die einzelnen Gemeinden – Kategorisierung der Gemeinden, Aufgabestellung im gesamten System, Prioritätsfeststellung im Hinblick auf Zuflussgebiet von einzelnen Wasserflüssen (Wasserspeicherung kombiniert mit Hochwasserschutz);

Vorlage von umfangreicher Überschwemmungsvorsorge (Wasserspeicher, trockene Polder, Schutzdämme), die zu den gemeinnützlichen Bauten, bzw. zu den gemeinnützlichen Maßnahmen zugeordnet werden;

Vorlage von Hochwassergebieten mit hohem Umfang, einschliesslich des Entwurfs von der verbindlichen Art zu deren funktioneller Anwendung;

Beurteilung von Entwürfen betreffend Entwicklungsflächen, Ingenieurbauwerke und räumliches System für die ökologische Stabilität bezüglich der Beeinflussung des Wasserhaushaltes im Gebiet und Sicherstellung deren optimalen Koordinierung;

Bestimmung des gesamten mittleren Ablaufkoeffizienten für den gesamten Kreis.

9. BEITRAG FÜR DEN HOCHWASSERSCHUTZ ALLGEMEIN

Allgemein lassen sich die Beiträge des Projektes auf drei Ebenen sehen:

Vorschläge zu Methoden im Rahmen der Erarbeitung der Dokumentation der Raumordnung – Möglichkeit der Einarbeitung in das Baugesetz

Vorschläge zur Motivation von Immobilieneigentümern zum Auffangen von Wasser auf dem Grundstück – Möglichkeit der Einarbeitung in das Grundsteuergesetz

Vorschläge zur Motivation der Gemeinden zum Auffangen von Wasser – Möglichkeit der Einarbeitung in das Gemeindegesetz

Vorschläge zur ökonomischen Unterstützung der Hochwasserschutzmaßnahmen in dem Gebiet – Vorschlag des „Hochwasserfonds“

Alle diese Vorschläge verfolgen primär die Frage der Verstärkung der Speicherfähigkeit des Gebietes, was folglich zur Verringerung der Finanzansprüche auf Ausbau passiver Schutzobjekte und gleichzeitig auch zur Verringerung des Ausmaßes der Schäden bei künftigen Überschwemmungen führt.

Konzeptionelle Überlegungen zur Implementierung eines DSS Planer-Client im Interreg IIIB Projekt FLOWS (Flood Plain Land Use Optimizing Workable Sustainability) für die Freie und Hansestadt Hamburg

Kai-Uwe KRAUSE, Christoph KÜPFERLE, Olaf SIMON, Stephan TRESSL

(Dr.-Ing. Kai-Uwe Krause, TU Hamburg-Harburg, Institut für Stadt-, Regional- und Umweltplanung (CAD/GIS in der Stadtplanung), Schwarzenbergstraße 95D, 21073 Hamburg, k.krause@tu-harburg.de
Dipl.-Ing. Christoph Küpfele, TU Hamburg-Harburg, Institut für Wasserbau, Denickestraße 22, 21073 Hamburg, c.kuepferle@tu-harburg.de
Dipl.-Ing. Olaf Simon, Bezirksamt Hamburg-Nord, Bauamt-Tief- u. Gartenbauabteilung, N/BA 40/T, olaf.simon@hamburg-nord.hamburg.de
Dipl.-Ing. Stephan Tressl, TU Hamburg-Harburg, Institut für Stadt-, Regional- und Umweltplanung, Schwarzenbergstraße 95D, 21073 Hamburg, s.tressl@tu-harburg.de)

1. EINLEITUNG

Wasser ist nicht nur Grundlage unseres Lebens, sondern auch umweltbestimmend und vielfältig erlebbar. Wasser verbreitet Atmosphäre und Stimmungen, die unser Gefühl ansprechen. Am Wasser zu wohnen bedeutet jenes Element zu erleben, welches jede Landschaft unmittelbar und auf Dauer mit Leben erfüllen kann. Das dynamische Vorhandensein von Wasser formt und prägt Landschaften permanent neu und schafft damit gesunde Lebensgrundlagen für uns alle.

Auch auf die Menschen üben Wasserflächen eine starke Anziehung aus und sind beliebte Erholungsgebiete. Man kann fragen, warum der Mensch überhaupt auf die Idee kam, an Gewässern Siedlungen zu errichten. Mehrere Faktoren spielen dabei eine Rolle. Wasser ist ein Lebensmittel, welches in der Nähe verfügbar sein muss. Auch wenn die Römer bereits ausgeklügelte Wasserleitungen bauten, so bedeutete ihr Bau einen Aufwand, den sich nicht jede Dorfgemeinschaft leisten konnte. Die räumliche Nähe zur Trinkwassergewinnung aus Flüssen war folglich ein Hauptgrund für Siedlungen in Ufernähe. Nicht zu unterschätzen ist die Funktion des Wassers als Verteidigungsmittel. Flüsse und auch künstlich angelegte Wassergräben können von Angreifern schwer überwunden werden.

Dazu kommt die Nützlichkeit des Wassers als Arbeitsmittel zur Reinigung der Wäsche, aber auch zum Färben. Die Nutzung der Wasserkraft in Mühlen (Getreideverarbeitung, Ölpressen) und Werkstätten (Schmiede) sind ein weiterer Grund für Siedlungen am Ufer. Der Aspekt des Wassers als Arbeitsmittel lässt sich bis heute fortführen, wenn man z.B. an Kernkraftwerke und die chemische Industrie denkt. In Flussauen finden sich zudem fruchtbare Böden für den Ackerbau, da Flüsse z.B. Löss transportieren und diesen bei Überschwemmungen regelmäßig ablagern. Nicht zuletzt stellte der Fischfang aus Flüssen einen bedeutenden Beitrag zur Nahrungsmittelgewinnung dar. Als Transportweg für Menschen und Waren sind Flüsse ein bis heute wichtiger Wirtschaftsfaktor. Der Umschlag von Waren zog Häfen und Werften für Schiffbau und –wartung nach sich. Zudem wurden landgebundene Verkehrsinfrastrukturen, wie Eisenbahnen und Straßen bevorzugt in Flussauen gebaut, weil hier eine relativ ebene Trasse ohne großen Bauaufwand (Erdbewegungen) genutzt werden konnte, wie zum Beispiel im Rheintal.

Standen früher vor allem die praktischen Erwägungen bei Siedlungsentscheidungen im Vordergrund, so kommen in heutiger Zeit weitere Faktoren hinzu. Zu nennen ist der Wunsch einiger Menschen, am Wasser zu wohnen, und zwar weniger aus praktischen Gründen, sondern aus Gründen eines bestimmten Lebensgefühls, das vereinfacht gesagt mit Individualisierung und Modeerscheinungen zusammen hängen. Außerdem wird Flüssen eine Erholungsfunktion zugesprochen, die sich in der Anlage von Radwegen und Erholungsgebieten widerspiegelt. Der Erholungswert besteht zwar unabhängig davon, ob sich Siedlungen in Wassernähe befinden, jedoch ist eine gewisse Nähe zwischen Wohn- und Erholungsort aus lebenspraktischen Erwägungen (z.B. weniger Aufwand für die Raumüberwindung) nahe liegend.

Man kann daraus schließen, dass die Nutzung der Flüsse auf verschiedenste Weisen zur zivilisatorischen Entwicklung beigetragen hat. Heute wäre ein Rückbau von Siedlungen in Flussnähe und somit aus potentiellen Überschwemmungsgebieten zwar denkbar, ohne dass die Gesellschaft grundlegenden Schaden nehmen würde. Aber wer will ernsthaft fordern, historische Altstädte, traditionelle Lebensräume und (Wirtschafts-) Standorte aufzugeben?

Kulturlandschaften überliefern, wie eng Städtebau, Gewerbe und Landschaftsgestaltung mit dem Wasser und dessen Nutzung verbunden waren. Diese Beziehung prägte nachhaltig das Bild der Städte. Dabei ist Wasser nicht nur Ver- und Entsorgungselement, es wurde in allen hohen Kulturen kunstvoll inszeniert, ästhetisch hervorgehoben und verehrt. Es bestimmt die Atmosphäre, markiert den Pulsschlag zwischen Stadt und Umland.

Große Wasserläufe geben Städten die besondere Atmosphäre und sind insoweit nicht nur stadtbildprägend, sondern das Wasser kann auch die Ästhetik eines Stadtbildes bewahren. Insbesondere große Wasserläufe sind daher ein sinnlicher Speicher von Lebens- und Aufenthaltsqualität. Flüsse und Wasserflächen sind ästhetische urbane Konstanten einer Stadt.

All zu gerne verdrängt man beim Anblick von Wasser, dass eine Nutzung am Wasser auch eine Gefahr beinhaltet: die Hochwassergefahr. In der jüngsten Vergangenheit haben durch Starkregen verursachte Überschwemmungen (an Oder und Elbe) verdeutlicht, dass eine erfolgreiche Raum- und Stadtentwicklung an der besonderen Würdigung der Hochwasserproblematik nicht mehr vorbeikommt. Hinzu kommen Aussagen von Klimaforschern, die auf zukünftig extremer werdende Niederschläge hinweisen. Diese Ereignisse und Entwicklungen haben dazu beigetragen, dass die Politik dem Thema Hochwasser mehr Aufmerksamkeit widmet und folglich zahlreiche Gesetzesänderungen vorgenommen hat. Das so genannte „Artikelgesetz zum vorbeugenden Hochwasserschutz“ vom 03.05.2005 ändert zahlreiche Gesetze, wie das Baugesetzbuch (BauGB), das Raumordnungsgesetz (ROG), das Wasserhaushaltsgesetz (WHG) und weitere Fachgesetze. Der Grundsatz des Artikelgesetzes zielt darauf ab, möglichst viel Wasser so lange wie möglich auf unbebauten Flächen zurückzuhalten, um Hochwasserpegel langsamer und weniger stark auflaufen zu lassen.

Hochwasserereignisse sind Teil unserer natürlichen Umwelt und insofern normalerweise keine besonderen Ereignisse. Ihre Bedeutung erlangen sie erst dadurch, dass der Raum, den der Fluss bei Hochwasser beansprucht, in vielen Teilen des Landes bereits mit anderen Nutzungen belegt ist. Zu diesen Nutzungen gehören Siedlungen, inklusive öffentlicher Einrichtungen, Gewerbe- und Industriegebiete sowie Verkehrswege. Durch diese Situation entsteht ein Flächennutzungskonflikt, der im Falle eines Hochwassers eine Vielzahl möglicher Schäden nach sich ziehen kann: Zuallererst kann ein Hochwasser für die ansässige Bevölkerung lebensgefährlich sein; an zweiter Stelle sind die Sachschäden zu nennen, die ein Hochwasser verursachen kann. Der natürliche Flusslauf und die durch Menschen geschaffenen Kulturnutzungen auf den überschwemmten Flächen stehen zumeist im Widerspruch zueinander. Eine Frage wird nach einem Hochwasser mit großen Schäden immer wieder gestellt: Wie kommt es, dass die Grundstückseigentümer an dieser Stelle bauen durften? Welche Verantwortung tragen die Bauleit- und die Regionalplanung?

Nur allzu vernünftig ist es daher, dass sich ein internationales interdisziplinäres Team zusammengefunden hat, um diese neuen Herausforderungen anzunehmen und gemeinsam Lösungen im Zusammenhang mit dem Projekt FLOWS zu erarbeiten. FLOWS steht für „Flood Plain Land Use Optimising Workable Sustainability“. FLOWS ist ein durch INTERREG III B gefördertes EU-Projekt. Ein Ziel im Rahmen von FLOWS ist es daher, eine Balance zu finden zwischen dem ästhetisch motivierten Bedürfnis am Wasser leben zu wollen und den Anforderungen an eine maximale Hochwassersicherheit. Diese Suche nach der Balance ist ein wichtiger Erfolgsfaktor für modernes urbanes Flussgebietsmanagement. Will man das Ziel erreichen, sowohl den urbanen Erfordernissen an Wohnqualität als auch mit den Bedürfnissen an eine hohe Lebenssicherheit gerecht zu werden, muss man bereit sein, mit dem Wasser im Einklang leben zu wollen und zu können.

2. FLOWS

Deutschland wurde Anfang 2004 als zusätzlicher Partner in das bereits bis zum laufende 30. Juni 2006 EU-Projekt FLOWS aufgenommen worden. Das Deutsche Team unter der Leitung der Behörde für Stadtentwicklung und Umwelt der Freien und Hansestadt Hamburg setzt sich wie folgt zusammen:

Technische Universität Hamburg-Harburg, Institut für Wasserbau
Technische Universität Hamburg-Harburg, Institut für Stadt-, Regional- und Umweltplanung
Universität Lüneburg, Fachbereich Wasser, Technik und Computing
Landwirtschaftskammer Hannover, Bezirksstelle Uelzen

Neben den deutschen Partnern sind Partner aus England (Leadpartner), Schweden, Niederlande und Norwegen am Projekt beteiligt. Das allgemeine Ziel des Projektes ist die nachhaltige Entwicklung in überschwemmungsgefährdeten Gebieten. Dies soll durch strategische, anwendungsbezogene und innovative Projekte in allen Partnerländern erreicht werden. Dabei sollen, aufbauend auf bereits bestehenden Raumplanungsstrategien, insbesondere interdisziplinäre Entscheidungshilfesysteme für Anwender aus der Wissenschaft, der Wirtschaft und der Verwaltung entwickelt, eingeführt und betrieben werden. So wird eine effiziente Verknüpfung verschiedenster Fachinteressen ermöglicht und die Planung von Infrastrukturmaßnahmen effektiv unterstützt. Im Rahmen von FLOWS werden von den deutschen Partnern folgende Schwerpunkte bearbeitet.

Erstellen von Risiko- und Überschwemmungskarten für die Flusseinzugsgebiete der Flüsse Kollau und der Tarpenbek sowie Verbesserung der Modelltechnik für die Flachlandproblematik. Entwicklung eines internetbasierten Unterstützungsportals für hochwasserangepasstes Bauen.

Erarbeitung eines Hamburgweiten Konzeptes zur Integration von Überschwemmungsinformationen in den Planungs- und Raumentwicklungsablauf. Implementierung eines webbasierten Entscheidungsunterstützungssystems (Decision Support Systems, DSS) mit Schwerpunkt Wassermanagement in kommunalen Verwaltungen (Bezirksämter Eimsbüttel und Hamburg-Nord).

Erarbeitung eines Daten-Harmonisierungs-Konzeptes zur Entwicklung und Einbindung der Ergebnisse von FLOWS in eine Hamburgweite Geodateninfrastruktur (GDI) unter der Berücksichtigung von internationalen offenen Geodatenstandards (OGC- Open Geospatial Consortium) sowie der Verlinkung der Ergebnisse mit der Metropolregion Hamburg.

Entwicklung eines Decision Support Systems (DSS) für die Landnutzung im Einzugsgebiet der Elbe in Bereich Niedersachsen unter der besonderen Würdigung der Wasserqualität und den Anforderungen an die Landwirtschaft.

Erste konkrete Ergebnisse liegen vor und werden anschließend kontinuierlich veröffentlicht (Internet www.flows.hamburg.de). Zum Ende des Projektes (Mitte 2006) wird es neben der internationalen auch eine nationale Schlusskonferenz geben, auf der die Ergebnisse der verschiedenen Arbeitspakete präsentiert und zur Diskussion gestellt werden.

3. HOCHWASSERMANAGEMENT IN HAMBURG

Bei der Abwehr von Hochwassergefahren auf dem Landesgebiet der Freien und Hansestadt Hamburg muss zwischen dem Hochwasserschutz an der Elbe und dem Hochwasserschutz an den Nebenflüssen der Elbe differenziert werden.

3.1 Hochwasserschutz an der Elbe

In der Nacht vom 16. auf den 17. Februar 1962 erreichte der Wasserstand der Elbe ein bis dahin noch nicht gekanntes Höhenniveau von 5,70 m+NN. Die Sturmflut überraschte eine Großstadt, die weder organisatorisch noch vom technischen Standard der Hochwasserschutzanlagen her auf ein solches Ereignis vorbereitet war. 60 Deichbrüche, 12.000 ha überschwemmte Flächen (ein

Sechstel des Hamburger Staatsgebietes), 20.000 evakuierte Einwohner, Schäden in Milliardenhöhe und 315 tote Hamburger Bürger waren die Folge.

Die Sturmflut von 1962 und das große Elbhochwasser im Jahr 2002 Jahr verdeutlichen, dass Hochwässer schon immer ein fester Bestandteil der Umwelt gewesen sind und dieses auch in Zukunft bleiben werden. Hochwasserschutz ist eine Daueraufgabe. Die zuständigen Fachleute sind angehalten, sich nicht von den aufgeregten öffentlichen Diskussionen, die regelmäßig unmittelbar nach Hochwasserereignissen aufkommen, beeinflussen zu lassen. Die Umsetzung von Hochwasserschutzkonzepten, die eine nachhaltige Verbesserung der Hochwassersicherheit zum Ziel haben, erfordert einen langen Atem. Vor einer Darstellung des Hochwasserschutzes bzw. der Hochwassergefahren in Hamburg muss eine inhaltliche Differenzierung des Begriffes Hochwasser vorgenommen werden. Wir müssen zwischen Hochwässern in der Stromelbe und in den Nebenflüssen der Elbe unterscheiden.

Die Hochwässer im Unterlauf der Elbe treten auf, wenn die Gezeitenflutwelle, die durch die Mondgravitation induziert wird, von einem Windstau überlagert wird. Der Windstau entsteht, wenn Winde aus westlicher Richtung große Wassermassen in die trichterförmige Mündung der Elbe drücken, die dann mit der Flut die Elbe aufwärts getragen werden. Treten bei der Überlagerung von Windstau und Gezeitenflutwelle extreme Wasserstände auf, so spricht man von einer Sturmflut.

Das Tide- bzw. Sturmflutgeschehen in der Elbe ist räumlich begrenzt durch die Hauptdeichlinie und das Elbsperrwerk bei Geesthacht, dass als ein Querriegel den stromaufwärts vom Sperrwerk gelegenen Teil der Elbe dem Tideeinfluss entzieht.

Hinter der Hauptdeichlinie befinden sich eine Vielzahl von Fließgewässern, die durch Schöpfwerke, Siele und Sperrwerke von dem Hauptstrom der Elbe getrennt sind. Auch in diesen Elbnebenflüssen können Hochwässer auftreten und zwar immer dann, wenn große Niederschlagswassermengen den Fließgewässern zugeleitet werden. Die hydrologischen Zusammenhänge und Ursachen dieser Art von Hochwasser entsprechen prinzipiell denen, die auch für Hochwässer oberhalb des Stauwehres Geestacht in der Stromelbe gelten. Erhöhte Oberwasserabflüsse wirken sich unterhalb von Geesthacht nur geringfügig auf die Wasserstände aus. Eine Gefahr durch Hochwässer aus dem Oberlauf der Elbe besteht für Hamburg nicht.

Entsprechend der vorstehend getroffenen Aussagen muss bei der Abwehr von Hochwassergefahren auf Hamburger Landesgebiet zwischen dem Hochwasserschutz an der Elbe und dem Hochwasserschutz an den Nebenflüssen der Elbe differenziert werden.

Hamburg hat seine Lehren aus der verheerenden Sturmflut von 1962 gezogen. Damit sich eine derartige Katastrophe nicht wiederholt, wird in Hamburg heute in eine Strategie in Anlehnung an die Empfehlung der LAWA „Instrumente und Handlungsempfehlungen zur Umsetzung der Leitlinien für einen zukunftsweisenden Hochwasserschutz“ verfolgt: Deshalb sind einfache Strategien zur Lösung eines Hochwasserproblems in der Regel nicht erfolgreich. Ein zukunftsweisender Hochwasserschutz umfasst neben den wasserbaulichen Maßnahmen (Technischer Hochwasserschutz) und dem natürlichen Wasserrückhalt auch eine weitere Komponente, den so genannten vorbeugenden Hochwasserschutz, bestehend aus einer Flächenvorsorge, Bauvorsorge, Verhaltensvorsorge und Risikovorsorge.

Die Hamburger Wasserwirtschaftsverwaltung hat sich sowohl beim Sturmflutschutz als auch beim Hochwasserschutz hinter der Hauptdeichlinie anspruchsvolle Ziele gesetzt. Für das Erreichen dieser Ziele stellen die folgenden Leitsätze den Handlungsrahmen dar:

Die folgenden Arbeitsschritte sind einzuhalten:

- Beschreibung der Gefahrenlage
- Analyse der Gefahrenlage
- Untersuchung der Handlungsalternativen
- Bewertung der Handlungsalternativen
- Entscheidung für eine Gesamtlösung
- konsequente und schnellstmögliche Umsetzung der Lösung

Die Lösung muss für das gesamte Flussgebiet, also länderübergreifend gefunden werden.
Der Schutz des Menschen hat absoluten Vorrang vor anderen Zielen.
Der Schutz von Sachwerten ist ein Teilziel und steht insoweit in Konkurrenz zu anderen Teilzielen (z. B. Naturschutz).
Der Katastrophenschutz (Organisation der Warnung und Verteidigung) muss vereinheitlicht werden.
Das Gefahrenbewusstsein muss wach gehalten werden (Bewusstsein statt Angst!).

Für den Sturmflutschutz wurde in Hamburg in der Vergangenheit viel getan. So wurden in den Jahren nach 1962 unter großen Anstrengungen neue, leistungsfähige Deiche und Hochwasserschutzwände errichtet. Ergänzend entstand eine neue Warn- und Deichverteidigungsorganisation. Die Anstrengungen haben sich gelohnt. Es konnten mehrere sehr schwere Sturmfluten, bei denen die Wasserstände der Elbe ein noch höheres Niveau als 1962 erreichten, ohne größere Schäden abgewehrt werden.

Bei den Nebengewässern der Elbe, die nach Starkregenereignissen ihr Wasser nicht mehr im Gewässerbett halten können und so zu starken Überschwemmungen der Auenbereiche führen, besteht weiterer dringlicher Handlungsbedarf. Hierauf wird nachfolgend eingegangen.

3.2 Hochwasserschutz an den Nebenflüssen der Elbe

Neben dem Elbstrom existieren in Hamburg eine Vielzahl von natürlichen und künstlichen Gewässern: Die Alster und Bille sowie viele Fleete, Kanäle und Bäche durchziehen die Stadt. Wie in kaum einer anderen Metropole ist das Element Wasser überall in Hamburg gegenwärtig. Doch die Gewässer verleihen der Metropole Hamburg nicht nur einen einzigartigen Flair, sondern können auch von Zeit zu Zeit zu Schäden führen, wenn sie über Ihre Ufer treten.

In der Vergangenheit sind große Flächen der Gewässereinzugsgebiete durch Bebauung oder Oberflächenbefestigung versiegelt worden. Die Flächenversiegelung führt dazu, dass größere Niederschlagswassermengen schneller den Vorflutern und Sielen zugeführt werden und so höhere Abflüsse bzw. Wasserstände auftreten. Bei ungünstiger Konstellation können sich aufgrund veränderter Fließzeiten Hochwasserspitzen aus Teileinzugsgebieten im Hauptvorfluter überlagern und so zu noch höheren Wasserständen führen.

Die Entsiegelung von Flächen im großen Umfang zur Vermeidung der vorstehend genannten nachteiligen Auswirkungen auf das Hochwasserregime von Fließgewässern ist auch in Hamburg ein erstrebenswertes Ziel, aber aufgrund der zunehmenden Verdichtung der Stadt nicht zu realisieren. Zur Zeit werden zahlreiche Wohnungs-, Gewerbe- und Gemeinbedarfsflächen im Zusammenhang mit einer inneren Stadtverdichtung gewonnen. Aufgrund des politischen Zieles der „Wachsenden Stadt" wird dieser Trend auch in Zukunft anhalten. Der Metropole Hamburg werden weitere Flächen verloren gehen, die aus wasserwirtschaftlicher Sicht die Funktion einer Niederschlagsspeicherfläche haben. Zum Teil existieren schon jetzt erste Entwässerungsengpässe, die bei einer zunehmenden Verdichtung verschärft und ohne Gegenmaßnahmen zu einer innerstädtischen Überflutung führen würden.

Um einer weiteren Verschärfung der Hochwassersituation entgegen zu wirken, hat die Hamburger Wasserwirtschaftsverwaltung schon vor 15 Jahren einen neuen Weg zur Bewirtschaftung von Niederschlagswasser eingeschlagen. Seitdem gilt in Hamburg der Grundsatz:

Versickerung,
Offene Oberflächenentwässerung,
Sielbau (Kanalbau).

Entsprechend dieser Reihenfolge sind bei jedem Bauprojekt, die Handlungsoptionen zur Niederschlagswasserbeseitigung abzuprüfen.

Die Versickerung von Niederschlagswasser soll möglichst dezentral, d. h. am Ort des Wasseranfalls, vorgenommen werden. Eine dezentrale Niederschlagswasserversickerung kann durch eine Regenwassernutzung, z. B. als Brauchwasser, sinnvoll ergänzt werden. Erst wenn eine Versickerung, z. B. aufgrund von hohen Grundwasserständen oder einer zu geringen Bodendurchlässigkeit, nicht möglich ist, muss das Wasser gefasst und abgeleitet werden.

Obwohl in Hamburg bei vielen Bauprojekten Maßnahmen zur dezentralen Niederschlagswasserbewirtschaftung erfolgreich eingesetzt wurden, führt der starke Rückgang von unbebauten Flächen doch zu einem erhöhten direkten Niederschlagsabfluss, welcher letztendlich von den vorhandenen Gewässern aufgefangen werden muss. In diesen Fällen ist nachzuweisen, dass die Vorfluter eine ausreichende Kapazität zur schadlosen Abführung der Wassermengen aufweisen.

Neben der zunehmenden Versiegelung von Flächen besteht aus wasserwirtschaftlicher Sicht das Problem, dass die natürlichen Retentionsräume vieler Fließgewässer in der Vergangenheit stark eingeschränkt worden sind. Natürliche Auenbereiche, die bei Hochwasser einen Teil der Wassermengen zwischenspeichern können, sind selten geworden. Häufig enden die Nutzungen auf den an das Gewässer angrenzenden Flächen erst an der Böschungsoberkante.

Eine Freistellung von Flächen zur Wiederherstellung von Retentionsräumen im großen Umfang ist in der Metropole Hamburg aufgrund der intensiven Flächennutzung nicht möglich. Sofern eine Vermeidung von Hochwasserspitzen durch flächenhafte Versickerung nicht möglich ist, muss die Zwischenspeicherung eines Teilabflusses zur Kappung des Hochwasserscheitels in speziell zu diesem Zweck errichteten Rückhaltebecken vorgenommen werden. Eine optimale Einbindung von derartigen wasserwirtschaftlichen Anlagen in das Stadtbild ist insbesondere bei Erschließungsmaßnahmen möglich, da die wasserwirtschaftlichen Belange im Rahmen der Bauleitplanung ausreichend berücksichtigt werden können.

Für die Beurteilung bestehender wasserwirtschaftlicher Verhältnisse und die Prognose der Auswirkungen von wasserwirtschaftlichen Maßnahmen wurden in den letzten Jahren in enger Kooperation mit dem Institut für Wasserbau (Prof. Pasche) der Technischen Universität Hamburg-Harburg verstärkt Niederschlag-Abfluss-Modelle eingesetzt. Ein Niederschlag-Abfluss-Modell ist in der Lage, die Teilkomponenten des landgebundenen Wasserkreislaufs in einem Einzugsgebiet abzubilden und die ablaufenden hydrologischen Prozesse durch Simulation zu quantifizieren. Dieses ermöglicht die Bearbeitung einer Reihe von Fragestellungen, wie z. B.

- die Ermittlung der Auswirkungen von Niederschlägen auf ein Gewässer (Erkennen von hydraulischen Schwachstellen)
- das Kennzeichnen überschwemmungsgefährdeter Bereiche bei Niederschlägen mit bestimmter statistischer Häufigkeit
- die Ermittlung des Einflusses von zusätzlicher Versiegelung in einem Einzugsgebiet durch Veränderung der entsprechenden Parameter
- die Ermittlung der Auswirkungen hydraulischer Sanierungsmaßnahmen (z. B. optimale Positionierung von Retentionsmaßnahmen).

Hamburg wird unter Zuhilfenahme derartiger leistungsfähiger Simulationssoftware das gesamte Hamburger Gewässersystem überprüfen und dabei diejenigen Stellen identifizieren, die schon zum jetzigen Zeitpunkt eine Gefährdung bedeuten oder in Zukunft, bei weiteren städtebaulichen Verdichtungen, eine Gefährdung darstellen könnten. Zu jedem Gefährdungspunkt werden hydraulische Sanierungsmaßnahmen vorgeschlagen, die entweder kurzfristig oder langfristig, je nach Gefährdungspriorität, umgesetzt werden können. Durch die exakte Berechnung der Wassermengen können Lösungen erarbeitet werden, die schonend mit den zur Verfügung stehenden Flächen umgehen. Vor dem Hintergrund der hohen Grundstückspreise in Hamburg ist dies ein wichtiger Punkt bei vorangestellten Kosten-Nutzen-Analysen. Der zielgerichtete Eingriff in Gewässerstrukturen fördert den sparsamen Umgang mit Finanzressourcen und ist auch aus ökologischer Sicht vorteilhaft, da der Gewässerausbau auf ein notwendiges Maß beschränkt werden kann.

Darüber hinaus können in urbanen Einzugsgebieten flächenrelevante wasserwirtschaftliche Maßnahmen nur in enger Anlehnung an die planerischen Zielformulierungen der Stadt- und Regionalplanung verwirklicht werden. Umgekehrt sollte bei stadtplanerischen Überlegungen stets eine enge Rückkopplung zu Hochwasserrisikoinformationen bzw. zum Wasserwirtschaftsexperten erfolgen. Erfolgreiches urbanes Flussgebietsmanagement basiert daher auf einem frühen fachübergreifenden Dialog zwischen den Ingenieurbau- und Stadtplanern.

4. HOCHWASSERVORSORGE

Es wurde bisher verdeutlicht, dass Hochwasserschutz ein vielschichtiges Problem ist und in diversen Lebensbereichen ansetzt. In der wachsenden Metropolregion Hamburg stehen die knappen Flächenressourcen unter einem erheblichen Nutzungsdruck. Neben dem Erfordernis der Bereitstellung von Flächen für den zunehmenden Wohnungs- und Gewerbebau gibt es weitere Flächenbedarfe für Verkehrsanlagen, Ver- und Entsorgungseinrichtungen, Naherholung und Landwirtschaft sowie für ökologische Ausgleichsmaßnahmen.

Vor diesem Hintergrund kommt der einer hochwasserbezogenen Stadtplanung eine besondere Bedeutung zu. Aufgabe der Raum- und Stadtplanung ist grundsätzlich, vor dem Hintergrund vielfältigster Nutzungskonkurrenzen sowohl begründeten Einzelinteressen als auch dem Wohl der Allgemeinheit gerecht zu werden. Die Raum- und Stadtplanung benötigt dabei als Abwägungs- und Entscheidungsgrundlage einen umfangreichen Zugriff auf raumbedeutsame Informationen und Entscheidungshilfesysteme. Dabei wird eine effiziente Verknüpfung verschiedenster Fachinteressen gewünscht mit dem Ziel, die Planung von Infrastrukturmaßnahmen effektiv zu unterstützen.

4.1 DSS für die Bearbeitung hochwasserrelevanter Information in Planungsprozessen

Beim EU-Projekt FLOWS geht es unter anderem um die Entwicklung eines webbasierten Entscheidungs-Unterstützungssystems (Decision Support System: DSS) für die Stadtplanung in Hamburg. Das Hauptziel des DSS ist die effektive Integration wasserwirtschaftlicher Belange mit konkreten Konsequenzbetrachtungen für stadtplanerische Entscheidungsprozesse. Das System soll dem Planer ermöglichen, Planungsvorhaben - beginnend bei ersten planerischen Überlegungen bis hin zu konkreten Funktionsplänen - auf wasserwirtschaftliche Verträglichkeit zu überprüfen. Das DSS soll die planende Dienststelle frühzeitig auf mögliche Flächennutzungskonflikte hinweisen. Grundsätzlich sollen die Planbereiche „Stadt(teil) entwicklungskonzepte, regionale oder gesamtstädtische Szenarien“ sowie die gesetzlichen (Plan)verfahren: Flächennutzungsplan, Bebauungsplan sowie auch das Baugenehmigungsverfahren unterstützt werden. Hierbei soll auch eine verbesserte Rückkopplung zum Wasserwirtschaftsexperten erfolgen.

Das Verfahren zur Aufstellung eines Bebauungsplans dauert zwischen 24 und 36 Monaten. Obwohl alle Fachbehörden eingebunden sind und ihre Einwände deutlich machen können, kommt es immer wieder vor, dass Fachbehörden ihre Bedenken erst in der zweiten Beteiligungsrunde vorbringen. Zu diesem Zeitpunkt ist das Planverfahren jedoch schon weit fortgeschritten. Viel Zeit und Geld wurde in ein Vorhaben investiert, das am vorgesehenen Standort ggf. überhaupt nicht realisierbar ist.

Das konzipierte DSS ist ein computergestütztes System, welches auf eine Vielzahl von Daten und digitalen Karten zugreift. Das DSS kann Informationen zu Beginn eines jeden Planungsprozesses zur Verfügung stellen, um Einschränkungen auf einer bestimmten Fläche frühzeitig sichtbar zu machen. Durch die frühzeitige Einbeziehung der betreffenden Fachdienststellen bereits vor der ersten regulären Beteiligung Träger öffentlicher Belange kann Umständen, welche eine vorgesehene Planung grundsätzlich in Frage stellen, nachgegangen werden.

Im Rahmen von Planungsprozessen ist es notwendig, eine Vielzahl verschiedener Informationen (Fachpläne, Karten, Luftbilder,…) zu bearbeiten. Die Lokalisierung der richtigen Fläche in Karten und Plänen mit unterschiedlichen Maßstäben und Detaillierungsgraden ist dabei zum Teil schwierig. Im vorgesehenen DSS werden alle für eine bestimmte Fläche relevanten Informationen auf Basis standardisierter Services dargestellt.

Ein weiteres Problem besteht darin, dass einzelne Pläne schlichtweg vergessen werden können. Die zuständige Fachbehörde wird den entsprechenden Hinweis im Planverfahren zwar geben, aber bis dahin bestehen über eine Planung nur mangelhafte Informationen. Stellt die Stadtplanung mittels des DSS frühzeitig fest, dass ein gewisses Ausschlusskriterium vorliegen könnte, wird sie sich mit der betreffenden Dienststelle in Verbindung setzen und wird sich ihre Information ggf. bestätigen lassen. Ein DSS wird daher auch nicht –wie man annehmen könnte– dazu führen, dass jegliche Fachbehörden überflüssig werden. Das Gegenteil ist der Fall. Die Stadtplanung wird immer wieder auf die Sachkenntnis der Fachabteilungen angewiesen sein. Das System soll dazu beitragen, dass die Stadtplanung ein größeres Verständnis für die Themen und Belange der Fachbehörden aufbringt und mit diesen in einen frühzeitigen und aktiven Dialog treten.

Das DSS ist als ein zweistufiges Entscheidungsunterstützungssystem konzipiert, durch das der Raum- und Stadtplaner die Möglichkeit erhält, seine aktuelle Planungsidee oder Planungsentwurf online im Hinblick auf Nutzungskonflikte und Umweltrisiken zu überprüfen. Das DSS ist von vornherein nicht nur auf die Bearbeitung von Hochwasserproblematiken ausgelegt. Die Methodik dieser Abfragemöglichkeit kann auch auf andere Fachgebiete (z.B. Verkehr, Lärmbelastung, Ver- und Entsorgung, Kosten-Nutzen-Kalkulation,…) übertragen werden.

Mittels Datenimport bzw. einfachen Skizzierfunktionen kann die Planung in das System eingegeben werden. Die Ausgabe ermöglicht eine direkte Konsequenzbetrachtung bezüglich des Hochwasserrisikos und der Hochwassergefährdung im Plangebiet sowie die Auswirkungen der Planung auf das gesamte Flusseinzugsgebiet. Im DSS sind folgende Funktionalitäten vorgesehen. Nachdem die Dienststelle (Stadtplanungsabteilung, Bauprüfabteilung) die zu beplanende Fläche auf der digitalen Stadtgrundkarte skizziert hat, wird angezeigt, welche hochwasserrelevanten und weiteren Belange der Fachbehörden zu berücksichtigen sind. Dies geschieht technisch durch eine Überlagerung (geometrische Verschneidung) der zu beplanenden Fläche und ihrer Umgebung mit den relevanten Fachinformationen (z.B. Überschwemmungsgebiet, Naturschutzgebiet, Altlasten). Die Darstellung des Plangebiets soll flurstücksgenau erfolgen.

In der zweiten Stufe des DSS sollen die vorliegenden Fachinformationen konkretisiert werden. Zum Beispiel soll dargestellt werden, welche Wassertiefen in einem Überschwemmungsgebiet vorliegen können (Simulation) oder welche Altlasten konkret vorhanden sind und welche Nutzungseinschränkungen sich daraus ergeben.

Ein solches Entscheidungs-Unterstützungs-System wird im Rahmen des EU Projektes FLOWS bis Mitte 2006 entwickelt und pilotartig in den Bezirken Eimsbüttel und Hamburg-Nord eingeführt werden.

Verfügbarkeit digitaler Daten und Kartenwerke sowie Nutzbarmachung in Hochwassersimulationsverfahren

Die Verfügbarkeit von digitalen Geobasis- (z.B. ALKIS: Amtliches Liegenschaftskataster-Informationssystem) und Geofachdaten und deren Interpretierbarkeit ist eine Basis für digitale Hochwassersimulationsverfahren. Die Modelle zur Hochwassersimulation benötigen bestimmte definierte Eingangsdaten, die in den Geobasis- und Geofachdaten in strukturierter Form enthalten sein müssen. Diese Daten müssen in einer einheitlichen Semantik (Bedeutung, Sinnhaftigkeit) aufbereitet werden bzw. zur Verfügung stehen (BILL/ZEHNER 2001, 232).

Die für Hochwassersimulationsverfahren benötigten Daten entlang des Laufes eines Flusses werden von unterschiedlichen administrativen Stellen räumlich verteilt erhoben und gepflegt. Entweder müssen die Daten in einem Informationssystem zusammengetragen werden, um als Basis für Simulationsverfahren dienen zu können, oder auf Basis standardisierter Webservices zugänglich und auswertbar sein. Die Möglichkeit, verschiedenartige Daten in einen einzelnen Arbeitsablauf (z.B. eine Simulationsverfahren) zu integrieren, bezeichnet man als Interoperabilität. Dies setzt voraus, dass die Semantik der Daten den Anwendern in einer einheitlichen Form zur Verfügung gestellt werden.

Im Rahmen des Interreg Projektes FLOWS (siehe oben) wurde im Sommer 2005 eine vorläufige Datenerhebung der Basisdaten für ein Entscheidungsunterstützungssystem der Freien und Hansestadt Hamburg zu Fragestellungen des Hochwasserschutzes durchgeführt. Im Rahmen dieser Erhebung wurden 90 Datensätze zusammengetragen. Circa drei Viertel dieser Datensätze sind für ein umfassendes Entscheidungsunterstützungssystem unbedingt notwendig. Im Einzelnen lassen sich folgende Fachthemen unterscheiden:

Statistische Daten
Meteorologie / Klimadaten
Hydrologie
Geobasisdaten
Pedologie / geologische Daten
Daten der Stadtentwässerung
Daten über die Dimensionierung und Steuerung von Regenrückhaltebecken (Rhb)
Gewässerdaten
Stadtplanung
Sonstige Karten/Unterlagen

Im Weiteren wird der Schwerpunkt auf die Beschreibung der für eine Hochwassersimulation benötigten stadtplanerischen Daten gelegt. Eine wichtige Datengrundlage für eine Modellierung des Niederschlagsabflusses ist der Grad der Versiegelung der bebauten Umwelt. Die Nutzung und die damit einhergehende Versiegelung von Flächen wird in Planwerken der vorbereitenden (Flächennutzungsplan) und verbindlichen (Bebauungsplan) Bauleitplanung geregelt. Diese Planwerke müssen als Datengrundlage in eine Modellierung Einzug halten. Neben einer durch vorhandene Nutzung determinierte Versiegelung müssen für eine Bestimmung des Status Quo der Versiegelung auch potentielle Baurechte, die noch nicht ausgenutzt wurden, in eine Modellierung einbezogen werde. Die Versiegelung von Grundstücken wird in Bauleitplänen durch die Grundflächenzahl (GRZ: Anteil des Grundstückes das überbaut werden darf) ausgedrückt. Wobei eine Überschreitung der GRZ für Nebenanlagen um 50% planmäßig zulässig ist. Falls z.B. in einem Bauleitplan eine GRZ von 0,4 ausgewiesen wurde, kann man von einer maximal zulässigen Versiegelung eines Grundstücks 60% ausgehen (GRZ:0,6). Neben der Angabe des maximalen zulässigen Versiegelungsgrad ist die Kenntnis der Stellung der baulichen Anlagen notwendig, um Schlüsse ziehen zu können, ob bauliche Anlagen eventuell von einem Hochwasserschadenereignis betroffen sind. In eine Niederschlagsabflussmodellierung müssen neben der Versiegelung von Baugebieten auch die Versiegelungswerte und die überbaubaren Grundstücksflächen von Gemeinbedarfs, Grünflächen, Ver- und Entsorgungsflächen sowie auf Flächen für einen besonderen Nutzungszweck Eingang finden. Für festgesetzte Verkehrsflächen und Verkehrsflächen besonderer Zweckbestimmung kann man für eine Berechnung der Niederschlagsabflussmenge von einem hundertprozentigen Versiegelungsgrad ausgehen.

Kommunale Bauleitpläne werden in Kommunen bzw. durch private Dienstleister erstellt und gepflegt. Diese Planwerke liegen bei den Kommunen bzw. Genehmigungsbehörden (Landkreis) vor. Weiterhin werden die Inhalte von Bauleitplänen in Raumordnungskatastern vereinfacht erfasst, wobei in der Regel die überbaubaren Grundstücksflächen (Baulinie + Baugrenze) nicht erfasst werden. Eine Vielzahl von Bauleitplänen wird aktuell digital erstellt. Die digitale Erstellung orientiert sich jedoch in vielen Fällen an der grafischen Ausgabe eines Bauleitplanes. Die Visualisierung von Bauleitplänen regelt bundesweit einheitlich die Planzeichenverordnung (PlanzV). Die semantische Aufbereitung der Inhalte eines Bauleitplans wird in der Regel über die Möglichkeiten der verwendeten Softwarepakete definiert. Diese Softwarepakete sind Fachapplikationen (z.B.: WS-LANDCAD) etablierter CAD-Systeme (z.B. AutoCAD) oder geografischer Informationssysteme (z.B. ArcGIS). Die Fachapplikationen verfügen alle über die Möglichkeit, die Darstellungen und Festsetzungen der Bauleitplanung grafisch und attributiv abzubilden. Die Fachapplikationen haben aber verschiedene Sichtweisen auf die Abbildung der Planzeichenverordnung in ihren jeweils zu Grunde liegenden Datenmodellen (abstraktes Abbild eines Ausschnittes aus der Wirklichkeit mit dem Ziel, bestimmte Gegebenheiten, genau in Datenstrukturen abbilden zu können, BILL/ZEHNER). Die Attribute einer Baugebietsfläche (z.B. Art und Maß der baulichen Nutzung, Bauweise, überbaubare Grundstücksfläche) werden in den einzelnen Softwarepaketen in unterschiedlichen Datenstrukturen (z.B. Bezeichnung der Tabellen und der Wertebereiche, die in Datentabellen gespeichert werden können) definiert, die in der Regel zwischen den einzelnen Programmen im Rahmen eines Datenaustausches nicht kompatibel sind. Um ein Hochwassersimulationsverfahren für eine Verarbeitung von Fachinformationen nicht für jeden Einzelfall neu anpassen zu müssen, ist es notwendig, die Datendefinitionen der Fachthemen zu standardisieren.

Austauschformate

Die Heterogenität der für die Erstellung digitaler Bauleitpläne eingesetzten IT-Systeme, das Fehlen eines standardisierten Daten-Formats zum Austausch von Bauleitplänen und das Fehlen eines technischen Standards für die Visualisierung von Bauleitplänen behindert derzeit den Aufbau elektronischer Dienste, um die Aufstellung, Genehmigung, Änderung und Nutzung von Bauleitplänen und deren Beteiligungsprozesse effektiv zu unterstützen. So werden während des Aufstellungsverfahrens Pläne oftmals in analoger Form an die beteiligten Akteure weitergegeben, was zeitraubend, fehleranfällig, ineffektiv und kostenträchtig ist. Durch das Fehlen von Standards gehen heute bei einer digitalen Datenübermittlung wertvolle Informationen verloren. Die fehlenden IT-Standards im Bereich der Bauleitplanung erschweren den Einsatz von Standard-Software. Die eingesetzten Systeme müssen stattdessen häufig – unter erheblichen Mehrkosten – an die Besonderheiten der einzelnen Kommunen angepasst werden.

Weiterhin können internetgestützte Visualisierungsservices für Auskunftsdienste im Rahmen der integrierten Vorgangsbearbeitung im Bau-, Umwelt- und Liegenschaftswesen, zur Auswertung von Bauleitplänen oder für eine Beteiligung der unterschiedlichen Akteure (Beteiligung der Öffentlichkeit) aufgebaut werden. Eine Standardisierung, die den elektronischen Austausch von Plänen und ihre rechnergestützte Auswertung ermöglicht, eröffnet hohe Potenziale, Verwaltungsvorgänge im Bereich der kommunalen Planung effektiver und kostengünstiger zu gestalten sowie qualitativ zu verbessern.

Bislang gibt es keine Übereinkunft über die semantische Beschreibung der Inhalte eines Bauleitplanes. Dies ist ein Themenfeld der E-Government-Initiativen MEDIA@Komm-Transfer und Deutschland online. Die Initiative Deutschland online verfolgt das Ziel, staatliche Zusammenarbeit auf Basis der Informationstechnologie neu zu ordnen und damit gezielt Bürokratiekosten zu reduzieren. (CDU/CSU/SPD 2005). Im Rahmen des Standardisierungsvorhabens „XPlanung“ wird ein einheitliches semantisches Objektmodell für Planwerke nach dem Baugesetzbuch erarbeitet (http://www.xplanung.de). Alle nach §§ 5 und 9 BauGB möglichen Darstellungen und Festsetzungen werden als raumbezogene Objekte modelliert. (BENNER/KRAUSE/MÜLLER 2005)

In Agglomerationsräumen kann ein standardisiertes Datenformat für Bauleitpläne helfen, den Planungsprozess horizontal zwischen benachbarten, aneinandergrenzenden Städten effizient aufeinander abzustimmen. In ländlich strukturierten, ausgedehnten Landkreise ist ein vertikaler Datenaustausch von mindestens ebenso großer Bedeutung zwischen den unterschiedlichen Akteuren: Planer – Kommune, Kommune – Landkreis, Planer – Landkreis, Landkreis – Land.

Die Objekt- und Datenmodelle werden auf der Basis internationaler Standards zur Datenmodellierung und zur Beschreibung und Austausch von raumbezogenen Daten des „Open Geospatial Consortium“ (OGC) entwickelt. Ein Standard des OGC ist die GML (Geography Markup Language), ein XML basiertes Austauschformat für Geoinformationen.

Für die Beschreibung der Darstellungen von Flächennutzungsplänen (FPlanGML) und der Festsetzungen von Bebauungsplänen (BPlanGML) wurden GML- Anwendungsschemata entwickelt. Die Austauschformate BPlanGML und FPlanGML ermöglichen einen ungehinderten, uneingeschränkten und verlustfreien Datenaustausch zwischen unterschiedlichen CAD/GIS Systemen bzw. Fachapplikationen. Schnittstellenprogrammierungen und Datenkonvertierungen können in Zukunft vermieden werden. Die Austauschformate orientieren sich an offenen Standards (OGC) und berücksichtigen insbesondere die ALKIS-NAS Schnittstelle (ALKIS NAS - Normbasierte Austauschschnittstelle des Amtlichen Liegenschaftskataster-Informationssystems der Vermessungsverwaltungen in Deutschland auf Basis von XML und GML).

Das OGC hat mit dem „Web Map Service“ (WMS) einen Service definiert, der es ermöglicht, standardisiert Karten in Form eines Pixelbildes z.B. als GIF, JPEG oder PNG in einem bestimmten Maßstab bzw. Auflösung in einem serverseitig vorab definierten Style zu visualisieren. Weiterhin ist es möglich, Sachinformationen über Geoobjekte auf einer Karte abzufordern. In einer erweiterten Spezifikation als „SLD-WMS“ Dienst kann auf die Visualisierung clientseitig Einfluss genommen werden. Der vom OGC spezifizierte „Web Feature Service“ (WFS) liefert GML Daten über eine Netzinfrastruktur an einen Client. Ein WFS könnte z.B. digitale Bauleitpläne in einem standardisierten Datenformat für Modellierungswerkzeuge zur Verfügung stellen.

In vielen Gebietskörperschaften wird aktuell an der Konzeption von Geodateninfrastrukturen gearbeitet, die es ermöglichen sollen, netzbasiert einen einheitlichen Zugriff auf Geobasis- und Geofachdaten über eine gemeinsame Dienste-Infrastruktur zur Verfügung zu stellen. Geodateninfrastrukturen setzten in der Regel auf offene Systemarchitekturen. Web Services auf Basis der Standards des Open Geospatial Consortiums stellen die moderne, internetbasierte Grundlage für den Aufbau der Geodateninfrastruktur dar. Aktuell besteht die Möglichkeit, die raumbezogenen Datengrundlagen, die für eine Modellierung der Überschwemmungsgefährdung notwendig sind, in den Aufbau von Geodateninfrastrukturen zu integrieren. Der Aufbau dieser Infrastrukturen wird sich ebenfalls wieder in der Regel an den administrativen Grenzen orientieren. Die Abbildung von Flussläufen und die angrenzenden raumbezogenen Daten werden eventuell in unterschiedlichen Geodateninfrastrukturen verwaltet. Solange diese jedoch auf Basis einheitlicher Visualisierungs- und Datendefinitionen aufgebaut werden, besteht die Möglichkeit, gewässerlaufbezogene Daten für Auswertungen zusammenzuführen.

4.2 Simulationsmodelle als Basis eines vorsorgenden Hochwasserschutzes auf Basis des Simulationstools KALYPSO-ENTERPRISE

Die beschriebenen Datensätze (siehe oben) werden in der Simulation „KALYPSO-ENTERPRISE“ eingespeist und verarbeitet. Das Programm-System KALYPSO-ENTERPRISE ist eine gemeinschaftliche Open-Source Entwicklung des Arbeitsbereichs Wasserbau der Technischen Universität Hamburg-Harburg (TUHH) in Kooperation mit der Firma Björnsen Beratende Ingenieure GmbH (BCE). KALYPSO erlaubt die Integration und Verwaltung von hydraulischen und hydrologischen Simulationsmodellen innerhalb einer einheitlichen Benutzeroberfläche.

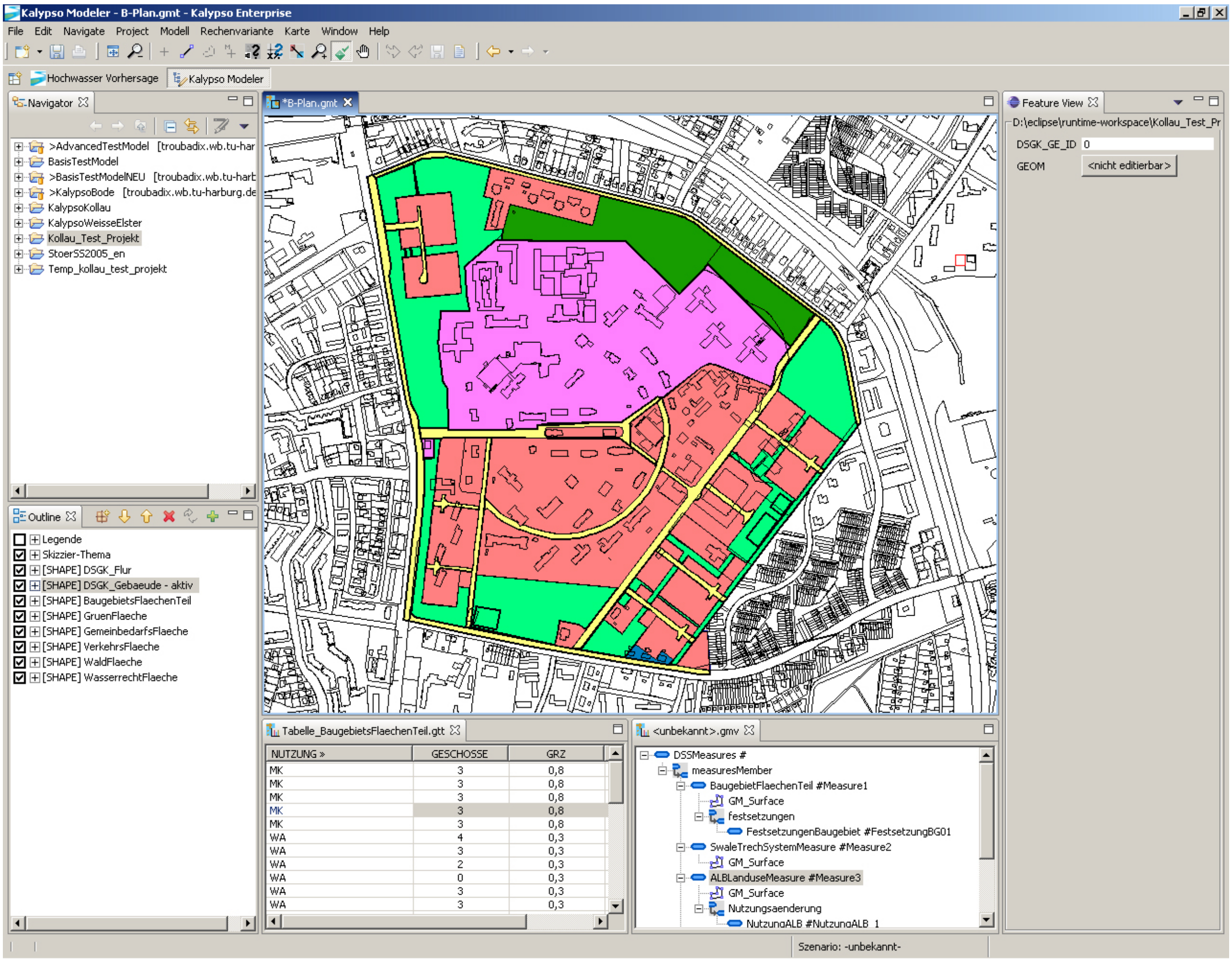


Abb.1: Oberfläche von KALYPSO Enterprise, Simulation von Hochwasserereignissen im Geltungsbereich eines Bebauungsplanes

Damit stellt KALYPSO eine Abstraktionsschicht mit folgenden Eigenschaften:

• Einheitliche Verwaltung und Strukturierung hydrologisch-hydraulischer Modelle
• Zentrale Datenspeicherung mit möglicher Datenbankanbindung
• Integration von hydrologischen und hydraulischen Berechnungsverfahren auf Basis unterschiedlicher Rechenkerne

Im Einzelnen verfügt KALYPSO-Enterprise über folgende Basisfunktionalitäten an der Software-Oberfläche:

• Kartenansicht mit Standardfunktionalitäten (zoom, pan, move, legende)
• Tabellenansicht auf verschiedenste Datenformate (z. Zt GML und Shape)
• Baumansicht für GML-Dateien
• Zeitreihenbrowser (Zeitreihenansicht) mit Standardfunktionalitäten
• Auswahlfilter für eine benutzerdefiniertes Selektieren
• Unterstützte Datenformate: ESRI shp, GML, ASCII Raster, csv,
georeferenziete Imageformate (tif, jpg, png)
• Externe Datenanbindung: Web-Map-Server, Web-Feature-Server, File-Browser
• Standardfunktionalitäten für ein File-Management (öffnen, schließen, löschen)
• Erweiterungen für speziellere Anwendungen (z.B. Hochwasservorhersagen, DSS)

KALYPSO ist eine in JAVA programmierte Open-Source-Software und basiert auf dem vom IBM entwickelten Framework ECLIPSE. Durch die Implementierung der oben genannten OGC-Schnittstellen (siehe oben) kann ein kontinuierlicher Datenfluss garantiert werden.

KALYPSO leistet für das Projekt FLOWS die Simulation von Hochwasserereignissen und den jeweiligen Wasserständen in einem ausgewählten geographischen Raum. Unter Vorgabe von Bemessungsniederschlägen, welche mittels statistischer Analysen aus Pegel- und Niederschlagsmessung im Vorfeld ermittelt wurden, können für unterschiedliche Jährlichkeiten (statistische Wahrscheinlichkeit) die verschiedenen Hochwasserereignisse simuliert werden (z.B. HQ 50, HQ 100, HQ 200, …). Diese verschiedenen Hochwasserereignisse können auf der Basis von einem Digitalen Höhenmodell (DGM) die durch das Ereignis überschwemmten Flächen angezeigen. Diese neu berechneten Überschwemmungsflächen werden dann mit den geplanten Bauflächen überlagert und ermöglichen so eine direkte Konsequenzbetrachtung der Planung in Bezug auf die Hochwasserverträglichkeit.

Außerdem werden auch Linien gleicher Wassertiefen („Wasserspiegellagen“) angezeigt, so dass für ein konkretes Bauvorhaben abzulesen ist, wie Hochwasserschutzeinrichtungen (Deiche, Geländeaufhöhungen usw.) dimensioniert werden sollten, damit die Bauwerke bis zu einem bestimmten Hochwasserereignis (z.B. HQ 100) sicher sind. Neben der Berechnung von Wassertiefen und Überschwemmungsflächen, besteht die Möglichkeit, die Ergebnisse der hydraulischen Berechnung mit einer Risikobetrachtung zu koppeln. Ein Risikomodul berechnet auf der Basis der neu berechneten Wassertiefen (1x1 Meter Raster) und statistischen Schadenerwartungswerten das spezifische Schadenspotential für bestimmte Flächen und Ereignisse. Diese Ergebnisse geben Aufschluss über das zu erwartende Schadenpotential, falls die Planung verwirklicht werden sollte. Die Simulation basiert zur Zeit (Stand 12/2005) auf einem stationären eindimensionalen Strömungsmodell in Kombination mit einem deterministischen Niederschlag-Abfluss-Modell, die Integration eines instationären 1d Strömungsmodell ist in Entwicklung. Der Risikoanalyse liegt ein regionaler Betrachtungsansatz zugrunde. Das Niederschlags-Abfluss-Modell bildet den vollständigen, landgebundenen Wasserkreislauf mit den Teilprozessen Schneespeicherung, Evapotranspiration, Bodenwasserspeicherung, Grundwasserneubildung, Oberflächenabfluss, Bodenzwischenabfluss, Grundwasserabfluss und Wellenverformung im Gerinne ab.

Die Herausforderung bei der Erstellung des Systems besteht darin, die komplexen hydraulischen und hydrologischen Prozess für einen fachfremden Experten (hier der Stadtplaner/innen) einfach und dennoch physikalisch sinnvoll bereitzustellen. Ein Planer kann mit Hilfe einer einfachen Navigation, durch die Definition weniger Attributwerte und digitalisieren von einfachen Geometrien auf einem Bildschirm den Themenkomlex Hochwasserschutz in seiner Planung in Alternativen bearbeiten. Durch die automatische Zusammenführung vom Nullszenario (Status Quo) mit der Planungsalternative, kann der Entwurf schon im Planungsstadium auf Basis einer physikalisch basierten Simulation auf Hochwasserverträglichkeit geprüft werden. Diese Prüfung ersetzt aber in keinem Fall die vom Hochwasserexperten zu führende hydraulische Nachweise, welche zur Genehmigung erforderlich sind.

Der große Vorteil des Systems besteht darin, dass bereits im Entwurfsstadium grobe wasserwirtschaftliche Fehler ohne große Zeitverluste dem Planer aufgezeigt werden. Das System stellt nicht nur die Auswirkungen dar, sondern erlaubt, vordefinierte Entlastungsmaßnahmen einzubauen. Die Maßnahmen beinhalten u. a. das Einfügen von Regenrückhaltebecken, die Berücksichtigung dezentraler Regewasserbewirtschaftung oder eine mögliche Gewässerrenaturierung. Geplant sind auch eine automatische Optimierung der Ausgleichsmaßnahmen nach verschiedenen Kriterien, sowie eine einfache Kosten-Nutzen Betrachtung.

5. AUSBLICK

Das Ziel dieses Projektes ist ein Proof of Concept. Die hier entwickelte Methodik soll Aufzeigen wie physikalisch basierte Echtzeit Simulation in den komplexen Planungs- und Genehmigungsprozess einfließen können um damit effizienter und nachhaltiger planen zu können. Das hier vorgestellte System versteht sich als Pilotanwendung und soll im Anschluss an das Projekt FLOWS weiterentwickelt und verbessert werden. Die bessere Unterstützung des Planers endet bekanntlich nicht mit der Integration von Hochwasseraspekten, sondern beinhaltet ein viel breiteres Spektrum. Die Erweiterung um die Themen Verkehr und Umwelt sind hier nur stellvertretend für alle Planungsrelevaten Belage zu nennen. Ein weitere wichtiger Punkt ist eine erweiterte Konfliktbetrachtung der verschiedenen Belange im Planungsprozess. Das System soll zukünftig dem Planer das Screening von großen raumbezogenen Datenmengen erleichtern und durch einen intelligenten Rechenalgorithmus, Daten in Abhänigkeit der Relevanz und des Konfliktpotenzials herausfiltern. Ein wichtiger Grundsatz sollte bei jeder Weiterentwicklung nicht aus den Augen verloren werden. Ein System ist nur so gut wie die Anzahl regelmäßigen Nutzern desselben.

IMMOBILIEN – VERGLEICHSPREISE STEIERMARKWEIT

Dieter LEITNER

(Dipl.-Ing. Dieter Leitner, ZT Daten-forum reg. Gen. mbH, Kaiser-Franz-Josef-Kai 38, A-8010 Graz, Mail: office@zt.co.at
Web: www.zt.co.at, www.map4you.at)

1. ABSTRACT

Das ZT-Datenforum bietet Immobiliensachverständigen, öffentlichen Institutionen und Banken den elektronischen Zugriff auf ca. 60.000 Kaufpreise steirischer Immobilien, gesammelt vom Land Steiermark und vom Steirischen Sachverständigenverband.

Wir betreiben seit mittlerweile 8 Jahren erfolgreich unter der Webadresse www.map4you.at, einen Geodatenserver, mit der Zielsetzung von den Genossenschaftsmitgliedern erhobene und bereits existierende Informationen über Grund und Boden via Internet zugänglich zu machen.

Im letzten Jahr wurde dieses Service um die Abfrage der Immobilienvergleichspreise erweitert. Das ZT-Datenforum bietet ab sofort die Möglichkeit der Kaufpreisabfrage von Liegenschaften, geographisch über Adresse, Grundstücksnummer oder GPS-Koordinaten und präsentiert Vergleichspreise nach Art und Zeitraum auf Übersichtskarten. Aktuelle Kaufpreise werden laufend über das ZT-Datenforum erhoben und von Sachverständigen kontrolliert.

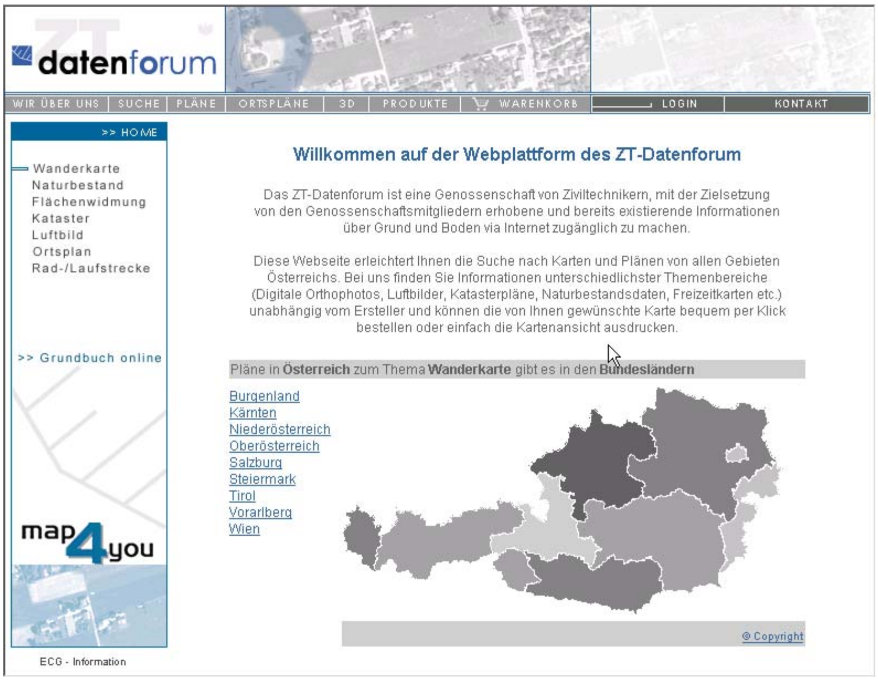


Abb.1:Startseite www.map4you.at

2. LIEGENSCHAFTSBEWERTUNG IN ÖSTERREICH

In Österreich ist das Liegenschaftsbewertungsgesetz zur Ermittlung des Wertes (Bewertung) von Liegenschaften, von damit verbundenen Rechten und darauf ruhenden Lasten in allen gerichtlichen Verfahren heran zu ziehen. Dieses Bundesgesetz beschränkt sich darauf, einen rechtlichen Rahmen zu setzen, ohne dabei die Tätigkeiten im Zuge von Bewertungen detailliert zu beschreiben. Es scheint nicht erforderlich, die Arbeit des Sachverständigen bis in jede Einzelheit umfassend zu determinieren. Vielmehr werden grundsätzliche Regeln für Bewertungen, für die Durchführung der Wertermittlungsverfahren und für die Gutachtenserstattung getroffen und die wichtigsten Begriffe bestimmt.

Im allgemeinen wird bei der Bewertung einer Immobilie deren Verkehrswert ermittelt. Dabei handelt es sich um jenen Wert (Preis), der bei einer Veräußerung der Sache üblicherweise im redlichen Geschäftsverkehr für sie erzielt werden kann. Besondere Wertzumessungen sind bei der Ermittlung des Verkehrswertes außer Betracht zu lassen. Für die Bewertung sind Wertermittlungsverfahren anzuwenden, die dem jeweiligen Stand der Wissenschaft entsprechen. Als solche Verfahren gelten insbesondere:

Vergleichswertverfahren (§ 4 LBG)

Ertragswertverfahren (§ 5 LBG)

Sachwertverfahren (§ 6 LBG)

Beim Vergleichswertverfahren wird der Wert einer Liegenschaft durch Vergleich mit tatsächlich erzielten Kaufpreisen vergleichbarer Liegenschaften (Vergleichswert) ermittelt. Zum Vergleich sind Kaufpreise heranzuziehen, die im redlichen Geschäftsverkehr in zeitlicher Nähe zum Bewertungsstichtag in vergleichbaren Gebieten erzielt wurden. Preisschwankungen aufgrund des zeitlichen Abstandes sowie abweichende Eigenschaften der Immobilie und geänderte Marktverhältnisse werden auf den Wert durch Zu- oder Abschläge berücksichtigt.

Im Sachwertverfahren wird der Wert einer Liegenschaft durch Zusammenzählung des Bodenwertes, des Bauwertes und des Wertes sonstiger Bestandteile ermittelt. Dabei wird der Bodenwert in der Regel als Vergleichswert durch Heranziehung von Kaufpreisen vergleichbarer Liegenschaften ermittelt. Auch beim Ertragswertverfaheren ist im Regelfall der Bodenwert zur Verzinsung des Bodenwertes im Vergleichswertverfahren zu ermitteln.

Laut §10 Liegenschaftsbewertungsgesetz sind die zum Vergleich herangezogenen Immobilien inklusive ihrer Wertbestimmungsmerkmale anzuführen und die dafür erzielten Kaufpreise anzugeben. Aus dieser rechtlichen Bestimmung heraus ist eine Kaufpreissammlung,, in der auch jene aus dem Kaufvertrag ersichtlichen wertbestimmenden Merkmale eingetragen sind, eine große Zeit- und Arbeitserleichterung für Sachverständige.

3. KAUFPREISSAMMLUNG DES LANDES STEIERMARK

Im Bereich der Fachabteilung 18A, Grundeinlösereferat der Landesregierung Steiermark, werden für die Grundeinlöseverfahren und die damit verbundenen Bewertungen von Liegenschaften, zur Erstellung der Gutachten, Verkaufspreise von umliegenden Grundstücken (Vergleichswerte) benötigt. Diese wurden seit dem Jahre 1997 durch amtliche Sachverständige bei den Bezirksgerichten gesammelt. Das ZT-Datenforum hat vom Land Steiermark alle gesammelten Datensätze bis Jahresende 2004 übernommen.

Die Datensätze wurden einer technischen Bereinigung unterzogen und nach der Verknüpfung mit einer Grundstückskoordinatendatenbank in ein WebGIS integriert.

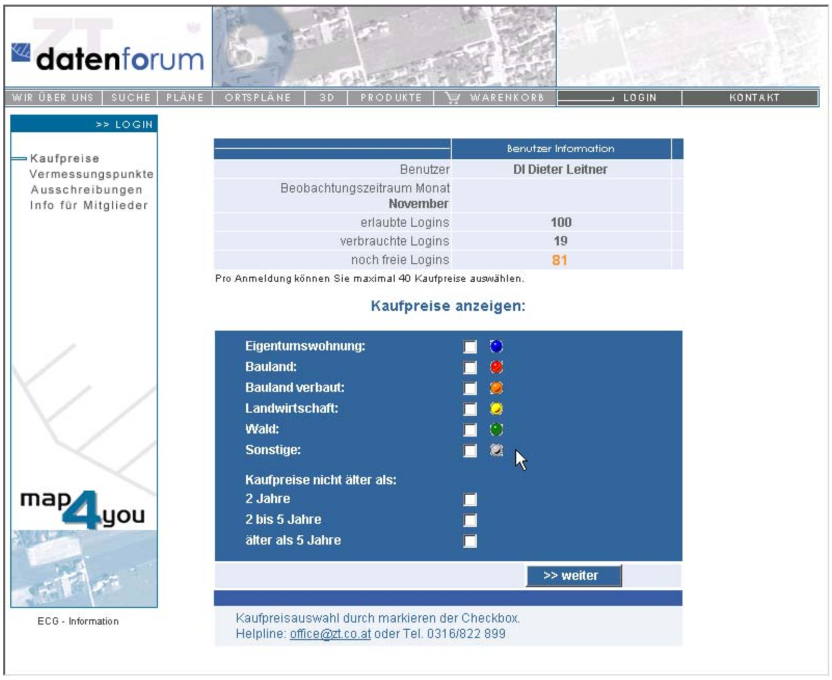


Abb.2:Benutzerinformation und Auswahlmenü

Die Bereinigung bestand aus einer Vollständigkeitsprüfung. Zudem wurden die einzelnen Attribute auf Plausibilität (Datum, Jahr, KG,..) überprüft. Preise, die gewissen regionalen Schranken aus Mittel-wertbildung und Erfahrungswerten von Sachverständigen nicht entsprachen und aus den Anmerkungen keine wertmindernden Informationen abgeleitet werden konnten, wurden eliminiert. Zum Schluss wurden die Datensätze anhand der Katastralgemeindenummer und der Grundstücksnummer geocodiert.

Zukünftig werden jährlich neue Vergleichspreise aus Kauf-, Bescheid- , Baurecht und Bestandsverträgen in allen Bezirksgerichten der Steiermark erhoben. Anmerkungen über Wertbestimmungsmerkmale (wie die Flächenwidmung, auf dem Grundstück befindliche Dauerkulturen, Dienstbarkeiten, Sondernutzungen...) werden dabei aus dem Kaufvertrag zum Vergleichspreis in einer Memospalte hinzugefügt.

Ein Datensatz besteht aus:

Tagebuchzahl, Jahr sowie Kaufvertragsdatum

Verkäufer – Käufer

Grundstücksnummer und Katastralgemeinde

Flächenausmaß

Gesamtpreis – Preis pro m²

Anmerkungen: wertrelevante Anmerkungen (wie Fläwi, GFZ, Lage etc.)

Diese so gesammelten Kaufpreise werden nun einem WebGIS in bequemer Art und Weise über die geographische Navigation oder eine der Suchfunktionen angezeigt. Die Datenbank beinhaltet derzeit 64.000 Kaufpreiseinträge seit dem Jahre 1997 verteilt über das gesamte Landesgebiet der Steiermark.

4. WEBGIS – GEONAVIGATOR

Die Bedeutung von Datenbanksystemen in den Bereichen Kartographie und Geoinformation ist in den letzten Jahren stetig angestiegen. Primäre Aufgabe von Datenbanksystemen war es zunächst, Daten in strukturierter Form zu speichern und bearbeiten zu können. Diese Möglichkeit wurde bereits früh für den Einsatz in Geoinformationssystemen erkannt, sodass Datenbanksysteme seit vielen Jahren in diesen implementiert sind.

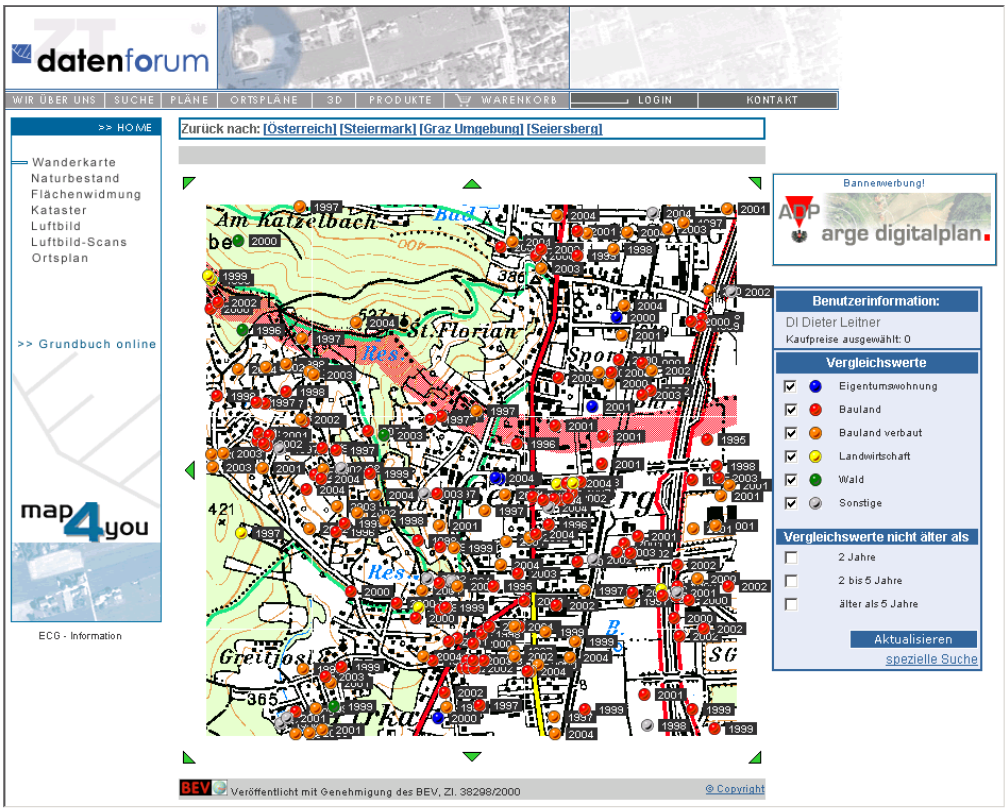


Abb.3:Anzeige von Vergleichspreisen

Der vom ZT-Datenforum seit 1999 entwickelte „Geonavigator“ ist eine Weiterentwicklung einer klassischen "Map Library“. Eine eintreffende Anfrage nach einer bestimmten Karte wird von einem Datenbanksystem bearbeitet und das Suchergebnis an den Webserver übermittelt. Dieser stellt die Karte im Browser des Nutzers als Rastergraphik dar.

Dabei wird das Datenbanksystem zur Verwaltung der statischen Rasterkarten und allen weiteren Daten verwendet. Der darzustellende Kartenausschnitt wird am Server erstellt. Als Ergebnis wird ein reiner HTML-Code zum Client gesendet. Dies hat eine geringe zu übertragende Speichermenge zur Folge und führt damit zu einem schnellen Bildaufbau. Serverseitige Technologie erlaubt es somit, Geometrie- sowie Sachdaten auf im Netzwerk zentral gelegenen Servern zu lagern. Beim Eintreffen einer Anfrage werden die notwendigen Daten lokal verarbeitet, das Resultat als verhältnismäßig kleine Datei zurückgesendet.

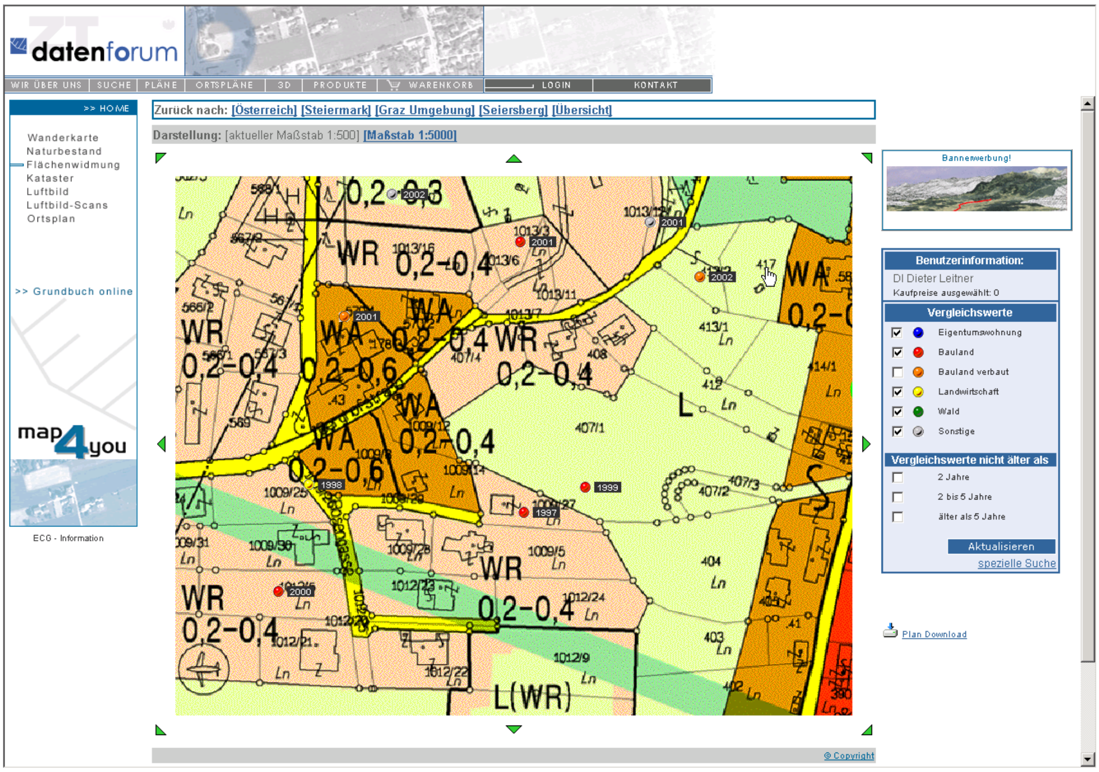


Abb.4: Vergleichspreise und Flächenwidmungsplan

Dies hat heute noch große Vorteile gegenüber klassischen GIS-Systemen, wenn die Interaktions-möglichkeiten für den Nutzer nur in eingeschränkter Form zu Verfügung stehen müssen, da die Abarbeitung auch einer großen Anzahl von Anfragen rasch und einfach am Server erledigt werden können. Der Geonavigator stellt ein reines Auskunftssysthem von lagebasierten Informationen ohne jegliche Eingriffsmöglichkeit in die Kartengestaltung dar und ist vielleicht genau deshalb speziell bei Projekten wie diesem geeignet, unbedarften Usern - in der Anwendung von Geoinformationssystemen - eine geographische Zugriffsmöglichkeit auf adressgenaue Informationen zu liefern und diese kartografisch darzustellen. Wobei der Zugriff auf die lagerichtige Information über mehrere Wege erfolgen kann:

geografische, hierarchische Navigation

Navigation über Listen

Suche nach geographischen Namen

Suche über Adresse

Suche über Grundstück

Abfrage über Koordinaten (WGS84, MGI, Gauß-Krüger)

Im Geonavigator des ZT-Datenforum werden mittlerweile weit über 3 Millionen Datenbankeinträge verwaltet. Alleine die Verwaltung der Mappenblätter MB500 benötigt für das gesamte Bundesgebiet über 1,3 Millionen Einträge. Zudem sind auf unseren Servern weit über 300.000 Kartenausschnitte in Bilddateien abgelegt.

5. ABLAUFSCHEMA UND USABILITY EINER ABFRAGE

Da der Anwenderkreis für dieses Service aus Sachverständigen, öffentlich Bediensteten und Bankmitarbeiter besteht, diese aber erfahrungsgemäß bis heute nur vereinzelt Kenntnis in der Anwendnung von digitalen kartographischen Produkten hatten, musste von Anfang an großes Augenmerk auf die Usability des Dienstes gelegt werden. Wie sich auch in letzter Zeit in anderen Bereichen, wie zum Beispiel Gemeinde-informationssystemen, gezeigt hat, ist der schnelle Zugang auf gewünschte Informationen ohne spezielle Gisfunktionen, für die Akzeptanz eines Dienstes in branchenfremden Disziplinen, oft von grösster Bedeutung.

Bei der Kaufpreisabfrage kann der Anwender nach erfolgter Anmeldung und Auswahl der gewünschten Immobilienkategorie aus einer der Suchfunktionen, wie zum Beispiel Adresssuche, auswählen und gelangt nach der Eingabe dieser direkt zum gewünschten Zielgebiet. Die Karte wird inklusive der vorhandenen Vergleichswerte als Punktsymbole mit Jahreszahl angezeigt. Dabei kann der User noch durch Auswahl aus einer Liste die gewünschte thematische Karte auswählen. Durch Anwahl eines speziellen Vergleichswertes wird die vorhandene Information über den Kaufvertrag in eine Liste eingetragen und in einem neuen Browserfenster angezeigt. Zusätzlich werden in dieser Liste weiterführende statistische Werte über die ausgewählten Vergleichspreise angeboten, wie Mittelwert, Standardabweichung oder valorisierter Mittelwert. Eine Auswahlliste mit den für die Bewertung laut §10 LBG benötigten Informationen läßt sich bequem ausdrucken oder in ein Gutachten einfügen.

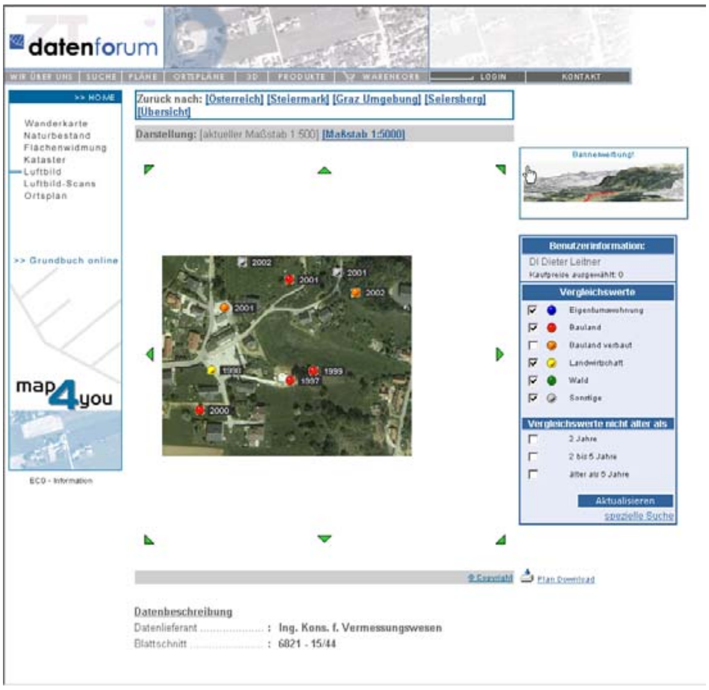


Abb.5: Vergleichspreise und Orthophoto

6. AUSBLICK

Der Dienst wird anhand von Anwenderanforderungen ständig erweitert und verändert. Zusätzlich werden neue Auswertungsmethoden integriert. Ebenso wird die Integration in vorhandene Softwarepakete zur Erstellung von Immobilienbewertungen überprüft. Ziel wird es sicherlich auch sein, zukünftig, wie in Deutschland schon seit Jahren praktiziert, zu einer landesweiten Bodenwertkarte zu gelangen. Auch andere Bundesländer zeigen schon reges Interesse, da es derzeit kein vergleichbares Produkt in Österreich für Immobiliensachverstädige gibt.

7. LITERATUR

Bundesgesetzblatt für die Republik Österreich: Liegenschaftsbewertungsgesetz, Ausgabe am 19. März 2005
Österreichisches Normungsinstitut (1997): ÖNORM B1802,Liegenschaftsbewertung, Wien
Bauer F.: Liegenschaftsbewertung, Vorlesungsscriptum, Technische Universität Graz
Bill R.: Grundlagen der Geo-Informationssysteme, Band 2, Herbert Wichmann Verlag, Heidelberg

Die Online-Leitungsauskunft eTRASSE
Spartenübergreifend - systemübergreifend - effizient

Martin FORNEFELD

(Dr. Martin Fornefeld, MICUS Management Consulting GmbH, Stadttor 1, 40219 Düsseldorf, Germany , Fornefeld@micus.de)

1. eTRASSE REDUZIERT KOSTEN FÜR LEITUNGSAUSKUNFT UND VERRINGERT LEITUNGSSCHÄDEN

Das Netz an Trassen und Versorgungsleitungen in Deutschland ist sehr dicht; alleine das deutsche Gasversorgungsnetz umfasst 460.000 km Leitungen. 85% aller Tiefbaumaßnahmen im Stadtbereich sind versorgungsbedingt, dabei kann es zu Schäden an Leitungen mit hohen Kosten kommen. Baustellenbetreiber sind daher verpflichtet, sich vor Baubeginn die notwendigen Informationen über die im Untergrund vorhandenen Trassen zu beschaffen. Die Betreiber müssen ihrerseits Auskunft zur Lage ihrer Leitungen geben.

Für die Auskunftssuchenden schafft die Informationspflicht einen hohen Aufwand: Bislang müssen die Informationen bei allen Betreibern einzeln eingeholt werden, da es keine zentrale Auskunftsstelle gibt. Bei den Leitungsbetreibern bindet die Auskunftspflicht hohe Ressourcen: Überregionale Unternehmen beantworten bis zu 20.000 Anfragen jährlich, bei großstädtischen Versorgern sind es immerhin noch 12.000 Anfragen pro Jahr. Insgesamt summieren sich die jährlichen Kosten für Netzdokumentation, -monitoring und -beauskunftung auf mehrere Millionen Euro.

Doch trotz des hohen Aufwands für beide Seiten kommt es zu Schäden an Leitungen. Fast jeder zweite Kabel- und Leitungsschaden ist auf Tiefbauarbeiten zurückzuführen. Je nach Art des Schadens fallen dabei z.B. für Betreiber von Gasleitungen Kosten von 1500 bis 2500 Euro pro Störungsfall an. Schäden für die Kunden (z.B. durch Produktionsausfall) kommen noch hinzu, so dass die Gesamtfolgekosten durch Schäden an Leitungen und Trassen auf jährlich 500 Millionen Euro geschätzt werden. Notwendig ist daher ein System, das eine verbesserte Informationsbereitstellung mit niedrigeren Kosten für die Beauskunftung verbindet.

Mit eTRASSE wurde ein neuartiges Konzept geschaffen, das diese Anforderungen erfüllt: Über das Internet generiert ein Auskunftsportal aus den jeweiligen Geoinformationssystemen der Leitungsbetreiber eine integrierte Auskunft für das betroffene Gebiet, die der Kunde sofort online erhält. Auf diese Weise werden nicht nur die Wünsche der Nutzer nach einer raschen und gebündelten Informationsbereitstellung erfüllt, sondern auch die Interessen der Leitungsbetreiber bezüglich ihrer Datenhoheit werden gewahrt, da die Daten bei den Versorgungsunternehmen verbleiben. Gleichzeitig verringert sich der Aufwand der Betreiber für die Beauskunftung ihrer Leitungen erheblich.

Gegenüber bestehenden Online-Auskünften, wie sie bereits von einzelnen Trassenbetreibern angeboten werden, bietet eTRASSE für die Nutzer einen wesentlichen Vorteil, weil durch die Bündelung nur eine einzige Anfrage gestellt werden muss, über die alle Betreiber erreicht werden.

Ein Prototyp wurde bereits mit Leitungsbetreibern und Bauämtern erfolgreich im Probebetrieb getestet.

2. eTRASSE - EINE WEBANWENDUNG AUF BASIS VON STANDARDS

Die Online-Leitungsauskunft eTRASSE arbeitet als Webanwendung mit OGC-konformen Web Map Services (WMS), Web Features Services (WFS), WFS Bridges und Aggregate Services, sowie mit Standards der allgemeinen IT. Hierdurch ist das System herstellerunabhängig, garantiert die Interoperabilität zwischen verschiedenen Systemen und ermöglicht eine beliebig erweiterbare Anwendung für alle Leitungsbetreiber. Die verteilt in verschiedenen Herstellersystemen vorliegenden Daten werden nicht aufwändig in ein zentrales GIS integriert, sondern verbleiben bei den Leitungsbetreibern, die sie aktuell halten. Eine unternehmensübergreifende Bündelung der Daten kann somit erstmals realisiert werden. Über das Auskunftsportal wird die Auskunft zur Lage der Leitungen den Nutzern online zur Verfügung gestellt. eTRASSE lässt sich über jeden Standardbrowser nutzen und ist somit ohne großen Aufwand und Kosten für die Kunden nutzbar.

Da die fortgeschrittene Signatur verwendet werden kann, ist die Integrität der Auskunft gesichert, d.h. die Gewissheit, dass die Daten der Auskunft nicht verändert werden können. Durch die Notwendigkeit der Registrierung wird ein Missbrauch der Daten durch unberechtigte Personen verhindert.

3. UNTERSCHIEDLICHE WORKFLOW-MODELLE ERMÖGLICHEN EINE ANPASSUNG AN DIE UNTERNEHMENSWÜNSCHE

Der bestehende Workflow einer Trassen- oder Leitungsauskunft wird durch eTRASSE für alle Beteiligten erheblich vereinfacht. Bislang müssen die Informationen bei den unterschiedlichen Betreibern einzeln eingeholt werden, da es keine zentrale Auskunftsstelle gibt. In Städten können durch die Vielzahl an Betreibern bis zu 200 Kontakte notwendig sein. Bereits die Bündelung und Weiterleitung der Anfragen führt daher zu einer deutlichen Arbeitserleichterung für die Baufirmen.

Zudem ist die Auskunft oft negativ (keine Leitungen betroffen); insbesondere außerhalb der Städte führen bis zu 80% der Anfragen zu einer negativen Auskunft. Schon eine einfache Bündelung nur der negativen Auskünfte würde daher den Aufwand für alle Beteiligten reduzieren; eine Bündelung der positiven Auskünfte würde den Aufwand für die Auskunftssuchenden weiter verringern. Einige Trassenbetreiber legen jedoch Wert darauf, im Falle einer positiven Auskunft - im betroffenen Gebiet ist eine Leitung vorhanden - die Auskunft inklusive Lageplänen, Kontaktinformationen usw. selber herauszugeben und nicht über ein zentrales Portal laufen zu lassen.

Für eTRASSE wurden daher zwei Workflow-Modelle entwickelt. Modell A bündelt die Auskünfte aller Leitungsbetreiber, sowohl bei negativer als auch bei positiver Auskunft. In Modell B werden nur die negativen Auskünfte gebündelt; wenn die Trasse eines Betreibers betroffen ist, so wird das System des betroffen Betreibers aufgefordert, die Auskunft direkt an den Kunden zu senden.

Beide Workflow-Modelle können parallel eingesetzt werden, so dass eTRASSE den Trassenbetreibern die Wahl lässt, auf welche Weise sie Auskunft geben möchten.

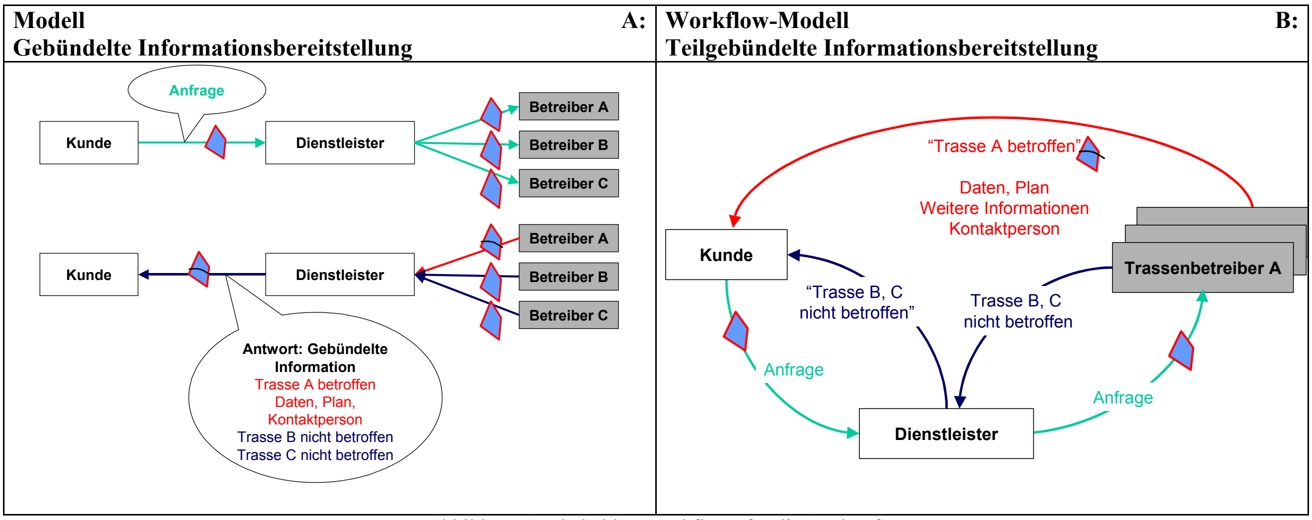


Abbildung 1: Die beiden Workflows für die Auskunft

4. DER ABLAUF EINER ANFRAGE ÜBER eTRASSE

Im folgenden wird mit einer Auswahl an Screenshots der Ablauf einer Anfrage für das Workflow-Modell A (gebündelte Informationsbereitstellung) dargestellt.

Da nur registrierte Benutzer Zugang zu eTRASSE haben, erfolgt zunächst ein Login. Über eine Eingabmaske kann im nächsten Schritt für die betroffene Fläche eine Adresse oder Koordinaten eingeben werden (nicht dargestellt). Die gefundene Stelle wird auf einer Katasterkarte dargestellt. Über einen Polygonzug kann der Benutzer eine Fläche auswählen, über die Auskunft erteilt werden soll.

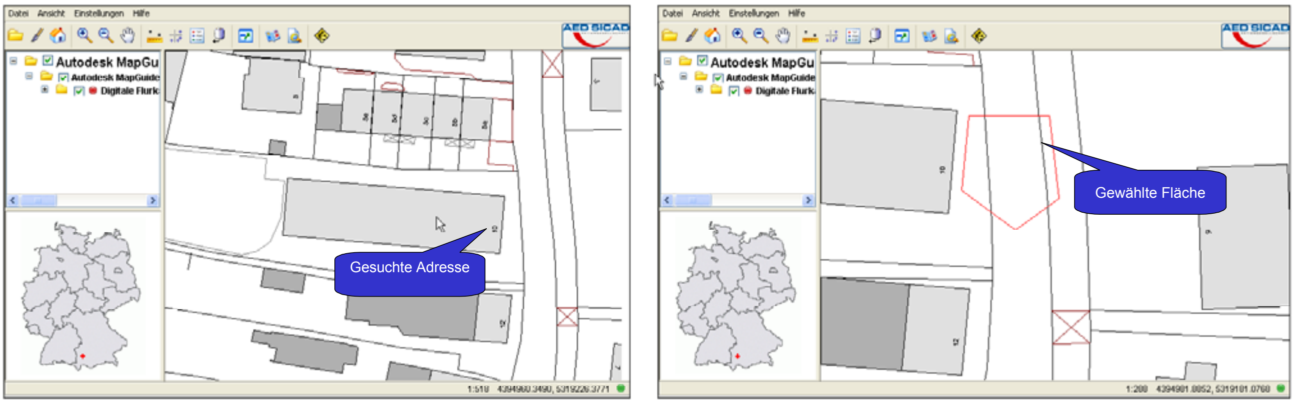


Abbildung 2: Stellen der Anfrage über Adresseingabe und Polygonzug

Die ausgewählte Fläche wird als Polygon an die WFS-Bridges der Trassenbetreiber gesendet. Diese leiten die Anfrage an den Web Feature Service des jeweiligen GIS-Systems weiter mit der Anfrage, ob Leitungen das Polygon schneiden.

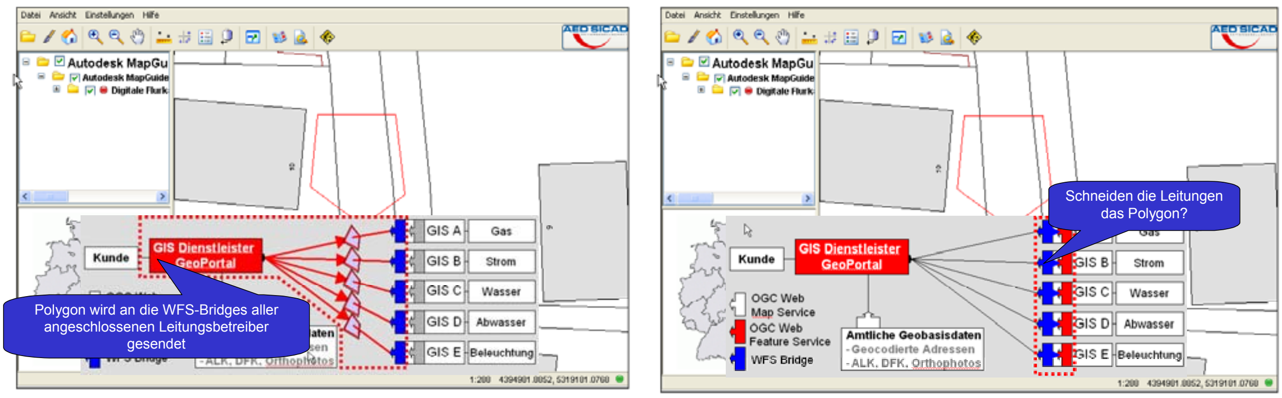


Abbildung3: Anfrage wird an die Trassenbetreiber weitergeleitet

Die WFS-Brücken werten die Antworten der Web Feature Services aus und erstellen eine Antwort: „Betroffen“ (eine oder mehrere Leitungen kreuzen die Fläche) oder „nicht betroffen“ (keine Leitungen schneiden die Fläche). Des zentrale Portal sendet die gebündelte Information über alle Trassenbetreiber an den Benutzer.

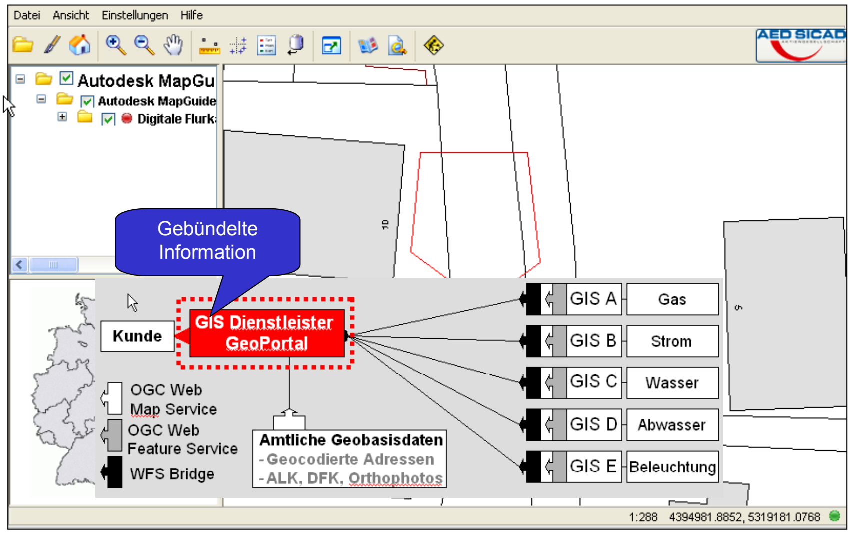
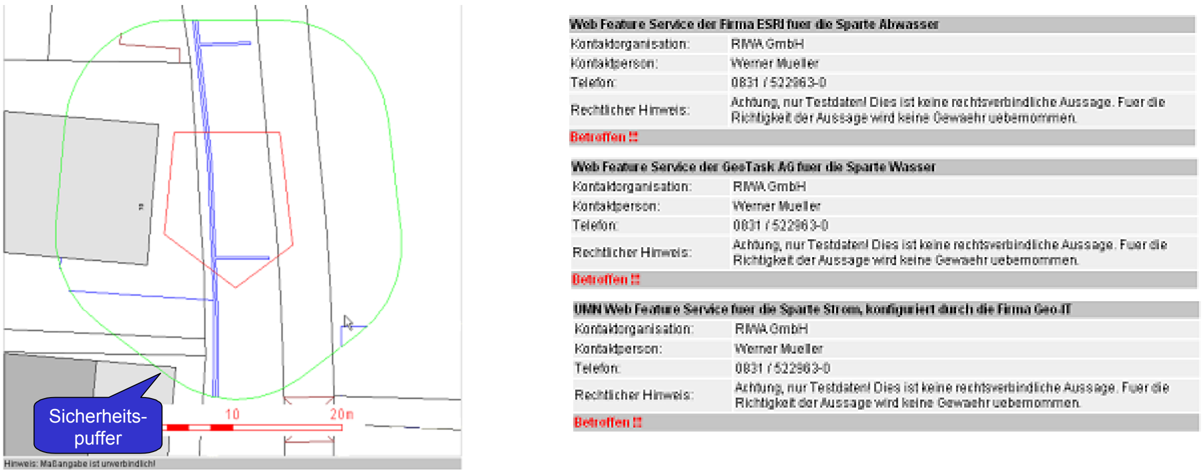


Abbildung 4: Die gebündelte Information wird an den Kunden zurückgeleitet

Der Benutzer erhält für die gewählte Fläche zuzüglich eines Sicherheitspuffers einen detaillierten Plan, in der alle Leitungen angezeigt werden, die betroffen sind. Für nicht betroffene Leitungsbetreiber wird die Information „nicht betroffen“ angegeben. Zusätzlich zur Karte erhält der Benutzer Informationen über die betroffenen Leitungen: Leitungsbetreiber, Sparte, Kontaktinformationen.



Web Feature Service der Firma ESRI fuer die Sparte Abwasser	
Kontaktorganisation:	RIWA GmbH
Kontaktperson:	Werner Mueller
Telefon:	0831 / 522963-0
Rechtlicher Hinweis:	Achtung, nur Testdaten! Dies ist keine rechtsverbindliche Aussage. Fuer die Richtigkeit der Aussage wird keine Gewaehr uebernommen.
Betroffen !!	

Web Feature Service der GeoTask AG fuer die Sparte Wasser	
Kontaktorganisation:	RIWA GmbH
Kontaktperson:	Werner Mueller
Telefon:	0831 / 522963-0
Rechtlicher Hinweis:	Achtung, nur Testdaten! Dies ist keine rechtsverbindliche Aussage. Fuer die Richtigkeit der Aussage wird keine Gewaehr uebernommen.
Betroffen !!	

UMN Web Feature Service fuer die Sparte Strom, konfiguriert durch die Firma Geo-IT	
Kontaktorganisation:	RIWA GmbH
Kontaktperson:	Werner Mueller
Telefon:	0831 / 522963-0
Rechtlicher Hinweis:	Achtung, nur Testdaten! Dies ist keine rechtsverbindliche Aussage. Fuer die Richtigkeit der Aussage wird keine Gewaehr uebernommen.
Betroffen !!	

Abbildung 5: Ausgabe der Information an den Kunden in grafischer Form mit Zusatzinformationen

5. NUTZEN DES SYSTEMS

Mit **eTRASSE** vereinfacht sich die Informationsbeschaffung erheblich, und der Aufwand für Auskunftsgebende sowie -suchende sinkt beträchtlich. Die Auskunft ist rund um die Uhr erhältlich und somit auch zu Tagesrandzeiten und im Notfall nutzbar.

Schäden an Leitungen werden vermieden, da der Workflow Prozesses „Leistungsauskunft“ durch das System wesentlich vereinfacht und transparenter wird. Bereits eine Reduzierung der Schäden um 5% kann 25 Millionen Euro jährlich einsparen.

Die Daten werden nicht zentral gesammelt, sondern verbleiben im GIS des jeweiligen Leitungsbetreibers. Neben einer größtmöglichen Aktualität, die hierdurch gesichert wird, verbleibt damit auch die Datenhoheit beim Betreiber. Ein Ausspionieren des kompletten Datenbestand eines Leitungsbetreibers wird durch das System verhindert, indem automatisch der Zugang beendet wird, sobald mehrere nebeneinander liegende Flächenstücke abgefragt werden. Die Systemarchitektur verhindert durch die Nutzung der WFS/WMS Bridges den direkten Zugriff auf die Daten der Leitungsbetreiber.

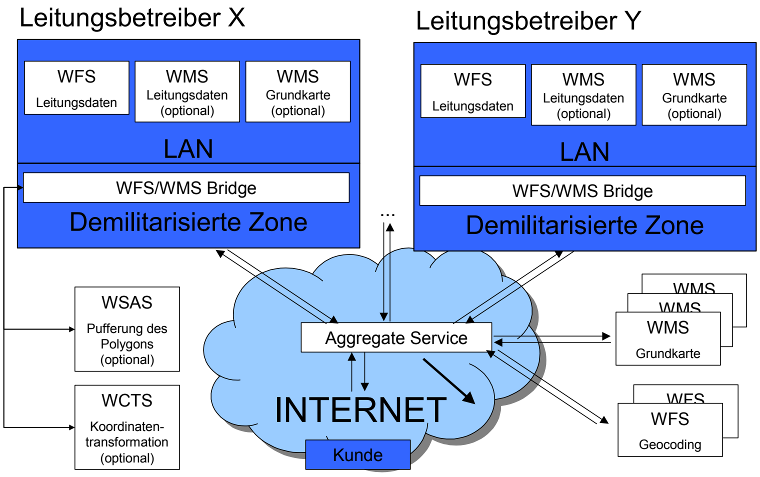


Abbildung 28: Die Systemarchitektur verhindert einen direkten Zugriff auf die Daten der Leitungsbetreiber

Durch eine zentrale Auskunftsplattform entsteht zudem höhere Sicherheit auch im Katastrophenfall. Das Wissen über gefährdete Infrastrukturen beschleunigt die Einleitung von gezielten Sofortmaßnahmen zur Schadensabwehr.

6. AUSBLICK

Für das Land Nordrhein-Westfalen soll die vorgestellte Lösung als landesweite Online-Leitungsauskunft pilotiert werden.

eTRASSE lässt sich jedoch nicht nur für die Beauskunftung von Leitungen einsetzen: Weitere Einsatzmöglichkeiten liegen im Bereich der Bausstellenkoordinierung, bei der die Tiefbauarbeiten unterschiedlicher Betreiber koordiniert werden (Mitverlegung). Erste Projekte zeigen, dass durch solche Online-Lösungen 20% der Tiefbaukosten eingespart werden können. Darüber hinaus wird hier eine Kommunikationsplattform zwischen Verwaltung und Wirtschaft geschaffen, die spitzenaktuelle Informationen über Veränderungen im Gebäude- und Infrastrukturbestand ermöglicht.

MICUS Management Consulting GmbH
MICUS Management Consulting GmbH ist auf die Erstellung umsetzungsorientierter Konzepte und Studien für Unternehmen sowie öffentliche Auftraggeber spezialisiert. Hohe Bekanntheit hat MICUS im Geoinformationsbereich mit ihren Marktstudien erzielt, die heute zu den meistgelesenen Studien weltweit zählen und vielfach als Standardwerke in der Branche zitiert werden.

Kontakt: Dr. Martin Fornefeld, MICUS Management Consulting GmbH, Stadttor 1, 40219 Düsseldorf, Tel. 0211 - 3003 420, Fax 0211 - 3003 200, info@micus.de, http://www.micus.de

🏆 reviewed paper

Wertschöpfungspotentiale geographischer Informationssysteme in der Immobilienentwicklung

Michael NADLER & Christian VON MALOTTKI

(Prof. Dr. Michael Nadler, Juniorprofessur Immobilienentwicklung und Immobilienfinanzierung, Dipl.-Ing. Christian von Malottki, Internationales Graduiertenkolleg „Visualisierung großer unstrukturierter Datenmengen", Technische Universität Kaiserslautern, Erwin Schrödinger Strasse, Gebäude 56, Raum 278/280, 67663 Kaiserslautern, Deutschland,
Email: nadler@rhrk.uni-kl.de und malottki@rhrk.uni-kl.de; Website: www.uni-kl.de/real-estate)]

1. ABSTRACT/ZUSAMMENFASSUNG

Im Rahmen von geografischen Informationssystemen (GIS) erfolgt die Sammlung, Verknüpfung, Analyse und Visualisierung von Daten mit räumlichem Bezug in digitalen Landkarten. Angesichts der Standortbezogenheit der Datengrundlage bietet sich aufgrund der gleichgerichteten Ziele eine kommerzielle Nutzung im Bereich der Immobilienwirtschaft an, die indes bislang in der Praxis nur in Form isolierter, heterogener und wenig transparenter Einzelanwendungen vollzogen wird. Die praktischen Probleme resultieren heute weniger aus der Technik, sondern ergeben sich vielmehr aus der Datenbeschaffung und –verfügbarkeit. Aus diesem Grund wird im vorliegenden Beitrag der mögliche Nutzen von GIS-Anwendungen am Beispiel der Wohnimmobilien ausgehend von den bestehenden empirischen Analysen zur Wertrelevanz räumlicher Datenparameter für Immobilien entwickelt. Die daraus resultierenden Anwendungen, Zielgruppen und Anforderungen immobilienbezogener GIS werden sodann anhand der Wertschöpfungskette im Lebenszyklus von Immobilien systematisch entwickelt. Nur auf Basis spezifischer Anwendungslösungen kann ein „Mehrwert" für Nutzer generiert und so eine entsprechende Zahlungsbereitschaft ausgelöst werden. In Verbindung mit den erforderlichen Implementierungskosten lassen sich dann zukünftig auch Aussagen über die Wirtschaftlichkeit von GIS-Investitionen bzw. GIS-Geschäftsmodellen für die einzelnen Nutzeradressaten in der Immobilienwirtschaft ableiten.

2. TECHNISCHE ENTWICKLUNGSTUFEN GEOGRAPHISCHER INFORMATIONSSYSTEME

Geographische Informationssysteme (GIS) zeichnen sich durch eine Verknüpfung räumlicher Daten in Form von Vektorobjekten oder Rasterdaten mit Sachdaten aus, die einem Zeichungsobjekt oder einer Georeferenz zugeordnet sind. Geoinformationssysteme ermöglichen Datenbankabfragen sowohl nach räumlichen als auch nach sachlichen Kriterien z.B. auf der Ebene der Gebäude(objekte). Denkbar sind jedoch auch Informationen auf höheren (Stadtviertel, Straßenzüge, Baugebiete) oder niedrigeren (einzelne Wohnungen, Geschosse) Maßstabsebenen. Basis für die gebäudebezogenen Geodaten sind im Regelfall die Daten der öffentlichen Vermessungsämter – in Form des Automatisierten Liegenschaftskatasters (ALK) liegen sie größtenteils digital und im Vektorformat vor. Dabei können z.B. auch Hausumringe oder -koordinaten separat bezogen werden. Geplant ist zudem die Integration von ALK und Automatisiertem Liegenschaftsbuch (ALB) in ein gemeinsames Geoinformationssystem ALKIS (Automatisiertes Liegenschaftskataster-Informationssystem), welches katastertechnisch relevante Sachverhalte (Flurstücknummern, Eigentümer usw.) mit den Objekten verknüpft. Weitere gebäudebezogene Sachdaten (wie Baualter, Stockwerkszahl, Nutzung o.ä.) liegen – wenn überhaupt – nur äußerst verteilt vor: Während kommerzielle Datenanbieter meist über relativ wenige Eigeschaften mit unklarer Qualität verfügen, hängen die öffentlichen Daten vom Engagement einzelner Ämter ab. Darüber hinaus sammeln private (Immobilien-)Unternehmen (z.B. Wohnungsbaugenossenschaften, Makler o.ä.) ihre eigenen Daten mehr oder weniger systematisch. Unproblematischer ist die Situation bei gebäudeübergreifenden Daten: Soziostrukturelle Parameter liegen bei Anbietern aus dem Direktmarketing vor. Zur Entfernungsberechnung werden Daten über das Straßennetz verwendet. Daten aus öffentlichen Quellen (bspw. über soziale Infrastruktur) sind jedoch ebenfalls sehr heterogen. Eine einheitliche Infrastruktur zum Bezug von Daten ist dabei nicht vorhanden. Es existieren neben Modellprojekten zur Vereinheitlung des Datenangebotes auf Ebene des Bundes und der Länder[1] privatwirtschaftliche Geodatenbroker, die sich auf die nutzergerechte Zusammenstellung der digitalen öffentlichen Daten spezialisiert haben und ihre Dienste per „Pay per Click" abrechnen. Alle Geo- und Sachdaten werden dabei in der Regel georeferenziert geliefert, um dem einzelnen Objekten unmittelbar die entsprechenden Informationen zuordnen zu können.

Auch wenn die deutschlandweite 2D-Digitalisierung von Grundkarten noch nicht abgeschlossen ist, haben parallel zu den o.a. Entwicklungen die ersten Akteure damit begonnen, die dritte Dimension in Geoinformationssystemen zu realisieren: Möglich ist dabei – bereits heute - eine georeferenzierte Einbindung von Luft- und Schägluftbildern in GIS-Systemen bzw. die Zugänglichkeit der Informationen im Internet.[2] Die Einbeziehung von Fotographie ist letztendlich jedoch nur ein Schritt zur 3D-Modellierung von Gebäuden, Stadtvierteln oder ganzer Städte. Einige große oder touristisch attraktive Städte haben demzufolge bereits erste 3D-Stadtmodelle entwickelt, welche entweder ein Grobmodell für das ganze Stadtgebiet oder eine aufwändige Detaillierung einzelner wichtiger Bereiche (Zentralbereiche, Entwicklungsschwerpunkte) umfasst.[3] Die Detaillierungsgrade[4] liegen dabei typischerweise „nur" auf der Ebene „Level of Detail (LOD)" 1 oder 2 (vgl. die folgende Tabelle 1), was auf die für Stadtmodelle resultierenden hohen Datenmengen zurückzuführen ist. Erst auf LOD 2 erfolgt dabei die Detaillierung der Gebäudekubatur (z.B. Modellierung von Dachformen) so-

---

1 Eine Zusammenstellung der Projekte zur einheitlichen Online-Nutzung der Geodateninfrastruktur in den einzelnen Bundesländern findet sich unter www.stadtentwicklung.berlin.de/download-gdi.de. Parallel hierzu engagiert sich der Bund im Interministeriellen Ausschuss für das Geoinformationswesen (IMAGI) und plant den Aufbau eines Geodatenportals. Verfügbar ist bereits eine Art Geodatensuchmaschine. Dieses Angebot einer deutschlandweiten Geodateninfrastruktur (GDI-DE, Suchmaschine unter www.geomis.bund.de) ist derzeit stark auf den Umweltbereich fokussiert.

2 Ein Beispiel bietet der Stadtplan der Stadt Bonn (http://stadtplan.bonn.de/mapbender/dhtml/index.php?)

3 Einen Überblick über Technik und mögliche Anwendungen bietet der STÄDTETAG NORDRHEIN-WESTFALEN (2004).

4 Die Detaillierungsgrade werden im Allgemeinen als „levels of detail" (LOD) bezeichnet. Entsprechend der Arbeit der Initiative Geodateninfrastruktur NRW, Special Interest Group (SIG) 3D, wird mit dem LOD 0 ein reines Geländemodell auf regionaler Ebene bezeichnet. Demgegenüber werden beim Level of detail 1 („Klötzchenmodell") dem Basispolygon aus der digitalen Grundkarte Höheninformationen zugeordnet. Im Regelfall kommen Höhenwerte zum Einsatz, die aus Laserscannings bzw. der Stereoauswertung von Fotos oder der Stockwerkszahl und angenommenen Höhen ermittelt werden. LOD 2 detailliert die Kubatur und Fassaden aus.

wie das Aufziehen bzw. „Mapping" von Fassadenfotos auf die einzelnen Gebäude. Auch wenn die Erstellung von Fassaden durch „Mapping" dezeit noch sehr teuer ist, ist zu erwarten, daß das Datenangebot aufgrund der zunehmenden Automatisierung und Verwendbarkeit der Ergebnisse in zahlreichen Disziplinen stark zunimmt und die Kosten hierfür eher fallen werden.

München (versch. Firmen, zu testen über www.münchen3d.de)	2.000 Gebäude mit Dachformen, 14.000 „Klötzchen"
Wiesbaden (GTA)	Gesamtstadt in „Klötzchen", Zentralbereich mit Detailkubaturen und teilweise Fassaden
Düsseldorf (CPA Geoinformation)	LOD 2 im engeren Citybereich, LOD 1 flächendeckend auf Basis von Stockwerkszahlen
Köln (GraphiX)	Innenstadt und angrenzende Bereiche mit Dachformen, kleinere Bereiche mit Fassaden
Bochum (Aerowest)	3D Modell als Basis für ein Autorennen entlang der Bochumer Entwicklungsgebiete
Hamburg (GIStech GmbH)	Ca.120.000 Gebäude mit Dachformen und exakter Höhe, Rest „Klötzchen" auf Basis von Stockwerkszahlen
Berlin (3dGeo GmbH, Vertrieb über www.geotainment.de)	Im Innenstadtbereich 26.000 Gebäude mit Fassen und Dachformen
Stuttgart	Gesamte Stadt als „Klötzchen", mit Dachformen für ca. 60 % des Stadtgebietes

Tab. 1: Deutsche Städte mit 3D-Stadtmodellen in Arbeit

Eine weitere Ausdetaillierung der Modelle[5] ist momentan eher Zukunftsmusik. Da dies für eine komplette Stadt von der Datenmenge her nicht darstellbar ist, beschäftigt sich die aktuelle Diskussion stärker mit der Schaffung von Schnittstellen auf der Objektebene mit Architektur-CAD-Programmen, die traditionell in 3D arbeiten.[6] Hierüber können zumindest für einzelne (noch zu erstellende) Immobilienobjekte detailreichere Visualisierungen vollzogen werden. Auch wenn ein fließender Übergang zwischen den LOD's besteht und erste Standardisierungsbestrebungen im Hinblick auf die Interoperabilität der Modelle initiert sind[7], muß zum jetzigen Zeitpunkt konstatiert werden, daß die angesprochenen Stadtmodelle in der derzeitigen Konzeption noch nicht „intelligent" sind. Denn eine Verknüpfung der digitalen Objekte, d.h. der 3d-Geovisualisierungen, mit Geosachinformationen wie z.B. Stockwerkszahl, Nutzung oder Bauzustand ist im Regelfall (noch) nicht gegeben. Dies lässt zwar in Zukunft interessante Entwicklungen erwarten, da dann die bisher eher im 2D-GIS vorliegende Verknüpfung von Sach- und Geoinformation auch in die bislang eher zur ansprechenden Darstellung verwandten 3D-Grafiken eingebunden werden könnte („3D-GIS"). Es muß sich indes bereits an diese Stelle diese Frage stellen, welche (öffentlichen oder privaten) Akteure diese technisch mögliche Weiterentwicklung von Geoinformationssystemen vollziehen und umsetzen werden.

3. DIE SPEZIFIZIERUNG DER IMMOBILIENWIRTSCHAFT ALS GIS-ANWENDER

So ist trotz dieser technisch machbaren Lösungsansätze derzeit eine auffallende Zurückhaltung bei kommerziellen Anwendungen im Bereich der 2D- und 3D-Geoinformationssysteme auf Seiten der Privatwirtschaft zu beobachten. Während Geoinformationssysteme im öffentlichen, vor allem im kommunalen Sektor Bedeutung und Verbreitung erlangt haben[8], z.B. im Tourismus, in der experimentellen Stadtplanung, dem Flächenmonitoring, der Simulation von Immisionen oder möglichen Katastrophen(-schutzmaßnahmen), gilt dies nur in geringem Umfang für diejenige Wirtschaftsbranche, die unmittelbares Interesse an räumlichen Daten haben müßte: die Bau- und Immobilienwirtschaft. Trotz zahlreicher Neuerungen auf dem Geodatenmarkt und entsprechenden Vermarktungsversuchen zeigt sich (bislang), dass die Mehrzahl der Projekte von Seiten der GIS-Forschung und der Softwarehäuser eher vage Ideen zur konkreten immobilienwirtschaftlichen Anwendung besitzen und demzufolge (noch) keine weitreichende Verbreitung erfahren haben. Da die Immobilienwirtschaft jedoch nicht als Vorreiteranwendung auf dem Geodatenmarkt agiert, erscheint es insofern zwangsläufig geboten, sich die konkreten Anwendungsmöglichkeiten bewusst zu machen.

Denn das Problem für Anwender, bspw.aus der Immobilienwirtschaft, liegt weniger in der technischen Leistungsfähigkeit und der Abfragemöglichkeiten[9] der 2D-GIS-Programme als vielmehr im Erwerb und in der Integration der benötigten Geovisualisierungs- und Geosachdaten. Denn hierbei tritt ein Wertschöpfungsparadoxon auf: Bei der Generierung und Aktualisierung von Rohdaten entstehen meist hohe Kosten, die jedoch an sich geringen Marktwert haben. Erst eine GIS-gestützte Auswertung erzeugt hohen Nutzen bei allerdings relativ geringen Zusatzkosten. Um gerade diesen hohen Zusatznutzen bzw. das zugehörige Wertschöpfungspotenital von Geodaten für die Immobilienwirtschaft zu konkretisieren, ist es indes eine empirische Quantifizierung erforderlich, welche Geodaten für welche immobilienwirtschaftlichen Adressaten bzw. Zielgruppen Wertrelevanz haben. Hierbei ist eine dynamische Betrachtung der Immobilie notwendig.

In der Immobilienwirtschaft, wie auch in vielen anderen Bereichen der Wirtschaftswissenschaften, hat sich diesbezüglich der Lebenszyklusansatz etabliert: Ganz allgemein bezeichnet der „Zyklus" ein periodisch ablaufendes Geschehen bzw. einen Kreislauf regelmäßig

5 Dabei bezeichnet Level of detail 3 das Architekturmodell, welches Fenster oder konstruktive Details als Vektordaten enthält. Level of detail 4 bilden im Innenraum begehbare Gebäude.

6 Vgl. z.B. ZEILE / SCHILDWÄCHTER / POESCH (2005) mit den dort genannten Quellenangaben.

7 Die in der SIG 3D der Initiative Geodateninfrastruktur NRW zusammen geschlossenen Städte, GIS-Anbieter und Forschungseinrichtungen haben zur Interoperabilität den gemeinsamen Standard City-GML entwickelt, der momentan für LOD 2 existiert und auf die weiteren Detaillierungsstufen ausgeweitet werden soll.

8 Vgl. zu den Analysen z.B. GUHSE (2005) oder KOHLMANN/MARKUS/THEURER (2003) mit den dort genannten Quellenangaben.

9 So sind für die Immobilienwirtschaft u. a. Abfragefunktionen eines GIS, wie etwa die Flächenverschneidung nach bestimmten Kriterien oder die Abstandsmessung und Flächenmessung sehr interessant und in der Regel auch heute schon über ein kommunal angebotenes GIS realisierbar.

ablaufender Ereignisse. Auf ein Gebäude bezogen gibt es zunächst keinen Zyklus, sondern nur eine Lebensspanne mit einem definierten Anfang und Ende. Von Zyklen kann nur innerhalb einer Gebäudelebensspanne gesprochen werden, wenn z. B. durch Modernisierungen ein sich wiederholender Vorgang eingeleitet wird. Möchte man jedoch den Kreislaufgedanken aufgreifen, so muss man das Grundstück in die Analyse miteinbeziehen. In diesem Fall ist es gerechtfertigt von Zyklen zu sprechen, wobei auf ein und demselben Grundstück immer wieder neue Objekte realisiert und abgebrochen werden. Die Gebäude durchlaufen dabei in idealtypischer Form immer wieder die gleichen Lebensphasen, die wie folgt visualisiert werden können:

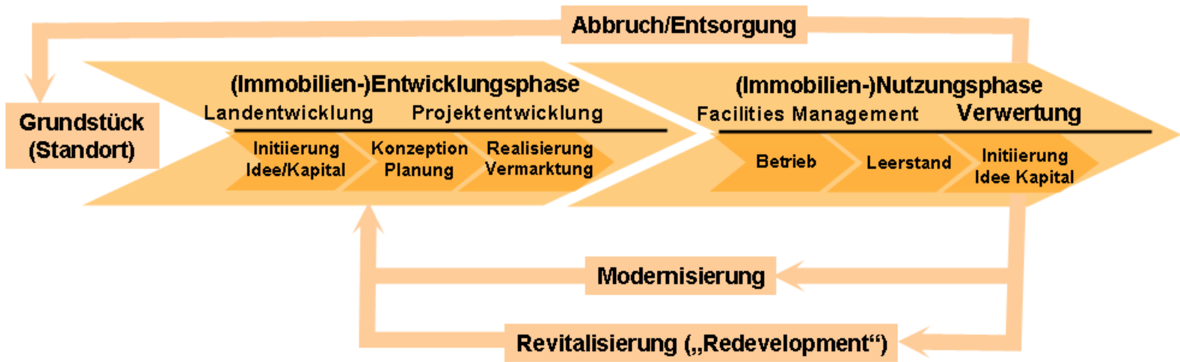


Abb. 1: Phasen im Immobilienlebenszyklus (eigene Darstellung)

Auch wenn sich zwischenzeitlich auch in der deutschen Immobilienwirtschaft das kreislauforientierte Lebenszyklusmodell durchgesetzt hat[10], so ist die Phasenabgrenzung und Phasenbezeichnung keineswegs einheitlich. Gemeinsam ist indes allen Systematisierungsansätzen eine Differenzierung zwischen der Phase der Immobilienentwicklung und der Immobiliennutzung[11]:

Hierbei lassen sich *Immobilienentwicklungen* grundsätzlich über das Zusammenführen von Projektidee, Grundstück, Kapital und Nutzer mit dem Ziel, einzelwirtschaftlich eine dauerhaft rentable Investitionprojekte zu tätigen und gesamtwirtschaftlich sozial- und umweltverträgliche Immobilienobjekte zu schaffen, charakterisieren. Während hierbei die (Bau-) Landentwicklung zum Ziel hat, baureifes Land zu schaffen, wird bei der typischerweise im Mittelpunkt stehenden Immobilien-Projektentwicklung i. e. S. ein Immobilienobjekt neu erstellt. Demgegenüber wird im Rahmen der Bestandsentwicklung („Redevelopment“) durch eine umfassende Sanierung, Modernisierung oder gar vollständige Neuausrichtung der Nutzungen bei einem bestehenden Objekt versucht, den Lebenszyklus der Immobilie zu erneuern.

Auslöser hierfür ist oftmals ein enstehender Leerstand in der Phase der *Immobiliennutzung*, welcher indes bei einem konsequenten Facilities Management (FM) zeitnah vom Besitzer der Immobilie (Bestandshalter) erkannt wird. Im Rahmen des FM werden entsprechend dem Branchenstandard der GEFMA alle kostenrelevanten Vorgänge rund um ein Gebäude betrachtet, analysiert und im Sinne der Wirtschaftlichkeit optimiert. Das kaufmännische FM bildet dabei gleichzeitig einen wesentlichen Bestandteil des betrieblichen Immobilienmanagements, indem der Bestandshalter sein Immobilienportfolio unter Risiko-Rendite-Aspekten optimiert. Hierzu zählt ggf. auch die Verwertung der Objekte in Form des Verkaufs oder des Abbruchs, womit dann wieder eine neue Entwicklungsphase im Lebenszyklus des Grundstücks initiiert werden kann.

Entscheidung für die Nutzung von Geoinformationssystemen in der Immobilienwirtschaft ist die Differenzierung zwischen den beiden Phasen im Immobilienlebenszyklus, da die beteiligten Akteure sich in den beiden Phasen unterscheiden. Damit resultieren divergierende Zielgruppen für GIS-Anwendungen, die ihrerseits abweichende Datenanforderungen an das GIS zur Folge haben. Sie sollen in der Folge exemplarisch verdeutlicht werden.

4. GEOVISUALISIERUNGSDATEN FÜR DAS MARKETING VON IMMOBILIEN- UND STADTENTWICKLUNGEN

Seit Mitte der neunziger Jahre sind die Bauinvestitionen wie auch die Bauumsätze in Deutschland rückläufig (vgl. die folgende Abb. 2)! Mittlerweile liegt das Investitionsvolumen im Jahre 2004 nominal bereits fast auf dem Niveau von 1991, real ist es um ca. 6 % gesunken. Fragt man nach den Gründen für diese rezessive Entwicklung, so sind zunächst die drei großen Investitionsbereiche voneinander zu separieren. Denn lange Zeit war der Wohnungsbau ein stabiler Nachfragemarkt für die gesamte Branche. Dies änderte sich im Jahr 2001 parallel zu den weltweit einsetzenden Konjunktur- und Börseneinbrüchen. Zwar wurden im letzten Jahr förderungsbedingt erhebliche Vorzieheffekte ausgelöst, jedoch ist die aktuelle Anzahl der Baugenehmigungen bereits wieder stark rückläufig. Der ostdeutsche Wirtschaftsbau ist schon seit Mitte der 90er Jahre rückläufig; in Westdeutschland setzte der Schrumpfungsprozess erst im Jahre 2001 ein. Er hat sich seither allerdings dramatisch verstärkt. Denn der Vermietungsmarkt für Bürogebäude und Gewer-beparks steckt in einer tiefen Krise. Ähnliches gilt auch für die öffentlichen Immobilieninvestitionen, vor allem im Bereich des Hochbaus. Diese sanken seit 1991 nominal um fast 30 % (8,5 Mrd. € 2004). Ausschlaggebend waren Sparzwänge infolge angespannter Finanzsituationen.

10 Vgl. z.B. die Richtlinie 100 der GEFMA (GErman Facility Management Association).

11 Zum Teil erfolgt darüber hinaus eine Abspaltung der Objektabbruchs und der Entsorgung als eigenständige Phase, die hier indes nicht weiter verfolgt wird. Denn Abbruch, Entsorgung und Altlastensanierung können als Teil der Land- und damit der Immobilienentwicklungsphase angesehen werden.

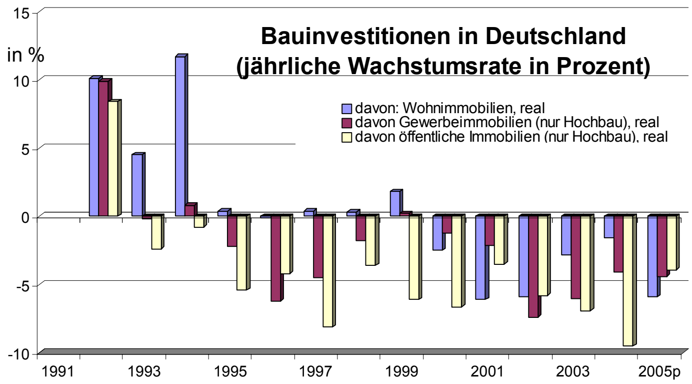


Abb. 2: Bauinvestitionen in Deutschland (Vgl. Statistisches Bundesamt: VGR)

Trotz und vielleicht auch wegen der dargestellten Entwicklung war bislang die private wie auch die institutionelle Nachfrage nach deutschen Immobilien eher begrenzt, da auch die zugehörigen Wertsteigerungen in allen Immobilienbereichen in Deutschland in der Vergangenheit nur geringe Werte aufwiesen.[12] Der Immobilienmarkt in Deutschland zeichnet sich demzufolge durch die Konstellation eines Käufermarktes aus, womit ein zielgerichtetes Marketing, d.h. eine optimale Gestaltung des Absatzbereiches, aus Sicht der Immobilienverkäufer zwangsläufig erforderlich ist:

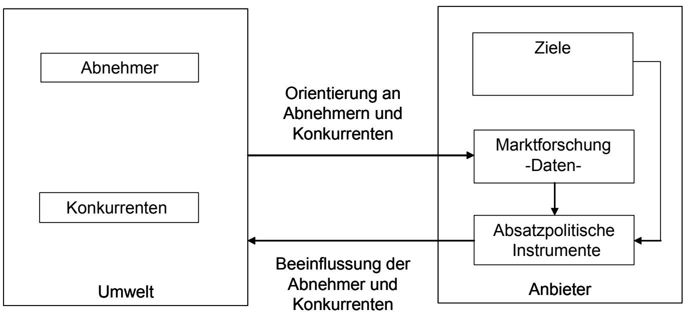


Abb. 3: Aktionsparameter im betrieblichen Marketing

Zu den Aktionsparametern des Marketings zählen hierbei neben der Marktforschung bzw. dem *Marktresearch*, in dem eine Analyse der potentiellen Nachfrager und Konkurrenten im Vergleich zur eigenen Unternehmenssituation vorgenommen wird, auch die sog. *absatzpolitischen Instrumente*. Hierbei versucht das Unternehmen im Rahmen des Marketing-Mixes gezielt Instrumente der Kontrahierungs-, Produkt-, Distributions- und Kommunikationspolitik zur Beeinflussung der Abnehmer und Konkurrenten einzusetzen. Beide Aktionsparameter haben auch Bedeutung im Rahmen der Entwicklungsphase von Immobilien, genauer im Rahmen ihrr Initiierung und Vermarktung (vgl. Abb. 2).

In der *Projektinitierung* nimmt die *Markt- und Standortanalyse* eine herausragende Bedeutung ein. Geosachdaten, die über ein laufend verfügbares Informationssystem bereitgestellt werden, können hier einen wesentlichen Beitrag zur einen beschleunigten Erstellung liefern. So werden Projektentwickler und Investoren inzwischen digital durch die Banken unterstützt, insbesondere das System HVB Expertise richtet sich gezielt an den Endkunden, indem es nach Eingabe des Straßennamens eine Qualitätsstufe der Wohnlage mit stadtspezifischen Preisen zuordnet. Während für Sektoren wie etwa die Büroimmobilien oder auch der Markt für unbebaute Gewerbeimmobilien nur begrenzt GIS-gestützte Informationen verfügbar sind, ist der Bereich der Handelsimmobilien derzeit wohl das bedeutendste Feld der computergestützten Standort- und Marktanalytik. Die starke theoretische Fundierung der Kaufkraftstrommodellierung, bspw. mittels Gravitationsmodellen, Logit-Modellen oder Voronoi-Diagrammen sowie die große Bedeutung von Wegen und Fahrzeiten ermöglicht eine sinnvolle computergestützte Einzugsbereichsmodellierung.[13] Grundsätzlich ist in diesem Bereich die Intensität der GIS-Nutzung stark von der Qualität der vorhandenen Eingangsdaten abhängig. Durch die großflächige Verknüpfung von digitalen Gebäuden und deren Eigenschaften (Stockwerkszahl, Baualter, Nutzung, Bruttogeschossfläche) sind schnellere und detaillierter Analysen eines Gesamtmarktes möglich. Angesichts der internen Anwendung der räumlichen Analysetools beim Entwickler/Investor oder bei seinem Makler/Berater, die hier die eigentliche Zielgruppe der GIS-Anwender darstellen (siehe Abb. 4), stehen bei der Markt- und Standortanalytik jedoch die Exaktheit der Geosachdaten im Vordergrund. Ansprechende Visualisierungen bzw. die Einbindung von Bildern oder 3D-Modellen, d.h. Geovisualisierungen sind allein für diesen Bereich wenig zielfördernd.

Anders ist dies in der Phase der *Vermarktung* der Immobilientwicklung (vgl. ebenfalls Abb. 4): Hier müssen einerseits wertrelevante Informationen bereitgestellt werden, gleichzeitig stellt aber auch die visuelle Art der Datenaufbereitung eine Herausforderung dar. Eine Verbesserung der Visualisierungstechnologie ist somit insbesondere dann interessant, wenn im Rahmen der Kommunikations- und Distributionspolitik ein kombiniertes Analyse- und Visualisierungstool bzw. dem potentiellen Immobiliennutzer oder Makler/Berater entscheidungsunterstützende Daten für ansprechende Präsentation bereit gestellt werden sollen.

12 Erst in den letzten zwei Jahren ist ein hohes institutionelles Investoreninteresse vor allem durch angelsächsische Investorengruppen in Deutschland zu beobachten. Zu den Gründen für diese Entwicklung vgl. NADLER (2006).

13 Vgl. hierzu z.B. V. SUNTUM (2000). Problematisch dabei ist jedoch das Erfordernis der Generierung von ausreichend detaillierten Bestandsaufnahmen, die eine Momentaufnahme des immer im Wandel begriffenen Handels leisten. Teilweise existieren eigene Softwareangebote, die große Filialisten erheben und digital in einem GIS zur Verfügung stellen (vgl. hierzu z.B. das Location GIS von Borchert GeoInfo).

	Projekt-initiierung	Projekt-konzeption	Projekt-konkretisierung	Projekt-realisierung
Institutionelle Investoren	beteiligt	beteiligt	beteiligt	Nicht beteiligt
Bauunternehmen	beteiligt	Nicht beteiligt	Nicht beteiligt	beteiligt
Banken	Nicht beteiligt	Nicht beteiligt	beteiligt	Nicht beteiligt
Nutzer	beteiligt	beteiligt	beteiligt	Nicht beteiligt
Architekten/Ingenieure	Nicht beteiligt	beteiligt	beteiligt	beteiligt
Makler/Berater	beteiligt	beteiligt	beteiligt	beteiligt
Kommunen (PPP/PFI)	beteiligt	beteiligt	beteiligt	beteiligt

Abb. 4: Akteure und Zielgruppen der GIS-Anwendung in der Immobilien-Entwicklungsphase

Grundsätzlich eignet sich dabei sowohl Geosachdaten als auch Geovisualisierungsdaten zur gezielten Immobilienvermarktung. Diese kann gleichermassen durch eine interne wie auch eine externe, durch Kunden im Internet selbständig durchzuführende Suche von Objekten erfolgen. Mindeststandard ist dabei eine Datenbank, die eine Suche nach Orten, Immobilienform und Preisspannen ermöglicht. Dies ist auch ohne Einsatz von Geodaten möglich. Fortgeschrittenere Portale ermöglichen dabei nicht nur eine Visualisierung der Treffer auf einer Karte, sondern vielmehr auch eine Verknüpfung mit Fotos, Schrägluftbildern oder Stadtmodellen.14 Eine flächenhafte Verfügbarkeit ansprechender Geodaten auf Foto- oder Stadtmodellbasis verknüpft mit relevanten Sachdaten würde hier auch eine teilautomatisierte Exposéerstellung in der Immobilienvermarktung ermöglichen. Vor dem Hintergrund der Bedeutung für die Standortwahl für Unternehmensansiedlungen bietet es sich deshalb auch für Kommunen und Regionen im Rahmen einer gezielten Wirtschaftsförderung und Vermarktung eigener kommunaler Flächen an, Standortinformationen (kostenfrei) bereitzustellen.

Zahlreiche Wirtschaftsregionen verfügen bereits über ein Standortinformationssystem, indem entweder über die Eingabe von Suchkriterien (Flächengröße, Entfernung zur Autobahn, zum Flughafen o.ä.) Gewerbeflächen in einer Datenbank abgefragt und dann kartographisch dargestellt wird. Alternativ erlaubt eine Karte mit Objekten und wählbaren Maßstäben die interaktive Information über Flächen oder Standorte, an denen der Benutzer Interesse findet. Dabei wird auf verschiedene externe Kartenquellen, z.B. Ausschnitte der topographischen Karte als Rasterdaten zurückgegriffen. Denkbar ist hier in Zukunft je nach gewünschtem Ausschnitt eine Einbindung weiterer Kartenquellen, z.B. der digitalen Stadtmodelle. Auf der Detailebene sind Visualisierungen zu einzelnen Baugebieten möglich. Interessant erscheint hier v.a. die Koppelung von Planung (d.h. Bürgerbeteiligung und Bebauungsplanung steht im Internet zur Verfügung) und die anschließende Nutzung der entsprechenden Infrastruktur für Vermarktungszwecke. Der Projektentwickler/Investor kann sich so über Parameter einzelner Grundstücke (Flächengröße, Preis, Versorgungsinfrastruktur) informieren, gleichzeitig aber auch die rechtlichen Bestimmungen des Bebauungsplans einblenden. Verkaufte Grundstücke werden angezeigt. Zahlreiche (kommunale) Visualisierungen findet man z.B. von städtebaulichen Großprojekten. Auf dem Markt sind virtuelle Spaziergänge durch CAD-Modelle oder 3D-Stadtmodelle, die speziell zu Marketingzwecken v.a. durch große Projektentwickler oder Wirtschaftsförderungen genutzt werden können, die bspw. an Messeständen mit aktuellen Stadtentwicklungsprojekten um Investoren werben.15

Insgesamt ist festzustellen, dass für alle Arten von Standortinformationssystemen bereits vielfältige Verknüpfungen und noch vielfältigere Verknüpfungsmöglichkeiten von Geovisualisierungs- und Geosachdaten bestehen. Aus Gründen der Aufwandsminimierung erscheint insbesondere bei städtebaulichen Großprojekten eine Koppelung der Sachdaten aus Standort- und Marktanalytik, Vermarktung und Planung sinnvoll. Die visuelle Aufwertung der Informationen in Form von Animationen oder 3D-Modellen macht auf einer regionalen Maßstabsebene wenig Sinn. In der Vermarktung privater großflächiger Immobilienentwicklungen erscheint eine Nutzung und ein entsprechender Bedarf durchaus gegeben, wenn das Volumen den entsprechenden Aufwand rechtfertigt. Synergien zwischen Planung und Vermarktung könnten dabei das Kosten-Nutzen-Verhältnis verbessern. Inwiefern in der Privatwirtschaft allerdings die Bereitschaft besteht, in größerem Maße die Kosten für entsprechende Visualisierungen zu tragen, bleibt abzuwarten. Hier wäre ein Feld für eine gezielte Wirtschaftsförderung der Kommune (Region) in der Entwicklungsphase, wenn diese kostenfrei Geosachdaten und Gevisualisierungsdaten potentiellen Investoren, Entwicklern und Maklers zur Verfügung stellen würde. In jedem Fall entstehen dabei Ansprüche an eine gute Qualität der Darstellung, gekoppelt mit einer leicht bedienbaren interaktiven Sachdatenabfrage.

14 Vgl. z. B. die Darstellungen auf www.immoscout24.de nur auf Stadtebene, auf www.vdm.de mit Detailkarte (wenn erwünscht). Amerikanische Portale bieten hier zusätzlichen Service. www.realtor.com erstellt z.B. sozioökonomische Profile des Viertels und informiert über Schulen und Geschäfte.

15 Ein gutes Beispiel für visualisierte Planung unter Einbezug von Vermarktungsaspekten bei ansprechender interaktiver Bedienung bieten die interaktiven Bebauungspläne des Landkreises Freising http://fs.mapsailor.de/fs-start.htm. Die Stadt Arnsberg – Gewinnerin des Internet-Preises des Informationskreises für Raumplanung - veröffentlicht beispielsweise ein solches Kataster im Internet, jedoch handelt es sich dabei um „normale" Pläne, in denen die Sachinformationen in parallel zu ladenden Tabellen ablesbar sind. Für den Spaziergang durch das neue Messeviertel in Köln vgl. BECKER/JHA (2003).

5. WERTRELEVANTE GEODATEN IN DER IMMOBILIEN-NUTZUNGSPHASE

5.1 Theoretische Fundierung der Wertrelevanz von Geosachdaten für Immobilienkapitalanleger

Mit dem Abschluss der Immobilienentwicklung beginnt die Lebenszyklusphase der Immobiliennutzung, womit in der Regel eine deutliche Reduktion der noch beteiligten Akteure und damit der möglichen Zielgruppe von GIS-Anwendern verbunden ist. Im wesentlichen reduziert sich dies auf den Investor, der die Immobilie im Bestand hält, und seinen möglichen Kreditgeber, d.h. auf die (Eigen- und Fremd-)Kapitalanleger. Erst bei einem „Re-Development“, welches in der Regel aus einem vermehrten Leerstand resultiert, vergrßert sich dies entsprechend dem Grundansatz gemäß Abb. 2.

	Projekt-abschluss	Nutzung	Leerstand	Projekt-initiierung
Institutionelle Investoren	beteiligt	beteiligt	beteiligt	beteiligt
Bauunternehmen	Nicht beteiligt	Nicht beteiligt	Nicht beteiligt	beteiligt
Banken	beteiligt	beteiligt	beteiligt	Nicht beteiligt
Nutzer	beteiligt	beteiligt	Nicht beteiligt	beteiligt
Architekten/Ingenieure	Nicht beteiligt	Nicht beteiligt	Nicht beteiligt	Nicht beteiligt
Makler/Berater	beteiligt	Nicht beteiligt	Nicht beteiligt	beteiligt
Kommunen (PPP/PFI)	beteiligt	Nicht beteiligt	Nicht beteiligt	beteiligt

Abb. 5: Akteure und Zielgruppen der GIS-Anwendung in der Immobilien-Nutzungsphase

Die Anlageentscheidung von Immobilieninvestoren wie auch die Kreditvergabeentscheidung der Banken wird insbesondere durch mikro- und makroökonomische Einfußfaktoren nachhaltig beeinflusst. Zu nennen sind hierbei im Falle etwa der Wohnimmobilien16 die negativen Einflüsse steigender Zinsen, hoher Einkommensunsicherheiten oder hoher Inflationsraten im Bereich des Konsums oder der Mieten. Während über deren Einfluss und über Instrumente zu deren Steuerung innerhalb von Wohninvestitionsentscheidungen zwischenzeitlich Forschungsergebnisse vorliegen17, sind die räumlichen Einflussfaktoren auf Immobilieninvestitionen in Europa bislang wenig erforscht. Hierzu zählen nicht nur diverse typische geographische Faktoren auf der Ebene von Makro- und Mikrostandorten (z.B. Verkehr und Infrastruktur), sondern auch sozioökonomische Faktoren, wie etwa die Bevölkerungsentwicklung oder die Sozialstruktur der jeweiligen Immobilien. Daneben gewinnen auch zunehmend ökologische Faktoren (z.B. Grün- und Freiflächen oder Lärmbelastungen) als wesentlicher Einflussfaktor für die Entwicklung der Immobilienwerte zunehmend an Bedeutung. Auch wenn diese Einflussfaktoren (siehe z.B. die demographischen Entwicklungen) oftmals erst sehr langfristig wirksam werden, haben sie angesichts durchschnittlicher Nutzungsdauern von Immobilieninvestitionen von bis 80-100 Jahren und von Finanzierungslaufzeiten von bis zu 30 Jahren gerade in diesem Bereich doch eine enorme Bedeutung.

Vor diesem Hintergrund könnten Geoinformationssysteme mit wertrelevanten Geosachdaten ein wichtiger Baustein für die Investitions- wie auch die Kreditentscheidung der dauerhaften (Eigen- und Fremd-)Kapitalanleger liefern. Voraussetzung hierfür ist indes eine empirische Validierung der Wertrelevanz der Geodaten für die Immobilienwerte und damit auch für die Anlageentscheidungen. Während diese selbst im Bereich der ansonsten gut erschlossenen Wohnimmobilien derzeit noch nicht verfügbar sind18, gilt dies nicht für die angelsächsischen Länder, in denen der Einfluss räumlicher Daten auf speziell Wohnimmobilien über ökonometrische Modelle quantifziert wird. Ausgangspunkt sind hierbei hedonische Modelle, in denen den Preis eines Gutes als eine Funktion aus seinen Charakteristika und Eigenschaften bestimmt wird. Erstmals 1974 hat ROSEN den Preis einer Wohnimmobilie wie folgt quantifiziert:

$P = f(z)$

wobei P der Preis des Wohnimmobilie ist, der durch eine Funktion seiner Eigenschaften und Charakteristika (z) bestimmt wird. Die unterschiedlichen Eigenschaften werden als Vektor beschrieben:

$z = (z_1, z_2, \ldots, z_n)$

wobei möglichst alle Eigenschaften des Hauses in diesem Vektor erfasst werden sollten. Grundsätzlich lassen sich die Eigenschaften eines Hauses vier großen Bereichen zuordnen:

Struktur: Die strukturellen Eigenschaften beschreiben den physischen Aufbau des Gebäudes und des Grundstücks, z. B. die Wohnfläche (m²), Anzahl der Zimmer oder die Gartenfläche (m²).

Erreichbarkeit: Die Erreichbarkeit beschreibt die Entfernung (in Meter oder Minuten) zur Innenstadt, zur nächsten Bushaltestelle, zum nächsten Einkaufszentrum oder auch zur nächsten Schule.

16 Die Wohnimmobilien werden im weiteren Verlauf exemplarisch als Anschauungsobjekt für GIS-Anwendungen in der Immobilien-Nutzungsphase gewählt, da hier

17 Vgl. hierzu z.B. NADLER (2001) und Nadler (2005).

18 Derzeit gibt es nur isolierte Forschungsstudien, die Einzelaspekte herausgreifen, wie z.B. der Einfluss von Frei- und Grünflächen auf Immobilienwerte im aktuell noch laufenden Forschungsprojekt der TU Berlin.

Nachbarschaft: Unter die Eigenschaften der Nachbarschaft fallen beispielsweise das Durchschnittsalter der Immobiliennutzer oder auch die Kriminalitätsrate und die ethnische Zusammensetzung im jeweiligen Stadtviertel.

Umwelt: Wertrelevante Eigenschaften sind z. B. der Grad der Luftverschmutzung, Art oder die Stärke der Lärmbelästigung.

Eine Untersuchung basiert im Allgemeinen auf tatsächlich verkauften Wohnimmobilien und ihren Eigenschaften. Bei der hedonischen Preisermittlung wird auf der Grundlage einer empirischen Untersuchung die allgemeine hedonische Preisfunktion mittels multipler Regression ermittelt, sodass am Ende die Auswirkungen jeder einzelnen Eigenschaft (unabhängige Variablen) auf den Gesamtpreis der Immobilie (abhängige Variable) herausgearbeitet werden kann bzw. die Bereitschaft der Immobilienbesitzer für eine Eigenschaft einen bestimmten Preis zu zahlen („willingness to pay") erkennbar wird. Nachdem zunächst die Form der hedonistischen Preisfunktion ermittelt wird, ist dann anhand verschiedener Prüfmethoden die Signifikanz der einzelnen kaufpreisbeeinflussenden Parameter zu überprüfen. Dies geschieht in der Regel unter Berücksichtigung räumlicher und zeitlicher Interdependenzen sowie des Problems der Multikollinearität mittels eines Regressionsmodells.

Vielfältige angelsächsische Untersuchungen seit Anfang der 90er Jahre19 zeigen dabei, daß z.B. die Erreichbarkeit des sog. „Central Business Districts (CBD)" und damit die Verkehrsinfrastruktur (Strassen/Autobahnen, ÖPNV) einen ebenso positiven Werteinfluss hat, wie etwa Einkaufsmöglichkeiten oder der Zugang zu kulturellen Aktivitäten wie Theater, Restaurants, Sportereignissen usw. Aber auch die (unter Umständen nicht vorhandene) Qualität von Schulen, die ethnische Zusammensetzung des Stadtviertels, die Höhe der Kriminalitätsrate und der Arbeitslosigkeit im Stadtviertel beeinflussen ebenso signifikant die Immobilienwerte wie etwa (längerfristige) demographische Entwicklungen. Sie kann gemessen werden z.B. über die Altersstruktur der Bevölkerung eines Stadtviertels. Eindeutig positiv wirken sich auch ökologische Faktoren aus: Ein Stadtviertel mit vielen Frei- und Grünflächen wird einem stark bebauten oder von Gewerbe geprägten Viertel vorgezogen, woraus nachhaltig höhere Immobilienwerte resultieren. Ein signifikant negativen Werteinfluss hat hingegen Lärm, welcher z.B. mit Lärmmessungen nachgewiesen wurde.

Fraglich ist allerdings, ob diese Ansätze uneingeschränkt auf den deutschen Immobilienmarkt und speziell den deutschen Wohnungsmarkt übertragen werden können. Gerade die heterogene Baustruktur und die Beliebtheit mischgenutzter Quartiere stellt eine einfache Modellierung der abhängigen Variable „Wert" anhand der o.a. exemplarischen Geosachdaten vor Probleme. Zudem weist allein die Preisentwicklung der Wohnimmobilien in Großbritannien und den USA in den letzten Jahrzehnten eine eklatant abweichende Entwicklung zu den deutschen Verhältnissen auf20: Während im angelsächsischen Raum, auf dem die bisherigen internationalen Forschungsergebnisse basieren, durchschnittliche jährliche Preissteigerungen im zweistelligen Bereich seit Anfang der 90er Jahre zu beobachten sind, sind die Wohnimmobilienpreise in Deutschland in den meisten Regionen höchstens konstant geblieben, in vielen strukturschwächeren Regionen sogar stark rückläufig. Möglicherweise ändert sich dieses Bild in Zukunft nachhaltig. Milliardenschwere Immobilienkapitalanlagen durch angelsächsische institutionelle Investoren in den deutschen Wohnungsmarkt deuten bereits darauf hin.21

5.2 Erweiterte Risiko- und Wertanalysen für die Finanzierung und das Management von Immobilien

Wie bereits anhand der Abb. 4 gezeigt, ist das Wissen um die wertrelevaten Eigenschaften von (Wohn-)Immobilien in der Nutzungsphase gleichermassen für die beiden noch beteiligten Akteure, den bestandshaltenden Investor sowie seine kreditgebende Bank22, d.h. für die (Eigen- und Fremd-)Kapitalanleger unerläßlich. Dies resultiert letztendlich aus den gesetzlichen Anforderungen für beide Akteursgruppen:

So ist gemäß § 25a Abs. 1 und 2 KWG jedes Kreditinstitut verpflichtet, alle wesentlichen Risiken zu steuern und zu überwachen. Gleichzeitg hat gemäß § 91 Abs. 2 AktG der Vorstand einer (Immobilien-)AG geeignete Maßnahmen zu treffen, insbesondere ein Überwachungssystem einzurichten, damit den Fortbestand gefährdende Entwicklungen früh erkannt werden. Für Investoren wie auch Kreditgeber ist zudem § 217 Abs. 2 und 3 HGB zu beachten, wonach grds. eine Prüfung hinsichtlich der zutreffenden Darstellung der Risiken bei der künftigen Entwicklung des Unternehmens erforderlich ist.

Verschärft werden diese Anforderungen noch durch die neuen Anforderungen gemäß Basel II, MaK sowie IFRS, wonach eine ausführliche und regelmäßige Prüfung zutreffender Risiken nachzuweisen und offenzulegen ist. Alle für die Beurteilung des Engagements wichtigen Faktoren (unter besonderer Berücksichtigung der nachhaltigen Ertragskraft des Objektes) sind in regelmäßgen Abständen zu beurteilen und zu analysieren.

Aufgrund dieser erheblichen gesetzlichen Vorgaben ist praktisch während des gesamten Investitions- bzw. Finanzierungszeitraumes (und nicht nur bei der erstmaligen Anlage- bzw. Kreditentscheidung) die Immobilienobjekte im Hinblick auf ihren nachhaltigen Wert und damit im Hinblick auf die Höhe möglicher Kreditausfall- bzw. Investitionsrisiken hin zu beurteilen.

Die Zielvorstellung einer Nutzung von Geosachdaten durch die internen und externen (Immobilien-)Wertermittler ist es dabei, den Aufwand für die Ermittlung von wertbestimmenden Einzelparametern zu mindern und gleichzeitig bessere, umfangreichere und detailliertere Eingangsdaten zu bekommen. Eine zentrale Bewertungsbasis bilden die von öffentlicher Seite zur Verfügung gestellten Bodenrichtwerte. Sie sind zunehmend georeferenziert und teilweise unter Eingabe einer Adresse per Internet abrufbar. Ausgegeben

19 Vgl. z.B. CAN (1990), THERIAULT / DES ROSIERS / VILLENEUVE / KESTENS (2003), DES ROSIERS / LAGANA / THERIAULT (2001), FIK / LING / MULLIGAN (2003), CASE / CLAPP / DUBIN / RODRIGUEZ (2004), GELFAND / ECKER / KNIGHT / SIRMANS (2004) sowie THEEBE (2004).

20 Vgl. NADLER (2001).

21 Vgl. NADLER (2006).

22 Dieser Bereich der erstmaligen Finanzierung einer Immobilienprojektentwicklung bzw. einer Landentwicklung wäre zwar der Entwicklungsphase zuzuordnen. Im Vergleich zum Bestandsgeschäft erweist sich dieses „Zwischenfinanzierungsgeschäft" als eher nachrangig, so dass fraglich ist, ob sich hier alleine ein entsprechendes Vermarktungspotential von GIS-Anwendungen ergeben würde.

werden dann die Werte, wobei zusätzlich Grundkarten, Stadtpläne oder topographische Karten eingebunden werden können.23 Auch Liegenschaftskarte und Liegenschaftsbuch lassen sich teilweise online abrufen. Die anbietenden Vermessungsämter vermarkten auch georeferenzierte Komplettdatensätze an Geodatenbroker, welche dann zu einem gegebenen Grundstück neben den Bodenrichtwerten weitere überlagerbare Informationen aus einer Hand anbieten. Deren Informationsgehalt ist jedoch stark vom Detaillierungsgrad abhängig ist, d.h. von der Fragestellung, ob sich die Daten auf ein Grundstück, eine Straße, einen Stimmbezirk oder ein ganzes Stadtviertel bzw. eine Postleitzahl beziehen. Durch verschiedene Anbieter verfügbar oder grundsätzlich verknüpfbar sind neben den Bodenrichtwerten insbes. Mieten (meist in stadtquartiersspezifischer Preiszuordnung durch einfache, mittlere, gute o.ä. Lagequalitäten), Bevölkerungsstrukturdaten (wie Einwohnerzahlen, -dichten, Ausländer- und Akademikeranteile sowie die Kaufkraft), Versorgungsstrukturen (Verkehr, Einzelhandel, Sozialeinrichtungen) sowie z.T. auch Lärm- und Schadstoffimmissionen.

Auch wenn damit die verschiedenen wertrelevanten Kategorien gemäß Kapitel 5.1 abgedeckt sind, besteht derzeit in diesem Bereich die zentrale Herausforderung v.a. in der Qualität und dem Detaillierungsgrad der Daten. Die Information veraltet meist schnell und nicht immer ist klar, aus welchen Quellen eine wie gute und detaillierte Information gewonnen wurde. Informationen wie Lärmwerte oder Sozialstrukturen ändern sich zudem oft sehr kleinteilig, so dass Fehler oder ungenaue Aussagen bei einer unkritischen Weiterverarbeitung zu großräumig erhobener Daten entstehen können.

Interessant ist die Einbindung der verfügbaren Informationen zu einer halbautomatisierten Bewertung. Hier werden in den angelsächsischen Ländern bereits große Anstrengungen unternommen, da dort auch unter Steuergesichtspunkten eine regelmäßige Bewertung notwendig ist. Auf dem deutschen Markt sind zwar viele verschiedene Softwareprodukte zur Immobilienbewertung, ein gewisser Automatisierungsgrad ist allerdings nur bei den wenigsten vorhanden. In ein automatisiertes System wird die Adresse der Immobilie zusammen mit gewissen Objektparametern (Baualter, Geschossfläche etc.) eingegeben. Daraufhin wird anhand der im GIS erfassten räumlichen Sachdaten ein Vorschlagswert generiert. Laut der Aareal Hypotheken-Management können auf diese Weise 50 bis 60 % der Objekte weitgehend automatisiert bewertet werden.24 Alternativ können räumliche Restriktionskriterien für die Entscheidungsträger eingeführt werden, beispielsweise ab bestimmten Lärmwerten keine Kreditvergaben mehr durchzuführen.

Grundsätzlich hat die Wertermittlung bzgl. der Geodatennutzung klare und steigende Ansprüche an die Qualität und Quantität der Geosachdaten. Insofern kann hier bereits durch ein „reguläres“ GIS ein hoher Nutzwert generiert werden. Erforderlich ist jedoch eine Verbesserung der Eingangsdaten sowie eine auf die deutschen Besonderheiten ausgerichetete Forschung zum Zusammenhang zwischen räumlichen Faktoren und Immobilienwerten (siehe Kapitel 5.1). Darüber hinaus gehende Visualisierungstechniken, bspw. in 3D, bieten hingegen eher geringen Zusatznutzen.25 Wichtiger erscheint hierbei vielmehr die Verknüpfung der externen Sachdaten aus dem GIS mit den internen liegenschaftsbezogenen Sachinformationen des bestandshaltenden Immobilieninvestor. Insbesondere gewerbliche, professionelle Investoren sowie kommunale Bestandshalter verfügen im Rahmen ihres Corporate Real Estate Managements (CREM) bzw. Public Real Estate Managements (PREM) über weitreichend verknüpfbare Sachdaten: So sind im Facility Management (FM) bereits vielfältige Systeme im Einsatz. Meist handelt es sich um CAD-Systeme, um Computer Aided Facility Management-Software (CAFM) oder Datenbanken wie das Real Estate Modul der Unternehmenssoftware von SAP. Der Aufgabenbereich für GIS-Entwickler besteht somit in diesem Bereich nicht darin, neue Strukturen zu schaffen. Vielmehr geht es darum, die Schnittstellen zwischen vorhandenen internen Managementdaten, die verteilt und in verschiedenen Formaten vorliegen, zu gewährleisten.26 Bestandshalter können bereits heute ihre Datenbanken, die Auskunft über das eigene Portfolio geben, durch GIS-Dienstleister bzw. GIS-Anwendersoftware visualisieren zu lassen, so dass gleichzeitig auch geographische Abfragen möglich sind.27 Im Zeitalter der 3D-Basisdaten könnten diese Informationen zwar auch in der dritten Dimension (siehe CORP 2006 Vortrag VON MALOTTKI) visualisiert werden, jedoch wird der Informationswert und Detaillierungsgrad von Geosachdaten aufwändigen Visualisierungen. Eindeutig vorgezogen. Denn (nur) die Sachinformationen (nicht die Visualisierungen) liefern Immobilienkapitalanleger eine wesentliche Entscheidungshilfe hinsichtlich der Einschätzung potentieller Risikofaktoren für die eigenen Investitions- und Finanzierungsentscheidungen. Dies gilt im übrigen nicht nur für professionelle, gewerbliche sondern auch für private Immobilieninvestoren, welche insbesondere bei den Wohnimmobilien in Deutschland als Bestandshalter und damit als poentielle Nutzer von GIS-Informationen eine herausragende Bedeutung zukommt:

23 In Nordrhein-Westfalen existiert das landesweite Bodenrichtwerte-Informationssystem (BORIS), www.boris.nrw.de. In anderen Ländern sind diese Informationen teils über kommunale Portale zu bekommen, ansonsten bieten sich die privaten Geodatenbroker an (vgl. zu den weiteren aktuellen Entwicklungen auch HEIDGER-GRÜNE (2004)).

24 Vgl. JANICKI / PIESKE (2004) sowie die Ausführungen zum Produkt LORA von der Firma on-geo. Problematisch sind Altbauten, sanierte Objekte oder Luxusobjekte, während die Ergebnisse in homogenen mittleren Lagen gut sind.

25 Gleichzeitig ist die Wertermittlungspraxis derjenige Bereich der Immobilienwirtschaft, der durch verschiedene Kooperationen am deutlichsten seinen Bedarf an Geodaten konkretisiert. Zu nennen sind bspw. die Special Interest Group Immobilien innerhalb der Initiative Geodateninfrastruktur NRW (vgl. www.gdi-nrw.de) oder der Runde Tisch GIS e.V. mit dem Projekt „Pilotierung Real Estate“ an der TU München (vgl. www.rtg.bv.tum.de).

26 In großem Stil setzt bspw. die RAG Immobilien AG als Besitzerin zahlreicher Immobilienbestände im Ruhrgebiet in Zusammenarbeit mit der eigenen Informatik-Tochtergesellschaft und ESRI Geoinformatik ein GIS um, welches Sachdaten der Liegenschaftsverwaltung mit SAP Real Estate und dem Add-On Land Use Management (Grundbucheinträge, Verträge und andere Sachinformationen) mit räumlichen Daten überlagert.

27 Vgl. hierzu z.B. KÜBLER / MAY (1999) sowie die ESRI-Anwenderkonferenz 2005. Immobilienspezifisches Programme sind bspw. ImmoGIS von Borchert GeoInfo oder der CRE-Valuemanager von Acurtrading GmbH. Grundsätzlich eignen sich aber auch die GIS-Programme aller großen GIS-Anbieter.

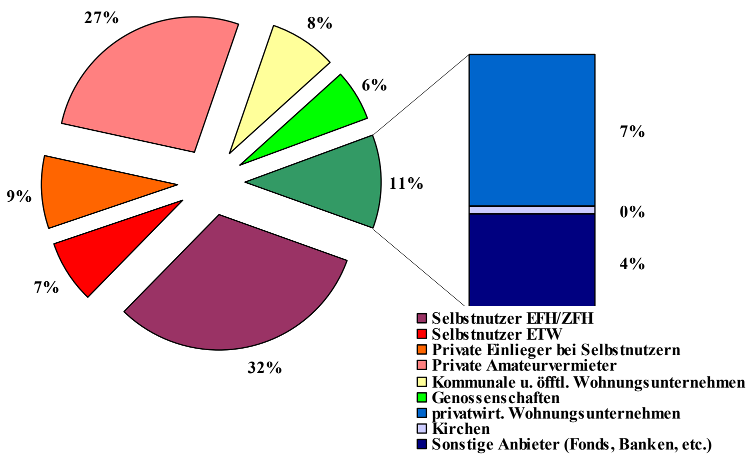


Abb. 6: Struktur der Bestandshalter am deutschen Wohnimmobilienmarkt (vgl. GDW, 2004)

An der Struktur der Bestandshalter vzw. Investoren am deutschen Wohnimmobilienmarkt zeigt exemplarisch die „Problematik“ von GIS-Anwendungen in der Nutzungsphase: Nur rund 25 % des gesamten Immobilienbestandes ist in der Hand professionell-gewerblicher Anbieter, die für eine immobilienwirtschaftliche GIS-Anwendung uneingeschränkt auch in Frage kommen. Beachtet man darüber hinaus die Finanzprobleme der öffentlichen Akteure und damit auch der zugehörigen Wohnungsbestände, so reduziert sich der potentielle Markt für GIS-Anwendungen in der Bestandsphase auf nur noch 11 % des gesamten Bestandes. Bedenkt man doch noch, daß derzeit insbes. am deutschen Wohnimmobilienmarkt aufgrund verstärkter angelsächsischer Investitionen durch entsprechende Investorengruppen ein sehr starker Konzentrationsprozeß im Gange ist (vgl. die Ausführungen in Kapitel 5.1), so reduziert sich auch diese Anzahl möglicher GIS-Anwender nochmals erheblich. Dies gilt zumindest in Bezug auf die mögliche Verknüpfung interner FM-Daten und externer Geodaten, denn im Bereich der Selbstnutzer wie auch der privaten Investoren werden in der Regel keine weitreichenden Mangementdaten vorhanden sein. Denkbar ist hier indes, daß sich auch diese Privathaushalte zukünftig für wertrelevante Geosachdaten interessieren, wenn es auch im europäischen und deutschen Raum gelingt, die Wertrelevanz dieser Geoinformationen für ihre investierten Immobilienwerte im Sinne des Kapitels 5.1. nachzuweisen.

6. RESÜMEE UND AUSBLICK

In den vorangegangenen Kapiteln ist deutlich geworden, dass sich auf dem Geodatenmarkt Weiterentwicklungen abzeichnen, die grundsätzlich auch für die Immobilienwirtschaft von Interesse sind. Oft ist jedoch das Problem, dass gerade im Sachdatenbereich Informationslücken bestehen, so dass beispielsweise der technisch zumindest auf Objektebene uneingeschränkt machbare Schritt in die dirtte Dimension nicht über fehlende Informationen hinwegtäuschen kann. Es sind letztlich weniger die visuellen als vielmehr die sachorientierten Geodaten, die den höchsten „Mehrwert“ für GIS-Anwender in der Immobilienwirtschaft versprechen. Institutionelle Portfolioentscheidungen von Investoren wie auch Immobilienbanken könnten im Hinblick auf ein mögliches „räumliches“ Diversifikationspotential informatorisch fundierter abgeleitet werden. Dies gilt selbstverständlich auch für private Immobilieneigennutzer, für die eine entsprechende Einschätzung im Hinblick auf die Wertstabilität ihres Wohneigentum bzw. ihrer Kapitalanlage zur Altersvorsorge eine wesentliche Entscheidungsunterstützung bieten kann. Gleichzeitig bieten internetbasierte, wertrelevante Geodaten auch ein weites Anwendungsfeld und möglicherweise zukünftig auch Einnahmegebiet für Städte und Regionen: Denn einerseits könnte ein ressourcenschonendes Bau- und Siedlungsflächenmanagement auf die wesentlichen räumlichen Werteinflüsse hin ausgerichtet werden. Auf diese Weise könnte potentiellen privaten wie auch gewerblichen Investoren im Sinne der „Ist-Situation“ ein effizientes Informationsportal für die eigene Standortwahl zur Verfügung gestellt werden. Zum anderen könnte ein derartiges Informationsangebot mit empirisch relevanten Einflussfaktoren (in der Ausgestaltung am jeweiligen Standort) die Kommunen gezielter in die Lage versetzen, in welchen Bereichen (z.B. Verkehr, Ökologie oder auch soziale Rahmenbedingungen) eine Verbesserung durch die kommunale Akteure bewirkt werden muss, um werthaltige private Immobilieninvestitionen in den verfügbaren Flächen sicherzustellen. Denn die resultierenden Kommunaleinnahmen von entsprechenden Wohn- und in der Folge Gewerbeimmobilieninvestitionen könnten gezielte Maßnahmen zur Stadtsanierung bzw. zum Stadtumbau rechtfertigen.

Auch 3D-Modellierungen und Visualisierungen, so aufwändig sie sind, können einen Mehrwert vor allem in der Entwicklungsphase von Immobilien entfalten. Sie dürften indes kaum durch einzelne Akteure im Rahmen eines Projektes umsetzbar sein. Die öffentliche Hand hat dies erkannt und setzt deshalb auf multifunktionale Entwicklungen. Diese im Grundsatz richtige und kostensparende Entscheidung bringt allerdings zeitliche Verzögerungen durch den erhöhten Koordinierungsaufwand mit sich. Die Immobilienwirtschaft als Anwender wird dabei zwar oft erwähnt, eine detaillierte Beschäftigung mit den Anforderungen der Branche an die Verwendbarkeit von multifunktionalen Systemen fehlt aber nahezu völlig. Hier sollte die Immobilienwirtschaft ihre Anforderungen an die Basisdaten formulieren oder in Beispielprojekten die Anwendbarkeit der Dateninfrastruktur testen. Zu erwarten ist hier zwar ein Engagement der bereits vorhandenen IT-Dienstleister mit immobilienwirtschaftlichem Schwerpunkt. Erforderlich wird jedoch auch ein verstärktes Forschungsengagement auf Universitätsebene sein. Zwar existiert inzwischen ein GIS-spezifischer Arbeitskreis der Gesellschaft für immobilienwirtschaftliche Forschung (gif) nicht mehr. Hingegen widmet sich nicht nur der „Runde Tisch GIS e.V.“ an der TU München, sondern auch das durch die Deutsche Forschungsgemeinschaft geförderte Internationale Graduiertenkolleg „Visualisierung großer unstrukturierter Datenmengen“ an der TU Kaiserslautern mittlerweile auch immobilienwirtschaftlichen Themen.

7. LITERATURVERZEICHNIS

Becker / Jha: Für Planung und Marketing: Erstellung eines 3-D-Stadtmodells unter Nutzung vorhandener Daten. In: GeoBIT 11/2003.

Can: The measurement of neighbourhood dynamics in urban house prices, in: Economic Geographic 1990, S. 254-272.
Case / Clapp / Dubin / Rodriguez: Modeling Spatial and Temporal House Price Patterns: A Comparison of Four Models. In: Journal of Real Estate Finance and Economics 2 / 2004, S. 167 – 191
Des Rosiers / Lagana / Theriault: Size and proximity effect of primary schools on surroundding house values, in: Journal of Property Research 2001, S. 1-20.
Fik / Ling / Mulligan: Modeling spatial variation in housing prices: a variable interaction approach, in: Real Estate Economics 2003. S. 623-646.
Gelfand / Ecker / Knight / Sirmans: The dynamics of location in home price, in: Journal of Real Estate Finance and Economics 2004, S. 149-166.
GdW: Wohnungswirtschaftliche Daten und Trends 2004/2005, Berlin 2004.
Guhse: Kommunales Flächenmonitoring und Flächenmanagement, Heidelberg, 2005.
Heidger-Grüne: Grundstücksmarktinformationen – veränderte Märkte erwarten andere Informationen. In: FuB 6 / 2004.
Janicki / Pieske: Die Bedeutung von Geodaten für eine Kreditfabrik. In: Immobilien und Finanzierung 23 / 2004.
Kübler / May: Geoinformationssysteme im Corporate Real Estate Management. In: Leipzig Annual Construction Engineering Report. 4 / 1999
Kuhlmann/Markus/Theurer: CAD und GIS in der Stadtplanung, Karlsruhe, 2003.
Nadler: Internationale Wohnungsfinanzierung, München, Wien, 2001.
NADLER: Evaluation of housing finance systems; in: UN-ECE (Ed.): Housing finance in countries in transition, New York, Geneva 2005.
Nadler: Die Vorteilhaftigkeit von Portfolioakquisitionen am deutschen Wohnimmobilienmarkt – eine Frage der Finanzierung?! In: F. Then Bergh (Hrsg.): Private Banking, Wiesbaden, 2006.
Städtetag Nordrhein-Westfalen: 3D-Stadtmodelle: Eine Orientierungshilfe für Städte in Nordrhein-Westfalen. Wuppertal, 2004
V. Suntum: Kaufkraftströme im Einzelhandel. Ein gravitationstheoretisches Prognosemodell. In: RuR 6 / 2000.
Thebe: Planes, Trains and Automobiles: The Impact of Traffic Noise on House Prices, in: Journal of Real Estate Finance and Economics 2004, S. 209-234.
Theriault/Des Rosiers/Villeneuve/Kestens: Modelling interactions of location with specific value of housing attributes, in: Property Management 2003, S. 25-62.
Wyatt / Ralphs: GIS in Land and Property Management, London, 2003.
Zeile / Schildwächter / Poesch: 3D-Stadtmodell- Generierung aus kommunalen Geodaten und benutzerspezifische Echtzeitvisualierung mithilfe von Game- Engine- Techniken. CORP-Paper, Wien, 2005.

Ihre Immobilien und Standorte fest im Griff

Martin GALANDA, Jürgen STROBL

(beide rmDATA GmbH, galanda@rmdata.at, strobl@rmdata.at; Abteilung Informationssysteme, Prinz-Eugen-Straße 12, 7400 Oberwart, office@rmdata.at, www.rmdata.at)

Geografische Informationssysteme gehören bereits zum alltäglichen Werkzeug in vielen Branchen und Geschäftsbereichen. Auch wenn es um die Verwaltung von Immobilien, Gebäuden, Standorten oder das Führen eines Werkskatasters geht, spielt GIS eine wichtige Rolle.

Die Anforderungen an derartige Software Lösungen reichen vom einfachen Darstellen der vorhandenen digitalen Daten, wie Kataster, Gebäudepläne, Leitungen, usw. in einer gemeinsamen Grafik, über Planungsfunktionalitäten und Störungsmanagement bis hin zu dem Abdecken von speziellen Workflows. Natürlich dürfen die klassischen GIS-Funktionen wie Sachdaten verwalten und suchen, Erzeugen von beliebigen Kartenausdrucken, Flächen ermitteln usw. nicht fehlen.

Die Dokumentenverwaltung ist eine weitere wichtige Komponente. Die Verwaltung von beliebigen Dokumenten wie Elektropläne, Protokolle oder Fotos inkl. zusätzlicher Informationen wie Erzeuger, Aktualität, usw. sollte zur Grundfunktionalität von solchen Software Lösungen gehören. Natürlich müssen diese Dokumente mit den grafischen Objekten wie Gebäude oder Leitungen einfach verknüpft werden können.

rmDATA bietet Lösungen für die Immobilien- und Standortverwaltung an, die optimal auf die Bedürfnisse der Anwender in Bezug auf IT Umgebung (Desktop, Intranet, Internet), Rahmenbedingungen (Kosten, etc.) und vor allem Funktionalität optimal abgestimmt sind. rmDATA. Die rmDATA-Anwendungen basieren größtenteils auf Standard Technologien der Firmen Microsoft und Autodesk. Der Anwender bewegt sich somit in einer vertrauten Arbeitsumgebung und die Anwendung ist durch die gewohnte und einfache Benutzeroberfläche sofort einsetzbar. Das System steht durch die verwendeten Technologien auf soliden Beinen und die getätigte Investition ist somit auch in der Zukunft gesichert. Die Aufwende und Kosten für die Datenpflege und –migration werden durch die Verfügbarkeit von Schnittstellen zu den gebräuchlichsten Datenformaten im CAD und GIS Umfeld und das Einhalten von internationalen Standards des Open Geospatial Consortiums (OGC) bei der Speicherung von Daten auf ein Minimum reduziert.

Am Beispiel der Bavaria Filmstudios München wird gezeigt, wie einfach der Aufbau eines solchen Systems sein kann. Die obigen Anforderungen werden dabei natürlich erfüllt. Flexibel einsetzbar, leicht bedienbar, rasche und umfangreiche Dateintegration von Autodesk DWG und DXF Formaten, ESRI Shape Dateien, Daten aus Oracle (Spatial), beliebigen Rasterdaten uvm., sowie ein faires Preis-/Leistungsverhältnis sind nur einige Highlights dieses Systems. Und die laufende Datenpflege ist dabei auch von externen Dienstleistern möglich. Die Anwendung dient zur internen Beauskunftung, zur übersichtlichen Verwaltung des gesamten Betriebsgeländes, zur Grobplanung von Bauvorhaben (Redlining Funktionalität) und als Werkzeug für ein effizientes Störungsmanagement.

Neben der Lösung für die Bavaria Filmstudios bietet rmDATA auch Software-Lösungen für die Immobilien- bzw. Standortverwaltung auf Basis von Autodesk Topobase™ an. Autodesk Topobase™ ist ein flexibler Geodatenserver auf Basis von Oracle. Nachdem die Daten OGC konform abgelegt werden, können CAD Clients (AutoCAD, etc.) , GIS Software (ArcGIS, MapInfo, etc.) und Web Clients (Autodesk MapGuide, etc.) auf denselben zentralen Datenbestand zugreifen. Das ojekt-orientierte Datenmodell, die topologische Datenstruktur, die verfügbare GIS-Funktionalität und die große Flexibilität bei der Verwaltung von Sachdaten ermöglichen es nicht nur die genannten Anforderungen umfassend zu erfüllen sondern bieten auch darüber hinaus wertvolle Werkzeuge für die Immobilien- und Standortverwaltung. Durch die große Fachschalenvielfalt können spezifische Branchenanwendungen optimal umgesetzt und damit eine Komplettlösung für die Verwaltung von Infrastrukturdaten angeboten werden. Der deutsche Konzern Henkel zum Beispiel stetzt für die Verwaltung des Firmengeländes auf eine solche Lösung.

rmDATA ist IT-Dienstleister mit langjähriger Erfahrung, fundiertem Know-How und innovativen Ideen für erfolgreiche Kunden in der Vermessung und Geoinformation. Im Bereich Geoinformation hat sich rmDATA auf die Bereiche Infrastrukture Management, Land Management und kommunales GIS spezialisiert. Weitere Informationen erhalten Sie unter www.rmdata.at.

Der Persönliche Reisebegleiter am Smartphone – Reiseinformation und Orientierung immer und überall

Stefan BRUNTSCH, Birgit LÖCKER, Karl REHRL

(ARC Seibersdorf research GmbH, Bereich Intelligente Infrastrukturen und Weltraumanwendungen, 2444 Seibersdorf, Österreich
stefan.bruntsch@arcs.ac.at, birgit.loecker@arcs.ac.at
Salzburg Research Forschungsgesellschaft mbH, Jakob-Haringer-Straße 5/III, 5020 Salzburg, karl.rehrl@salzburgresearch.at)

1. EINLEITUNG

Open-SPIRIT – Der Persönliche Reisebegleiter ist ein Reiseinformations- und Navigationssystem für Smartphones, mit dem sich Reisende, insbesondere Fahrgäste des Öffentlichen Verkehrs, jederzeit und überall orientieren und informieren können. Der Persönliche Reisebegleiter wurde im nationalen Forschungsprojekt Open-SPIRIT von einem Konsortium aus Verkehrsverbünden, Forschungseinrichtungen und Softwarelieferanten entwickelt.

Die in Open-SPIRIT entwickelten Dienste des Persönlichen Reisebegleiters umfassen die:

- intermodale und überregionale Tür-zu-Tür-Routenplanung,
- kontinuierliche und positionsabhängige Navigation entlang der geplanten Route sowie in Gebäuden und Umsteigeknotenpunkten,
- Personalisierung und Speicherung von Routen in einem persönlichen Benutzerprofil.

Eine spätere Erweiterung des Persönlichen Reisebegleiters um elektronisches Ticketing wurde im Forschungsprojekt als Konzept erarbeitet.

Als besondere Innovation des Persönlichen Reisebegleiters ist neben der offenen IT-Architektur die kontinuierliche Orientierung und Navigation von Reisenden auf allen Routenabschnitten, auch in Gebäuden und Umsteigeknotenpunkten, hervorzuheben. Für die Fußgängernavigation innerhalb von Umstiegsgebäuden wurde ein völlig neues Konzept entwickelt, da die Abläufe und Technologien der Kfz-Navigation hierfür nicht übertragbar sind. Das beinhaltet sowohl die Datenerfassung und -modellierung, die Routensuche und Wegfindung, die Positionierung als auch die eigentliche Navigation bzw. Informationspräsentation.

Bei der intermodalen Tür-zu-Tür-Routenplanung am Smartphone wurde insbesondere auf Benutzerfreundlichkeit geachtet. Aufgrund der erschwerten Eingabemöglichkeiten am Handy wurde ein Personalisierungskonzept entwickelt, das durch Speicherung von Routen und persönlichen Punkten die Handhabung des Systems deutlich vereinfacht.

Das Pilotsystem des Persönlichen Reisebegleiters wurde in allen Ausprägungen einem vertieften Test durch Benutzer unterzogen. Dieser Benutzertest fand im Oktober 2005 in der Wiener Station Matzleinsdorfer Platz statt. Aus den Ergebnissen der Tests und den Erfahrungen aus der Prototyp- und Pilotsystementwicklung werden Empfehlungen für die Überführung des Open-SPIRIT – Persönlichen Reisebegleiters in den Regelbetrieb abgeleitet.

Folgende **Ergebnisse** wurden innerhalb des Forschungsprojektes erreicht:

- Definition aller relevanten Benutzer- und Systemanforderungen;
- Systemkonzept, offene Architektur;
- Technisches Konzept zu elektronischem Fahrgeldmanagement;
- Open-SPIRIT – Der Persönlicher Reisebegleiter für Smart Phones (Prototyp);
- Test-Setups für kleinräumige Navigation und Orientierung (indoor und outdoor) am Wiener Matzleinsdorfer Platz und am Grazer Jakominiplatz;
- Resultate der Validierung eines Demonstrationsbetriebes;
- Pläne der Verkehrsdienstleister für den Transfer der Ergebnisse in den Regelbetrieb.

2. FUNKTIONEN DES PERSÖNLICHEN REISEBEGLEITERS AM SMARTPHONE

Folgende Dienste stehen dem Open-SPIRIT-Benutzer mit dem Persönlichen Reisebegleiter auf seinem Smartphone zur Verfügung:

Routenplaner

Im Routenplaner wird dem Benutzer eine intermodale Tür-zu-Tür-Routenplanung ermöglicht. Er kann die üblichen Parameter wie Start- und Zielort, Abfahrts-/ Ankunftszeit und diverse Routeneinstellungen, wie z. B. kürzeste Verbindung oder bevorzugte Verkehrsmittel, eingeben. Für registrierte Benutzer sind diese Voreinstellungen schon gesetzt und zusätzlich können im Profil oft benutzte Routen (Start- und Zielort) oder eigene POI gespeichert werden. Als Ergebnis der Routenabfrage wird dem Benutzer eine Übersicht alternativer Routen sowie Details zu jedem Abschnitt der Route (Start- und Zielfußweg, ÖV-Fahrt(en), Umstiegsweg) als Liste ausgegeben. Außerdem wird für die Gesamtroute oder einzelne Abschnitte eine Karte angezeigt. Für große, komplexe Umstiegsgebäude ist es dann möglich, den in Open-SPIRIT entwickelten Orientierungs- und Navigationsdienst zu starten.

Orientierung und Navigation

Mit diesem Dienst wird dem Benutzer eine positionsabhängige Orientierung und Navigation in komplexen Umstiegsgebäuden wie z.B. der Station Matzleinsdorfer Platz in Wien ermöglicht. Auf Fuß- bzw. Umstiegswegen innerhalb von Gebäuden soll sich der Benutzer anhand von Leitinformationen orientieren, die das bestehende Leitsystem (Beschilderung) am mobilen Client abbilden.

Die Umstiegsnavigation ist der Hauptschwerpunkt der Entwicklungsarbeit in Open-SPIRIT gewesen. Die Orientierung während des Umstiegs umfasst die visuelle und textuelle Präsentation der Umstiegsroute sowie geeigneter Leit- und Umgebungsinformationen auf mobilen Endgeräten.

Für die grafische Darstellung der geplanten Route wurde in Open-SPIRIT eine Variante mit interaktiven Rasterbildern (Standardumstiegsnavigation) und eine Variante mit 3D- bzw. perspektivischer Vektordarstellung entwickelt. Die Route wird in eine

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

Umgebungsdarstellung eingebettet. Diese ermöglicht dem Benutzer den Vergleich zwischen der Darstellung am Mobiltelefon und seiner realen Umgebung als Voraussetzung für die Navigation. Dem Benutzer werden außerdem die nächsten Schritte (Räume) auf seinem Weg entlang der Route in Textform erläutert. Der Kontext zur Route wird über die Positionierung vom System automatisch hergestellt. Bei feststellbaren Abweichungen von der Umstiegsroute wird der Benutzer entsprechend alarmiert.

Die Position des Benutzers wird über unterschiedliche technische Verfahren festgestellt und im Kontext der Route dargestellt. Innerhalb von Gebäuden wird im Rahmen von Open-SPIRIT der Benutzer mit Hilfe von Bluetooth positioniert. Sollte dem Benutzer keine Positionierung zur Verfügung stehen, kann er sich durch manuelles Weiterklicken zu den jeweiligen Knotenpunkten in der Ergebnisanzeige der aktuelle Route orientieren und dann genauere Leitinformationen für den nächsten Streckenabschnitt anschauen. Außerhalb von Gebäuden funktioniert die automatische Positionierung mittels GPS.

Aufgrund der baulichen Gegebenheiten ist zu erwarten, dass das Handy nicht dauerhaft mit dem Server verbunden ist (z.B. aufgrund fehlenden Empfangs). Die Anzeige eines berechneten Weges und die Navigation in Bauwerken müssen deshalb auch offline möglich sein. Dies setzt ein Herunterladen der notwendigen Information am Beginn der Reise voraus.

Benutzerprofil und Personalisierung

Im Benutzerprofil kann jeder Benutzer persönliche Einstellungen vornehmen und Daten hinterlegen. Diese sind einerseits für die Routenplanung und Navigation sowie andererseits für das geplante e-Ticketing notwendig.
Routenplanungs-/ Navigationseinstellungen können beispielsweise sein: bevorzugte Verkehrsmittel, schnellste/ kürzeste/ bequemste Verbindung, behindertengerechte Wege, eigene POI, gespeicherte Routen etc.

3. FUßGÄNGER- UND INDOOR-NAVIGATION

3.1 Anforderungen

Die Anforderungen an Fußgängernavigation und -orientierung auf intermodalen Routen sind unterschiedlich. Durch die Benutzung von verschiedenen Transportmitteln und den Wechsel zwischen diesen sind unterschiedliche Konzepte zur Wegfindung und Navigation notwendig. Zu betrachten sind verschiedene Netzwerke (Straßennetzwerk, Fußgängernetzwerk, ÖV-Netzwerke, Umsteigenetzwerke), unterschiedliche Zielsetzungen (Finden eines Zugangspunktes zu einem Netzwerk, Finden eines Transportmittels, Finden einer Zieladresse, Wählen der optimalen Route) und auch bestimmte Einschränkungen in den unterschiedlichen Situationen (keine automatische Positionierung, mobile Benutzer, Verfügbarkeit von Navigationsdaten).

Bei aktuellen Fußgängernavigationssystemen für den Außenbereich handelt es sich meist um adaptierte Autonavigationslösungen. Die Navigationsunterstützung für Fußgänger basiert dabei in der Regel auf Turn-by-Turn-Anweisungen in Bezug auf das darunter liegende Straßennetz. Dabei werden in vielen Fällen die besonderen Bedürfnisse der Fußgänger vergessen. So ist es bei der Autonavigation ausreichend, die aktuelle, z.T. ungenaue GPS-Position eines Autos immer auf die Straßenmittelachse abzubilden, da der Fahrstreifen automatisch aus der Richtung ermittelt werden kann. Das Abbilden der Positionen der Fußgänger auf die Straßenmittelachse ist aber nicht zweckmäßig. Vielmehr müssten gesicherte Gehwege und Übergänge im Kartenmaterial erfasst sein und auch für das Fußwegerouting zur Verfügung stehen.

Im öffentlichen Verkehr ergibt sich wiederum eine andere Situation: die Wegsuche und Navigation von Reisenden findet entweder auf Basis eines öffentlichen Verkehrsnetzes oder an den definierten Umsteigepunkten zwischen den Verkehrsnetzen oder -linien statt. Während die Wegfindung in öffentlichen Verkehrsnetzen in Zeit und Raum festgelegt ist und die Orientierung meist auf Basis von logisch strukturierten Netzplänen erfolgt, ist die Komplexität an den Umsteigepunkten wesentlich höher. Rüetschi und Timpf (2004) differenzieren zwischen den kognitiven Konzepten zur Wegfindung in Umsteigegebäuden oder in öffentlichen Verkehrsnetzen und bezeichnen die Navigationsräume analog dazu als *Scene Space* bzw. *Network Space*. Auf Basis eines logischen Modells für Umsteigegebäude und bestehenden Konzepten für Wegfindung und Fußgängernavigation wurden die nachfolgenden Anforderungen für eine Navigationsanwendung definiert.

Modellierung und Erfassung von Umsteigegebäuden und -bereichen: Im Gegensatz zur Fußwegenavigation im Außenbereich, wofür bereits die Daten über das Straßennetz verfügbar sind, sind für Umsteigegebäude in der Regel gar keine geeigneten Daten in elektronischer Form vorhanden. Zu erfassen sind neben der logischen Struktur des Gesamtgebäudes vor allem unterschiedliche Ebenen, Bereiche, Eingänge, Verbindungen zwischen Bereichen, Verbindungen zum ÖV und zum Straßennetz, Fußwege, Eigenschaften von Fußwegen (z.B. Treppen) oder wichtige Hinweistafeln. Dabei ist allerdings auch darauf zu achten, dass der Aufwand der Erfassung möglichst gering gehalten wird.

Zusätzlich zu intermodalen Routen im Straßen-, Fußwege- oder ÖV-Netzwerk müssen auch Routen in Umsteigegebäuden berechnet werden können. Dazu ist ein Routingnetzwerk für das Umsteigegebäude zu erstellen und mit den anderen Netzwerken zu integrieren.
Aber auch im Außenbereich ist es für eine bessere Fußgängernavigation im Umfeld der Stationen notwendig, ein eigenes Fußwegenetz zu erfassen. Das vorhandene Straßennetz, auf dem zu Fuß gehen erlaubt ist, hat sich als zu wenig genau erwiesen. Für eine realistische Darstellung von Straßen und Fußwegen in der Karte müssen reale Straßenbreiten bekannt sein, damit die Fußwegroute tatsächlich auf dem entsprechenden Gehsteig / der entsprechenden Fußgängerfläche dargestellt wird.
Navigationsanweisungen: Diese müssen auf wichtige Eigenschaften des Umsteigebauwerks Bezug nehmen (z.B. wichtige Hinweistafeln, Eigenschaften des Bauwerks wie Treppen, Aufzüge, Rolltreppen, Durchgänge, Hallen). Dazu sind diese Daten soweit als möglich in das Fußwegenetz zu integrieren, um die Beschreibung der Route bei der Routenberechnung automatisch generieren zu können. Meterangaben für Wegstrecken, Abbiegeanweisungen mit links oder rechts erachten wir in dieser Umgebung als nicht zielführend. Anweisungen wie „den Gang entlang bis zur Treppe“ oder „die Treppe hinauf, die mit dem Schild ‚Triester Straße’ gekennzeichnet ist“ nehmen konkret Bezug auf die Umgebung und sind daher vorzuziehen.

Positionierung: Anders als im Außenbereich kann in Umsteigegebäuden nicht auf GPS-Positionierung zurückgegriffen werden. Dadurch entsteht die Anforderung an ein alternatives Positionierungssystem für Gebäude. Gleichzeitig ist es aber auch nicht realistisch, dass alle Umsteigegebäude mit einem Positionierungssystem ausgestattet sind. Daher ist außerdem die Anforderung gegeben, dass die Wegbeschreibung so detailliert ist, dass Reisende auch mit Hilfe von Selbstpositionierung zum Ziel finden.

Personalisierung: Durch eine Personalisierung des Navigationsdienstes besteht für Benutzer die Möglichkeit, nur bestimmte Routeninformationen aus dem Fußwegenetzwerk und der Umgebung zu selektieren und zu berücksichtigen. So können bei der Berechnung der Umsteigeroute die Präferenzen (wie z.B. Ausschluss von Treppen, kurze Umsteigewege, durchschnittliche Gehgeschwindigkeit, usw.) von einzelnen Benutzern berücksichtigt werden. Auch die Auswahl an relevanten Hinweistafeln kann auf Basis der persönlichen Route durchgeführt werden.

Mobilität: Bei der Konzeption und Implementierung der Anwendung muss speziell auf Anforderungen von mobilen Anwendungen geachtet werden. Dies sind z.B. eingeschränkte Ressourcen von Smartphones, mögliche Nicht-Verfügbarkeit einer Netzwerkverbindung, eingeschränkte Informationsdarstellung, eingeschränkte Bedienbarkeit (Rehrl, Leitinger, Bruntsch 2005).

3.2 Routenberechnung als Grundlage der Navigation

Für die intermodale Routenberechnung wird ein integriertes Routingnetz genutzt, dass aus dem Öffentlichen Verkehrsnetz, dem Straßennetz und dem Fußgängernetz im Außenbereich sowie innnerhalb von Gebäuden besteht. An bestimmten Punkten wie z.B. den Zugängen zu den ÖV-Stationen gibt es Verknüpfungspunkte zwischen den Netzen. Das Fußgängernetzwerk innerhalb der Gebäude ist graphenbasiert mit Knoten und Kanten. Jedem Knoten und jeder Kante sind Attribute zugeordnet, die detaillierte Informationen für die Routenberechnung und die Generierung der Wegbeschreibungen enthalten. Unter anderem geben die Attribute Auskunft über den Typ einer Kante, und zwar Fußweg, Treppe, Rolltreppe, Aufzug oder Rampe. Dadurch können barrierefreie Wege für Personen mit Mobilitätseinschränkung berechnet werden. Die Gehgeschwindigkeit im Gebäude ist abhängig vom Benutzer. Deswegen kann diese auch bei der Eingabe eingegeben bzw. im Benutzerprofil hinterlegt werden.

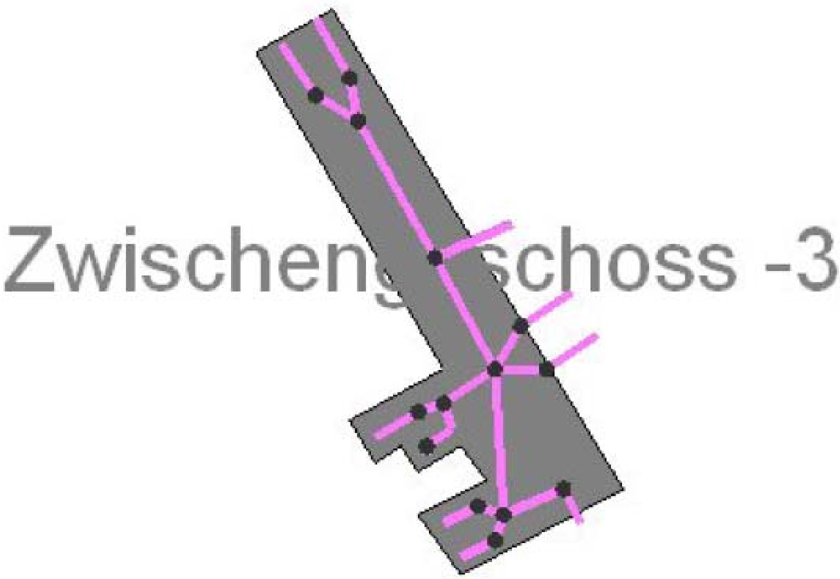


Abbildung 1: Umstiegswegenetz im Zwischengeschoss -3 am Matzleinsdorfer Platz (Open-SPIRIT 2005)

3.3 Orientierung und Navigation

Der Orientierungs- und Navigationsdienst, der für den Persönlichen Reisebegleiter entwickelt wurde, bietet dem Reisenden einerseits Karten und andererseits Textanweisungen als Hilfe an. Die Kartendarstellung stellt aufgrund der relativ kleinen Displaygröße und der geringeren Rechenleistungen am Mobiltelefon eine Herausforderung dar. Die Informationen in der Karte mussten optimiert und vereinfacht werden, so dass nur begehbare Gebäudeflächen und Bahnsteige, Wände, Gateways (Treppen, Rolltreppen, Aufzüge, Rampen) und die berechnete Route mit den zugehörigen Wegweisern dargestellt werden. Die Karten werden deswegen dynamisch aus dem geografischen Modell mit einstellbaren Parametern vom Server generiert. Für Außenbereiche können existierende Straßenkarten auch durch Luft- oder Satellitenbilder ersetzt werden.

Im Gegensatz zur Autonavigation machen bei der Fußgängernavigation Textanweisungen wie „Gehen Sie 25 Meter geradeaus und dann rechts“ keinen Sinn. Es müssen vielmehr Anweisungen gegeben werden, die sich auf die Umgebung und dort vorhandene Orientierungselemente (Landmarks), wie z.B. Wegweiser, Treppen oder Rolltreppen, beziehen. Um den Aufwand bei der Erfassung der Daten möglichst gering zu halten, wurde die textliche Beschreibung aus vordefinierten Textbausteinen entlang einer Route zusammengebaut. Die Textbausteine beschreiben jeweils einen Teil der Route zwischen zwei Entscheidungspunkten. Eine Anweisung kann z.B. „Gehe zum unteren Ende der Treppe mit dem Schild ‚Triester Straße‘. Gehe die Treppe hinauf.“ sein.

Abbildung 2: Screenshots der Routenergebnisliste und der Navigationsdarstellungen im Persönlichen Reisebegleiter

3.4 Indoor-Positionierung

Da in Umsteigegebäuden in der Regel keine GPS-Positionierung möglich ist, muss auf eine alternative Technologie zur Positionierung zurückgegriffen werden. Dazu wurden verschiedene Technologien zur Indoor-Positionierung verglichen (Hightower, Borriello 2001; May et al. 2003) und hinsichtlich der Anforderungen überprüft. Die Wahl viel schließlich auf eine Bluetooth-basierte Positionierung. Bluetooth ist in aktuellen Smartphones verfügbar, wodurch eine breite Anzahl von Endgeräten unterstützt werden kann. Die meisten der kommerziell verfügbaren Bluetooth-Positionierungssysteme verwenden allerdings eine Server-basierte Lokalisierung, die nur mit Hilfe von vernetzten Bluetooth Access Points funktioniert. Das Problem der Herstellung einer flächendeckenden Netzwerkverkabelung in Umsteigegebäuden veranlasste uns, eine alternative Lösung zu wählen.

Unsere Lösung verwendet eine Menge von Bluetooth-Beacons, die an definierten Stellen im Umsteigegebäude angebracht werden. Diese Beacons sind im System georeferenziert und senden ihre eindeutige Kennung aus. Am Smartphone wird ständig eine Bluetooth-Inquiry ausgeführt, wodurch zu jedem Zeitpunkt festgestellt werden kann, welche Beacons gerade sichtbar sind. Die Navigationsanwendung am Smartphone kann jederzeit eine Liste aller Bluetooth Beacons für das Gebäude vom Server anfordern und hält diese Liste dann lokal im Speicher. Wird durch die Bluetooth-Inquiry eine neue Beacon-Kennung festgestellt, dann wird in dieser Liste nach dem Beacon gesucht. Dadurch wird eine zellbasierte Positionierung durchgeführt und es wird ein bestimmter Bereich im Gebäude ausgewählt, in dem sich der Benutzer aufhält. Mit Hilfe der gespeicherten Beacon-Kennung bzw. der Georeferenz kann eine zugeordnete Karte ausgewählt und die Position der Person eingezeichnet werden. Außerdem können Anweisungen für den kommenden Wegabschnitt angezeigt werden. Je feiner die Zellen unterteilt werden, desto genauer kann die Position der Person festgestellt werden. Zellen sollten sich dabei nicht überschneiden. Dazu ist es notwendig, die Reichweite der Bluetooth-Beacons konfigurieren zu können. Bei den von uns eingesetzten Bluetooth-Beacons (Bluelon BodyTags1) kann die Sendestärke zwischen -40dB und +6 dB in 2 dB Schritten eingestellt werden. Das entspricht einem Zellendurchmesser von ungefähr zwei Meter bis zu 60 Meter (bei freier Sicht). Bei den Tests hat sich herausgestellt, dass die optimale Zellengröße bei 4 Metern liegt. Außerdem konnte festgestellt werden, dass die von uns gewählte Indoor-Positionierungstechnologie relativ gut funktioniert hat. Natürlich müssen die Anzahl und Positionen der Bluetooth-Beacons für eine bessere Navigation noch optimiert werden. Teilweise auftretende längere Zeiten für die Suche nach Beacons werden durch einen Fehler in der Implementierung der Bluetooth-API verursacht, der es nicht zulässt, die Bluetooth-Enquiry schon frühzeitig (nach 5 s) abzubrechen.

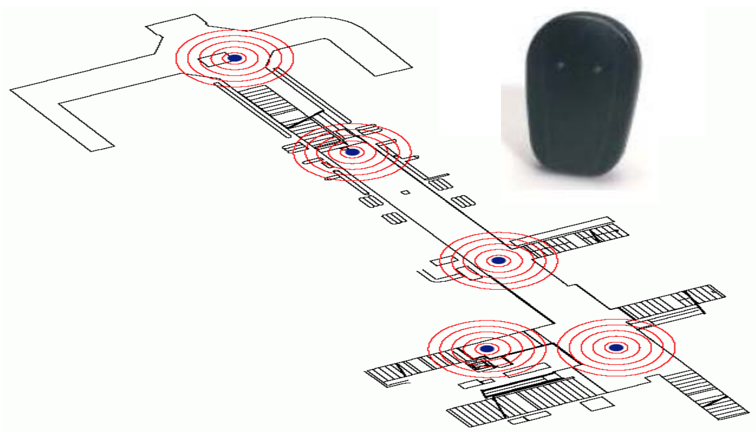


Abbildung 3: Bluetooth-Beacon und Plan der Bluetooth-Positionen am Matzleinsdorfer Platz

[1] http://www.bluelon.com

Die Outdoor-Positionierung funktioniert mit einem GPS-Receiver in Kombination mit einem Route-Matching-Algorithmus. Die automatische Umschaltung von der Indoor- zur Outdoor-Positionierung wird durch die Definition von Übergangsbereichen, die die Information zum neuen Positionierungssystem enthalten, erreicht. Wenn man ein Gebäude verlässt, stößt man jedoch oft auf das Problem, dass heutige GPS-Receiver eine genaue Position erst nach einiger Zeit anzeigen (Rehrl, Göll, Leitinger, Bruntsch 2005).

4. IMPLEMENTIERUNG DES PILOTSYSTEMS

Während des Forschungsprojektes Open-SPIRIT wurde der Persönliche Reisebegleiter als Pilotsystem umgesetzt. Die gesamte Anwendung ist strukturiert in Server- und Client-Komponenten. Für die intermodale Routenplanung auf der Server-Seite wird auf das EFA-System2 zugegriffen. Dieser Service wurde um die Berechnung von Indoor-Fußwegen und die Bereitstellung von Karten und Textanweisungen zur Indoor-Navigation erweitert. Die Kommunikation zwischen Client und Server und vice versa erfolgt mittels XML. Karten werden als georeferenzierte Rasterkarten an den Client übermittelt. Sie werden in einzelne Kacheln geteilt, um die Ladezeiten zu optimieren.

Der Client, der auf dem Smartphone installiert werden muss, wurde mittels J2ME umgesetzt. Als Testgerät wurde das im Handel erhältliche Smartphone Nokia 6630 eingesetzt. Die Anwendung funktioniert aber auch bestens auf neueren Nokia-Handys wie das N70 oder N90. Der Client am Smartphone teilt sich in das Routenplanungs- und das Navigationsmodule. Für alle Routenplanungsvorgänge und die Benutzereinstellungen wird ein Microbrowser benutzt, der mit dem EFA-Server interagiert und die am Server generierten, XML-basierten Seiten darstellt.

Für die Navigation wird das so genannte Navigation Smartlet verwendet. Es ist so umgesetzt, dass es Routen- und Kartendaten von dem Local Data Cache abruft. Dieser entscheidet, ob die entsprechenden Daten lokal schon vorhanden sind oder vom Server abgeholt werden müssen. Dieser Mechanismus erlaubt ein frühes Herunterladen und späteres Nutzen von Routen- und Kartendaten für die Navigation. Das Navigation Smartlet bekommt die Position des Nutzers vom Location Service. Dieser fragt die Position von unterschiedlichen Positionierungssystemen (z.B. Bluetooth oder GPS) ab. Wenn dem Navigation Smartlet die Position des Nutzers bekannt ist, wird dem Nutzer die Karte des entsprechenden Raums bzw. Routenabschnitts mit den zugehörigen Navigationsanweisungen angezeigt.

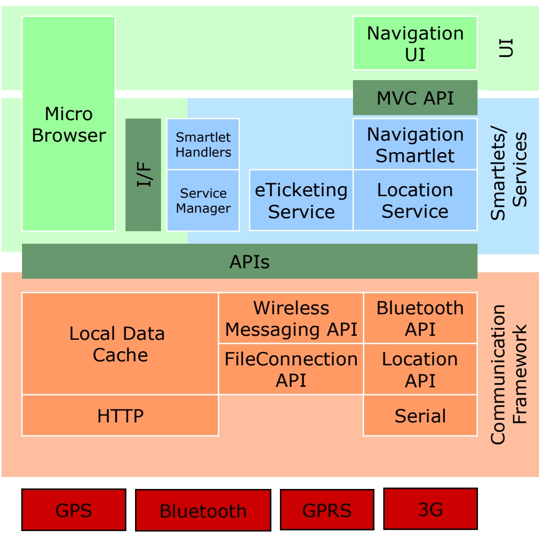


Abbildung 4: Open-SPIRIT J2ME-Client-Architektur (Open-SPIRIT 2005)

5. BENUTZERTEST

Beim Open-SPIRIT Benutzertest, der am 20. und 21. Oktober 2005 an der Station Matzleinsdorfer Platz stattfand, wurde Open-SPIRIT – Der Persönliche Reisebegleiter Interessenten und zukünftigen Benutzern vorgestellt und das entwickelte Pilotsystem getestet. Gemeinsam mit den Wiener Linien hat das Open-SPIRIT Projektteam die Testpersonen an einem Informationsstand empfangen. Nach einer kurzen Einführung durch einen unserer Mitarbeiter konnten die Tester alle Funktionen des Persönlichen Reisebegleiters ausgiebig testen. Zuerst wurde eine Testroute mit öffentlichen Verkehrsmitteln geplant, bei der man am Matzleinsdorfer Platz ein-, aus- oder umstieg. Nachdem sich der Benutzer über alle Details zur Fahrtroute und zum Fahrplan informiert hatte, konnte für den Fußweg durch die Station das Navigationsmodul mit 2D- oder 3D-Kartenanzeige gestartet werden. Mit diesem war eine lückenlose Navigation entlang des Weges innerhalb und außerhalb des Umstiegsgebäudes durch die Darstellung der Route und der aktuellen Umgebung mit leicht erkennbaren, physischen Anhaltspunkten und Wegweisern möglich. Die Position im Gebäude wurde mittels Bluetooth-Technologie und außerhalb mit GPS automatisch ermittelt.

Nach dem Test wurden die Testpersonen in einem kurzen Interview um Feedback gebeten. Und das ist durchaus positiv ausgefallen. Viele Personen haben sich gefreut, dass mit Open-SPIRIT – Dem Persönlichen Reisebegleiter endlich auch ein mobiles Reiseinformations- und Navigationssystem für Fahrgäste des öffentlichen Verkehrs entwickelt wurde. Andere wussten noch gar nicht, dass man so viele Informationen mit dem Handy bekommen kann. Der Gesamteindruck von Open-SPIRIT ist mit einer durchschnittlichen Bewertung von 2,43 (auf einer Skala von 1 bis 6) positiv ausgefallen. Von allen 20 Test-Usern haben vier Open-SPIRIT mit sehr gut beurteilt und weitere neun Personen mit gut. Zwei Probanden empfanden die Benutzerfreundlichkeit und

2 http://www.mentzdv.de/en/produkte/efa.htm

Funktionalitäten des Systems als befriedigend. Nur fünf der 20 Test-User waren zum Zeitpunkt des Praxistests mit Open-SPIRIT noch nicht zufrieden.

Zusammenfassend lässt sich aus den Ergebnissen des Benutzertests ableiten, dass die Anzeige am Display, die Fahrtenübersicht und die Detailansicht in Summe positiv beurteilt wurden. Verbesserungspotenzial gibt es nach Angaben der Test-User bei der Bedienung von Open-SPIRIT, insbesondere bei der Eingabe von Start- und Zielort über die Handytastatur, und bei der 2D-Kartendarstellung. Hier sollte vor allem die Unterstützung bei der Orientierung und das Finden des aktuellen Standorts benutzerfreundlicher gestaltet werden.

6. MARKTCHANCEN

Zur Sicherstellung des wirtschaftlichen Erfolgs von Open-SPIRIT – Dem Persönlichen Reisebegleiter wurde die Entwicklung auf bereits eingeführte Dienste und Technologien der Mobiltelefonie abgestützt und mittels Fragebogen jene Eigenschaften der Open-SPIRIT Dienste, wie z. B. die Darstellungsart der Routenplanung oder der Preis pro Abfrage, ermittelt, die zu einer Kaufentscheidung führen. Die Fragebogenaktion ermöglichte weiters die Marktsegmentierung in drei homogene Kundengruppen, deren Nutzungspräferenzen zum einen in die technische Umsetzung des Persönlichen Reisebegleiters eingingen und zum anderen durch geeigenete Marketingmaßnahmen besonders in den Vordergrund gerückt werden können, was zu einer höheren Marktdurchdringung der Open-SPIRIT Dienste führt.

Zur Open-SPIRIT Zielgruppe zählt per Definition jeder Smart Phone User der Öffentliche Verkehrsmittel benutzt. Für die Berechnung des adressierbaren Marktes wurde die prognostizierte durchschnittliche Smart Phone Dichte (Gartner Group 2004) proportional auf den Bevölkerungsbestand in den sieben österreichischen Teilmärkten (Statistik Austria 2005). Ende 2005 wird der adressierbare Gesamtmarkt in Österreich auf ~651.000 mit einem Smart Phone ausgestattete Personen geschätzt, Ende 2008 soll diese Zahl auf ~1.75 Mio. ansteigen, wobei die Ost-Region als Teilmarkt das mit Abstand größte Marktpotenzial aufweist.

Nach Analyse des Marktes und der Ergebnisse des Fragebogens lassen sich folgende drei Kundengruppen für Open-SPIRIT – Den Persönlichen Reisebegleiter bilden: Die Funktionsorientierten stellen mit einem Anteil von 42% des Gesamtmarktes den mit Abstand größten Teilmarkt dar. Die Preisbewussten sind mit einem Anteil von 32% der zweitgrößte Open-SPIRIT Teilmarkt. Die Businesskunden bilden mit einem Anteil von 27% des Gesamtmarktes die kleinste Kundengruppe. Der durchschnittliche österreichische Open-SPIRIT Kunde lässt sich daraus abgeleitet somit wie folgt beschreiben. Er ist männlich, zwischen 20 und 39 Jahren alt, lebt in Wien und Wien Umgebung und ist Angestellter oder Arbeiter. Er ist mit einer Zahlungsbereitschaft von rund 40 Cent pro Abfrage preissensitiv und legt bei einem mobilen Reisebegleiter wie Open-SPIRIT besonderen Wert auf den Service, sich entlang eines Weges navigieren zu lassen.

Auf Basis des adressierbaren Marktes und der Ergebnisse aus dem Web-Fragebogen wurden in einem letzten Schritt die Marktchancen von Open-SPIRIT Diensten ermittelt, dargestellt durch die erwartete Open-SPIRIT Marktdurchdringung (= Diffusion). Mit Hilfe des Bass Modells (Bass 1969) wurde berechnet, wie viele Personen zum Zeitpunkt t Open-SPIRIT tatsächlich nutzen werden. Die hier dargestellten Werte beziehen sich auf den Beobachtungszeitraum Jänner 2006 - Dezember 2008, die Berechnungen erfolgten auf Quartalsbasis. Abbildung zeigt die Anzahl der Kunden pro Quartal, die Open-SPIRIT das erste Mal nutzen. Dabei zeigt sich, dass im ersten Jahr (d.h. in den ersten vier Quartalen) die Steigerungsrate der neuen Open-SPIRIT Nutzer verhältnismäßig stark ist, ab dem 5. Quartal leicht abflacht und bis zum Ende des Prognosezeitraums konstant ansteigt.

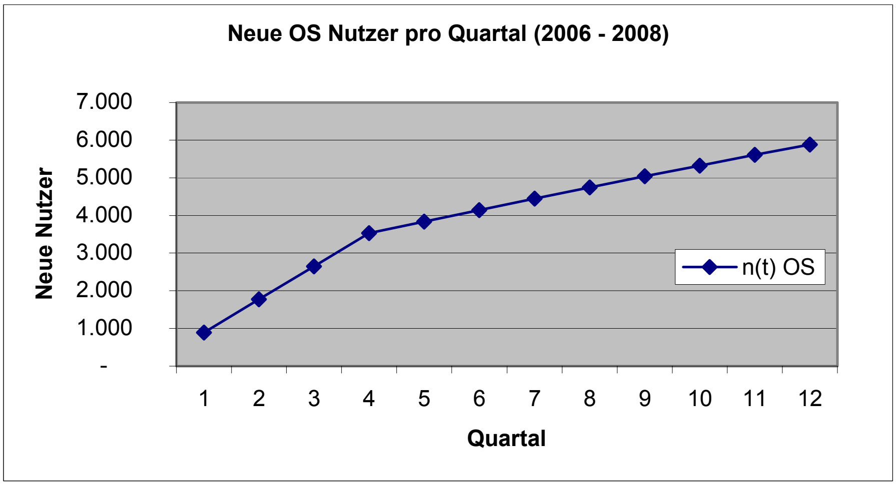


Abbildung 5: Neue Open-SPIRIT Nutzer (Österreich) (Open-SPIRIT 2005)

Die Anzahl der Nutzer sagt aber noch nichts über die Nutzungshäufigkeit aus. Diese hängt von verschiedenen Faktoren (z.B. Ladezeit, Darstellungsqualität, Preis etc.) ab. Unter der Annahme, dass all diese Faktoren, bis auf den Preis pro Abfrage, den Kundenanforderungen entsprechen und über den Berechnungszeitraum konstant bleiben (ceteris paribus), wurden mit Hilfe der Variation des Preises für 6 Szenarien die daraus resultierende Nutzungshäufigkeit für den Prognosezeitraum 2006 bis 2008 ermittelt.

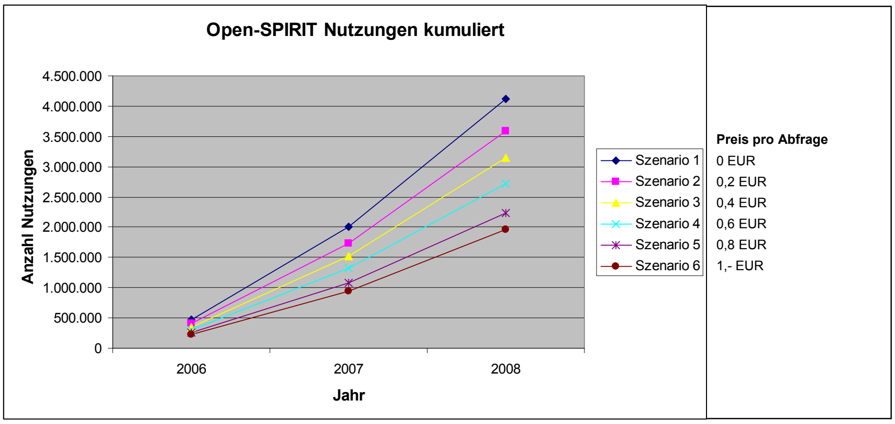


Abbildung 6: Anzahl der Open-SPIRIT Nutzungen kumuliert, 2006 – 2008 (Open-SPIRIT 2005)

Bei einem Preis von EUR 0,- pro Abfrage wird die Summe der Abfragen im Jahr 2006 bei ~ 470.000 liegen, im Jahr 2007 bei rund 2 Mio. und im Jahr 2008 bei mehr als 4,1 Mio. Nutzungen. Bei einem Preis von EUR 1,- hingegen liegt die erwartete Anzahl an Nutzungen im Jahr 2006 bei rund 220.000, im Jahr 2007 bei fast 1 Mio. und im Jahr 2008 bei ~ 2 Mio. Abfragen.

7. REALISIERUNGSEMPFEHLUNGEN

Basierend auf den gewonnen Erkenntnissen ergaben sich hinsichtlich der Überführung von Open-SPIRIT in den Regelbetrieb aus ökonomischer Sicht folgende Empfehlungen.

Die Umsetzung der **überregionalen Fahrplanauskunft** würde den Kundennutzen erhöhen und die Attraktivität von Open-SPIRIT – Dem Persönliche Reisebegleiter steigern. Dies ist derzeit nicht einmal innerhalb von Österreich noch nicht einmal mittels Internet möglich.

Dem Dienst **Outdoor- und Indoor-Navigation** sollte bei der Weiterentwicklung des Systems besondere Aufmerksamkeit geschenkt werden, wobei hier im Speziellen die 3D-Navigation ein Alleinstellungsmerkmal darstellen würde und für Kunden, die mit 2D-Karten nicht so vertraut sind, eine echte Alternative wäre. Eine Wahlmöglichkeit zwischen den beiden Darstellungsvarianten würde somit die Benutzerfreundlichkeit des Systems erhöhen.

Aus Sicht der **Datenerfassung** sind bei der Überführung der Open-SPIRIT Dienste in den Regelbetrieb ist zu beachten, dass die Digitalisierung der Umstiegsgebäude innerhalb einer definierten Zone und ab einer bestimmten Größe flächendeckend und lückenlos erfolgt. Aktualität des Contents, Gültigkeit und eine hohe Verfügbarkeit sind unbedingt zu gewährleisten.

Die Integration der geplanten **E-Ticketing** Funktion in das Dienste Angebot würde den Kunden des Öffentlichen Verkehrs einen zusätzlichen Komfort bieten und somit die Attraktivität von Open-SPIRIT weiter erhöhen. Das Ticket soll sowohl für verschiedene Verkehrsmittel (z.B. Bus, Straßenbahn, Zug, U-Bahn), als auch für verschiedene Verkehrsdienstleister (z.B. Wiener Linien, ÖBB, Grazer Verkehrsbetriebe) gültig sein und beim Kauf automatisch auf das Mobiltelefon geladen werden.

Bei der Einführung der Open-SPIRIT Dienste in den Markt ist eine **sensible Preispolitik** zu verfolgen. Je nach strategischer Zielausrichtung und Höhe der einmaligen und laufenden Kosten, die dem Betreiber durch Open-SPIRIT entstehen, ist der Preis pro Service Bündel zu gestalten. Um einen möglichst großen Kundenkreis anzusprechen sollten segmentspezifische Unterschiede berücksichtigt und die verschiedenen Service Bündel unterschiedlich bepreist werden.

Das für Open-SPIRIT attraktivste Segment ist das der **Businesskunden.** Diese sind, nicht zuletzt aufgrund von Dienstreisen oder Besprechungen außer Haus, oftmals ortsunkundig und nicht sehr preissensibel. Bei der strategischen Bearbeitung des Gesamtmarktes sollte darauf geachtet werden, dass diesem Teilmarkt ein besonderer Stellenwert eingeräumt wird.

Der Open-SPIRIT Regelbetrieb ist nicht nur für Betreiber und Nutzer Öffentlicher Verkehrmittel in Wien und Wien Umgebung von Interesse, da eine **breite Anwendung der Open-SPIRIT Dienste bzw. der Indoor-Navigation in unterschiedlichen komplexen Gebäuden** wie z.B. Flughäfen, Krankenhäuser, Amtsgebäuden etc. ebenso Sinn machen würde **wie für bestimmte Veranstaltungen**, z.B. die Fußballeuropameisterschaft 2008 mit Spielstätten in Wien, Klagenfurt, Salzburg und Innsbruck. Die Erfassung und Digitalisierung des Contents stellt einen geringen Kostenfaktor dar und kann betreiberabhängig erfolgen. Bei der Ausstattung der Gebäude mit Bluetooth Beacons könnten sich Synergien ergeben, die gemeinsame Nutzung eines Beacon Netzes durch mehrere Betreiber würde wiederum zu einer Kostenreduktion für alle Beteiligten führen.

8. LITERATURVERZEICHNIS

Bass, F.: A new product growth for model consumer durables; Management Science, Vol. 15, No 5, 1969
Gartner Group: Mobile Terminals: Austria 1999 – 2008; Dataquest, Juni 2004
Hightower J. und Borriello: Location Systems for Ubiquitous Computing. IEEE Computer, 34(8), S. 57–66, 2001
May, A.J. et al: Pedestrian navigation aids: information requirements and design implications. Personal Ubiquitous Computing, Vol. 7, S. 331-338, Springer-Verlag London, 2003
Open-SPIRIT Konsortium: Open-SPIRIT Endbericht-Technischer Teil, Wien, 2005
Rehrl, Göll, Leitinger, Bruntsch: Combined indoor/outdoor Smartphone navigation for public transport travellers, 3rd Symposium on LBS & TeleCartography, Wien, November 2005
Rehrl, Leitinger, Bruntsch: Navigationsunterstützung für intermodal Reisende in komplexen Umsteigebauwerken, in: Beiträge des Spezialforums „Offene Plattformen für Reiseinformationsmanagement und Mobilitätsdienste“ im Rahmen der AGIT 2005, Salzburg, Juli 2005
Rüetschi und Timpf: Modelling wayfinding in public transport: network space and scene space. In Proc. Spatial Cognition 2004, Chiemsee, 2004
Statistik Austria: Bevölkerungsvorausschätzung 2001 bis 2050, Statistisches Jahrbuch 2005

reviewed paper

Die Bedeutung des öffentlichen Verkehrs für Frauen in ländlichen Regionen

Dagmar METH

(Dipl.-Ing. Dagmar Meth, Institut für Verkehrswesen, Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur Wien, Peter Jordan-Straße 82, 1190 Wien, dagmar.meth@boku.ac.at)

1. PROBLEMSTELLUNG

Durch den Rückzug von Versorgungseinrichtungen aus kleinen Gemeinden sowie durch zunehmende Zersiedelung sind viele Einrichtungen des täglichen Bedarfs für die Bewohner nicht (mehr) fußläufig erreichbar. Oft müssen mehrere Kilometer zum Nahversorger, zum Arzt oder zur Volksschule zurückgelegt werden. Ohne öffentliches Verkehrsangebot ist es für Personen ohne Pkw-Verfügbarkeit mitunter schwer, Versorgungseinrichtungen zu erreichen. Das öffentliche Verkehrsangebot ist in ländlichen Regionen in der Regel an den Schülerverkehr angepasst. Zu Zeiten geringerer Nachfrage, etwa am Wochenende oder während der Schulferien, ist es meist unzureichend bzw. gar nicht vorhanden (Abb.1). Kleine, peripher gelegene Siedlungen sind oft nicht erschlossen. Es kommt zur sozialen Benachteiligung für Personen ohne Pkw-Verfügbarkeit und zum Schwinden ihrer sozialen Kontakte. Es wird davon ausgegangen, dass diese Probleme in erster Linie Jugendliche, ältere bzw. gebrechliche Menschen und besonders Frauen betreffen. Die Situation wird durch fehlende Nahversorgungseinrichtungen in kleinen Ortschaften verschärft, immer mehr Orte müssen ohne Lebensmittelgeschäft auskommen; im Bezirk Jennersdorf (Burgenland) haben beispielsweise 32% der Bewohner kein Kaufhaus im Ort (WIRTSCHAFTSKAMMER BGLD 2004).

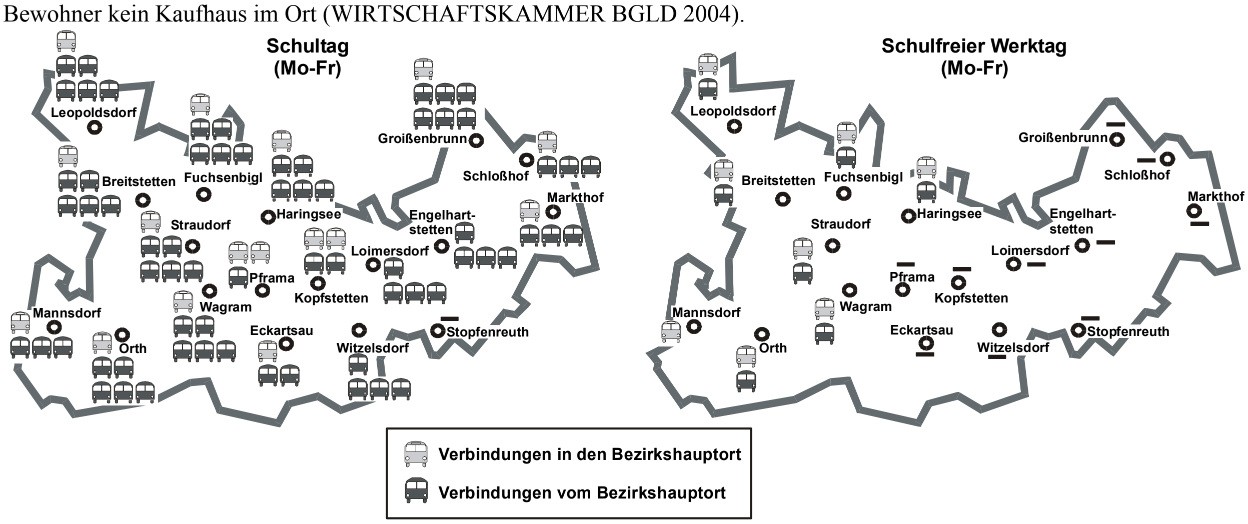


Abb.1: Angebot an öffentlichen Verkehrsverbindungen in den Bezirkshauptort an Werktagen - Beispiel Südliches Marchfeld (SAMMER et al. 2001)

2. DAS PROJEKT ARTS

Das EU-Forschungsprojekt ARTS (ARTS-CONSORTIUM 2004) hatte die Effizienz innovativer Verkehrslösungen in dünn besiedelten ländlichen Regionen zum Inhalt. Im Rahmen dieses Projekts wurden in acht europäischen Ländern unterschiedliche Modellprojekte, die die Verbesserung des öffentlichen Verkehrs zum Ziel hatten, installiert und untersucht. Vier dieser Modellprojekte hatten bedarfsgesteuerte öffentliche Verkehrsangebote zum Inhalt, drei beschäftigten sich mit der Verbesserung des Schülerverkehrs bzw. dessen Öffnung für reguläre Fahrgäste, ein Projekt konzentrierte sich auf verkehrstelematische Fahrgastinformationen. In Österreich wurde ein bedarfsgesteuertes öffentliches Verkehrsangebot, das Dorfmobil, in der Gemeinde Klaus an der Pyhrnbahn (Oberösterreich) umgesetzt und evaluiert. Für die Evaluierung dienten die Aufzeichnungen der einzelnen Fahrten (Fahrtenblätter) der ersten fünf Betriebsmonate (1437 Fahrgäste) sowie eine Befragung jener Fahrgäste, die in diesem Zeitraum das Dorfmobil benutzt haben (Nettostichprobe: 52 Personen).

Im November 2004 wurde in der Gemeinde Klaus eine postalische Haushaltsbefragung durchgeführt, bei der das stichtagsbezogene Mobilitätsverhalten sowie die soziodemographischen Charakteristika von Personen ab sechs Jahren abgefragt wurde (adaptiertes KONTIV-Verfahren). Die Haushaltsadressen wurden zufällig gezogen. Bei einer Bruttostichprobe: 324 Haushalte) betrug die Rücklaufquote 57%. Es liegen Daten von 184 Haushalten (443 Personen, 1116 Wege) vor.

3. MOBILITÄTSCHANCEN VON BEWOHNERN DER GEMEINDE KLAUS

3.1 Pkw-Verfügbarkeit

Der Motorisierungsgrad in ländlichen Regionen Österreichs liegt derzeit – je nach Bezirk – zwischen 500 und 600 Pkw pro 1000 Einwohner. Dies legt die Vermutung nahe, dass jeder Haushalt über zumindest einen Pkw verfügt. Die Haushaltsbefragung in der Gemeinde Klaus (2004) zeigt allerdings, dass in 17% der Haushalte kein Pkw vorhanden ist (Abb.2). Etwa drei Viertel der Haushalte ohne Pkw sind Einpersonenhaushalte, von denen wiederum 85% Frauenhaushalte sind. Ein im Haushalt vorhandener Pkw ist oft nicht für die Frau verfügbar. Knapp die Hälfte der Haushalte besitzt einen einzigen Pkw. Dieser wird untertags häufig vom Mann benutzt (z.B. für den Weg zur Arbeit). Jede siebente Frau, die in einem Haushalt mit Pkw lebt, besitzt keinen Führerschein.

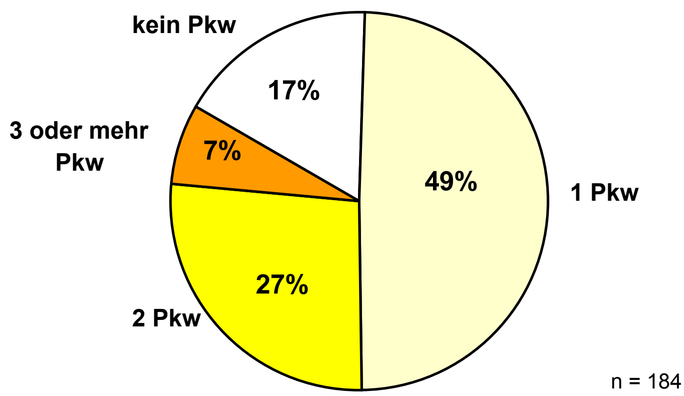


Abb.2: Anzahl der Pkw im Haushalt (Gemeinde Klaus)

Männer haben häufiger die Möglichkeit, einen privaten Pkw zu lenken als Frauen. Nur 7% der Männer ab 18 Jahren haben keinen Pkw im Haushalt bzw. keinen Führerschein, bei den Frauen sind es 24%. Außerdem haben Männer häufiger einen Pkw zur Verfügung, den sie nicht mit anderen Haushaltsmitgliedern teilen müssen – 51% nutzen ihren Pkw alleine, unter Frauen sind es nur 39% (Abb.3). Durch die Tatsache, dass viele Frauen keinen Pkw zur Verfügung haben, ist es ihnen nicht möglich, einen Arbeitsplatz zu erreichen und somit einer Erwerbstätigkeit nachzugehen, wenn ein entsprechendes öffentliches Verkehrsangebot fehlt.

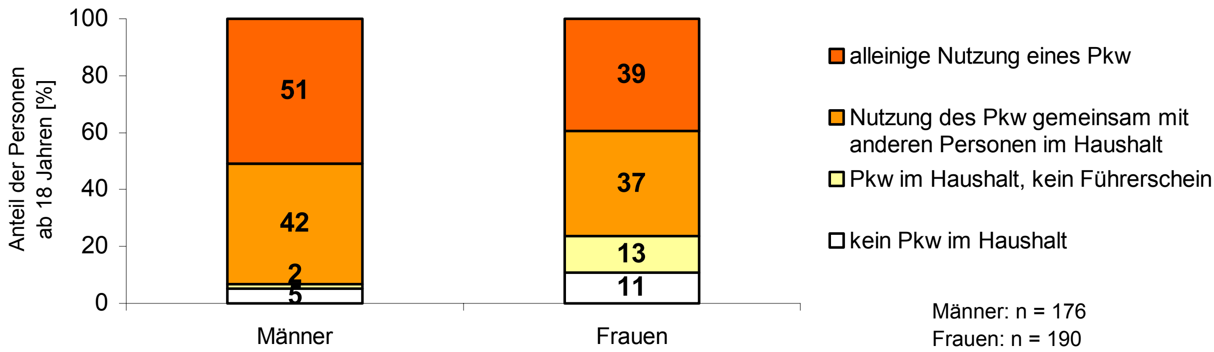


Abb.3: Pkw-Verfügbarkeit von Personen ab 18 Jahren (Gemeinde Klaus)

3.2 Führerscheinbesitz

Der Grund der ungleichen Verteilung in der Pkw-Verfügbarkeit ist in erster Linie in der Tatsache begründet, dass Frauen seltener einen Führerschein besitzen. 98% der Männer ab 18 Jahren und 86% der Frauen besitzen einen Führerschein. Während in der jüngeren Bevölkerung der Anteil der Personen mit Führerschein bei Männern wie bei Frauen bei nahezu 100% liegt, gibt es in den Altersklassen ab 45 Jahren einen deutlichen Unterschied im Führerscheinbesitz zwischen Männern und Frauen, der sich mit zunehmendem Alter vergrößert. Bei den über 75-Jährigen besitzen 91% der Männer einen Führerschein und nur 5% der Frauen (Abb.4). Es wird noch über 40 Jahre dauern, bis der Anteil der Frauen mit Führerschein so hoch ist wie jener der Männer.

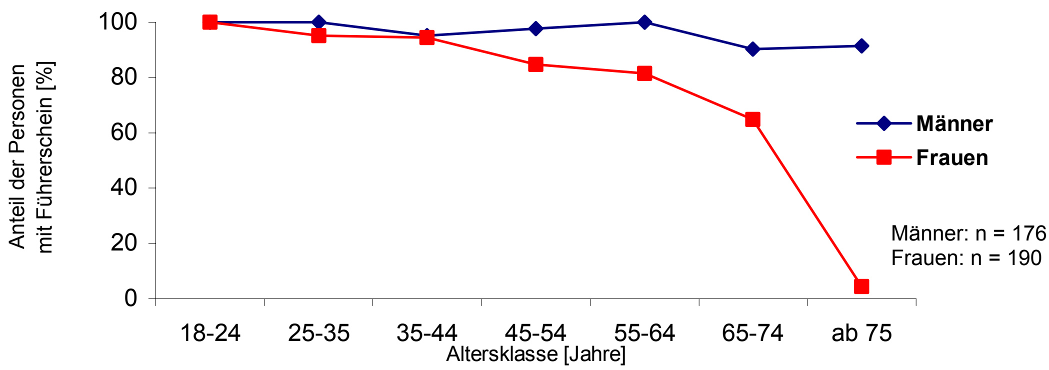


Abb.4: Anteil der Personen ab 18 Jahren mit Führerschein in Abhängigkeit von der Altersklasse (Gemeinde Klaus)

4. MOBILITÄTSVERHALTEN VON BEWOHNERN DER GEMEINDE KLAUS

4.1 Tageswegelänge

Geprägt durch die Rolle in Familie und Gesellschaft sowie durch den Zugang zu motorisierten Verkehrsmitteln unterscheidet sich das Mobilitätsverhalten der Frauen von jenem der Männer. In der Gemeinde Klaus legen Männer täglich mehr Wege zurück als Frauen und haben einen größeren Aktionsradius. Durchschnittlich absolviert ein Mann 3,0 Wege an einem Werktag, eine Frau 2,6

Wege. Während ein Mann täglich eine Distanz von etwa 62,9 km zurücklegt, kommt eine Frau auf durchschnittlich 44,0 km, das sind rund 30% weniger (Abb.5).

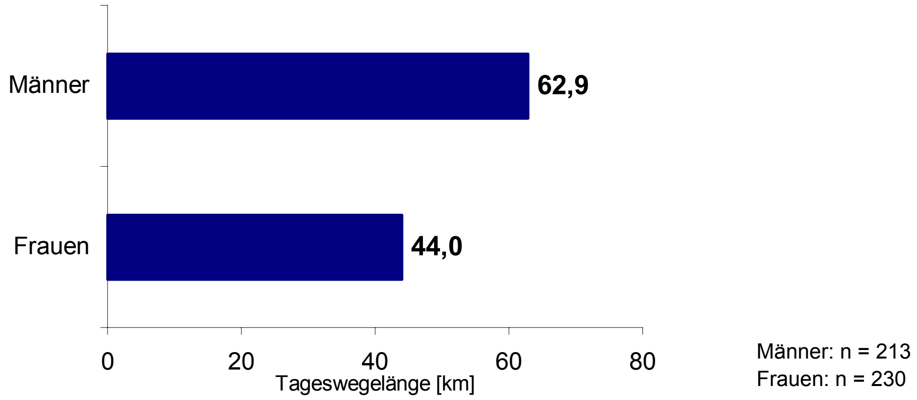


Abb.5: Durchschnittliche Tageswegelänge von Männern und Frauen (Gemeinde Klaus)

4.2 Verkehrszweck

Hinsichtlich des Verkehrszwecks unterscheiden sich die Wege der Frauen deutlich von jenen der Männer. Der Anteil des Berufspendlerverkehrs ist bei den Männern (42%) etwa doppelt so hoch wie bei den Frauen (20%). Dies ist ist eine logische Konsequenz der Erwerbsquote der 15-59-Jährigen in Klaus, die bei den Männern 85% beträgt und bei den Frauen 67% (STATISTIK AUSTRIA 2004). Dementsprechend legen Männer auch mehr dienstliche Erledigungen zurück. Große Unterschiede bestehen auch in den Erledigungswegen, deren Anteil bei den Männern 22% ausmacht, bei den Frauen 37%. Insgesamt werden 62% der Versorgungswege (privater Erledigungsverkehr) Erwachsener von Frauen durchgeführt. Der Anteil der Servicewege (Personentransport) ist bei Frauen viermal höher als bei Männern (Abb.6).

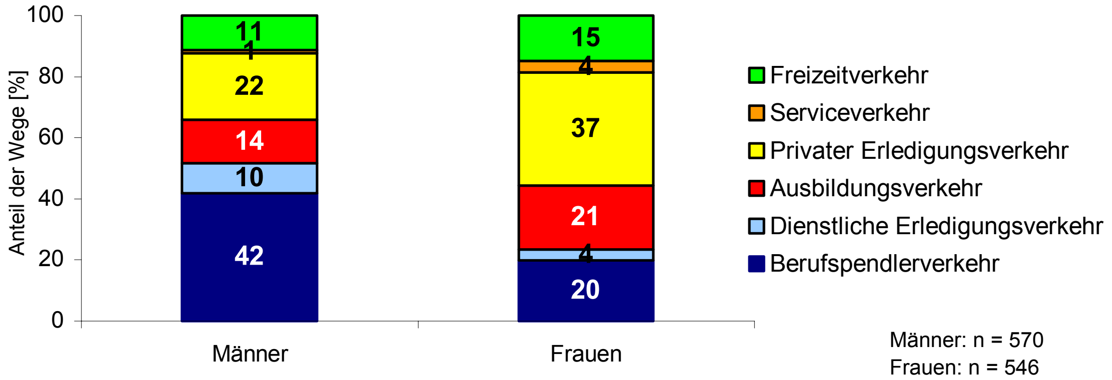


Abb.6: Verkehrszweck der Wege von Männern und Frauen (Gemeinde Klaus)

4.3 Verkehrsmittelwahl

Die unterschiedlichen Zugänge zu motorisierten Verkehrsmitteln sowie die gegenwärtig unterschiedlichen Mobilitätsbedürfnisse von Männern und Frauen, die sich u.a. in der Tageswegelänge und den Verkehrszwecken äußern, spiegeln sich in der Verkehrsmittelwahl wider. Der Anteil der Wege, die nicht motorisiert zurückgelegt werden, ist bei Frauen mit 31% etwa doppelt so hoch wie bei Männern mit 15%. Männer nutzen häufiger einen Pkw, sie legen 63% ihrer Wege als Pkw-Lenker zurück, Frauen 40%. Frauen sind hingegen häufiger als Pkw-Mitfahrerinnen (12%) und in öffentlichen Verkehrsmitteln (15%) unterwegs (Abb. 7).

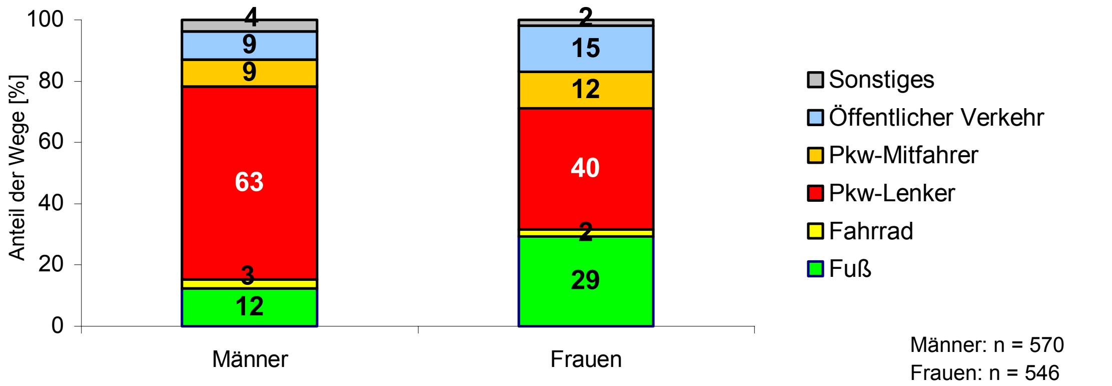


Abb.7: Verkehrsmittelwahl von Männern und Frauen (Gemeinde Klaus)

5. DAS DORFMOBIL IN KLAUS AN DER PYHRNBAHN

Ein zufriedenstellendes Angebot an öffentlichem Linienverkehr – etwa in Form eines Stundentaktes – ist für dünn besiedelte Räume kaum gerechtfertigt, da die Nachfrage aufgrund der hohen Motorisierung und der geringen Einwohnerzahl der einzelnen Ortschaften sehr gering ist. Eine Fahrgasterhebung im Bezirk Güssing zeigt, dass – abgesehen vom Schülertransport – an einem Werktag selbst bei einem Stundentakt zwischen den Ortschaften und der Bezirkshauptstadt nur 27 Fahrgäste pro 1000 Einwohner den Bus nutzen (SAMMER et al. 2005). Es ergibt sich daher die Notwendigkeit, neue Wege im öffentlichen Verkehr zu beschreiten. Anhand des Dorfmobils wird eine kostengünstige Möglichkeit der öffentlichen Verkehrsversorgung für kleine Gemeinden vorgestellt und die Nutzung des Angebots durch die Fahrgäste, insbesondere durch Frauen, aufgezeigt sowie die Auswirkungen auf ihr Alltagsleben dargestellt.

In der 1.200-Einwohner Gemeinde Klaus an der Pyhrnbahn (Oberösterreich) entstand seitens einiger Gemeindepolitiker und einiger Bürger der Wunsch nach einem öffentlich zugänglichen Verkehrsmittel, das auch entlegene Siedlungsgebiete der Gemeinde bedient und somit die Erreichbarkeit von Versorgungseinrichtungen für alle Bewohner sicherstellt, als Zubringer zu Bus und Bahn fungiert, soziale Kontakte stärkt, Hol- und Bringdienste reduziert und geringe Kosten für die öffentliche Hand verursacht.

Im Rahmen des EU-Projekts ARTS (ARTS-CONSORTIUM 2004) konnte in Klaus ein bedarfsgesteuertes Verkehrsangebot umgesetzt werden - das Dorfmobil. Das Dorfmobil ist seit Dezember 2002 in Klaus (Abb.8) unterwegs. Nach einem Probebetrieb von 12 Monaten wurde es in den Dauerbetrieb übergeführt. Es entspricht dem Prinzip eines Anruf-Sammeltaxis, mit dem Unterschied, dass es von Gemeindebürgern über einen gemeinnützigen Verein ehrenamtlich organisiert und betrieben wird. Aufgrund der dispersen Siedlungsstruktur in der Gemeinde, der Größe des Bedienungsgebiets und dem absolut gesehen geringen Fahrgastaufkommen entschied man sich für Flächenbedienung und beliebige Abfahrtszeiten.

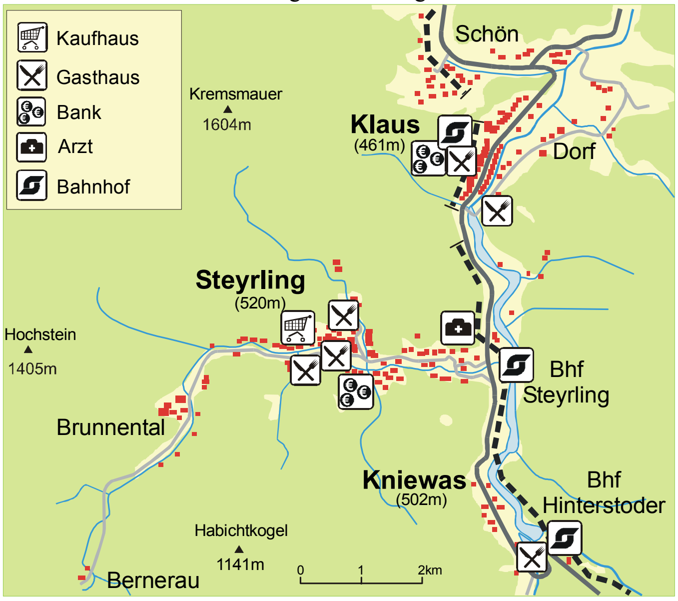


Abb.8: Siedlungsgebiet und Versorgungseinrichtungen der Gemeinde Klaus an der Pyhrnbahn (Oberösterreich)

Das Dorfmobil verkehrt an Werktagen (Montag bis Freitag) von 7:00 – 19:00 Uhr. Es bedient das gesamte Siedlungsgebiet der zur Gemeinde Klaus gehörenden Ortschaften Klaus, Steyrling und Kniewas und die unmittelbar an die Gemeinde angrenzenden, zur Gemeinde Klaus orientierten Siedlungen der Nachbargemeinden (Schulsprengel Klaus). Als Fahrzeug dient ein für 6 Personen zugelassener Leasing-Pkw. 6 Männer und 5 Frauen (Abb.9) versehen abwechselnd Bereitschaftsdienst, wofür sie eine geringe Aufwandsentschädigung (maximal EUR 1,50 pro Stunde) erhalten. Sie nehmen via Mobiltelefon die Fahrtenwünsche entgegen, tragen sie ins Fahrtenbuch ein und führen die Fahrt durch.

Das Dorfmobil ist spätestens eine halbe Stunde vor der gewünschten Abfahrtszeit telefonisch anzufordern. Die Fahrgäste werden von zuhause bzw. einem vereinbarten Ort abgeholt und zu ihrem Ziel gebracht. Pro Fahrgast wird ein Fahrtkostenbeitrag von EUR 1,50 eingehoben. Die Kosten (inkl. Rücklagen für evtl. Fahrzeugneuanschaffung) von etwa EUR 18.000,- pro Jahr werden zu 26% durch die Fahrtkostenbeiträge gedeckt. Der restliche Betrag wird durch Mitgliedsbeiträge, Veranstaltungen des Vereins, Sponsoren und Förderungen des Landes Oberösterreich aufgebracht. Pro Betriebskilometer fallen Gesamtkosten in der Höhe von EUR 0,57 an. Dies entspricht etwa der Hälfte eines herkömmlichen Anruf-Sammeltaxisystems.

Abb.9: Das Dorfmobil und eine Gruppe der Fahrerinnen und Fahrer

Im ersten Betriebsjahr nutzten 3288 Fahrgäste das Dorfmobil, das sind 13,2 Fahrgäste pro Betriebstag. Erwartungsgemäß wird das Dorfmobil hauptsächlich von Personen benutzt, die über keinen Pkw verfügen – 95% der Fahrgäste haben keinen Führerschein bzw. keinen Pkw im Haushalt. Der auf die einzelnen Altersgruppen fallende Anteil der Fahrgäste ist in Abb.10 dargestellt. Jüngere sowie ältere Personengruppen (bis 24 Jahre und über 75 Jahre) unter den Fahrgästen sind gegenüber deren Verteilung in der Gesamtbevölkerung überrepräsentiert, die „automobilen" Altersklassen (zwischen 25 und 64 Jahren) unterrepräsentiert. Während unter Jugendlichen (bis 24 Jahre) der Anteil der männlichen Fahrgäste höher ist, dominieren in allen anderen Altersklassen die weiblichen Fahrgäste.

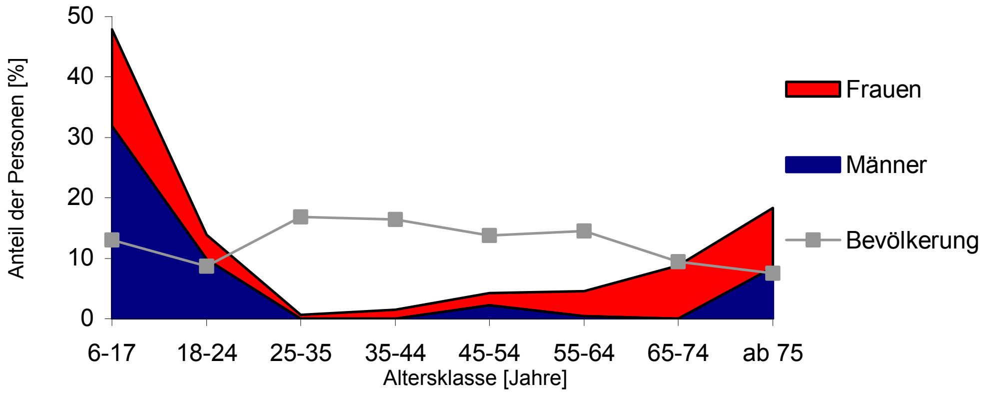


Abb.10: Anteil der Gesamtbevölkerung ab 6 Jahren und der Dorfmobil-Fahrgäste in Abhängigkeit von der Altersklasse

Am meisten wird das Dorfmobil für Freizeitwege genutzt. 40% der Wege dienen Freizeitaktivitäten, wie beispielsweise Besuche bei Bekannten, der Teilnahme an Veranstaltungen oder Seniorennachmittagen. Fast ein Viertel der Fahrten haben ihren Ausgangspunkt bzw. ihr Ziel an einer Haltestelle von Bus oder Bahn. 16% der Wege sind dem Ausbildungsverkehr (Volksschule, Nachhilfeunterricht) zuzuordnen. 13% führen zum bzw. vom Kaufhaus. 5% dienen privaten Erledigungen bei Post, Bank oder am Gemeindeamt, 3% der Wege sind Arztwege.

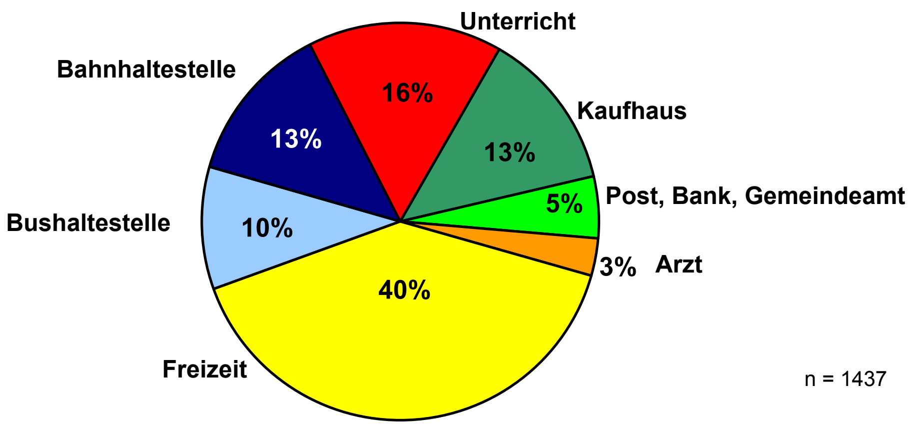


Abb.11: Verkehrszwecke der Wege mit dem Dorfmobil

Vor Einführung des Dorfmobils waren die Fahrgäste häufig auf Mitfahrgelegenheiten angewiesen. 82% der Wege würden ohne das Dorfmobil mit einem anderen Verkehrsmittel zurückgelegt, hauptsächlich als Pkw-Mitfahrer. 11% der Wege, die mit dem Dorfmobil durchgeführt werden, könnten ohne dessen Inbetriebnahme nicht stattfinden, dies sind zur Hälfte Freizeitwege, außerdem Wege zum Kaufhaus und zur Bank. Diese Wege würden zum Teil von anderen Personen als Nachbarschaftshilfe erledigt. 7% der Wege hätten ein anderes Ziel. Personen, die in der Nähe der Bahnstation wohnen, würden, wie vor Einführung des Dorfmobils, mit der Bahn zum Einkauf oder Arzt nach Kirchdorf fahren (Abb.12).

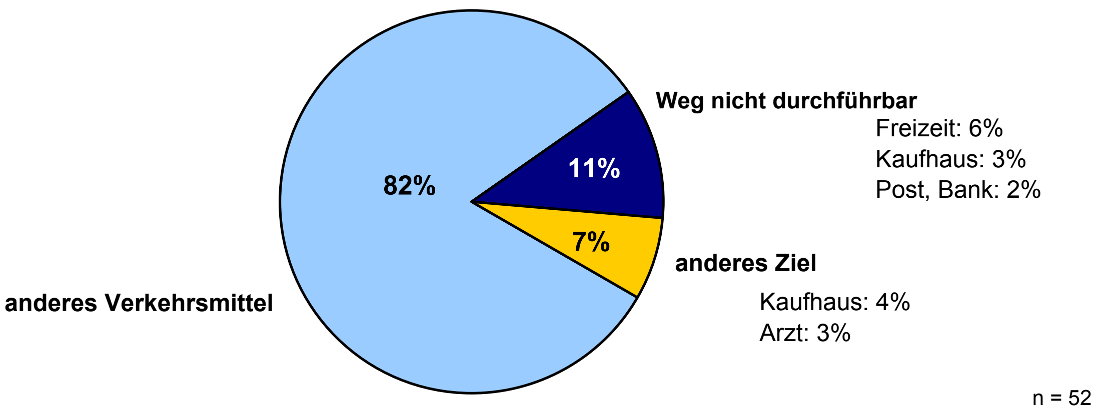


Abb.12: Alternativen für die Dorfmobil-Wege

Die Zufriedenheit der Fahrgäste mit dem Dorfmobil ist groß. Personen, die über keinen Pkw verfügen, können ihren Tagesablauf nun organisieren, ohne dass sie dabei auf Mitfahrgelegenheiten angewiesen sind. Das Dorfmobil hat Auswirkungen auf die Lebensqualität der Fahrgäste. 48% der Personen gaben an, seit Einführung des Dorfmobils mehr Kontakt zu anderen Menschen im Ort zu haben. 90% fühlen sich durch das Dorfmobil in ihren täglichen Erledigungen flexibler und unabhängiger.

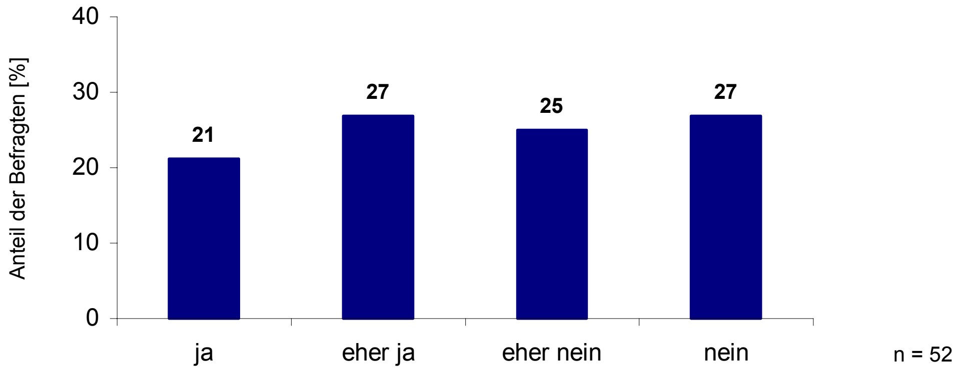


Abb.13: Antwort auf die Aussage: Seit es das Dorfmobil gibt, habe ich mehr Kontakt zu anderen Menschen im Ort.

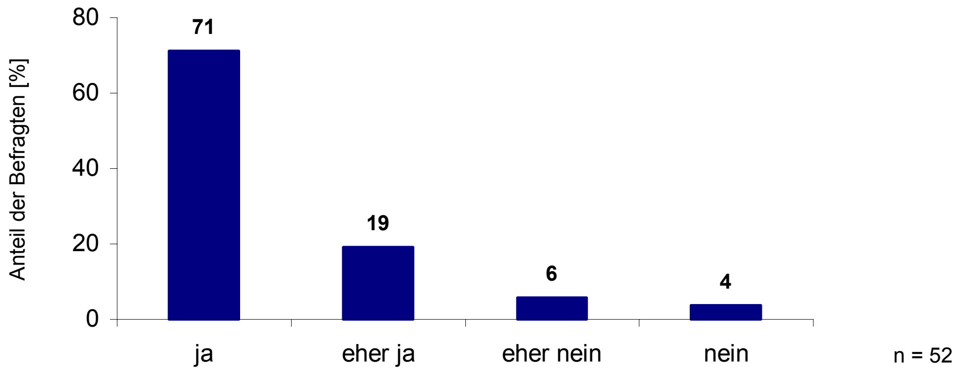


Abb.14: Antwort auf die Aussage: Seit es das Dorfmobil gibt, bin ich flexibler und unabhängiger.

6. SCHLUSSFOLGERUNGEN

Die Rücknahme des öffentlichen Verkehrsangebots bzw. ein unzureichendes Angebot trifft nicht nur Frauen, sondern alle Personen, die keinen Pkw zur Verfügung haben. Jedoch sind Frauen (derzeit noch) in einem höheren Maße betroffen als Männer - der Anteil jener Frauen ab 18 Jahren, die nie einen Pkw zur Verfügung haben, liegt etwa 3,5-mal so hoch wie jener der Männer. Erst in etwa 40 Jahren wird es keinen Unterschied in der Pkw-Verfügbarkeit zwischen Frauen und Männern mehr geben. Ist kein zufriedenstellendes öffentliches Verkehrsangebot vorhanden, kann dies u.a. zu folgenden Konsequenzen führen:

Probleme bei der Erreichbarkeit von Versorgungseinrichtungen (sowohl innerhalb der Gemeinde als auch in regionalen Zentren) bzw. eine Abhängigkeit von der Hilfsbereitschaft Dritter für Haushalte ohne Pkw-Verfügbarkeit.

Zwang zur Anschaffung eines Zweitautos im Haushalt, um die Kinder zur oft einige Kilometer entfernten Haltestelle des Schulbusses zu bringen.

eine geringere Erwerbstätigkeit von Frauen, da die Erreichbarkeit von Arbeitsplätzen ohne Pkw oft nicht gegeben ist. Die Kosten eines Zweitautos verschlingen häufig den Großteil des Einkommens.

Die öffentliche Verkehrserschließung ländlicher Gemeinden erhöht die Lebensqualität der Bevölkerung. Wo herkömmlicher Linienverkehr aufgrund der geringen Nachfrage zu unwirtschaftlich ist, bieten Angebote wie das Dorfmobil, die bei Bedarf angefordert werden können, komfortable Alternativen. Um Erreichbarkeits- und Versorgungsprobleme von vornherein gering zu halten und die öffentliche Verkehrserschließung zu vereinfachen sind kompakte Siedlungsstrukturen anzustreben und die fußläufige Erreichbarkeit innerhalb einer Ortschaft zu forcieren.

7. QUELLEN

ARTS-Consortium: Actions on the integration of rural transport services, Deliverable 5, Evaluation and transferability of results, Funded by the European Community under the "Competitive and Sustainable Growth" programme, 2004

Sammer G., Meschik M., Meth D. et al: Mobilitäts- und Versorgungserfordernisse im Strukturschwachen ländlichen Raum als Folge des Strukturwandels. Untersuchungsgebiet Marchfeld, Zwischenbericht, Datenanalyse, 2004

Sammer G., Meth D, Neumann A.: Vertiefte Untersuchung von Mobilität und (Nah-)Versorgung im Unteren Pinka- und Stremtal. Vorabzug des Schlussberichts, 2005

Statistik Austria: Volkszählung vom 15. Mai 2001, Wohnbevölkerung nach Lebensunterhalt, Gemeinde Klaus an der Pyhrnbahn (40906), http://www.statistik.at/blickgem/vz3/g40906.pdf [29.11.2005]

Wirtschaftskammer Burgenland (Hrsg.): Nahversorgungsgrad, 2004

reviewed paper

Wie viel Technologie braucht der Nutzer? - Praktische Erfahrungen aus dem Betrieb eines Anrufsammeltaxis in einer Landgemeinde

Michael MESCHIK

(Dipl.-Ing Dr. Michael Meschik, Institut für Verkehrswesen, Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur, Peter Jordan Str. 82, A – 1190 Wien, michael.meschik@boku.ac.at)

1. SITUATION

Von 1999 bis 2001 wurden im Forschungsprojekt MOVE fünf dünn besiedelte österreichische Regionen hinsichtlich Versorgungsdefizite mit Verkehrsangeboten und Gütern des täglichen Bedarfs untersucht (Abbildung 29). Die Versorgungsqualität und das Mobilitätsverhalten wurden erhoben, Möglichkeiten zur Verbesserung des Nahversorgungsangebots und des Verkehrsangebots wurden mit der betroffenen Bevölkerung entwickelt und diskutiert. Es zeigte sich, dass die Erreichbarkeit von Zielen - besonders für Personen ohne Kfz-Verfügbarkeit - mit zunehmender Motorisierung und abnehmender Bedienungshäufigkeit des öffentlichen Verkehrs schlechter geworden ist. Dies wird als Abnahme der Lebensqualität empfunden.

Abbildung 29: Die 5 Untersuchungsregionen im Projekt MOVE (2000)

2. VERKEHRSANGEBOT UND AUSWIRKUNGEN

Im Zuge des EU-Forschungsprojekts ARTS wurde 2003 in einem dieser Gebiete, konkret in der Gemeinde Klaus an der Pyhrnbahn, ein bedarfsgesteuertes Verkehrsangebot installiert (Abbildung 30).

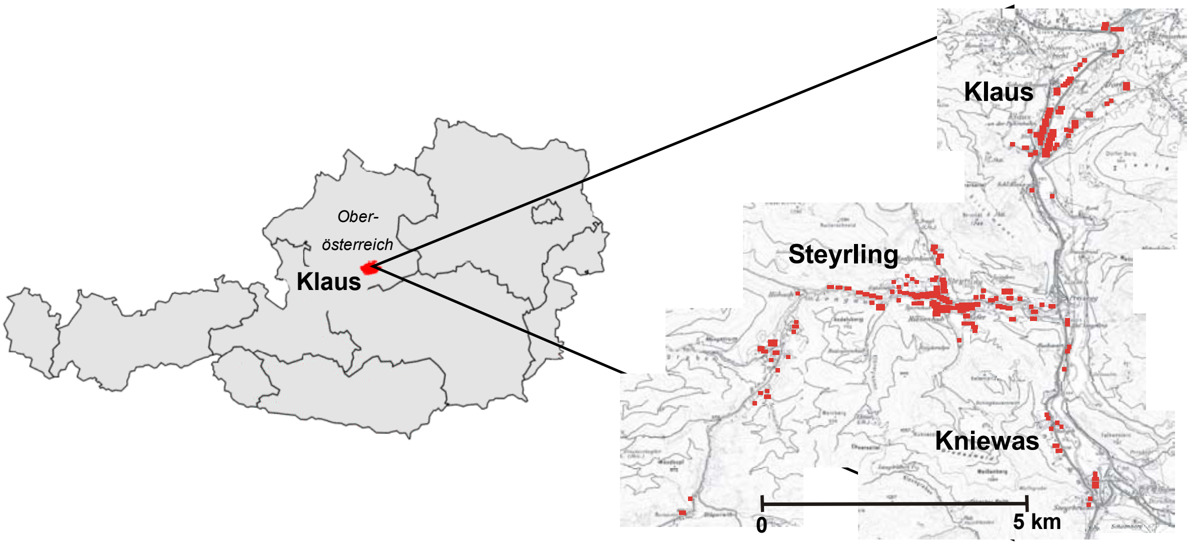


Abbildung 30: Das Untersuchungsgebiet Klaus a.d. Pyhrnbahn

Betreiber des „Dorfmobils“ ist ein gemeinnütziger Verein aus Gemeindemitgliedern, 5 Fahrerinnen und 6 Fahrer sind Mitglieder des Vereins und erhalten eine geringe Aufwandsentschädigung. Dieses „Dorfmobil“ – ein Anrufsammeltaxi - ist nun bereits im vierten Jahr erfolgreich in Betrieb und fährt nach Voranmeldung montags bis freitags zwischen 6 und 19 Uhr zu allen Zielen innerhalb der Gemeinde (Abbildung 31f).

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

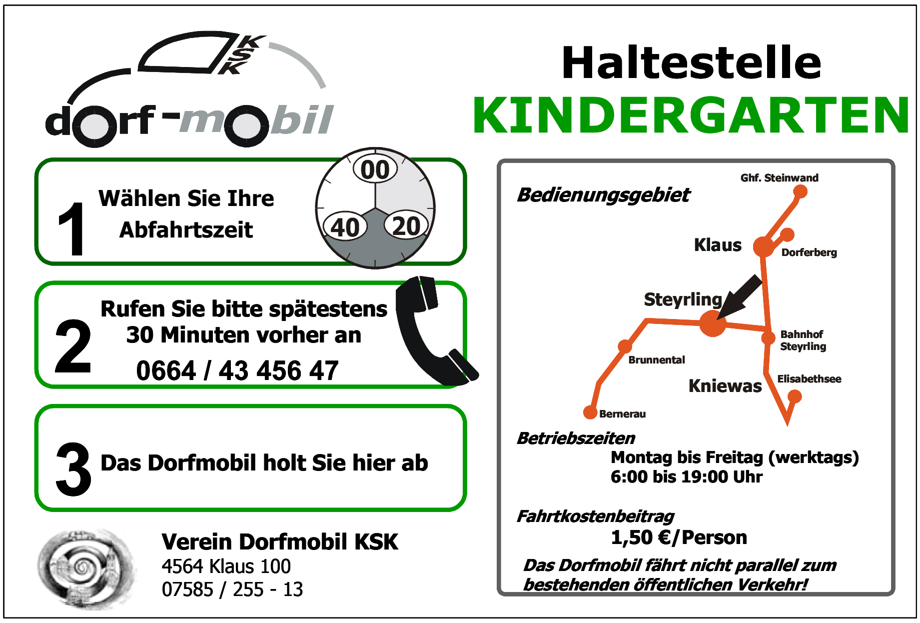


Abbildung 31: Benutzungshinweise für das Dorfmobil (Haltestellenaushang) in Klaus a.d. Pyhrnbahn

Das Dorfmobil wird telefonisch vorbestellt. Die diensthabende Fahrerin nimmt die Bestellung am Mobiltelefon entgegen und trägt die gewünschte Fahrt auf einem Fahrtenblatt ein.

Der Fahrgast wird beispielsweise von zu Hause abgeholt und zum Geschäft gefahren. Bei Bedarf wartet die Fahrerin oder ist dem Fahrgast behilflich.

Wurde eine Rückfahrt vorbestellt, so bringt das Dorfmobil den Fahrgast wieder nach Hause.

Abbildung 32: Bestellung und Ablauf von Personentransporten mit dem Dorfmobil in Klaus a.d. Pyhrnbahn

Im ersten Betriebsjahr wurden an 250 Betriebstagen insgesamt 3288 Fahrgäste bei 2640 Dorfmobil-Fahrten befördert. Dies ergibt im Schnitt 13,2 Fahrgäste pro Betriebstag. Die mittlere zurückgelegte Fahrtenlänge eines Fahrgastes beträgt 7,5 km. Insgesamt wurden vom Dorfmobil im ersten Betriebsjahr 31.600 km (inklusive Leer- und Servicefahrten) zurückgelegt.

Begleitendes Untersuchungsprogramm

In der Vorstudie, dem Projekt MOVE (SAMMER et al. 2000 und 2003), sowie in einer Diplomarbeit (MAIR 2003) wurden die Situation im Untersuchungsgebiet erhoben und konkrete Verbesserungsvorschläge zur Verkehrssituation und Nahversorgung ausgearbeitet. Im EU-Projekt ARTS (ARTS-CONSORTIUM 2004a und 2004b) wurden das Dorfmobil installiert und die Auswirkungen mit einem umfassenden Untersuchungsprogramm bewertet. Tabelle 3 zeigt einen Überblick über die angewendeten Verfahren, Stichprobengrößen etc. Zusätzlich wurden über den Umfang des Probebetriebs von ARTS hinausgehende Ergebnisse von LANTZBERG (2005) ausgewertet.

Tabelle 3: Angewendete Erhebungen und eingesetzte Untersuchungsmethoden zum Projekt „Dorfmobil“ in Klaus a.d. Pyhrnbahn

Zeitpunkt	Untersuchung	Methode	interviewte Personen	Erläuterungen
Dez. 02 – Dez. 03	Wegeuntersuchung Projekt MOVE	Schriftliche Wegefragebogen	Haushalte	Alle Wege erfasst; modifiziertes Kontiv-Design
Mai 2003	Fahrgastinterviews	Vertiefte, persönliche Interviews	52	Jeweils 1 Stunde
Mai 2003	Fahrerinterviews		9	Jeweils 45 Minuten
August 2003	Nicht-Benutzer Interviews		104	Jeweils 45 Minuten
Juni 2003	Betreiberbefragung	Fokusgruppe		
September 2003	öffentliche Hand (Amt der OÖ Lsreg.)	Telefoninterview	1	20 Minuten

Die Erreichbarkeit von Kaufhaus, Arzt, Freunden etc. wurde durch Einführung des Dorfmobils entscheidend erleichtert. Die Lebensqualität der Fahrgäste ohne Kfz-Verfügbarkeit und damit zumindest der soziale Bereich der Nachhaltigkeit konnten nachweislich verbessert werden. Elf Prozent der mit dem Dorfmobil durchgeführten Wege hätten vor der Einführung nicht stattfinden können, acht Prozent hatten ein anderes Ziel, da keine entsprechenden Verkehrsmöglichkeiten verfügbar waren (Abbildung 33).

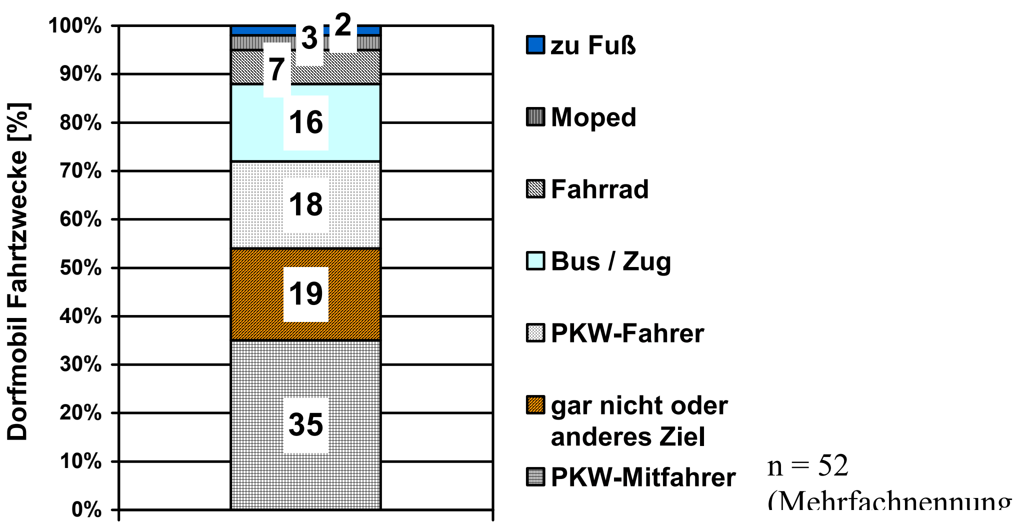


Abbildung 33: Wie wurden die genannten Wege, welche jetzt mit dem Dorfmobil zurückgelegt werden, vor der Einführung des Dorfmobils in Klaus a.d. Pyhrnbahn durchgeführt?

Die Nutzer des Dorfmobils sind im Wesentlichen von öffentlichen Mobilitätsangeboten sowie Hol- und Bringdiensten abhängig und zwei Bevölkerungsgruppen zugehörig: Kinder und junge Leute unter dem für eine Lenkerberechtigung erforderlichen Alter von 18 bzw. 16 Jahren und Senioren (Abbildung 34). Beide Gruppen verfügen kaum über motorisierte Fahrzeuge. Bei Frauen über 60 Jahren beträgt der Anteil der Führerscheinbesitzerinnen unter 30%. Führerscheinbesitzer nutzten das Dorfmobil kaum.

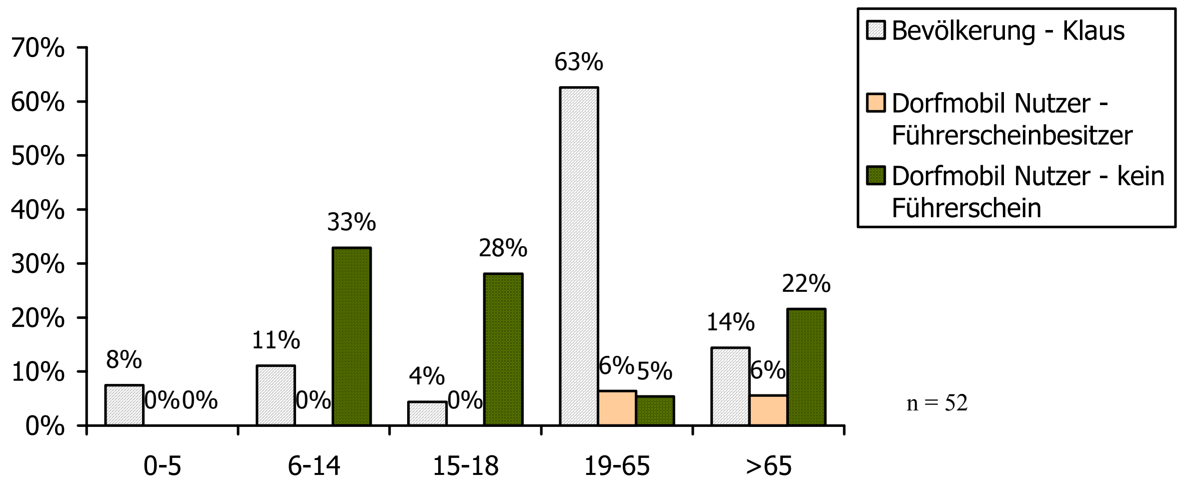


Abbildung 34: Altersmäßige Verteilung der Gesamtbevölkerung im Vergleich zu den Fahrgästen im ARTS-Modellprojekt Dorfmobil (Klaus a.d. Pyhrnbahn) nach Führerscheinbesitz

3. TECHNOLOGIEEINSATZ

Aus den Voruntersuchungen waren die Charakteristika von Betreibern (Verein mit freiwilligen FahrerInnen) und Nutzern (Kinder, Jugendliche und Senioren) bekannt. Im Gemeindegebiet wohnen ca. 1200 Personen, 13 Fahrten werden täglich im Schnitt (2003) mit dem Dorfmobil durchgeführt. Der Betrieb und die Steuerung des Dorfmobils wurden bewusst ohne wesentliche technische Installationen umgesetzt. Die Buchung von Fahrten erfolgt über ein Mobiltelefon, der diensthabende Fahrer bzw. die Fahrerin versucht, die Fahrtwünsche zu Sammelfahrten zusammen zu legen.

Die freiwilligen FahrerInnen und nicht zuletzt der sparsame Einsatz von Telekommunikation und der Verzicht auf eine Buchungszentrale (diese Aufgabe wird von den FahrerInnen selbst wahrgenommen) ermöglichen eine sehr kostengünstige Lösung. Die Kosten für das Dorfmobil werden durch Fahrtkostenbeiträge (27%), Mitgliedsbeiträge (7%), Sponsoren und Spenden (33%) sowie durch Förderungen (33%) aufgebracht. Aus den entstehenden Kosten von ca. € 18.000,- pro Jahr ergeben sich durchschnittliche Kosten von € 6,82 je Fahrt, von € 5,47 je Fahrgast und von € 0,57 je gefahrenem Kilometer (inklusive Leer- und Servicefahrten). Ein herkömmliches Taxi würde etwa doppelt so teuer kommen, zusätzlich fallen in ländlichen Gebieten teils hohe Kosten für die An- und Abfahrt des Taxis an. In Klaus selbst gibt es kein Taxiunternehmen, das nächste Taxi aus der Nachbargemeinde hat etwa 15 km Anfahrtsweg bis zum Siedlungsschwerpunkt von Klaus.

3.1 Vorhandene Telekommunikation

Die Befragung der Haushalte in der Gemeinde ergab erwartungsgemäß eine beinahe flächendeckende Versorgung mit Telefonen (Abbildung 35). Nur 3% der Haushalte verfügen über kein Telefon. Beinahe 60% der Haushalte verfügen über keinen PC, 16% der Haushalte können über einen PC das Internet nutzen (Abbildung 36).

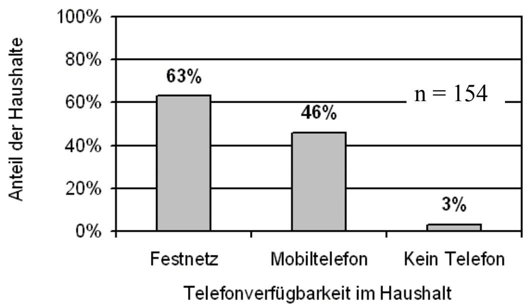


Abbildung 35: Verfügbarkeit von Telefonen in den untersuchten Haushalten in der Gemeinde Klaus a.d. Pyhrnbahn

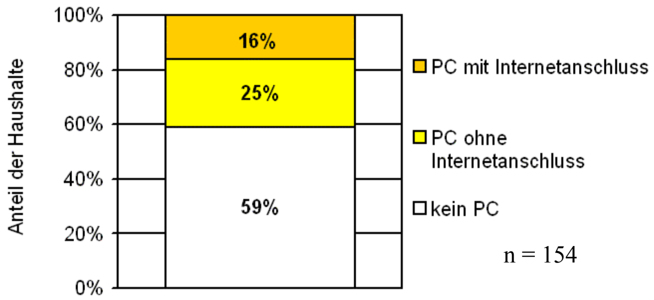


Abbildung 36: Verfügbarkeit von Computern und Internet in den untersuchten Haushalten in der Gemeinde Klaus a.d. Pyhrnbahn

Die vertieften Interviews mit den Fahrgästen und die Auswertung aller Fahrten, die im ersten Betriebsjahr durchgeführt wurden, ergaben, dass die Reservierung von Fahrten durch den Fahrgast fast ausschließlich telefonisch erfolgt und zumindest die älteren Fahrgäste auch keine andere Form der Kontaktaufnahme wünschen. Die telefonische Reservierung funktioniert in der Gemeinde Klaus a.d. Pyhrnbahn, einem kleinen Gebiet mit nicht zu großem Fahrtenaufkommen, ausgezeichnet (Tabelle 4). Von den befragten Fahrgästen wünschte sich nur eine einzige (junge) Person auch die Möglichkeit der Fahrtreservierung mittels SMS.

Tabelle 4: Zustimmung der befragten Fahrgäste des Dorfmobils Klaus an der Pyhrnbahn zum Betrieb des Dorfmobils [%]	sehr	eher schon	eher nicht	nicht

Das Angebot **Dorfmobil gefällt** mir gut.	**94%**	**6%**	0%	0%
Der **Preis von 1,50 €** ist angemessen.	**90%**	**10%**	0%	0%
Es stört mich nicht, dass sich meine **Fahrt durch andere zusteigende Fahrgäste verlängert**.	**98%**	**2%**	0%	0%
Ich bin mit der **Fahrzeugausstattung** zufrieden.	**100%**	0%	0%	0%
Das **Dorfmobil ist pünktlich.**	**92%**	**4%**	0%	**4%**
Ich komme mit den **Fahrern gut zurecht.**	**92%**	**8%**	0%	0%
Die **telefonische Vorbestellung** funktioniert gut.	**92%**	**4%**	0%	**4%**

3.2 Technikphobie?

Die Fähigkeit, technische Geräte zu bedienen, ist gerade bei der Gruppe der Senioren sehr unterschiedlich ausgeprägt, Internet ist hier kaum verfügbar. Selbst Mobiltelefonie wird oft gemieden. Einschalten, Pin-Eingabe, Telefonieren etc. sind für Ungeübte nicht zu unterschätzende Hürden. Dazu kommt, dass viele gängige Mobiltelefone für Senioren nicht benutzerfreundlich sind. Das Display spiegelt, zeigt zu kontrastschwache und zu kleine Buchstaben, die Tasten sind für Kinderfinger dimensioniert. Bei den geringsten technischen Problemen fallen die Geräte als Kommunikationsmedium aus: entladene Batterie, Klingelton zu leise oder irrtümlich ausgeschaltet usw. Es ist anzunehmen, dass die Gruppe der Senioren unter den Fahrgästen (vgl. Abbildung 34) auch das Internet selbst dann nicht nützt, wenn in ihrem Haushalt ein PC verfügbar ist. Dies wird sich in naher Zukunft ändern, wenn die heutigen Generationen an Mobiltelefon- und PC-Nutzern in diese Altersklassen vorgerückt sein werden. Erhebungen zu einem anderen Projekt in ARTS in einem ländlichen Gebiet Finnlands haben ergeben, dass dort bereits jetzt 34% der Haushalte mit PC samt Internetzugang ausgestattet sind. Gegenwärtig müssen Informationen z.B. über den Fahrplan und Kontaktaufnahme mit einer Buchungszentrale allerdings so einfach und zuverlässig wie möglich funktionieren.

Auch von der Fahrerseite konnten keine besonders aufwändig zu bedienenden technischen Geräte eingesetzt werden. In Klaus mussten einige der FahrerInnen im grundlegenden Umgang mit dem Mobiltelefon geschult werden. Vorschläge zur Verwendung eines PC oder eines Handheld Computers zur Verwaltung der Fahrtenbuchungen wurden teilweise mit stark abnehmender Bereitschaft zur Mitarbeit seitens einiger FahrerInnen beantwortet.

3.3 Technik auf die Bedürfnisse abstimmen

Erfahrungen aus einem anderen Projekt von ARTS haben gezeigt, dass großer technischer Aufwand nicht notwendigerweise Nutzen für die Fahrgäste bringt, zumindest aber genau auf deren Bedürfnisse abgestimmt werden muss. In Wales wurde mit großem Aufwand (€ 1,69 Mio.) ein System zur Echtzeit-Fahrplaninformation für einige Buslinien installiert. Zum Vergleich betrug das Budget für das Dorfmobil etwa € 22.000,- für das erste Betriebsjahr, mit Aufteilung der hohen Leasing-Anzahlung auf 3 Betriebsjahre nur ca. € 18.000,- pro Jahr. Der hohe Betrag des Systems in Wales beinhaltet ein Gesamtpaket mit Website, digitale Anzeigen an einigen wenigen Haltestellen, einen Server mit Sprachausgabe, die Kommunikationsgeräte in den Linienbussen, sowie Betriebskosten von etwa € 150.000,- pro Jahr. Mittels Internet, SMS, per Mobiltelefon oder über das Festnetz kann man den Server kontaktieren und unter Eingabe der Nummer einer Bushaltestelle die Auskunft erhalten, ob der Linienbus die gewählte Haltestelle pünktlich bzw. wie viel verspätet erreichen wird.

Das Projektsgebiet liegt im "Gwynedd county" nahe des Snowdonia Nationalparks. Es beinhaltet Küstenabschnitte und Touristenattraktionen (wie z.B. Burg Caernarfon), Landwirtschaft und Tourismus sind die Haupteinnahmequellen. Die installierte Echtzeit-Fahrplaninformation sollte auch den Tourismus fördern. Untersuchungen vor Einführung des Systems zur Echtzeit-Fahrplaninformation hatten bereits erbracht, dass die Fahrgäste der Busse den Nutzen des Systems realistischer einschätzten als die Betreiber (Abbildung 37).

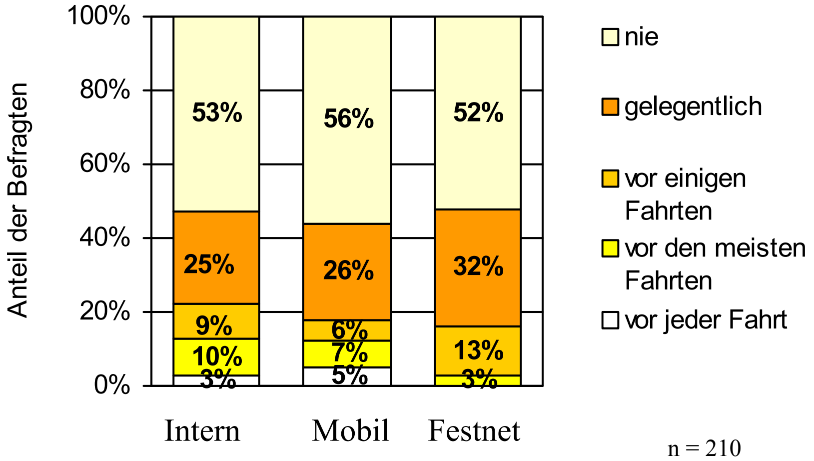


Abbildung 37: Antworten von Fahrgästen auf die Frage, ob und womit Sie Echtzeit-Fahrplaninformation in Anspruch nehmen würden (Befragung von Fahrgästen in Linienbussen vor Umsetzung des Projekts in Wales)

Auf die Frage nach möglichen Verbesserungen im Linienbusbetrieb kam der Wunsch nach Zugang zu Echtzeit-Fahrplaninformation von der Häufigkeit an siebenter Stelle, zwischen „komfortableren" und „sauberen Bussen" (Abbildung 38).

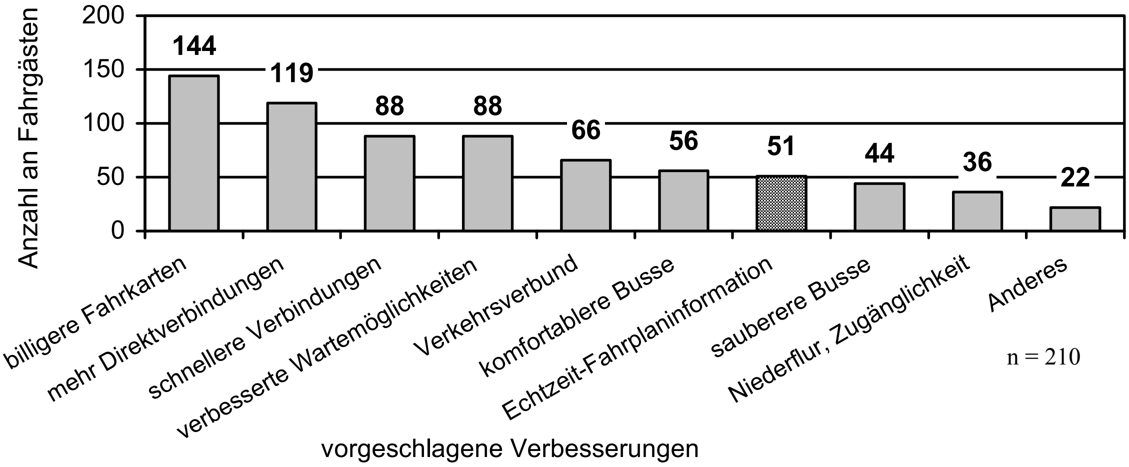


Abbildung 38: Verbesserungsvorschläge von Bus-Fahrgästen, Mehrfachnennungen, vorgegebene Antworten (Befragung von Fahrgästen in Linienbussen vor Umsetzung des Projekts in Wales)

Noch deutlicher brachten befragte Touristen (ebenfalls vor Umsetzung des Projekts in Wales) zum Ausdruck, dass sie viele andere Verbesserungen wesentlich mehr begrüßen würden als Echtzeit-Fahrplaninformation (Abbildung 39).

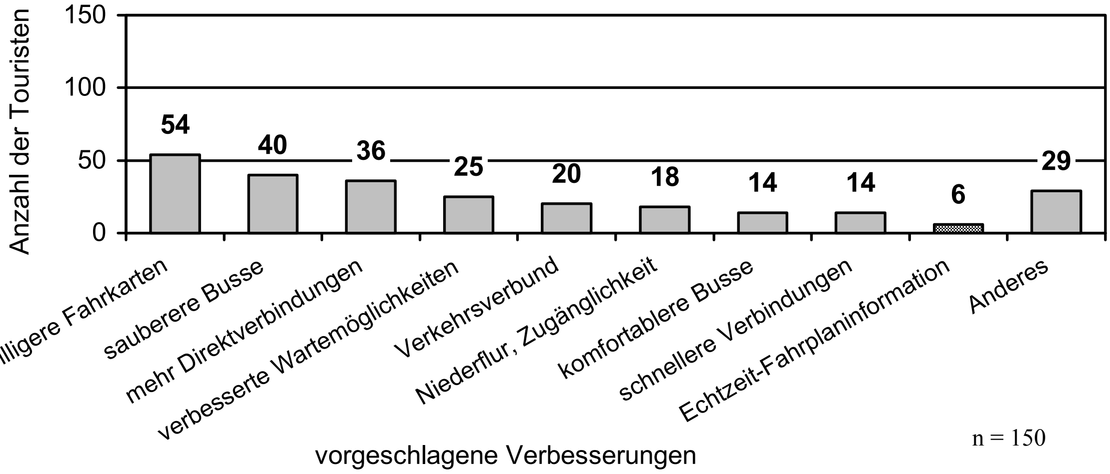


Abbildung 39: Verbesserungsvorschläge für den Linienbusbetrieb durch Touristen, Mehrfachnennungen, vorgegebene Antworten (Befragung von Touristen vor Umsetzung des Projekts in Wales)

Auswertungen nach Einführung der Echtzeit-Fahrplaninformation haben ergeben, dass die Busfahrgäste die Auskunftsmöglichkeiten via Internet und Telefon kaum genutzt haben (Abbildung 40). Von den befragten Touristen wussten 41% nicht, wie man SMS versendet oder empfängt, obwohl 95% ein Mobiltelefon besaßen oder verfügbar hatten (Abbildung 41f).

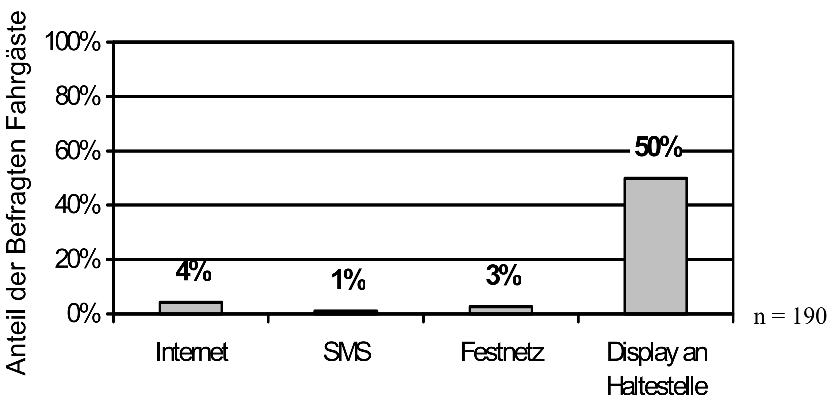


Abbildung 40: Anteile der Fahrgäste, welche Echtzeit-Fahrplaninformation in Anspruch genommen haben nach Methoden der Informationsgewinnung (Befragung von Fahrgästen in Linienbussen nach Umsetzung des Projekts in Wales 2003)

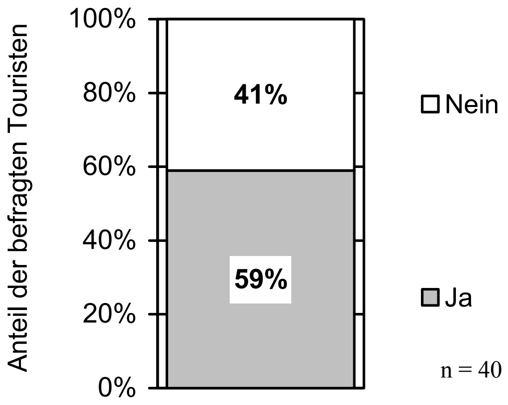


Abbildung 41: „Wissen Sie, wie man SMS sendet und empfängt?“ (Befragung von Touristen nach Umsetzung des Projekts in Wales 2003)

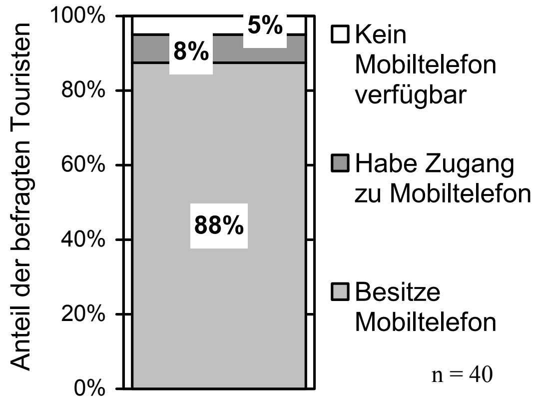


Abbildung 42: Touristen mit Zugang zu Mobiltelefonen (Befragung von Touristen nach Umsetzung des Projekts in Wales 2003)

Schlussfolgerungen Wales

Eine Nutzen-Kostenuntersuchung für das Projekt in Wales müsste eigentlich zu dem Ergebnis kommen, dass die Investitionen in die telematikgestützte Echtzeit-Fahrplaninformation für die Fahrgäste zu keinen messbaren Verbesserungen geführt haben. Die Displays an den Haltestellen wurden von 50% der Fahrgäste wahrgenommen, die Informationsmöglichkeiten über Telefon oder Internet wurden kaum verwendet. Das System wurde ohne Rücksicht auf die potentiellen Nutzer installiert, so wurde u.a. auch nicht untersucht, ob und wie viel die Bus-Kurse verspätet unterwegs sind. Es bleibt der Vorwurf, dass mit dem Geld tatsächliche Verbesserungen in der Bedienungsqualität des öffentlichen Verkehrs möglich gewesen wären, wie z.B. dichtere Intervalle oder besserer Komfort.

3.4 Telematikeinsatz für Folgeprojekte

Der bewusst sehr einfach organisierte Betrieb des Dorfmobils in Klaus a.d. Pyhrnbahn (FahrerIn mit Mobiltelefon ist gleichzeitig die Buchungszentrale) hat auch Nachteile, hauptsächlich Erschwernisse im Verwaltungsaufwand, Schreib- bzw. Auswertungs- und Buchhaltungsarbeiten, aber auch geringe Möglichkeiten zur Fahrtoptimierung:

Monatlich wird die Einteilung der FahrerInnen für den Folgemonat in einer Besprechung festgelegt.

Missbräuchliche Verwendung des Fahrzeugs z.B. für Privatfahrten könnte nur an Hand der niedergeschriebenen Fahrtkilometer nachgewiesen werden. Dies erfolgt inzwischen nur zu Tagesbeginn und –ende. Die beiden Kilometerstände für jede Fahrt zu notieren hat sich im praktischen Fahrtbetrieb als zu aufwändig erwiesen.

Monatlich werden die durchgeführten Fahrten abgerechnet und die wichtigsten Eckdaten archiviert.

Die wissenschaftliche Auswertung von Fahrtcharakteristika erfordert die händische Eingabe der Fahrtdaten.

Jede Fahrt muss vorgemerkt werden. Derzeit geschieht dies händisch auf einem eigenen Fahrtenblatt. Wenn für den Folgetag reserviert wird, kann so die Bestellung an den nächsten Fahrer weitergegeben werden.

Die Reservierung sollte mindestens eine halbe Stunde vor Antritt der gewünschten Fahrt erfolgen. Tatsächlich rufen viele Fahrgäste erst unmittelbar vor Fahrtantritt an. Da die FahrerInnen ihre Tätigkeit als sozialen Dienst an den Bewohnern der Gemeinde sehen, wird meist sofort gefahren, sofern keine andere Buchung vorliegt. Dadurch wird die Zusammenlegung von Fahrten erschwert (Abbildung 43f).

Nach erfolgter Fahrt wird dies ebenfalls auf dem bereits angelegten Fahrtenblatt vermerkt, ebenso die Anzahl der Fahrgäste, ob es sich um eine Sammelfahrt handelt, wie bezahlt wurde etc. Der Nachweis von Sammelfahrten ist besonders bei überschneidenden Fahrtrouten schwer möglich, da meist für jedes einzelne Fahrtziel ein eigenes Fahrtenblatt geführt wird.

Sammelfahrten sind die Voraussetzung für die finanzielle Förderung des Dorfmobils durch das Amt der Oberösterreichischen Landesregierung. Nur durch Sammelfahrten unterscheidet sich das Dorfmobil als öffentliches Verkehrsmittel von einem gewöhnlichen Taxi. Die FahrerInnen sind mit der Zusammenlegung von Fahrtwünschen zu Sammelfahrten bei durchschnittlich 10,5 Fahrten (maximal 25 Fahrten an einem Tag) überfordert. Aus den Daten der Fahrtenblätter ergibt sich ein mittlerer Fahrgast-Besetzungsgrad von 1,25 Fahrgästen pro Fahrt für das erste Betriebsjahr. Da in den Fahrtenblättern Sammelfahrten oft nicht vermerkt wurden, handelt es sich dabei um einen Mindestwert, stichprobenartig konnte ein Fahrgast-Besetzungsgrad von 1,5 Fahrgästen/Fahrt erhoben werden. Für eine typische Betriebswoche (01. bis 05.09.2003) wurden alle Fahrten nach Zusammenlegungsmöglichkeit ausgewertet. 7 Einkaufsfahrten von Pensionisten und Freizeitfahrten von Jugendlichen, die an keine bestimmte Uhrzeit gebunden sind, wären ohne Probleme mit anderen Fahrten zusammenzulegen. Es handelt sich dabei um ca. 10% aller Fahrten bzw. ein bis zwei Fahrten pro Tag. Der Fahrgast-Besetzungsgrad würde von 1,25 auf ca. 1,7 ansteigen und es könnten Betriebskosten von ca. € 30 pro Monat eingespart werden.

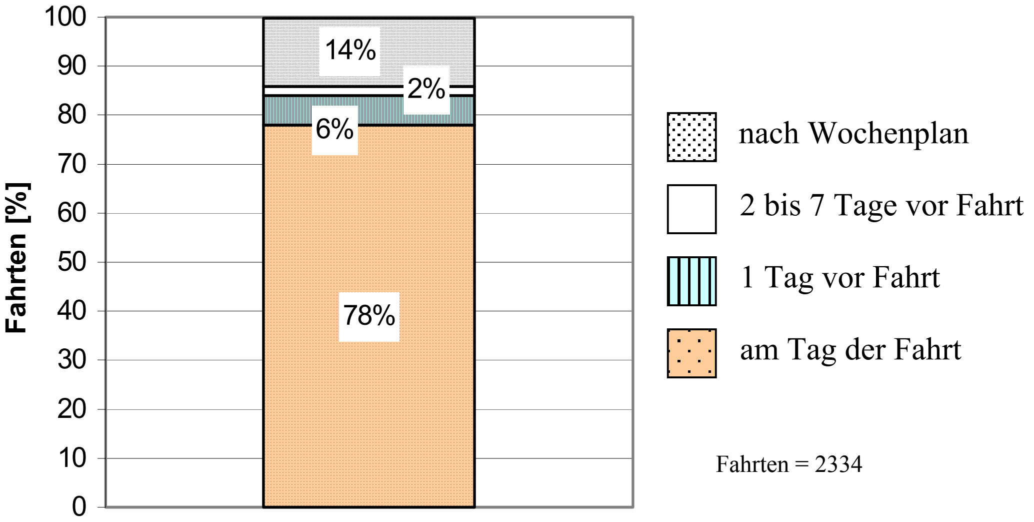


Abbildung 43: Zeitpunkt der Reservierung von Fahrten mit dem Dorfmobil

Nur 8% der Fahrten werden einen Tag oder länger vorher reserviert, 14% der Fahrten sind Zubringerdienste zu öffentlichen Verkehrsmitteln für Schüler, die regelmäßig bzw. nach Stundenplan erfolgen (Abbildung 43). Die Mehrzahl der Fahrten wird kurzfristig reserviert, 69% werden maximal 2 Stunden vor Fahrtantritt angefordert, bei 16% wird unmittelbar nach Anruf gefahren (Abbildung 44).

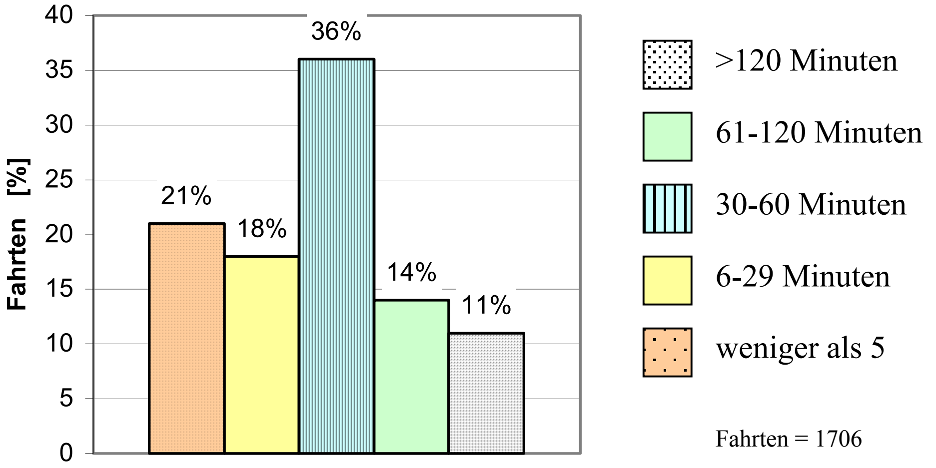


Abbildung 44: Reservierungszeitpunkt vor Fahrtantritt von jenen Fahrten des Dorfmobils, die am Tag der Vorbestellung durchgeführt werden

Wenn Telematikeinsatz den Betrieb des Dorfmobils in Klaus a.d. Pyhrnbahn erleichtern soll, wären folgende Verbesserungen wünschenswert:

Automatische Registrierung des Fahrers / der Fahrerin z.B. mittels Chipkarte;

Automatische Registrierung und Abrechnung von regelmäßigen Fahrgästen (Mitgliedern des Vereins) z.B. mittels Chipkarte;

Automatische Abrechnung der gefahrenen Kilometer und Auswertemöglichkeit von Fahrten mittels GPS-Koordinaten, gleichzeitig einfache Kontrollmöglichkeit, um missbräuchliche Verwendung des Dorfmobil(fahrzeugs) auszuschließen;

Motivation zu frühzeitiger Buchung etwa durch Zuerkennung eines Frühbucherbonusses durch eine Buchungszentrale;

Zusammenfassen eines höheren Anteils an Fahrten zu Sammelfahrten durch eine Buchungszentrale. Je früher gebucht wird, desto einfacher lässt sich dies bewerkstelligen.

4. SCHLUSSFOLGERUNGEN

Aus den Erfahrungen der Forschungsprojekte MOVE und ARTS, insbesondere aus dem Probebetrieb in Wales und dem nun bereits länger als drei Jahre andauernden Betrieb des Dorfmobils in Klaus a.d. Pyhrnbahn, lassen sich folgende Thesen formulieren:

Um erfolgreich zu sein, ist das Angebot im bedarfsgesteuerten öffentlichen Verkehr unbedingt auf die Bedürfnisse der Nutzer abzustimmen.

Telematikeinsatz hat eine unterstützende Funktion und darf nicht als Selbstzweck betrieben werden, außer es soll die Funktionstüchtigkeit im praktischen Einsatz erprobt werden.

Telematikeinsatz sollte im Hintergrund und möglichst vollautomatisch erfolgen. Derzeit kann von Fahrgästen nicht die Bedienung von Pocket-PCs oder PDAs erwartet werden. Die einfache Bestätigung von Eingabeaufforderungen („Knopf drücken") ist bereits eine hohe Anforderung.

Kontrolle der durchgeführten Fahrten sowie sonstiger Vorgänge durch eine befugte Instanz (Fahrtenzentrale, Auftraggeber etc.) sollte für gute Informationsweitergabe an die Fahrgäste möglichst online erfolgen, Abrechnung muss durch die Speicherung relevanter Daten möglich sein.

Für die Verkehrswissenschaft ist das Sammeln von standardisierten Daten zur Informationsgewinnung über Vorgänge im öffentlichen Verkehr äußerst wünschenswert.

Die Datenschutzrichtlinien sind selbstverständlich einzuhalten.

5. QUELLEN

ARTS-Consortium (2004a) Deliverable 5: Evaluation and transferability of results. Funded by the European Community under the 'Competitive and Sustainable Growth' programme (1998-2002). http://www.rural-transport.net

ARTS-Konsortium (2004b) Öffentlicher Personennahverkehr im ländlichen Raum - Handbuch. Fünftes Forschungsrahmenprogramm der Europäischen Union - Wettbewerbsorientiertes und nachhaltiges Wachstum. http://www.rural-transport.net

Land Oberösterreich (09.01.2006) http://www.land-oberoesterreich.gv.at/cps/rde/xchg/SID-3DCFCFC3-8723A06D/ooe/hs.xsl/36978_DEU_HTML.htm

Lantzberg, R. (2005) Das „Dorfmobil" in der Gemeinde Klaus / Pyhrnbahn in OÖ – Erstes Betriebsjahr. Diplomarbeit am Institut für Verkehrswesen der Universität für Bodenkultur, Wien.

Mair, G. (2003) Alternativer Öffentlicher Verkehr – Ein Dorfmobil für die Gemeinde Klaus / Pyhrnbahn in OÖ. Diplomarbeit am Institut für Verkehrswesen der Universität für Bodenkultur, Wien.

Sammer, G., Meschik, M., Meth, D., Weber, G., Kofler, T., Wagner, H. (2000) MOVE - Mobilitäts- und Versorgungserfordernisse im strukturschwachen ländlichen Raum als Folge des Strukturwandels - 1. Zwischenbericht. Institut für Verkehrswesen, Institut für Raumplanung und Ländliche Neuordnung. Universität für Bodenkultur. Wien. http://www.boku.ac.at/verkehr/move.htm

Sammer, G., Meschik, M., Meth, D., Weber, G., Kofler, T., Wagner, H. (2003) MOVE - Mobilitäts- und Versorgungserfordernisse im strukturschwachen ländlichen Raum als Folge des Strukturwandels. Untersuchungsgebiet Klaus – Windischgarsten. Schlußbericht. Institut für Verkehrswesen, Institut für Raumplanung und Ländliche Neuordnung. Universität für Bodenkultur. Wien. http://www.boku.ac.at/verkehr/move.htm

Modellierung und Verwaltung von U-Bahnanlagen im Rahmen des digitalen 3D Stadtmodells

Gerald FORKERT

(Dr. Gerald Forkert, Geodata IT GmbH, Hütteldorferstraße 85, 1150 Wien, forkert@geodata.at)

1. EINLEITUNG

Die unterirdischen U-Bahn-Bauwerke der Wiener Linien werden in Zukunft gemeinsam mit dem digitalen Stadtmodell 3dimensional aufbereitet, in einer zentralen 3D-Datenbank des Magistrats Wien verwaltet und verschiedenen Anwendern in der Stadt zugänglich gemacht. Zu diesem Zweck wurde das bei der Stadt Wien eingesetzte Stadtmodellierungssystem CityGRID für unterirdische Anlagen erweitert. Zusätzlich wurden Schnittstellen für die 3D Visualisierung und Analyse im Rahmen des kommunalen Geoinformationssystems ArcGIS geschaffen. Die 3D Modellierung der U-Bahnanlagen erfolgt bei den älteren Linien anhand der analogen Pläne, bei den neuen Linien anhand der digitalen Planungsdaten.

Durch die Integration der U-Bahnbauwerke wird das 3D Stadtmodell nun zusätzlich für Anwendungen der Verkehrsbetriebe, für den Katastrophenschutz und für den Leitungskataster nutzbar.

Die in diesem Beitrag beschriebene Lösung wurde im Rahmen des Softwarepakets CityGRID realisiert und erprobt und kann somit auch in anderen Städten eingesetzt werden.

2. AUFBAU, VERWALTUNG UND NUTZUNG DES 3D STADTMODELLS

2.1 Das Stadtmodell als 3D Geoinformation

In diesem Beitrag beziehen wir uns auf das 3D Stadtmodell im Sinne eines dauerhaft gepflegten und aktuell gehaltenen Geo-Datensatzes. Um die dafür erforderliche Finanzierung langfristig sichern zu können, müssen möglichst viele Anwnedungen mit 3D Informationen unterstützt werden. In Wien, wie auch in den meisten anderen Großstädten zählen die Stadtplanung und der Lärmschutz zu den Hauptnutzern die entscheidend zur Finanzierung beitragen. Mit der in diesem Beitrag vorgestellten Integration unterirdischer Anlagen wird das 3D Stadtmodell auch zur wertvollen Informationsquelle für den Leitungskataster, den Katastrophenschutz und für die öffentlichen Verkehrsbetriebe.

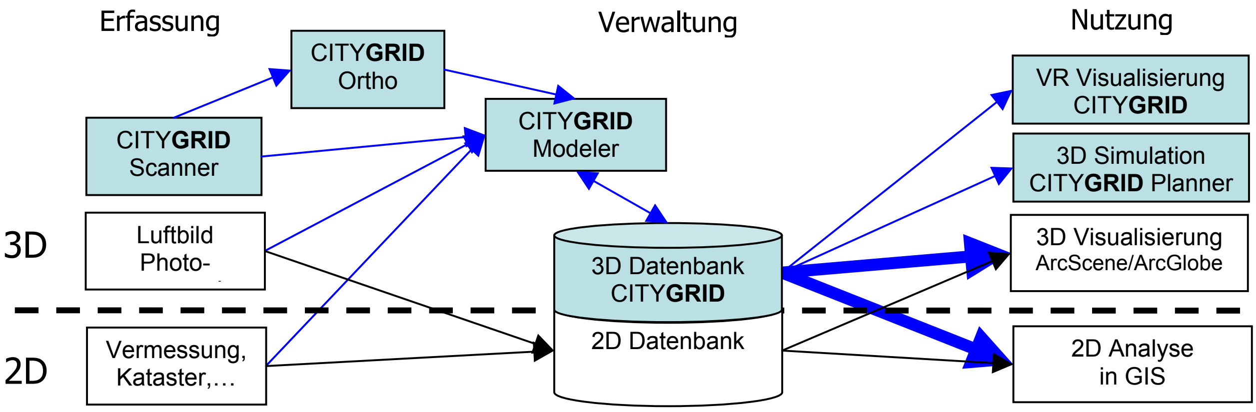


Abb. 1: Ausbau des vorhandenen 2D GIS zu einem 3D Informationssystem mit Hilfe von CityGRID

2.2 Linienorientierte 3D Modellierung

Mit dem System CityGRID ist es nun möglich, das 3D Stadtmodell auf effiziente Art unter größtmöglicher Nutzung vorhandener Geodaten zu erstellen. Dabei hat sich besonders das Prinzip der Modellierung nach Objektlinien bewährt, da strukturierte Linieninformation einerseits direkt vermessen werden kann und andererseits die für die 3D Modellierung erforderliche Information beinhaltet. Das „Herzstück" von CityGRID ist daher der mächtige Triangulationsalgorithmus.

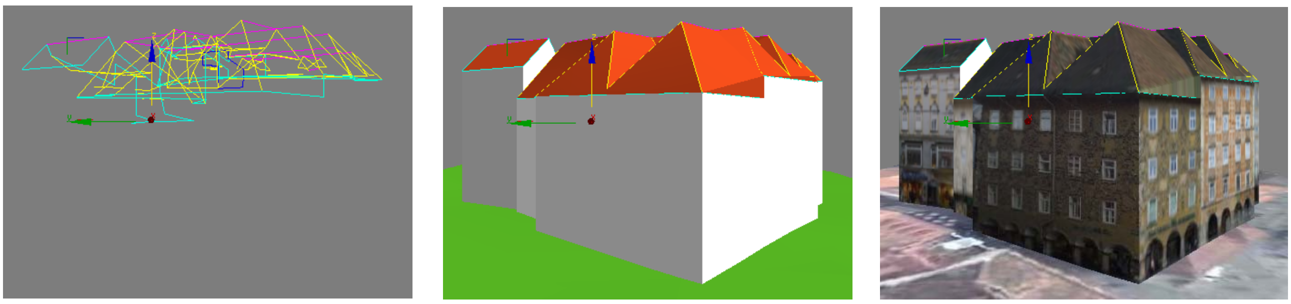


Abb. 2: gemessene Dachlinien (links), trianguliertes Flächenmodell (Mitte), Texturierung (rechts) mit dem CityGRID Modeler

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

2.3 Datenbank gestützte Verwaltung

Als Voraussetzung für die Aktualisierbarkeit muss das Stadtmodell in einer 3D Datenbank geführt werden. Auch hier bietet der linienorientierte Ansatz aufgrund seiner sehr kompakten Beschreibung der 3D Geometrie große Vorteile.

Die Nutzung des 3D Stadtmodells durch die oben angeführten „Fachanwender" erfolgt konsequenterweise im GIS. Mit Hilfe von CityGRID kann aus der aktualisierbaren linienorientierten 3D Datenbank eine GIS kompatible Datenbasis abgeleitet werden. Dabei wird speziell auch die 3D Fähigkeit der ArcGIS Extension 3D Analyst genutzt, die es ermöglicht, das 3D Stadtmodell verlustfrei im GIS darzustellen.

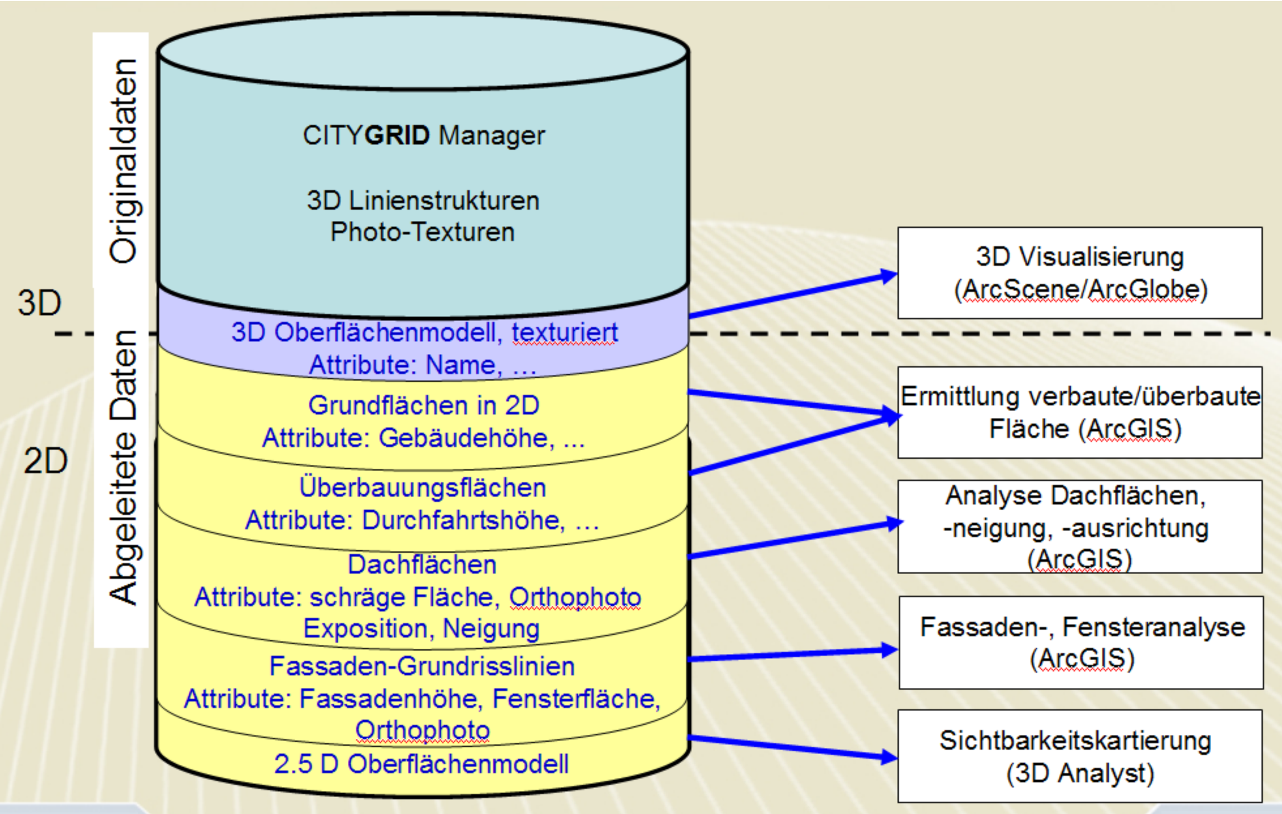


Abb. 3: Ableitung von GIS Themen aus der original 3D Datenbank des CityGRID Manager

3. U-BAHNANLAGEN IM STADTMODELL

3.1 Modellierung unterirdischer Bauwerke

CityGRID unterstützt die rasche Modellierung unterirdischer Bauwerke aus Konstruktionsplänen, egal ob diese analog oder digital vorhanden sind. Bei Papierplänen hat es sich als besonders effizient erwiesen direkt die Strukturlinien zu digitalisieren und mit Hilfe von Längs- und Querschnitten die 3. Dimension anzugeben. Beim vorliegen digitaler Planungsdaten besteht die Möglichkeit, auf Wunsch CAD Körper der baulichen Objekte zu bilden und daraus automatisch die Linienstruktur abzuleiten. Bei Verfügbarkeit des CityGRID Modeler im Planungsbüro ist aber auch im Falle digitaler Planungsdaten die direkte Ermittlung der 3D Strukturlinien der weitaus schnellere Weg. Aus den Strukturlinien lässt sich mit CityGRID automatisch das 3D Flächenmodell bilden.

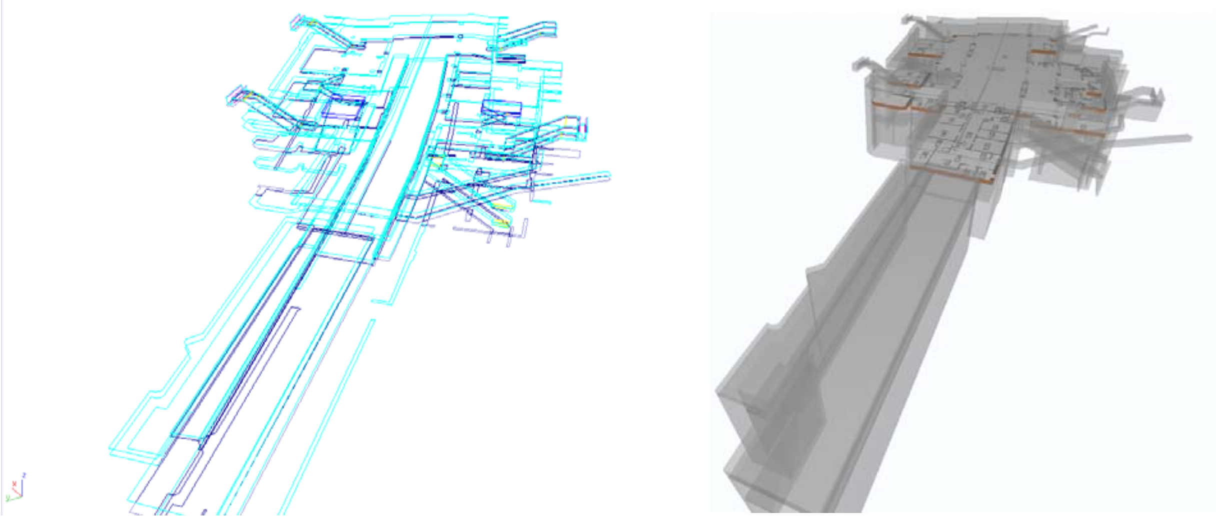


Abb. 4: digitalisierte 3D Strukturlinien (links), automatisch abgeleitetes 3D Modell mit aufgemappten Geschoßplan (rechts)

3.2 Nutzungs unterirdischer Bauwerke im Rahmen des GIS

Im Falle der Wiener U-Bahn sollte die 3D Modellierung zunächst nur die äußere Hülle umfassen. Dies war die Anforderung aus dem Leitungskataster um bei der Projektierung neuer Leitungen optimale Trassenverläufe bei der Querung von U-Bahnanlagen ermitteln zu können. Es hat sich jedoch sehr schnell herausgestellt, das beim direkten Digitalisieren der 3D Strukturlinien mit geringem Mehraufwand auch die relevante innere Struktur der U-Bahnanlagen berücksichtigt werden kann. Auf diese Art können nun auch sicherheitsrelevante Fragen, z.B. „wie gelange ich am schnellsten zu dem Ort an dem der Feuermelder X aktiviert wurde?" wesentlich schneller als bisher beantwortet werden. Auch hier hat sich das bereits beim oberirdischen Stadtmodell erprobte Konzept bewährt, die U-Bahnanlagen in 3D zu erstellen und zu aktualisieren, im GIS in 3D zu visualisieren und in 2D zu analysieren.

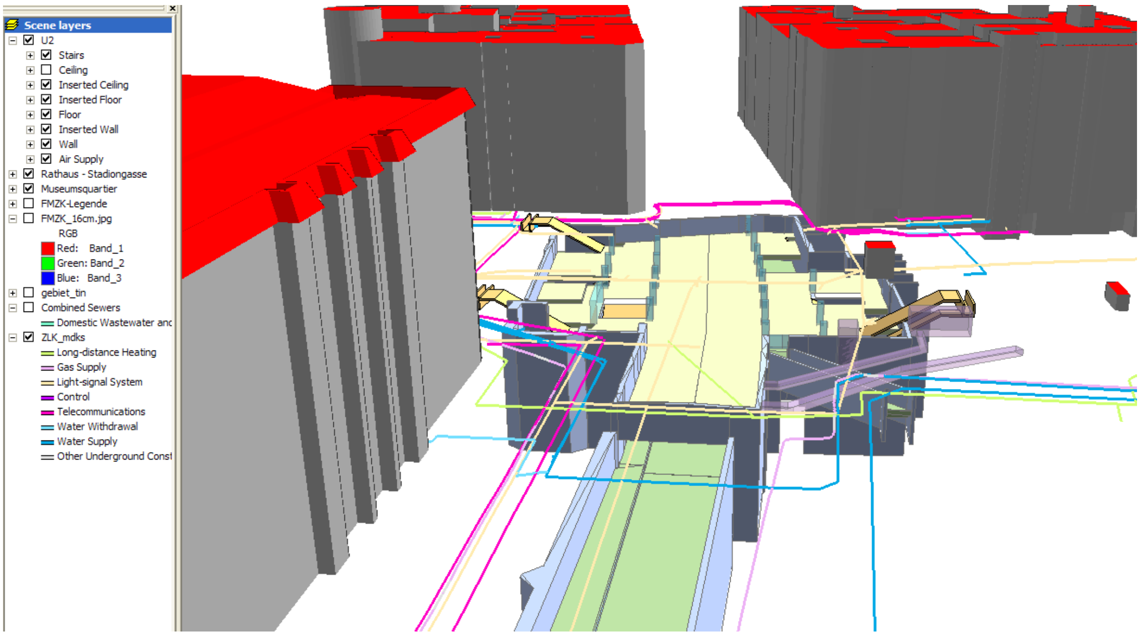


Abb. 5: 3D Visualisierung der U-Bahnanlagen (generiert mit CityGRID) gemeinsam mit vorhandenen GIS Themen (z.B. vom Leitungskataster) in ArcGIS, Modul ArcScene/

4. STATUS UND AUSBLICK

Die in diesem Betrag beschriebenen Erweiterungen von CityGRID für den Export nach ArcGIS einerseits und die Modellierung von unterirdischen Bauwerken andererseits wurden im Jahr 2005 umgesetzt und bei der Stadt Wien implementiert. In der Pilotphase wurden auch schon ca. 6 Kilometer U-Bahnlinien modelliert, inklusive 3 komplexe, mehrgeschossige Knotenstationen. Für die Wienstrom GmbH wurde eine ca. 6km lange unterirdische 380KV Leitung modelliert und ins 3D Stadtmodell integriert. Stichprobenartige Kontrollen haben ergeben, dass die absolute Genauigkeit der aus Konstruktionsplänen erstellten Modelle im dm-Bereich liegt.

Im Jahr 2006 werden sich auch jene Planungsbüros, die mit der Projektierung neuer U-Bahnlinien beauftragt sind, an der 3D Modellierung beteiligen. Die nach den Anforderungen des Leitungskatasters erstellten 3D Modelle werden durch die Magistratsabteilung 14 (EDV) in der zentralen 3D Datenbank der Stadt Wien verwaltet und sind so für weitere Anwendergruppen der Stadt nutzbar. Interesse an der Nutzung dieser Daten gibt es bereits von seiten der Wiener Verkehrsbetriebe und der Feuerwehr.

Weitere Informationen zu diesem Thema finden sich auch auf http://www.citygrid.at

Regionalisierte Büroflächenbedarfsprognosen unter Verwendung von Büroflächen-GIS

Gerhard STEINEBACH, Christian VON MALOTTKI

(Prof. Dr.-Ing. Gerhard Steinebach, TU Kaiserslautern, Lehrstuhl Stadtplanung, steineb@rhrk.uni-kl.de
Dipl.-Ing. Christian v. Malottki, TU Kaiserslautern, Internationales Graduiertenkolleg „Visualisierung großer unstrukturierter Datenmengen“, malottki@rhrk.uni-kl.de)

1. ABSTRACT / ZUSAMMENFASSUNG

Im vorliegenden Artikel wird zunächst der Nutzen von Büroflächenbedarfsprognosen zur Abschätzung von Leerstandsrisiken und zur planerischen Flächenvorsorge dargestellt. Methodische Unterschiede bestehen zwischen planerisch orientierten deutschen Büroflächenbedarfsprognosen, die hypothetische Versorgungsstände mit detaillierten Bestandsaufnahmen abgleichen und hieraus den Flächenbedarf ableiten, und ökonomisch geprägten angloamerikanischen Modellen, die den Flächenmarkt und seine Zyklen modellieren. Die Ansätze lassen sich verknüpfen. In jedem Fall sind hierzu jedoch umfangreiche Eingangsdaten notwendig, die sowohl geographische als auch sachliche Informationen enthalten. Eine Datenhaltung und Fortschreibung in einem Geoinformationssystem bietet sich hierzu an, wobei dadurch auch Daten für interessante Forschungsfragestellungen bezüglich des Verhaltens unterschiedlicher Teilmärkte zur Verfügung stehen würden. Der Artikel zeigt die für ein derartiges System notwendigen Daten und schließt mit einem Ausblick auf mögliche Kombinationsnutzungen unter Integration von 3D-Stadtmodellen oder interaktiven Standortsuchdatenbanken

2. AUFGABE VON BÜROFLÄCHENBEDARFSPROGNOSEN

Der Büroflächenmarkt ist derzeit vor allem durch die extremen Flächenüberangebote in den Schlagzeilen. Schwankungen von Angebot und Nachfrage treten dabei insbesondere in den großen Dienstleistungsmetropolen auf. Grund hierfür ist die große Zahl von Einzelakteuren, die ohne vertieftes Wissen um die Marktlage und die Konkurrenzprojekte nach Fertigstellung spekulativ Immobilien entwickeln (vgl. Dobberstein 2000). Hinzu kommen Sonderentwicklungen wie in Ostdeutschland, wo angesichts steuerlicher Vorteile Neubauten weit über den Bedarf hinaus entwickelt wurden und somit bspw. in Leipzig und Dresden Leerstandsquoten von bis zu 30 % erreicht wurden (vgl. Pelzl 1998). Die Leerstände allein der neun größten deutschen Bürometropolen summierten sich im Jahr 2004 zusammen auf knapp zehn Millionen Quadratmeter Mietfläche. Dies ergibt jährliche Mietausfälle für Investoren von über einer Milliarde €. Für die Städte verursachen die starken Marktschwankungen über längere Zeiträume Brachen, wobei kostspielige Infrastruktur vielfach bereits vorgehalten werden muss und die Brachflächen das städtebauliche Erscheinungsbild beeinträchtigen.

In kleineren Städten ist der Markt für Büroimmobilien noch intransparenter als in den großen Dienstleistungsmetropolen. Hier haben sich vielfach noch keine richtigen Büromietmärkte ausgebildet, das Projektentwicklungsgeschehen ist von Eigennutzern oder nicht-spekulativen Projektentwicklungen für konkrete Nutzer geprägt. Dadurch sind die Märkte weniger volatil. Allerdings führt das niedrige Mietpreisniveau oft dazu, dass sich die Renovierung bzw. das so genannte refurbishment funktional veralteter Bürogebäude der 50er, 60er und 70er Jahre nicht mehr lohnt. Da Konkurrenzentwicklungen mangels attraktiver Bürocluster vielfach in besser erreichbaren Randlagen entstehen (vgl. Dobberstein 2004) führt dies zu einem nicht mehr nutzbaren Sockelleerstand (vgl. Scheffler 2004). Gerade in zentralen und stadtbildprägenden Lagen hat diese Form des Leerstandes städtebauliche Folgen, die sich negativ auf das Stadtimage, die Attraktivität des Zentrums, das Stadtmarketing sowie die Ansiedlungsbemühungen neuer Unternehmen auswirken.

Während in der Vergangenheit der Bedarf und die Inanspruchnahme von Büroflächen kontinuierlich gewachsen sind (vgl. von Einem / Tonndorf 1990), mehren sich in Deutschland inzwischen die Anzeichen, die von einem verlangsamten Wachstum, einer Stagnation oder sogar einem Rückgang der mittel- bzw. langfristigen Inanspruchnahme von Büroflächen ausgeht. Als Gründe hierfür kommen in Frage:

- Die Zahl der Bürobeschäftigten nimmt ab, da globalisierungsbedingt Dienstleistungsarbeitsplätze ins Ausland verlagert werden, gleichzeitig aber auch der Strukturwandel mit seiner Verschiebung von Nichtbüro- zu Büroarbeitsplätzen an Schwung verliert.
- Die Zahl der Bürobeschäftigten nimmt ab, da bedingt durch den demographischen Wandel dem Arbeitsmarkt ab 2020 ein zu geringes Erwerbspersonenpotenzial zur Verfügung steht und die Arbeitgeber auf die Arbeitsmarktengpässe mit Rationalisierung und Verlagerung der dann teurer werdenden Arbeit antworten werden.
- Die Flächenkennziffer, also die jedem Bürobeschäftigten zur Verfügung stehende Bürofläche, ist nach den massiven Anstiegen der Vergangenheit eine unsichere Größe. Während eine Verknappung des Arbeitsangebotes eher für die Ausweitung attraktiver Arbeitsumgebungen spricht, ergeben sich Rationalisierungsmöglichkeiten – u. a. auch durch das derzeitige Nischenprodukt *desk sharing* – welche die Büroflächenkennziffer in Deutschland auf ein Niveau senken könnte, welches aus teuren ausländischen Metropolen wie London, Tokio oder New York bekannt ist.

Der wesentliche Faktor für die Büroflächennachfrage liegt zudem in der Entwicklung des wirtschaftlichen Wachstums, da dieses – nachfrageseitig beeinflusst von Faktoren wie dem demographischen Wandel – im wesentlichen die Nachfrage nach Arbeit und somit die Notwendigkeit von Büroflächen begründet.

Angesichts dieser steigenden langfristigen Unsicherheiten kann nicht mehr davon ausgegangen werden, dass Überkapazitäten lediglich aufgrund der zyklischen Marktschwankungen entstehen und wie bislang innerhalb des nächsten Zyklus abgebaut werden. Dabei kursieren Schlagworte wie „Rentner fragen keine Büroflächen nach“ (Simons 1999) oder die Aussage, dass jeder bis 2050 in Ostdeutschland benötigte Quadratmeter Bürofläche bereits gebaut ist (vgl. Just 2005). Alles in allem steigen im Büroflächenmarkt die Risiken für Entwickler, Banken, Investoren und Kommunen.

Solche pauschalen Aussagen sind im vorliegenden Zusammenhang zu präzisieren . Zunächst erfordern die zunehmenden Unsicherheiten eine verbesserte Standort- und Marktforschung, damit der Informationsgrad der Marktteilnehmer standort- und produktbezogen erhöht wird. Banken und Investoren können so konkreter das Leerstandsrisiko von Investments in Bestands- und Neubauten einschätzen. Für Stadtplanung und Wirtschaftsförderung stellt sich die Frage nach dem Bedarf für Flächen / Neubauten sowie nach dem Risiko von Fehlentwicklungen in der Stadtentwicklungs- oder Flächennutzungsplanung bzw. bei großflächigen Projekten wie Flächenrevitalisierungen und Konversionsvorhaben.

Für alle Akteure ist somit wichtig, dass der Büroimmobilienmarkt zunehmend von Forschung, Kommunen und Research-Abteilungen der Immobilienwirtschaft beobachtet wird. Detailliertere Büromarktprognosen finden in Deutschland derzeit jedoch fast ausschließlich für die Bürohochburgen Frankfurt, Berlin, Hamburg, Düsseldorf und München statt.

Standortunabhängig bestehen die folgenden Forschungs- und Entwicklungsherausforderungen:

- Quantifizierbare Informationen sind auch bei großen Unsicherheiten besser als rein qualitative Trendaussagen. Dabei addieren sich jedoch Unsicherheiten, die bereits in den Eingangsdaten enthalten sind, zu den Prognoseunsicherheiten, die besonders bei langfristigen Zielhorizonten immer höher werden. Gerade bei längerfristigen Entwicklungen begibt sich eine Prognose schnell auf dünnes Eis.
- Für regional entscheidende Projektentwickler, Investoren, Banken, Stadtplaner und Wirtschaftsförderer liegt gerade in der Regionalisierung von Prognosen der entscheidende Mehrwert gegenüber der allgemeinen Bestimmung von Trends. Hierbei entstehen zusätzliche Anforderungen an die Genauigkeit von Eingangsdaten.

Notwendige Verbesserungen in der Büroflächenbedarfsprognostik laufen deshalb v. a. in zwei Richtungen:

- Zum Einen müssen die Prognoseverfahren selbst weiterentwickelt werden. Dabei können überschlägige Berechnungen anhand von Annahmen zu wichtigen Einflussgrößen durch statistische Verfahren ersetzt oder angereichert werden. Ein kurzer Überblick hierzu wird in Kapitel 3 gegeben.
- Zum Anderen muss die Qualität der Eingangsdaten verbessert werden. Da Büroflächenanalysen nicht durch statistische Angaben wie die Wohnbaustatistik oder die Handels- und Gaststättenzählung unterstützt werden, existieren lediglich heterogene und unvollständige Datenquellen bei Einzelakteuren, obwohl das Thema eigentlich eine GIS-gestützte Datenhaltung verlangt. Ansätze und Vorschläge hierzu folgen in Kapitel 4.

3. GESAMTSTÄDTISCHE MODELLRECHNUNGEN UND IHRE EINGANGSDATEN

Modellrechungen zum Flächenbedarf haben in der raumbezogenen Planung eine längere Tradition. Dabei ist zu berücksichtigen, dass nach einem Prognose- und Quantifizierungsboom in den 60er Jahren, als die Zukunft eine berechenbare Größe schien, eine gewisse Ernüchterung eintrat, die Platz gab für eher vorsichtige Zukunftsabschätzungen mithilfe von Szenarien oder qualitativen Verfahren (vgl. Akademie für Raumforschung und Landesplanung 1998, 113 ff.). Dies soll jedoch nicht eine Begründung dafür liefern , dass man angesichts unklarer Zukunftsentwicklungen und planerischer Handlungspotenziale auf quantitative Prognosen verzichten sollte oder könnte. In diesem Kontext ist der Begriff der Prognosen aber weiter gefasst zu verstehen, so dass verschiedene quantitative Szenarien und Modellrechnungen unter Variation von Einzelparametern und ihren möglichen Entwicklungen integriert werden können.

Im deutschsprachigen Raum wurden dabei insbesondere in der Wohnungsmarktprognose zahlreiche wissenschaftliche Arbeiten (vgl. z.B. Voß 1998) und praxisnahe Modellrechungen (vgl. z.B. Bundesamt für Bauwesen und Raumordnung 2001; Pestel-Institut 2003) durchgeführt. Dabei lässt sich das Vorgehen nur bedingt übertragen: Während bei Wohnflächenbedarfsprognosen meist auf der Basis von Haushalten gearbeitet wird, ist die Betrachtungseinheit beim Büroflächenbedarf der einzelne Bürobeschäftigte (also derjenige Beschäftigte, der einen Arbeitsplatz in einer marktfähigen Bürofläche belegt).

In Deutschland veröffentlichte Studien, die eher einen planerischen oder geographischen Hintergrund besitzen und meist für öffentliche Auftraggeber erstellt wurden, setzen stabile Marktgleichgewichte voraus. Dabei wird davon ausgegangen, dass Angebot und Nachfrage auf dem Büroflächenmarkt gleich sind und mittelfristig genau diejenige Menge gebaut wird, die als Bedarf (definiert als hypothetischer Versorgungsstand) auch benötigt wird. Nicht mehr marktfähige Büroflächen werden ebenso wie abgerissene Gebäude aus der Berechnung herausgenommen. Die Fragestellung lautet: Welche Fläche wird für die zu erwartenden Nutzer benötigt?

Grundsätzlich entsteht Büroflächenbedarf aus drei Gründen:

- Die Zahl der Bürobeschäftigten steigt.
- Die Höhe der von jedem Beschäftigten verbrauchten Flächen (die so genannte Flächenkennziffer steigt)
- Vom Markt genommene Büroflächen erzeugen einen Ersatzbedarf.

Der Bedarf zum Zeitpunkt t+x errechnet sich dann durch folgende Formel:

(1) $BED_{t+x} = BB_{t+x} * FKZ_{t+x} - [BEST_t - (ABG_t + ABG_{t+1} + \ldots + ABG_{t+x})]$

BED: Bedarf; BB: Bürobeschäftigte; FKZ: Flächenkennziffer; ABG: Abgänge (Abriß + struktureller Leerstand); BEST = Flächenbestand; t: aktuelle Periode; t+x: Prognosehorizont

In einem Folgeschritt kann der Bedarf mittels Datensätzen aus der Vergangenheit oder Plausibilitätsannahmen auf verschiedene Unternehmenstypen, Mikrostandorte oder Gebäudetypen aufgespaltet werden (vgl. z.B. Senatsverwaltung für Stadtentwicklung Berlin 2001).

Der Vorteil dieser Methodik besteht darin, dass sich alle zukünftigen Entwicklungen im Modell abbilden lassen, da ein Zukunftstrend entweder Einfluss hat auf einen der Faktoren, oder für die quantitative (nicht aber die standörtliche) Entwicklung des Büroflächenbedarfes nicht ausschlaggebend ist.

Der Nachteil besteht darin, dass die Änderungen insbesondere bei Beschäftigtenzahl und Flächenkennziffer sich nur schwer quantitativ abschätzen lassen. Während bei der Schätzung der Bürobeschäftigung noch auf Arbeitsmarktprognosen zurückgegriffen werden kann, beruht die Fortschreibung der Flächenkennziffer auf Annahmen. Dabei ändern sich die beiden Größen im Zeitablauf auf verschiedene Art und Weise:

- Durch längerfristige kontinuierliche Entwicklungen: Z.B. sorgte die Tertiärisierung bisher für eine Steigerung, der demographische Wandel zukünftig wohl für ein Absinken der Bürobeschäftigten (für einen Überblick über die Trends und ihre Einflussfaktoren siehe v. Malottki 2003). Wie sich ein insgesamt negativer Bedarf dennoch auf einen vielleicht positiven Flächenbedarf im Teilsegment Neubau oder *refurbishment* auswirkt, ist weitestgehend unerforscht, zumal die Zahl der Städte mit bereits jetzt zurückgehenden Bürobeschäftigtenzahlen gering ist (ein Beispiel ist Ludwigshafen).
- Durch die zyklische Entwicklung auf dem Büroflächenmarkt: Z.B. schwankt die Flächenkennziffer in Abhängigkeit von der Marktlage – sie steigt bei schlechter Konjunktur, da dann die Betriebe entlassen, aber nach wie vor Mieter ihrer Büroflächen bleiben.

In der Praxis ist die obige Formel v. a. dann sinnvoll einzusetzen, wenn Zukunftsentwicklungen zyklenbereinigt (d.h. mittel- bis langfristig) prognostiziert werden. Zyklische Schwankungen könnte sie nur dann sinnvoll modellieren, wenn die Einflüsse der Marktschwankungen bekannt wären. Dies ist zumindest bei der Flächenkennziffer nicht der Fall. Aber auch langfristig ist die Flächenkennziffer eine Problemgröße, zu der kaum Zukunftsschätzungen möglich sind. Bestand und Abriss sind stadtplanerische Größen (vgl. folgendes Kapitel).

Die angloamerikanische Planungs- und Immobilienforschung, die weitgehend aus der Ökonomie beeinflusst wird, modelliert die stets ungleichen Marktkategorien von Angebot und Nachfrage. Der Ausgleich zwischen Angebot und Nachfrage erfolgt über die Anpassung der Mietpreise, die Veränderung der Leerstandsrate und (mit erheblicher zeitlicher Verzögerung) das Neubauvolumen. Die Ergebnisse wenden sich an Investoren, Makler und Mieter, wobei die Tatsache, dass räumliche Parameter wie Neubau, Abriss und Flächenabsorption „mitmodelliert“ werden, eine Anwendung auch in der Stadtplanung für sinnvoll erachten lässt. Dabei existieren unterschiedliche Modelle, wobei im folgenden eine vereinfachte Grobstruktur vorgegeben wird, die der Mehrzahl zugrunde liegt (für einen Überblick über die Modelle siehe: Hysom / Crawford 1997 und McDonald 2002 mit den darin zitierten Originalquellen)

(2) $L = f(ABS, NEUB, ABG)$ — L: Leerstandsquote; ABS: Nettoabsorption (zusätzlich in Anspruch genommene Flächen); NEUB: Neubau; ABG: Abgänge

(3) $M = f(L)$ — M: Miethöhe

(4) $ABS = f(M; \Delta BB)$ — BB: Bürobeschäftigung

Die Funktionen und die rechnerischen Zusammenhänge werden dabei ökonometrisch geschätzt. Erweiterungen beschäftigen sich u. a. mit der Dynamisierung und dem verzögerten Abbau von Marktungleichgewichten und der Endogenisierung des Neubauvolumens in Abhängigkeit von Kapitalmarkt und Mieten (aus kontinentaleuropäischer Perspektive wären noch planerische Regelungen hinzuzufügen), so dass die Zeitverzögerung zwischen dem Entschluss zu bauen und der Fertigstellung auch statistisch die „Schweinezyklen“ auf dem Immobilienmarkt nachvollziehen lässt (vgl. DiPasquale / Wheaton 1996). Des weiteren existiert umfangreiche Forschung zum Thema der Leerstandsrate und ihrer Auswirkung auf Mieten (vgl. Hartung 1998 und die darin zitierten amerikanischen Quellen).

Der Vorteil der ökonometrischen Schätzungen liegt darin, dass nur zwischen denjenigen Größen nach statistischen Zusammenhängen gesucht wird, die auch als Datenquelle verfügbar sind. Andernfalls wird mit Proxy-Variablen gearbeitet, z.B. könnte bei Unkenntnis über die Entwicklung der Bürobeschäftigtenzahl die Beschäftigungsentwicklung in den wichtigsten tertiären Sektoren als Näherungsvariable dienen. Ein derartiges Vorgehen erhöht natürlich die Höhe des statistischen Störterms, lässt aber das Vorhaben nicht an mangelnden Eingangsdaten oder willkürlichen Schätzungen scheitern. Insgesamt sind die Modellrechnungen stark auf die Datenverfügbarkeit von Maklern ausgelegt. So spielt der Gesamtbestand einer Stadt an Büroflächen meist nur eine indirekte Rolle bei der Leerstands- und Abrissquote. Zudem funktioniert das Modell auch, wenn nicht alle Büroflächen eines Marktes (d.h. einer Stadt) betrachtet werden. Beschränkt man sich bei der Flächenquantifizierung auf große reine Bürogebäude ohne Mischnutzungen, so muss lediglich die Beschäftigtenzahl BB angepasst werden. Die zyklische Komponente der Entwicklung der Flächenkennziffer ist über den Zusammenhang zwischen Miete und Absorption enthalten. Es verbleibt als entscheidender Nachteil jedoch die fehlende Integration der langfristigen Entwicklung der Flächenkennziffer. Aus diesem Grund ergeben Fortschreibungen des Modells auf längerfristige Zeithorizonte regelmäßige Zyklen, ohne dass sich an der zyklenbereinigten Entwicklung viel verändert (vgl. Hendershott / Lizieri / Matysiak 1999).

Um dies zu umgehen, können die beiden geschilderten Ansätze zusammengefügt werden, indem man die (empirisch allerdings kaum fassbare) Größe der zyklenbereinigten Flächenkennzifferentwicklung in Formel (2) einbaut, Formel (3) und (4) unverändert lässt und anschließend den Bedarf als Summe aller Nettoabsorptionen errechnet:

(5) $L_t = f(ABS, NEUB, ABG, FKZ\_LANGFR)$ — FKZ_LANGFR: Zyklenbereinigte Flächenkennziffer

(6)) $BED_{t+x} = ABS_t + ABS_{t+1} + \ldots + ABS_{t+x}$

Der Vorteil dieses Vorgehens liegt darin, dass langfristige und kurzfristige Entwicklungen überlagert betrachtet werden können. Dies erscheint wichtig, da Erkenntnisse über die Folgen bestimmter Marktzustände aus der kurzfristigen Modellierung (bspw. der Zusammenhang zwischen Leerstand und Miethöhe) auf längerfristige Phänomene wie den Arbeitsplatzabbau durch Verlagerung in Billiglohnländer oder den demographischen Wandel übertragen werden können. Sind die Parameter bekannt, so kann eine stadtweite Markt- und Bedarfsmodellierung angegangen werden. Bei der Fortschreibung sind die Parameter der Beschäftigungsentwicklung und des Neubauvolumens exogen, so dass mit ihnen verschiedene Szenarien durchgespielt werden können.

4. DETAILLIERUNG DER INFORMATION DURCH BÜROFLÄCHEN-GIS

Die entscheidende Herausforderung für eine Modellierung besteht – neben der statistischen Methodenkenntnis – in der Verfügbarkeit von Eingangsdaten:

- Die Bürobeschäftigung kann mittels einer inzwischen bei Maklern und Researchern eingebürgerten Methodik über die Daten der Bundesanstalt für Arbeit erhoben werden (vgl. Dobberstein 1997). Die Anwendbarkeit der Methode endet jedoch auf Gemeindeebene. Beschäftigungsdaten zu einzelnen Arbeitsstätten liegen nur verteilt und in mangelhafter Qualität vor.

- Miete, Absorption, Leerstand, Bestand, Abriss und Neubauvolumen sind klassische Maklergrößen. Sie werden als Aggregatgrößen teilweise in Marktberichten für Städte oder Stadtviertel veröffentlicht. Für immobilienwirtschaftliche und planerische Fragestellungen sind jedoch Mikrodaten erforderlich.

Dabei besteht das Problem, dass kein Makler den Überblick über alle Vermittlungen seiner Konkurrenten haben kann. Die damit verbundenen Probleme der Datenqualität könnten durch eine zentrale Bestandsdatenbank gelöst werden. Diese könnte als black box bei neutralen Institutionen (vgl. Kolwitz 2004) oder bei Wirtschaftsförderungen angesiedelt sein (vgl. Flüshöh / Stottrop 2005). Die zentrale Fortschreibung für einen Standort ermöglicht zudem die Erfassung von Veränderungen im Zeitlablauf.

Dabei könnte noch ein weiteres Problem gelöst werden: Jede Büroimmobilie ist individuell – und die Nutzer treffen Entscheidungen nach individuellen Prioritätensetzungen. Dabei existieren vielfältige, aber keine vollständigen Substitutionsbeziehungen. Der Nutzer sucht einen Kompromiss zwischen den Preisen und den gewünschten Charakteristika. So entstehen Teilmärkte. Die in Kapitel 3 dargestellten Rechnungen geben zwar einen Gesamtrahmen an, auf der Ebene des Teilmarktes kann sich die Situation trotzdem abweichend von der Gesamtmarktlage darstellen. So kann durchaus auf einem Teilmarkt ein Engpass bestehen, während auf dem anderen der Leerstand steigt. Das in der Realität häufigste Beispiel ist Leerstand in überalterten Büroflächen (die dann nicht mehr als Substitut wirken können), wobei die Kosten für redevelopment nicht über den Ertrag aus der erneuerten Immobilie finanziert werden können. Dies könnte sich erst dann ändern, wenn die Engpässe im hochpreisigen Segment für Preissteigerungen sorgen würden und Nutzer lieber alte als überteuerte Flächen in Anspruch nehmen. In der Praxis sind gerade die standörtlichen Substitutionsbeziehungen auch stadtübergreifend so vielfältig, dass aus Sicht der Kommunen Engpässe in keinem wesentlichen Marktsegment vorhanden sein dürfen. Zu den Einflüssen der Teilmärkte aufeinander und zum Umzugsgeschehen in Abhängigkeit von Teilmarktentwicklungen besteht jedoch erheblicher Forschungsbedarf – und zwar sowohl theoretisch als auch empirisch.

Teilmärkte lassen sich v.a. an folgenden Kriterien festmachen:

- Qualität der Büroflächen. Bauliche Ausstattungsparameter werden im amerikanischen Raum meist mit drei Stufen A, B und C gemessen. Die Qualität ist dabei stark mit dem Baualter korreliert.
- Standort: Hier geht es bspw. um die Entscheidung zwischen *central business district* und Peripherie.
- Der Nutzer der Flächeneinheit – gegliedert nach Größe und Betriebstyp: Sie wollen ihren gesamten Bedarf in einem Objekt realisieren, dabei darf aus Gründen der Außendarstellung das ganze Objekt nicht um ein Vielfaches größer als der Flächenbedarf sein. Da die Branche wenig Aufschluss über Standort- und Qualitätsbedarf gibt, empfiehlt sich zunächst eine Gliederung anhand der regionalen oder überregionalen Ausrichtung des Betriebs.

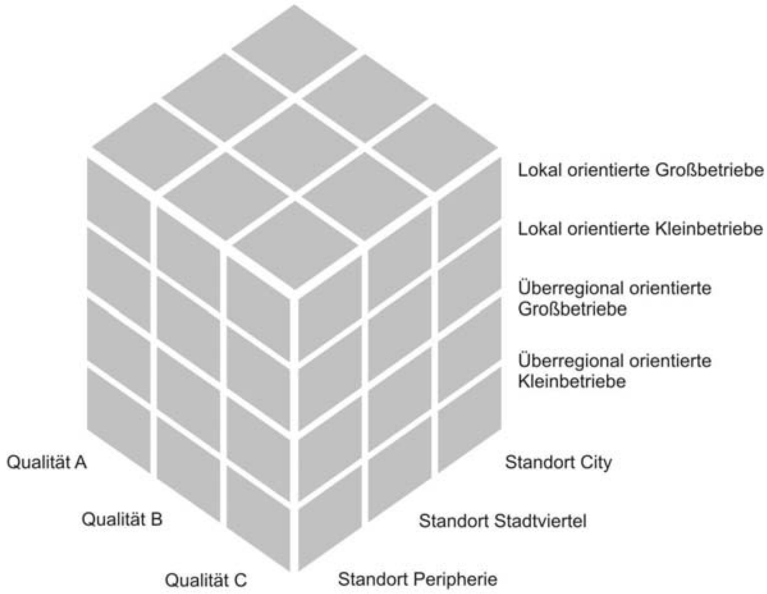


Abb.: Segmentierung des Büroflächenmarktes in unterschiedliche Teilmärkte

Zur verbesserten Aggregatdatenbildung, der Schaffung von Zeitreihen und der beliebigen Abfrage von Teilmärkten nach sachlichen oder geographischen Kriterien empfiehlt sich eine kombinierte Sach- und Geodatenhaltung in einem Geoinformationssystem. Hierein müssen folgende Informationen integriert werden:

Geodatengrundlage:

- Gebäudeumrisse aus Katasterdaten.
- Zur Flächenrechnung sind zudem Stockwerkszahlen erforderlich, die jedoch nicht in jeder Stadt vorliegen.

Gebäudeinformationen:

- Entscheidend ist die Filterung von reinen Bürogebäuden (und je nach Fragestellung auch der kleinteiligen Büroflächen in mischgenutzten Gebäuden). Detailliert lässt sich dies durch Begehungen erfassen (vgl. Flüshöh / Stottrop 2005), es können jedoch auch durch kommerzielle Firmendatenbanken mit den Geodaten verknüpft werden und um Gebäude mit Haushalten oder Handelsfirmen bereinigt oder teilbereinigt werden. Eine künftige Ausbreitung der 3D-Stadtmodelle mit Fassaden-Mapping lässt auch eine „Begehung am Schreibtisch“ möglich erscheinen.
- Wünschenswert sind Baualter oder Gebäudezustand. Die Daten kommerzieller Anbieter sind mäßig, interessant sind Gebäudealterkartierungen, die in manchen Städten vorliegen. Refurbishment-Maßnahmen sind retrospektiv nur durch Begehung zu erheben.

Nutzerinformation:

- Die Aktualität und die Branchenzuordnung kommerzieller Firmendatenanbieter ist am genauesten. Eine Nutzerklassifizierung anhand der Branche lässt jedoch nur bedingt auf den Firmentypus schließen, so dass hier eine manuelle Sortierung nach Kriterien wie Firmengröße und überregionaler Bedeutung angeraten scheint.
- Interessant wäre die Zuordnung von Arbeitsplatzzahlen zu Arbeitsstätten, diese liegen jedoch nicht in ausreichender Qualität vor.

All dies ist mit erheblichem Aufwand verbunden. Da aus Sicht von Planung und Wirtschaftsförderung großflächige Büroflächen und Büroflächennutzer das interessanteste Teilmarktsegment darstellen, sollten Datenerhebungen hier starten und zunächst um Näherungswerte für kleinteilige Büroflächen in mischgenutzten Gebäuden ergänzt werden.

Neben der Verbesserung von Eingangsdaten für aktuelle Prognosen und der Bereitstellung von Zeitreihendaten für die Forschung bzgl. des Verhaltens der einzelnen Teilmärkte sind weitere Anwendungen und Ausbaustufen denkbar. Möglich ist auch eine Erweiterung des Systems zu Standortsuchdatenbanken für Büroflächen - wie sie sowohl für Gewerbeflächen, als auch für Wohnungen bekannt sind. Dabei ist technisch gesehen zunächst unerheblich, ob die Datenhaltung sowie die interaktive Bereitstellung durch Makler, Wirtschaftsförderungen oder Kooperationsprojekte geschieht. Zur Visualisierung der Treffer sind bestehende 3D-Stadtmodelle geeignet. Zukunftsmusik wäre die Integration eines 3D-Stadtmodells zusammen mit den Sachinformationen zu einzelnen Bürogebäuden in ein interaktives 3D-GIS, welches bspw. bei der Vermarktung von Gewerbeparks oder Konversionsvorhaben zum Einsatz kommen könnte.

Im Rahmen eines Dissertationsvorhabens an der TU Kaiserslautern werden die eingangs dargestellten Methoden und ihre Anreicherung durch verknüpfte Geo- und Sachdaten derzeit in einer Fallstudie bearbeitet, so dass eine Einschätzung von Aufwand, Problemen und zu erwartenden Prognoseergebnissen möglich sein wird.

5. LITERATURANGABEN

Akademie für Raumforschung und Landesplanung (Hg.): Methoden und Instrumente räumlicher Planung. Hannover 1998.

Bundesamt für Bauwesen und Raumordnung (Hg.): Wohnungsprognose 2015. Berichte Band 10. Bonn 2001.

Di Pasquale, Denise / Wheaton, William C.: Urban Economics and Real Estate Markets. Englewood Cliffs 1996.

Dobberstein, Monika: Bürobeschäftigte: empirische Ermittlung von Bürobeschäftigtenquoten für Büroflächenanalysen. In: Grundstücksmarkt und Grundstückswert, 8 (1997), 6, S. 321-329.

Dobberstein, Monika: Das prozyklische Verhalten der Büromarktakteure. Interessen, Zwänge und mögliche Alternativen. Arbeitspapier zur Gewerbeplanung Nr. 2. Dortmund, 2000.

Dobberstein, Monika: Funktionsmechanismen von Büromärkten jenseits der Top-Standorte am Beispiel Braunschweig. Vortrag auf dem 3. GIF-Forum „Metropolen versus Mittelstädte". Frankfurt, 12.02.2004.

Einem, Eberhard von / Tonndorf, Thorsten: Büroflächenentwicklung im regionalen Vergleich. Schriftenreihe Forschung des Bundesministers für Raumordung, Bauwesen und Städtebau Heft Nr. 484. Berlin, 1990.

Flüshöh, Christian; Stottrop, Daria: Zwischenergebnis Büroflächenvollerhebung Düsseldorf. Arbeitspapier zur Gewerbeplanung Nr. 8. Dortmund, 2005.

Hagen, Hans, Steinebach, Gerhard; Münchhofen, Michael; Ruby, Maja; Scheler, Inga; Wadlé, Michael; Michel, Frank: Datenmanagementsystem für die Stadtplanung; CORP2005, Wien 2005.

Hartung, Frank: Der Büroflächenmarkt der Landeshauptstadt Düsseldorf unter besonderer Berücksichtigung der Leerstandsproblematik. Diss. Dortmund, 1998.

Hendershott, Patric H. / Lizieri, Colin M. / Matysiak, George A.: The Workings of the London Office Market. In: Real Estate Economics 1999, S. 365-387.

Hysom, John L. / Crawford, Peggy J.: The Evolution of Office Building Research. In: Journal of Real Estate Literature 1997, S. 145-157.

Just, Tobias: Demografische Auswirkungen auf die Büromärkte – ein Update. Vortrag auf dem 4. Gif-Forum am 15.02.2005.

Kolwitz, Kai: Alles nur Zahlenzauber? In: Immobilien Wirtschaft und Recht 3 / 2004, S. 12 ff.

v. Malottki, Christian: Büroflächenbedarf der Arbeitswelt von morgen. Kaiserslautern, 2003.

McDonald, John F.: A Survey of Econometric Models of Office Markets. In: Journal of Real Estate Literature 2002, S. 223 – 242.

Pelzl, Wolfgang: Analyse und Prognose des Büro- und Handelsflächenmarktes im Graphischen Viertel in Leipzig unter besonderer Berücksichtigung des Industriepalastes. Vortrag, 25.06.1998.

Scheffler, Rolf: Marktanalysen zum Büroflächenleerstand und ihre Bedeutung für Wertermittlungen. In: Grundstücksmarkt und Grundstückswert 1 / 2004.

Senatsverwaltung für Stadtentwicklung Berlin: Bürostandort Berlin: Strukturen und Perspektiven bis 2010. Berlin, 2001.

Simons, Harald: Perspektiven des westdeutschen Wohnungs- und Büromarktes bis 2030. In: Informationen zur Raumentwicklung, 1999, S. 745 ff.

Voß, Oliver: Ein empirisches Simulationsmodell für die westdeutschen Wohnungsmärkte. Münster, 2001.

„Wien KULTUR“ – Geodaten mit kulturellem Inhalt
Das neue Internetportal der Stadt Wien

Wolfgang BÖRNER, Karl FISCHER, Robert SAUL, Peter SCHEUCHEL

(alle Magistrat der Stadt Wien, Österreich)

In der gegenwärtigen Phase des Stadtwachstums und der Veränderungen in Wien, einer Stadtentwicklungs- wie auch einer Stadtverdichtungsperiode, ist es notwendig, die Kenntnisse und Regulative über den schützenswerten Baubestand und Kulturgüter in technologisch modernster Form aufzubereiten, zu analysieren und den Bürgerinnen und Bürgern in ansprechender Form zu präsentieren.

Kurz- und mittelfristiges Ziel ist der Ausbau des Kulturgüterkatasters unter dem Titel WIEN-KULTUR und einer neuen Web-Portallösung, welche dem Benutzer erlaubt, Informationen über wesentliche Identitätsmerkmale der Stadt einfach abzurufen. Das bisher in den Web-Applikationen genützte Informationsmaterial soll in einer web-technologisch neu aufbereiteten Form in diese Portallösung einfließen und durch, in der Stadt Wien bereits vorhandene oder teilweise digital vorhandene Datenbanken und Archive ergänzt werden.

Die von der MA 53 in Auftrag gegebene Usability – Studie soll mit Adaptionen zur Ausarbeitung des Portals genutzt werden.

Die inhaltliche Erweiterung des Kulturgüterkatasters im Rahmen von WIEN KULTUR bringt für die Stadtplanungs- -und Kulturabteilungen sowohl eine Optimierung von abteilungsinternen Arbeitsabläufen als auch eine Zeitersparnis für auskunftsgebenden Abteilungen und deren Referenten und kann *als Informationsquelle für weitere Nutzergruppen intern auch extern über eine Internetversion* fungieren.

Eine Verbesserung der Handhabung und eine Erweiterung unter WIEN-KULTUR mit für die Öffentlichkeit gedachten Daten soll sowohl den BewohnerInnen und BesucherInnen als auch MitarbeiterInnen unserer Stadt im Netz einen noch genaueren Überblick bieten und für viele Entscheidungsfindungen einen wertvollen Beitrag leisten.

Die Visualisierung der geographischen Daten erfolgt durch die Nutzung eines Web Map Services (WMS), welches über einen Webbrowser angesprochen werden kann.

Dieses WMS ermöglicht die Internet-gestützte Erstellung von Karten aus dem Geodatenhaushalt der Stadt Wien, sowie die Abfrage von thematischen Informationen der zugrunde liegenden Geodaten.

Das WMS hält sich an die weltweiten Standards für den normierten Austausch von digitalen Karten, welche vom Open GIS Consortium (OGS) spezifiziert wurden.

Die graphische Gestaltung des Interface erfolgt unter Berücksichtigung der neuen Gestaltungsrichtlinien (Web Style Guide) für Web Applikationen der Stadt Wien.

Ein neuer Ansatz zur Abgrenzung von Stadtregionen: methodische Grundlagen und Perspektiven zur Anwendung

Rudolf GIFFINGER, Robert KALASEK und Erich WONKA

(Department für Raumentwicklung, Infrastruktur- und Umweltplanung,
Fachbereich Stadt- und Regionalforschung, TU Wien;
Statistik Austria, Abteilung Register (Kartographie und GIS))

1. EINLEITUNG

Die Definition und räumliche Abgrenzung von Stadtregionen ist eine traditionelle und typische Aufgabe der Raumforschung und Regionalanalyse. Vor dem Hintergrund der verstärkten räumlichen Trennung verschiedener Aktivitäten, dem Prozess der Suburbanisierung und dem Entstehen von Pendlerverflechtungen stehen seit den 1960iger Jahren Fragen zu den Beziehungen zwischen der Stadt als dem Zentrum mit seinem ‚Hinterland' als Außengebiet der Stadtregion im Mittelpunkt der Forschungsbemühungen (Klemmer, 1971; Fuchs, 1997a und 1997b) Die Definition von Stadtregionen stellt dabei einerseits aus deskriptiver Sicht ein Instrument zur Raumbeobachtung dar (Boustedt, 1975, S. 342) und andererseits aus raumentwicklungspolitischer Sicht eine heute wichtige Raumkategorie für die räumliche Entwicklung in Europa. So ist es ein Ziel im ESPON (European Spatial Planning Observation Network), so genannte FUA's (functional urban areas) bei einer grenzüberschreitenden Betrachtung zu identifizieren, da ihnen für die polyzentrische Entwicklung im Gebiet der EU eine zentrale Bedeutung beigemessen wird (ESPON, 2004, S. 53ff).

Bei der Definition der Stadtregion lassen sich zwei Problemschwerpunkte erkennen, die Anlass für die Weiterentwicklung und Modifizierung geben. Dies sind (1) Fragen zur inhaltliche Definition der Stadt oder städtischen Agglomeration über entsprechende Merkmale der Größe, Dichte und Struktur bzw. der Außenzone über entsprechende funktionale Merkmale. Dies sind (2) Fragen des räumlichen Ansatzes, worunter insbesondere die Verwendung eines adäquaten räumlichen Bezugssystems gemeint ist. Während die meisten Arbeiten sich auf den ersten Fragenkreis bei der Definition und Operationalisierung konzentrieren, legen wir die Aufmerksamkeit insbesondere auf Fragen des räumlichen Ansatzes, da uns die Merkmale ‚Dichte' und ‚Geschlossenheit' für die Operationalisierung des städtischen Siedlungsgebietes als die zentralen Voraussetzungen für die weitere Definition von ‚Stadtregion' erscheinen.

Zu diesem Zweck behandeln wir folgende Fragen:

- Im Kapitel 2 wird als erstes kurz dargestellt, von welcher idealtypischen Vorstellung bei der Operationalisierung von Stadtregionen zumeist ausgegangen wird und wie die Begriffe ‚Kerngebiet' und ‚Außengebiet' in traditionellen Ansätzen bislang definiert worden sind. Danach wird der eigene Ansatz kurz beschrieben, wobei vor allem die Bedeutung des räumlichen Ansatzes, welcher der Operationalisierung zugrunde gelegt wird, herausgearbeitet werden soll.
- Im Kapitel 3 werden auf Rasterbasis die städtischen Kerngebiete in Österreich mittels der Merkmale ‚Dichte' und ‚Geschlossenheit' definiert und danach für die gesamte städtische Agglomeration (= Summe von mehreren Gemeinden) über die aggregierten Pendlerverflechtungen das ‚Außengebiet' identifiziert. Zwei unterschiedliche Varianten zur Definition des Kernsiedlungsgebietes werden vorgestellt. Technische Detailfragen sowie Effekte der verbesserten räumlichen Abgrenzung werden zudem behandelt.
- Im abschließenden Kapitel 4 erfolgt eine Einschätzung des hier entwickelten Ansatzes für aktuelle Problemstellungen auf verschiedenen räumlichen Ebenen.

2. STADTREGION: DEFINITION UND OPERATIONALISIERUNG

In den folgenden Ausführungen wird durchwegs von dem traditionellen Verständnis des Begriffes ‚Stadtregion' ausgegangen. Angesichts veränderter technologischer, kommunikativer und wirtschaftlicher Bedingungen innerhalb der letzten 40 Jahre wird allerdings dann die traditionelle Definition modifiziert, um der heutigen Situationen der Siedlungsentwicklung und insbesondere der Verstädterung gerecht zu werden: von der Kernstadt zur homogen dichten städtischen Agglomeration im Sinne des städtischen Kerngebiets. Der dem traditionellen Verständnis zugrunde liegende räumliche Ansatz wird kurz skizziert, um dann die Besonderheiten des eigenen Raster basierten Ansatzes herauszuarbeiten.

2.1 Zum traditionellen Verständnis von ‚Stadtregion'

In der Definition von ‚Stadtregion' wird grundsätzlich von einem gravitationstheoretischen Verständnis ausgegangen. Darunter versteht Boustedt (1975, S. 432) „denjenigen Umlandbereich im Agglomerationsraum einer (großen) Stadt, dessen Einwohner überwiegend nicht-landwirtschaftliche Berufe ausüben und von denen der überwiegende oder zumindest ein erheblicher Teil seine Existenzgrundlage in den Arbeitsstätten der Kernstadt hat."

Gemäß diesem monozentrischen Verständnis hat Boustedt (1975, S. 344) ein räumliches Modell zur Erfassung und Strukturierung des Agglomerations- und Verdichtungsprozesses entwickelt. Die Stadt ist Zentrum, welches mit seinem Umland in funktionalen Verflechtungen steht. Dem Kerngebiet gegenüber stellt Boustedt die ‚Umlandzone', worunter jene verstädterten Gemeinden zu sehen sind, die in starker Pendlerverflechtung zum Kerngebiet (Summe aus Kernstadt und ‚Ergänzungsgebiet' stehen.

(1) zur inhaltlichen Definition

Bei der Operationalisierung dieser Vorstellung von ‚Stadtregionen' in Österreich oder Deutschland lagen bislang das Augenmerk hauptsächlich auf den Fragen (1) zur Definition der Stadt und des Kerngebietes und (2) zur Definition der ‚Umlandzone'.

ad (1) zur Definition der Stadt und des Kerngebietes

Hier liegen die Bemühungen primär darauf, Indikatoren zur Erfassung des Verstädterungsgrades, zur Größe, zur wirtschaftlichen Struktur und auch zur Dichte zu definieren. Städtische Kerngebiete sind daher solche, die bestimmte Schwellenwerte im Verstädterungsgrad, in der Beschäftigtenstruktur und in der Bevölkerungsdichte überschreiten und gleichzeitig in der Summe der Kernstadt mit ihren Ergänzungsgebieten eine bestimmte Mindestgröße (meist in der Bevölkerungszahl) als Agglomeration aufweisen.

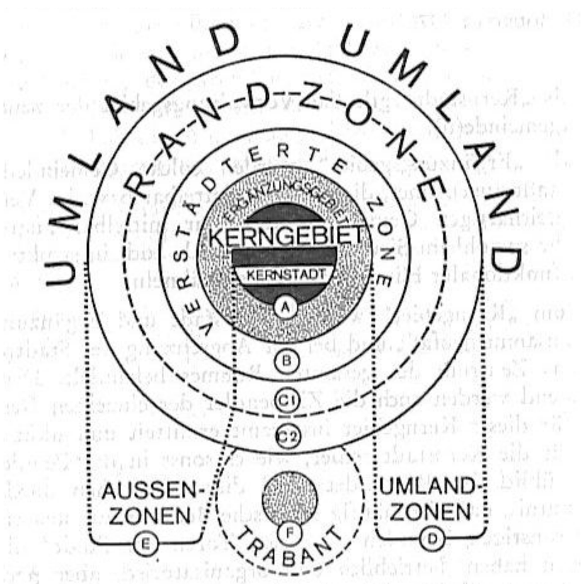


Abb. 1 Modell der Stadtregion

Quelle: Boustedt 1975, S. 344

Die Auswahl an Indikatoren hat sich im Vergleich der Arbeiten im Laufe der Zeit kaum geändert, große Aufmerksamkeit lag auf der Festlegung der Schwellenwerte angesichts sich ändernder Siedlungsstrukturen über die Zeit. (vgl. für deutsche Stadtregionen: Klemmer, 1971, S. 11 ff; Boustedt, 1975, S. 348; oder für österreichische Stadtregionen: Kaufmann, 1973; Fuchs, 1997a, S. 76 ff)

Ein rein morphologischer Ansatz zur Abgrenzung von Agglomerationen geht auf die Initiative von N.U.R.E.C. (Network on Urban Research in the European Community) 1989 zurück. Dabei werden Agglomerationen auf Basis von zueinander dicht benachbarten Gebäuden und siedlungsnahen Einrichtungen (Friedhöfe, Sportanlagen, etc.) als geschlossen verbaute Gebiete definiert. Diese Identifikation von städtischen Agglomerationen basiert somit auf dem sichtbaren Ausdruck der Siedlungstätigkeit, lässt aber keine weitere thematische Differenzierung aufgrund der verwendeten Informationsquelle zu.

ad (2) zur Definition der ‚Umlandzone'

Die Definition der Umlandzone erfolgt gemäß dem gravitationstheoretischen Verständnis anhand eines Indikators, der die funktionale Verflechtung der umgebenden Gemeinden mit dem Kerngebiet zum Ausdruck bringt. Dies ist in den meisten Arbeiten bisher der Anteil der Auspendler in die Kernstadt oder in das Kerngebiet in Bezug auf die wohnhaft erwerbstätige Bevölkerung. Die Außengrenze der Außenzone wird durch einen Schwellenwert in diesem Pendlerindikator festgelegt.

Zur Stadtregion werden z.B. in der Arbeit zu den österreichischen Stadtregionen zum Stand 1991 schließlich nur jene städtischen Kerngebiete, die auch eine ihr eindeutig zugeordnete Pendler-Außenzone aufweisen.

(2) zum räumlichen Ansatz

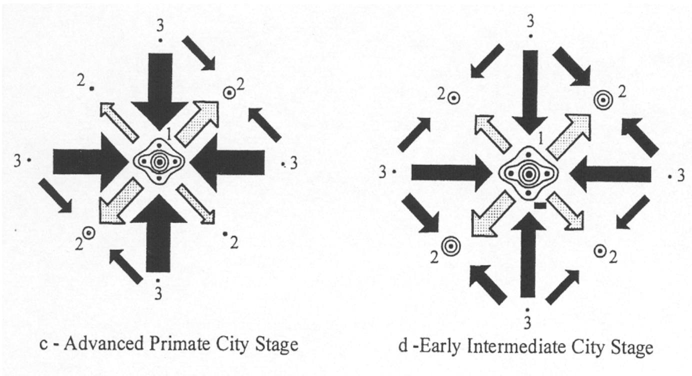
Angesichts der Verfügbarkeit von statistischem Material vor allem auf Gemeindeebene erfolgte die Indikatorenbildung auch meist auf dem Aggregationsniveau der Gemeinden (vgl. Boustedt, 1975). Dies hat zwar verschiedene Vorteile: z.B. Vergleichbarkeit über mehrere Beobachtungszeitpunkte bei unveränderten Gemeindegrenzen; Vielfalt an gesicherten statistischen Informationen – vor allem auch zu Pendlerverflechtungen. Daneben besteht aber eine Reihe von Nachteilen: z.B. keine Abbildung der Siedlungsentwicklung als ein kleinräumig diskontinuierlicher Prozess – weder innerhalb noch zwischen Gemeinden; keine Berücksichtigung kleinräumiger topologischer Informationen; keine ‚sinnvollen' Flächenbezugsmöglichkeiten bei der Berechnung von Dichteindikatoren.

Für die Definition der österreichischen Stadtregionen wurde erst 1991 versucht, einen verbesserten räumlichen Ansatz zu entwickeln, indem anstelle der Gemeinden die Siedlungseinheiten als räumliche Bezugseinheiten verwendet wurden (Fuchs, 1997a). Da die Siedlungseinheiten keine Rücksicht auf Gemeinde- und sonstige territoriale Grenzen nehmen, war dies ein Fortschritt gegenüber der Kernraumabgrenzung der Stadtregionen 1981, die mit Hilfe von Statistischen Zählsprengeln erfolgte.

2.2 Zum modifizierten, eigenem Verständnis von ‚Stadtregion'

Vor dem Hintergrund des technologischen Wandels und der sich ändernden wirtschaftlichen Bedingungen kommt es nicht nur zu einer wirtschaftlichen Umstrukturierung im Stadtgebiet. Vielmehr erfolgen gleichzeitig Ausdehnungsprozesse, die die Umlandgebiete verstädtern. Neben typischen Prozessen der Suburbanisierung sind dies durch standörtlich differenzierte Bedingungen auch neue Zentren demographischen und wirtschaftlichen Wachstums, die bestehende monozentrische Situationen auflösen und zu polyzentralen Situationen führen. (vgl. Loibl, et al., 2002) Die Siedlungsentwicklung ist somit von dem Zusammenwachsen verschiedener sich ausdehnender Städte/Zentren geprägt, sodass immer größere städtische Agglomerationen im Sinne von polyzentralen Kerngebieten entstehen.

Geyer (2002) hat die Argumentation von Friedman (1966) weiterführend den polyzentralen Wachstumsprozess in 6 Phasen visualisiert. Abbildung 2 veranschaulicht nun für die Phase c und d, wie ehemals außerstädtische Gemeinden und Kleinstädte durch Verdichtungs- aber auch Dispersionsprozesse zu Subzentren des Agglomerationsraumes geworden sind und wie durch die Verflechtungen mit den umgebenden Städten/Gemeinden Verdichtungs- und Dispersionsprozesse – vor allem entlang der Verkehrsachsen - fortgeführt werden. (Tönnies, 2002, S. 63 ff)



Der städtische Verdichtungsraum ist daher nicht als ein mono- sondern polyzentrischer Agglomerationsraum zu verstehen. Die Gravitationsannahme zur Herausbildung der Stadtregion gilt aber weiterhin. Um dieser Vorstellung der polyzentrischen Siedlungsentwicklung in städtischen Agglomerationen gerecht zu werden, verwenden wir in dem eigenen Ansatz nun folgende Begriffe:

Abb. 2: Phasen der Verstädterung und polyzentraler Entwicklung
Quelle: Geyer, 2002 (Ausschnitt)

- *Agglomerationsraum*: Jenes Gebiet, das durch relative gleichmäßige Verdichtung als städtischer Siedlungsraum (oder Kernraum bei Fuchs, 1997a) zu betrachten ist;
- *Kernsiedlungsgebiet*: jenes räumlich geschlossene Teilgebiet des städtischen Agglomerationsraumes, das eine entsprechende Größe und relativ homogene Dichte aufweist;
- *Ergänzungsgebiet*: jene weniger dichten und räumlich geschlossenen Gebiete von Gemeinden, deren Bevölkerung und Beschäftigte mehrheitlich dem Kernsiedlungsgebiet zugerechnet werden;
- *Außenzone*: jene funktionalen Ergänzungsgebiete (Gemeinden), die in starker Verflechtung zum Agglomerationsraum stehen. (= Umlandzone nach Boustedt)
-

(1) zur inhaltlichen Definition
Gegenüber früheren Ansätzen gehen wir von der Tatsache aus, dass Verdichtungs- und Agglomerationsprozesse aus der Siedlungstätigkeit von privaten Haushalten und Personen sowie auch von Betrieben und Beschäftigten resultieren, die entsprechenden konsumtiven und produktiven Tätigkeiten nachgehen. So hatte schon Boustedt (1975, S. 344) betont, dass zur Abgrenzung von Verdichtungsräumen nicht nur die Bevölkerungsdichte sondern die Dichte aus Bevölkerung und Beschäftigten berücksichtigt werden sollte. Wir verwenden daher für die Identifikation des Kernsiedlungsgebietes den Verdichtungsgrad aus Wohnbevölkerung und Beschäftigten (mit Ausnahme der Beschäftigten in der Landwirtschaft). Selbstverständlich könnten an Stelle dieses Dichteindikators als zentrales Merkmal auch andere zusätzliche (Dichte-)Indikatoren verwendet werden. Eine kleinräumig genau definierte Dichte stellt allerdings im Vergleich zu anderen Indikatoren ein unverwechselbares Kennzeichen zur Identifikation des Agglomerationsraumes dar. Für die Definition der Außenzone werden – wie in früheren Arbeiten – die Pendlerverflechtungen aus allen Quellgemeinden bezüglich des gesamten Agglomerationsraumes verwendet.

(2) zum räumlichen Ansatz
Der hier verwendete räumliche Ansatz unterscheidet sich grundsätzlich von den bisher entwickelten Ansätzen. Wir verwenden an Stelle von statistischen Einheiten wie Gemeinden oder Siedlungseinheiten gleichförmige Rasterzellen von 500*500 m Seitenlänge, denen jeweils die genaue Anzahl an Wohnbevölkerung und Beschäftigten zugeordnet ist. Aufgrund dieses Wechsels von statistischen Einheiten zur Raster basierten Darstellung lassen sich nicht nur Dichtewerte mit großer Genauigkeit berechnen, es werden auch topologische oder geometrische Merkmale wie Nachbarschaft, Distanzen oder Flächen sehr gut operationalisierbar. Damit werden auf Rasterbasis unterschiedlich verdichtete Siedlungsräume identifizierbar, indem durch die Festlegung von Dichte-Schwellenwerten solche Raster zu größeren Einheiten als potentiellen Agglomerationsräumen zusammengefasst werden, die zueinander benachbart und gleichzeitig unabhängig von administrativen Einheiten sind.

3. RASTER BASIERTE DEFINITION DER STADTREGIONEN ÖSTERREICHS

Ausgangsbasis für die beiden folgenden Varianten ist das räumliche Bezugssystem auf Rasterbasis, sodass für jede Zelle die Zahl der Bewohner und der Beschäftigten bekannt ist. Dadurch lassen sich als erstes die räumliche Verteilung von Bevölkerung und Beschäftigten relativ genau im Raum verorten und gleichzeitig möglichst genaue Dichteverhältnisse im Siedlungsraum berechnen.

3. 1 Einfach definierte Variante A mit einem Dichteschwellenwert

Um eine gewisse Vergleichbarkeit zu früheren Stadtregionsmodellen zu gewährleisten, wird in der Variante A darauf geachtet, dass alle Ergebnisse, die mit Hilfe der Raster basierten Operationalisierung erfolgen, wieder auf Gemeindeebene dargestellt werden können.

Folgende Arbeitsschritte sind zur Bestimmung der Stadtregionen notwendig:

1. Festlegung des Kernsiedlungsgebietes

- Abgrenzung auf der Grundlage von 500*500 m großen Rasterzellen. Diese Rastergröße wurde deshalb genommen, weil sie geeignet erscheint, um natürliche Siedlungsbarrieren (z.B. größere Flüsse) berücksichtigen zu können.
- Benachbarte Rasterzellen, deren kombinierte Einwohner-/Beschäftigtendichte über 250 Personen je km² ist, werden zusammengefasst. In Ausnahmefällen werden einzelne Rasterzellen in den Kernsiedlungsraum inkludiert, wenn der Dichtewert kleiner als 250 ist.
- Die so definierten potentiellen Kernsiedlungsgebiete werden dann als Kernsiedlungsgebiet ausgewählt, wenn sie mehr als 20.000 Personen (Einwohner und Beschäftigte) umfassen.

2. Festlegung des Ergänzungsgebietes

- Verschneiden des Raster basierten Kernsiedlungsgebietes mit den Gemeindegebieten (Polygonen)
- Auswahl jener Gemeinden, in denen mehr als die Hälfte der Einwohner plus Beschäftigte im Kernsiedlungsraum gemäß Punkt 1 liegen. Der Agglomerationsraum besteht somit aus dem Kernsiedlungsgebiet und dem jeweiligen Ergänzungsgebiet (siehe Abbildung 3).

3. Festlegung der Außenzone

- Definition des Prozentsatzes der Agglomerationsraum orientierten Gemeinde-Auspendler.
- Teil der Außenzone sind Gemeinden mit einem Anteil der Auspendler an allen Auspendlern von mehr als 45 % bei einer Bandbreite von plus/minus 2%. Die Zahl der Tages-Auspendler muss gleichzeitig größer als 100 sein.
- Gemeinden, die diese beiden Kriterien nicht erfüllen, aber von Gemeinden umgeben sind, die diese erfüllen, werden der Außenzone zugerechnet, sodass die Außenzone immer ein geschlossenes Gebiet ist.

Das Ergebnis dieser Variante A mit den benannten Kriterien ist in Abbildung 3 ersichtlich:

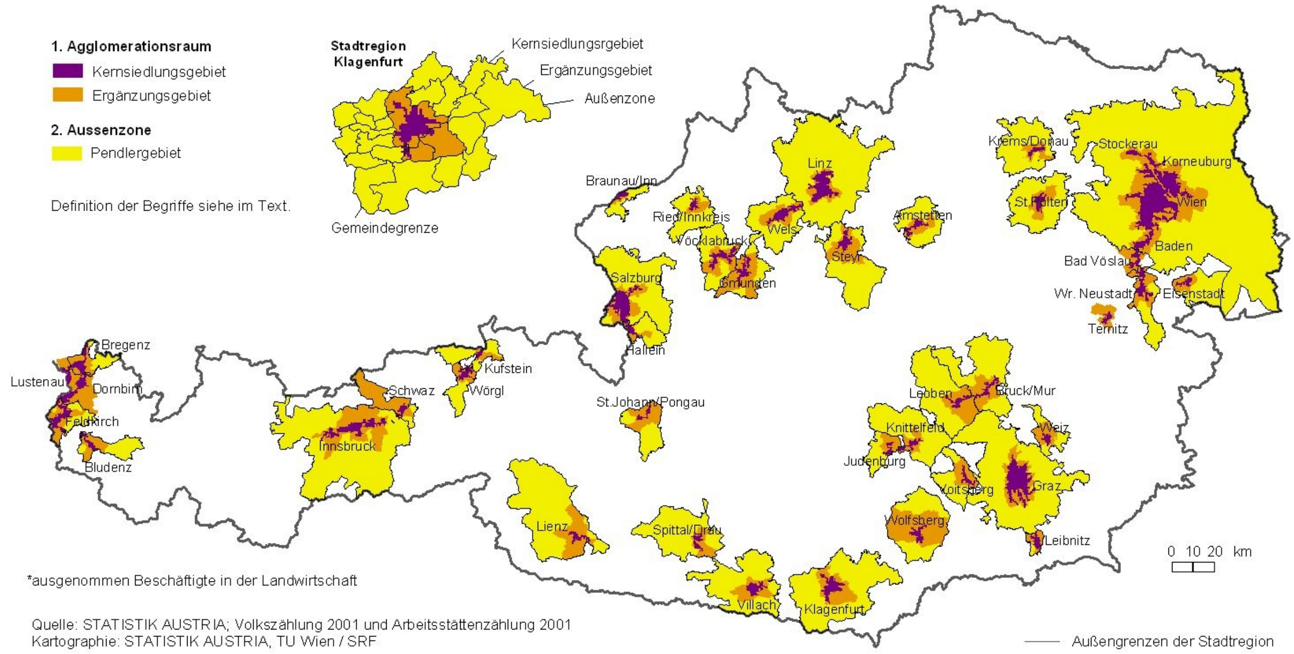


Abb. 3: Beispiel zur Raster basierten Abgrenzung der Stadtregionen in Österreich
Quelle: Statistik Austria, Volkszählung, 2001; Arbeitsstättenzählung 2001; eigene Darstellung

Präzisierung gegenüber 1991:

Welche verbesserten räumlichen Effekte die Raster basierte Identifikation von Stadtregionen gegenüber früheren Ansätzen hat, soll folgendes Beispiel aus der Region Villach verdeutlichen:

Wie schon weiter oben beschrieben, wurden im räumlichen Ansatz 1991 die Siedlungseinheiten verwendet. Da statistische Auswertungen mit Gemeindedaten gemacht werden sollten, mussten entsprechende Übergangsregeln gefunden werden, um von den Siedlungseinheiten auf die Kernsiedlungsgebiete der jeweiligen Gemeinde zu schließen. Das Problem dabei war, dass die genaue kleinräumige Situation in den Siedlungsgebieten nicht ausreichend berücksichtigt werden konnte, sodass sich heute (bei verbesserter räumlicher Grundlage) die Umlegung von Siedlungseinheiten auf die Gemeinden in manchen Fällen als ungenau erweist.

So wurde, wie aus der Abb. 4 (obere Abbildungen) hervorgeht, die Gemeinde Arnoldstein zum Agglomerationsraum Villach zugeordnet. Diese Gemeinde grenzt zwar an die Gemeinde Villach, ist aber von dieser topographisch getrennt. Das Siedlungsgebiet der Gemeinde Arnoldstein geht in Richtung Villach über die Gemeinde Finkenstein. Letztere wurde aber nicht zum Kernraum Villach gerechnet. Im Gegensatz dazu ist die Raster basierte Bildung von Kernsiedlungsgebieten deutlich präziser (siehe Abbildung 4 unten). Die Zuordnung von Rasterzellen zum Kernsiedlungsgebiet wird durch die räumlich differenziert Dichteabbildung erleichtert. Bei dieser Vorgangsweise kommt man daher zum Ergebnis, dass nur die Gemeinde Villach den Agglomerationsraum bildet.

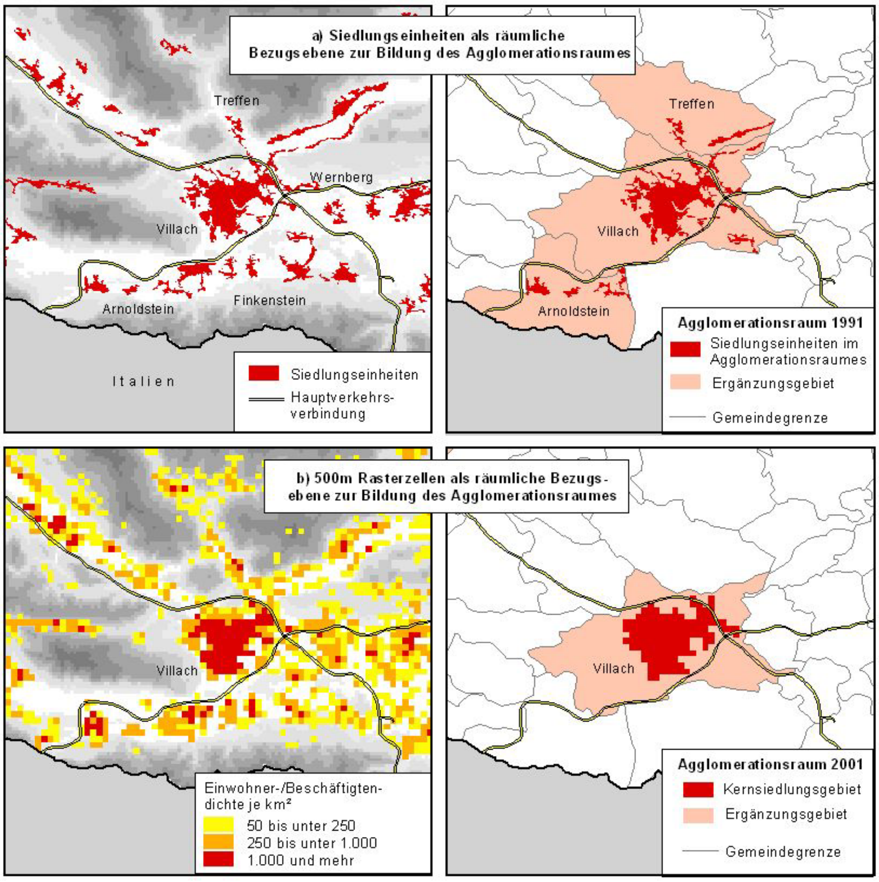
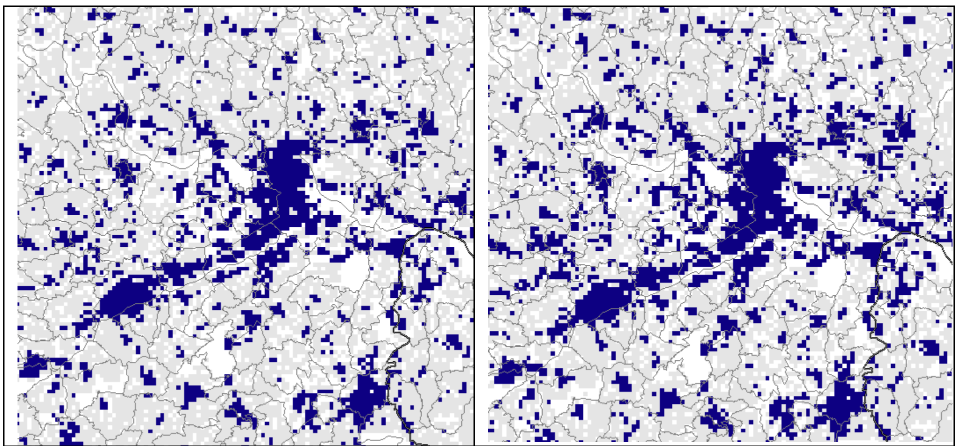


Abb. 4: Effekte unterschiedlicher räumlicher Ansätze 1991 und 2001.
Quelle: Statistik Austria, Volkszählung, 2001; Arbeitsstättenzählung 2001; eigene Darstellung

3.2 Interaktiv definierte Variante B mit zwei Dichteschwellenwerten

In der Folge wird ein erweitertes Raster basiertes Modell zur Identifikation des Agglomerationsraumes vorgestellt. In Variante A erfolgte zur Abgrenzung des Agglomerationsraumes im ersten Schritt die Vorauswahl von Rasterzellen über einen Schwellenwert für die kombinierte Einwohner/Arbeitsplatzdichte. Aneinander grenzende Rasterzellen mit Werten über dem Schwellenwert werden dabei zum geschlossenen Kernsiedlungsgebiet zusammengefasst. Die Wahl des Schwellenwertes ist insofern von großer Bedeutung als ein niedriger Wert vor allem in Bereichen mit disperser Siedlungsstruktur zu großen zusammenhängenden und daher wenig aussagekräftigen Siedlungsgebieten, ein hoher Wert hingegen zu stark verdichteten und meist stark isolierten Insellagen führt.



Dichte > 60 BevBesch pro 0,25km ² : = 240 BevBesch / km²	Dichte > 50 BevBesch pro 0,25 km² : = 200 BevBesch / km²

Abb. 5: Raster basierte Identifikation von Siedlungsgebieten bei einem Dichteschwellenwert
Quelle: Statistik Austria, Volkszählung, 2001; Arbeitsstättenzählung 2001; eigene Darstellung

Angesichts der großen Effekte, die unterschiedliche Dichteschwellenwerte auf die Identifikation von Kernsiedlungsgebieten haben, wird nun ein interaktiv definierter Raster basierter Ansatz skizziert der

- dem grundlegenden Modell der Operationalisierung über ‚Dichte' und ‚Geschlossenheit' folgt,
- die skizzierte Schwellenwertfestlegung durch Verwendung von zwei Werten erweitert,
- in Form eines dynamischen Modells im GIS implementiert ist

Die Implementierung erfolgt in ArcView 3.2 unter Nutzung der MapModels-Erweiterung (Riedl und Kalasek, 1998 und Benedikt et al. 2002). Es bieten sich damit die Möglichkeiten,

- das räumliche Analysemodell als Datenflussgraph (flow chart) zu entwerfen und
- die Ausführung der im Modell implementierten Analyseschritte und verwendeten Parameter über dieses Interface interaktiv zu steuern (Riedl und Kalasek, 1998 und Benedikt et al. 2002).

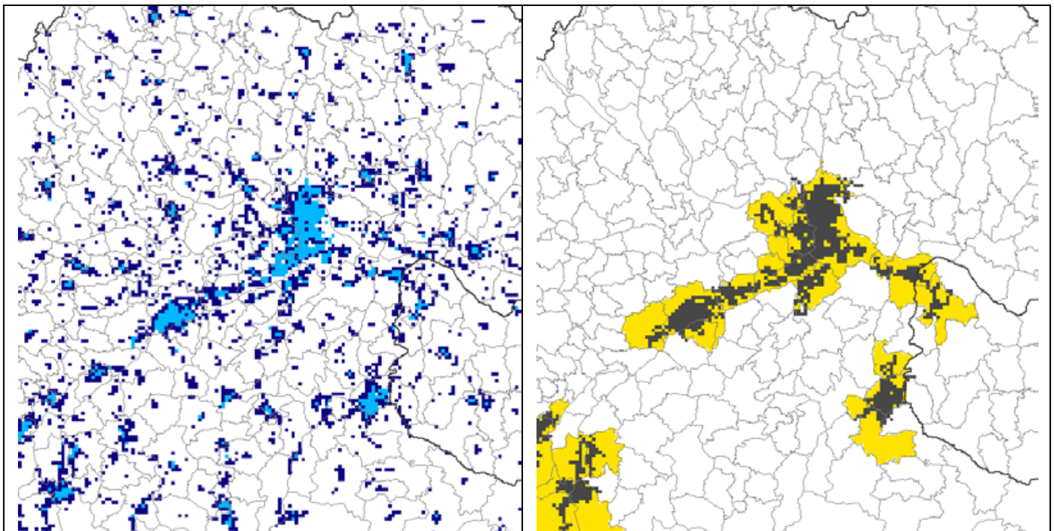
Zur Festlegung des Kernsiedlungsgebietes werden nun – im Gegensatz zur Variante A – zwei verschiedene Schwellenwerte für die ‚Dichte' verwendet. Der niedrigere Wert wird so gewählt, dass die Topologie bestehender Siedlungsgebiete mit geringerer Dichte als potentielle Kernsiedlungsgebiete (Typ A) weitestgehend erhalten bleibt (siehe Abb. 6 an der Region Linz/Wels). Über den höheren Wert werden die stark verdichteten Zentren der potentiellen Kernsiedlungsgebiete mit ihrer markant hohen Siedlungsdichte (Typ B) ausgewählt.

Danach werden über das Verhältnis der Flächen des Typs A und Typs B jene Typ-A-Flächen ausgeschieden, deren hoch verdichteter Siedlungskern (Typ B) den gewählten Flächenanteil unterschreitet. Auf dieser Basis erfolgt dann die endgültige Auswahl der Kernsiedlungsgebiete über einen Schwellenwert für die Summe der Bevölkerung und Beschäftigten

Damit werden in unserem Beispiel die Kernsiedlungsgebiete ausgewählt

(1) gemäß entsprechender Dichte des Typs A (260 Personen / km²) und B (1600 Personen / km²),
(2) gemäß des Verhältnisses von Typ-B- zu Typ-A-Flächen (Anteil von Typ B an A > 20 %) und
(3) gemäß einem definierten Schwellenwert aus der Summe der Bevölkerung und Beschäftigten in den nach (1) und (2) ausgewählten potentiellen Kernsiedlungsgebiete.

Die Festlegung des Ergänzungsgebietes erfolgt in analoger Weise zur oben beschriebenen Vorgangsweise der statischen Variante. Der Agglomerationsraum besteht somit wieder aus dem Kernsiedlungsgebiet und dem Ergänzungsgebiet. Jeder Agglomerationsraum ist damit ein geschlossenes und dicht besiedeltes Gebiet mit mehr als 20.000 Personen (Einwohner und Beschäftigte).



Nach Anwendung von Kriterium (1): Typ-A-Flächen (dunkel): Dichte > 65/0,25km²), und Typ-B-Flächen (hell): Dichte > 400/0,25km²)	Nach Anwendung der Kriterien (2) Verhältnis Typ-B-Fläche zu Typ-A-Fläche sowie (3) Größe

Abb. 6: Identifikation von Kernsiedlungsgebieten bei 2 Dichteschwellenwerten
Quelle: Statistik Austria, Volkszählung, 2001; Arbeitsstättenzählung 2001; eigene Darstellung

4. PERSPEKTIVEN ZUR WEITERENTWICKLUNG DER RASTER BASIERTEN DEFINITION

Welche methodischen Verbesserungen bietet der hier vorgestellte Raster basierte Ansatz?

- sehr genaue Abbildung von Dichte im Kernsiedlungsgebiet

Selbstverständlich sollten hierzu noch weitere Sensitivitätsanalysen bezüglich der Rastergröße angestellt werden, um zu bewerten, wie unterschiedliche geographische Bedingungen wie Flussläufe, Geländestufen, unterschiedliche Siedlungsformen, etc. am besten berücksichtigt werden können.

- präzise Operationalisierung von 'Geschlossenheit des Kernsiedlungsraumes'

Durch die Raster basierte Abbildung der Dichte lassen sich topologische Kriterien wie Nachbarschaft oder Dichteverhältnisse in einer bestimmten Distanz zu einer Rasterzelle problemlos darstellen.

- verbesserte kartographische Möglichkeiten der Abbildung des Agglomerationsraumes sowie der Außenzone

Der Siedlungsraum kann generell auf Rasterbasis definiert werden, sodass sowohl der Agglomerationsraum wie auch die Außenzone möglichst genau kartographisch dargestellt werden können. Auch Möglichkeiten der Generalisierung bieten sich durch die Aggregation von Inhalten von kleineren auf größere Rasterzellen an.

- verbesserte Definition der Außenzone

Sobald auch Pendlerstatistiken auf Rasterbasis zur Verfügung stehen, lässt sich die räumliche Verteilung von Pendlerbeziehungen genauer abbilden, als dies derzeit auf Basis der Gemeindedaten möglich ist. Vermutlich stehen solche Daten in Kürze von Seiten der Statistik AUSTRIA zur Verfügung.

Vor allem die *interaktiv definierte Variante B* verdeutlicht

- die realitätsnahe und verbesserte Abbildung von polyzentrischen Agglomerationsräumen durch die Integrierung von zwei Dichte-Schwellenwerten
- die Problem orientierte und flexible Operationalisierung der Kriterien (1), (2) und (3), wobei durch die Implementierung des Ansatzes mithilfe von MapModels zwei (benutzerorientierte) Vorteile offenbar werden: die rasche und wiederholte Testung unterschiedlicher Schwellenwerte bezüglich der drei Kriterien sowie die Anwendung der drei Kriterien auch in anderer als der hier dargestellten Reihenfolge.

Welche inhaltlichen Perspektiven bieten sich?

Die Definition von Stadtregionen dient als Instrument zur empirisch-quantitativen Betrachtung der Raumentwicklung und zur Identifikation des Verstädterung- und Verdichtungsprozesses im Rahmen der allgemeinen Siedlungsentwicklung. Damit können nicht nur Veränderungen gegenüber der Situation in früheren Jahrzehnten verglichen werden, vielmehr liefern sie die Basis für vertiefende regionalanalytische, raumwirtschaftliche oder auch soziologische Studien zu Fragen der wirtschaftlichen Umstrukturierung und des sozialen Wandels mit ihren sich ändernden Ansprüchen an den Raum.

Die Identifikation von Stadtregionen gewinnt darüber hinaus seit einigen Jahren aus raumordnungspolitischer Sicht mehrfach an Bedeutung:

- Erstens stellt sich die Frage, inwieweit städtische Agglomerationen bzw. Stadtregionen mit Vorstellungen zur Zentralität von Orten bzw. mit bestehenden Zentrale Orte Systemen (noch) korrespondieren. Fragestellungen zur Abbildung der Versorgung mit verschiedenen zentralen Einrichtungen lassen sich thematisch und räumlich in bisher nicht erreichter Genauigkeit behandeln.
- Zweitens wurden im Zuge des europäischen Integrationsprozesses auf europäischer Ebene im Rahmen von ESPON so genannte FUA's (functional urban areas) abgegrenzt. Dabei stand bei der Definition die Vergleichbarkeit zwischen den Staaten im Vordergrund gegenüber einer sorgfältigen Diskussion auf nationaler Ebene. Eine sorgfältige Überprüfung und gegebenenfalls Modifikation angesichts nationaler Besonderheiten des Stadtsystems wäre daher sinnvoll.
- Drittens wurde über das EUREK (Europäische Kommission, 1999) der Begriff/die Konzeption der polyzentrischen Siedlungsentwicklung eingeführt. Aus raumordnungspolitischer Sicht Österreichs stellt sich daher die Frage, inwieweit in Österreich metropolitane Stadtregionen als Bestandteil eines leistungsfähigen zentraleuropäischen Städtenetzwerkes identifiziert werden können. Gleichzeitig ist die Frage zu klären, welche polyzentralen Strukturen und stadtregionalen Verflechtungen innerhalb Österreichs (auch unter Berücksichtigung von benachbarten Grenzstädten) bestehen, um nationale Strategien zur Förderung eines hierarchisch differenzierten Stadtsystems zu entwickeln und die stadtregionale Entwicklung auf verschiedenen räumlichen Ebenen zu stärken.

5. LITERATUR

Benedikt J., Reinberg S. und Riedl L. (2002): "A GIS application to enhance cell-based information modeling" veröffentlicht in: International Journal of Information Sciences 142 (2002) pp151-160, Elsevier.

Boustedt O. (1975) Grundriss der empirischen Regionalforschung. Teil III: Siedlungsstrukturen. Hannover: Hermann Schroedel Verlag

ESPON (2004) 111 – Final Report, Potentials for polycentric Development in Europe. auf //www. espon.lu/online/documentation/projects/thematic/1873/fr-1.1.1_revised.pdf, gesehen am 9.1.2001.

Europäische Kommission (1999) Europäisches Raumentwicklungskonzept – EUREK, Luxemburg

Fuchs I. (1997a) Stadtregionen 1991 – Das Konzept. In Statistische Nachrichten 2/1997, S. 76 – 83.

Fuchs I. (1997b) Stadtregionen 1991 – Ausgewählte Grunddaten. In Statistische Nachrichten 5/1997, S. 324 – 338.

Geyer H.S. (2002) International Handbook of Urban Systems. Cheltenham: Edward Elgar Publ. Inc.

Kaufmann A. (1973) Abgrenzung von Stadtregionen. Wien: (= Band 12 aus dem Institut für Stadtforschung).

Klemmer P. (1971) Der Metropolisierungsgrad der Stadtregionen. Hannover: Jaenicke Verlag (= Veröffentlichungen der ARL, Band 62).

Loibl W., Giffinger R. und Sedlacek S. (Hrsg.) (2002) STAU-Wien: Stadt-Umlandbeziehungen in der Region Wien – Siedlungsentwicklung, Interaktionen und Stoffflüsse. Endbericht - Teil B: Daten, Theorie, Methoden und Ergebnisse; ARC Seibersdorf research Report, ARC-S-0181b, BV, 197 Seiten.

N.U.R.E.C. (1994) Atlas of Agglomerations in the European Union. Network on Urban Research in the European Union (formerly European Community), Duisburg, Vol. I.

Riedl L. und Kalasek R. (1998): "MapModels - Programmieren mit Datenflußgraphen", in: Strobl, Dollinger (Hrsg.): Angewandte Geographische Informationsverarbeitung; Beiträge zum AGIT-Symposium Salzburg 1998; Wichmann Verlag Heidelberg, 1998.

Tönnies G. (2002) Entwicklungstendenzen der Siedlungsstruktur: Konzentrations- und Dispersionsprozesse. In Blotevogel H.H. (Hrsg.) Fortentwicklung des Zentrale-Orte-Konzepts. ARL Forschungs- und Sitzungsberichte 127, Braunschweig: VSB.

Städtisches Grünvolumen – neuer Basisindikator für die Stadtökologie? Bestimmungsmethodik und Ergebnisbewertung

Gotthard MEINEL, Robert HECHT, Wolfgang SOCHER

(Dr. Gotthard Meinel, Leibniz-Institut für ökologische Raumentwicklung e. V., Weberplatz 1, 01217 Dresden, G.Meinel@ioer.de; Robert Hecht, Leibniz-Institut für ökologische Raumentwicklung e. V., Weberplatz 1, 01217 Dresden, R.Hecht@ioer.de;
Wolfgang Socher, Umweltamt der Landeshauptstadt Dresden, Postfach 120012, 01001 Dresden, WSocher@dresden.de)

1. PROBLEM

Städtisches Grün ist unverzichtbar und erfüllt direkt und indirekt elementare ökologische Funktionen (Biotopfunktion, CO2-, O2-Bilanz, Temperatursenkung, Staubfilterung, Grundwasserneubildung etc.). Durch Baumschatten und Verdunstungskälte mindert es das Aufheizen versiegelter Flächen. Zudem bilden Parkanlagen Oasen der Ruhe und Erholung und erfüllen somit eine soziale Funktion. Laut Umfrage (bundesweite Umfrage der Bürgerzufriedenheit mit kommunalen Grünflächen 2004) suchen 23 % der Bevölkerung täglich und 53 % 1- bis 3-mal wöchentlich Grün- und Parkanlagen auf.

Wegen der Bedeutung des Stadtgrüns werden seitens der Stadtplanung zunehmend Indikatoren für eine quantitative Beschreibung der Vegetation gesucht. Als Pendant zu den Indikatoren der baulichen Nutzung wie der Grundflächenzahl (GRZ) und der Geschossflächenzahl (GFZ) können das die vegetationsbezogenen Indikatoren Biotopflächenfaktor (BFF), Bodenfunktionszahl (BFZ), Durchgrünungsgrad oder die Grünvolumenzahl (GVZ) mit ihrer ökologischen Aussagekraft sein (u. a. Heber 1993, Kenneweg 2002). Der in Forst und Landwirtschaft häufig verwendete Blattflächenindex (LAI) ist für Fragestellungen in der Stadtumweltplanung weniger aussagekräftig, berücksichtigt er doch nicht die Vegetationshöhe, die aber für viele Wirkungen von Vegetation in der Stadt wie Lärmminderung, Staubbindung, Verdunstung, Beschattung und auch die Erholung bedeutungsvoll ist.

Während für den Grünflächenanteil (Durchgrünungsgrad) eine zweidimensionale Erfassung ausreicht, ist für die Berechnung des Grünvolumens zwingend eine dreidimensionale Erhebung erforderlich. Teilweise von den Städten geführte Baumkataster können zwar eine Datengrundlage von Grünvolumenerhebungen sein, erfassen den Baumbestand aber nur sehr selektiv (meist nur Straßenbäume). Flächendeckende städtische Grünkartierungen sind sehr kosten- und zeitaufwändig, sodass eine Grünvolumenkartierung in der Praxis nur für wenige lokale Planungsvorhaben erfolgt. In der Stadtplanung werden daher vereinfachend Grünvolumen in Abhängigkeit der zugrunde liegenden Bedeckungsart von Bezugsflächen geschätzt (Arlt et al. 2003). Diese konventionellen Verfahren besitzen aber einen hohen Verallgemeinerungsgrad, da sie nur auf repräsentative Einzelflächenaufnahmen mit einer anschließenden Extrapolation auf die Fläche beruhen.

Im Zuge der zunehmenden Verfügbarkeit dreidimensionaler Messungen auf Laserscannerbasis scheint es sinnvoll, derartige Daten zur Bestimmung städtischen Grünvolumens zu verwenden. Problematisch ist, dass städtische Laserscannerbefliegungen zur Erstellung eines hochwertigen Geländemodells (wo Vegetation störend wirkt) zu 90 % in laubfreier Zeit stattfinden. Fraglich war es nun, ob das Messsignal trotz der fehlenden Vegetation ausreichend ist, um die Vegetation zu rekonstruieren, denn allein für die laserscanbasierte Aufnahme städtischer Vegetationshöhen fehlen den Kommunen die finanziellen Mittel.

Nach dem Elbe-Hochwasser erfolgte im Dezember 2002 im Auftrag des Stadtvermessungsamtes Dresden eine Laserscannerbefliegung der Stadtfläche Dresdens. Da das Ziel in der Erstellung eines hochgenauen Digitalen Geländemodells (DGM) als Grundlage für Hochwassermodellierungen bestand, wurde die erste (Firstpulse) und letzte Reflexion (Lastpulse) des Lasersignals zwar aufgezeichnet, aber aus Kostengründen und da vom Auftraggeber nicht ausdrücklich gefordert nur der Lastpulse prozessiert. Da gerade der Firstpulse ein wichtiges Vegetationshöhensignal liefert, gingen wichtige Informationen verloren. Mit dieser suboptimalen Datenlage liegen allerdings typische Ausgangssituationen vor, die die nachfolgenden Arbeiten praxisnahe und sinnvoll erscheinen lassen.

2. METHODIK DER BESTIMMUNG STÄDTISCHEN GRÜNVOLUMENS

Grundlage der Untersuchungen war eine Laserscanbefliegung der Stadt Dresden im Dezember 2002 mit einem Optech ALTM 1225 (rotierender Spiegel) der Firma Topscan mit einer Punktdichte von 1,1 Punkten/m² (TopScan, Projektbericht, 2002). Neben den Messpunkten (nur Lastpulse), die klassifiziert waren nach Bodenpunkten, Oberflächenpunkten, Kunstbauten und Stabilisierungspunkten wurden seitens der Firma auch ein mittels der Software SCOP++ aus den Bodenpunkten interpoliertes Digitales Geländemodell (DGM) und ein aus allen Messpunkten mittels Maximalfilter berechnetes Digitales Oberflächenmodell (DOM) jeweils in einer Rasterweite von 1 m geliefert.

Zur Analyse des Laserantwortverhaltens in verschiedenen Vegetationstypen wurden für ein 520 x 514 m großes Untersuchungsgebiet Vegetationshöhen auf Basis von hochauflösenden Luftbildern photogrammetrisch gemessen und anschließend zu einem normalisierten Oberflächenmodell der Vegetation (Referenz-Vegetations-nDOM) interpoliert. Über die Aufnahme von Referenzflächen für drei Hauptvegetationstypen (Strauch, Nadelbaum, Laubbaum) konnten die Laserscannerdaten dann evaluiert werden.

Hauptproblem der Bestimmung des Grünvolumens aus Laserscandaten laubfreier Befliegungszeit ist das ungenügende Reflexionssignal von Laubbäumen. Der Laserstrahl wird durch das wenig dichte Astwerk von Laubbäumen häufig erst von unteren Zweigen, dem Stamm oder auch überhaupt nicht reflektiert. Andererseits wird die Oberfläche und damit das Volumen von Nadelbäumen und Sträuchern sehr gut wiedergegeben (Meinel & Hecht 2004). Tabelle 1 zeigt die stark unterschiedlichen Messergebnisse für die Vegetationsarten Sträucher, Nadel- und Laubbaum im Vergleich zu einer photogrammetrischen Referenzmessung. Letztere werden bei der Nutzung des originalen Lasersignals in der Höhe um 64 % und in Volumen gar um 93 % unterschätzt.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

Vegetationstyp	Strauch (<3 m)	Nadelbaum (3-30 m)	Laubbaum (3-30 m)
Anzahl Referenzflächen	28	32	67
Referenzflächen [m²]	977	1 924	34 476
Mittlerer Quotient Laseroberflächen-/Lasergesamtpunkte [%]	52,0 (23,6)	89,4 (7,5)	5,5 (4,3)
Mittlere Referenzmesspunkthöhe [m]	2,4 (1,6)	12,7 (5,6)	15,6 (5,0)
Mittlere Lasermesspunkthöhe der Oberflächenpunkte [m]	2,2 (1,2)	13,2 (5,3)	5,6 (6,5)
Mittleres Referenz-Grünvolumen der Referenzflächen [m³/m²]	1,6 (0,7)	11,2 (4,3)	10,9 (5,0)
Mittleres Lasergrünvolumen der Referenzflächen [m³/m²]	1,4 (0,7)	11,4 (3,5)	0,8 (0,5)
Mittlere Volumendifferenz der Referenzflächen [m³/m²]	+0,2	-0,2	+10,2
Spezifisches Referenz-Grünvolumen über alle Flächen [m³/m²]	1,80	12,13	14,63
Spezifisches Lasergrünvolumen über alle Flächen [m³/m²]	1,41	11,74	0,70
Spezifische Volumendifferenz über alle Flächen [m³/m²]	+0,39	+0,39	+13,92

Tab. 1: Referenz- und Lasermodell im Vergleich auf Basis von typendifferenzierten Referenzflächen (Standardabweichungen in Klammern)

Andererseits ergibt der Quotient aus der Anzahl von Laseroberflächenpunkten und der Gesamtzahl aller Laserpunkte in einem lokalen Fenster von 6 m (entspricht der relativen Punktdichte) sowie die Höhe der Oberflächenpunkte ein gutes Kriterium der Trennung der verschiedenen Vegetationsbestände. Abbildung 1 zeigt die drei Hauptvegetationsarten in dem von „Vegetationshöhe" und berechneter „relativer Punktdichte" aufgespannten Merkmalsraum. Messpunkte in Sträuchern zeichnen sich durch eine geringe Höhe und eine weite Spannbreite von Oberflächenpunktdichten aus. Oberflächenpunkte im Baumbestand sind in der Regel über 2 Meter hoch, während der Laubbaumbestand mit dem Kriterium „relative Punktdichte" gut von dichtem Nadelbaumbestand getrennt werden kann.

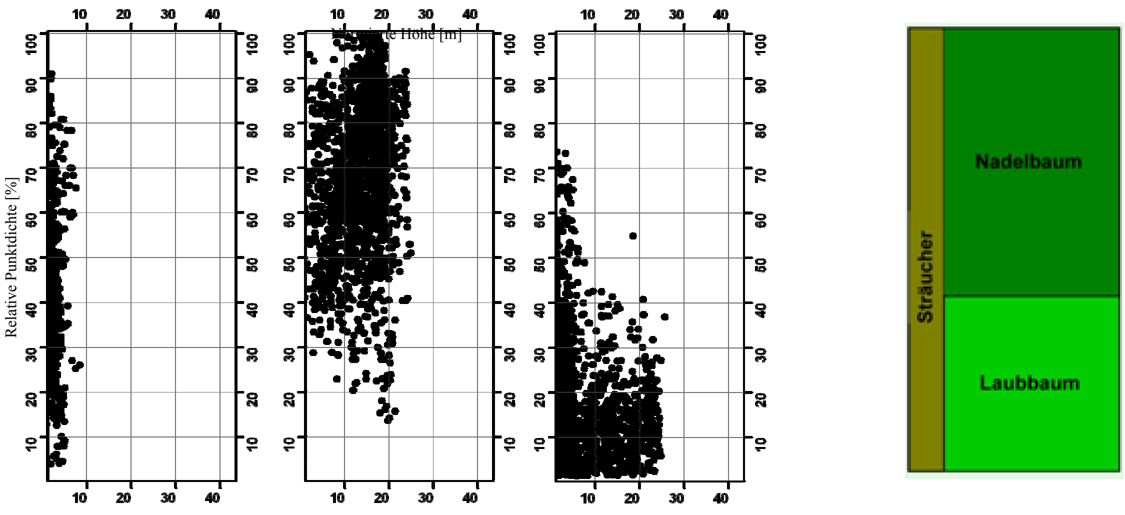


Abb. 1: Verteilung der Vegetationsarten Strauch (links), Nadelbaum (Mitte) und Laubbaum (rechts) im zweidimensionalen Merkmalsraum sowie schematische Darstellung der Vegetationstrennung

Die derart getrennten Vegetationsbestände müssen somit unterschiedlich rekonstruiert werden. Dafür bieten sich Zylinder an, welche mithilfe jeweils lokal ermittelten Indikatoren in Zylinderhöhe und -radius gesteuert werden. Diese werden für jeden Oberflächenpunkt im Laubbaumbestand in das interpolierte Laser-nDOM gesetzt. Der virtuelle Zylinderradius kompensiert dabei den Flächenverlust, während die virtuelle Zylinderhöhe dem „Höhenverlust" entgegenwirkt.

Da die Klassifizierung der Oberflächenpunkte in Vegetationstypen keine scharfen Grenzen aufwiesen (Abb. 1), erfolgte die Definition unscharfer Mengen (Fuzzy-Mengen) für die Klassifizierung (Meinel & Hecht 2005). Die Zugehörigkeitsfunktionen wurden jeweils für die relative Punktdichte und die normierte Höhe aufgestellt. Mithilfe der Fuzzy-Logik lassen sich dann regelbasiert die Zylinder in Höhe und Radius über die Eingangsgrößen relative Punktdichte und normierte Höhe für jeden Oberflächenpunkt steuern. Eine Regel des Fuzzy-Modells zur Radiussteuerung wäre z. B.: „Wenn die normierte Höhe hoch und die relative Punktdichte niedrig ist, dann konstruiere einen großen Zylinderradius" (Laubbaumrekonstruktion); „Wenn die normierte Höhe sehr niedrig und die relative Punktdichte hoch ist, dann konstruiere keinen Zylinderradius" (Strauchwerk – benötigt keine Rekonstruktion). Da es zu räumlichen Überschneidungen der Zylinder kommt, werden diese nach dem Prinzip der Höhendominanz in das Vegetations-nDOM gesetzt. Die Aufstellung der Zugehörigkeitsfunktionen, der Regeln und der Ausgangsvariablen erfolgte auf Basis der in Abbildung 1 gezeigten empirischen Erhebungen. Durch Ausschlusskriterien (z. B. ein Laubbaum ist mindestens 2,5 Meter hoch) und Optimierungen auf Basis der Referenzmessungen erfolgte ein wissensbasierter Eingriff in die initialen Fuzzy-Modelle.

Im Ergebnis des komplexen Rekonstruktionsverfahrens wurden die in Tabelle 2 gezeigten Ergebnisse erzielt.

Vegetationstyp	**Strauch (<3 m)**	**Nadelbaum (3-30 m)**	**Laubbaum (3-30 m)**
Referenz Grünvolumen in Summe [m³/m²]	1,80	12,13	14,63
Unkorrigiertes Laser-Grünvolumen in Summe [m³/m²]	1,41	11,75	0,70
Korrigiertes Laser-Grünvolumen in Summe [m³/m²]	1,84	12,09	14,60
Volumendifferenz im Vergleich zur Referenz [m³/m²]	-0,04	0,04	0,03

Tab. 2: Korrigiertes Laser-Grünvolumen im Vergleich zur Referenz

Die Ergebnisse zeigen die Volumendifferenz im Vergleich des 2,5-dimensionalen Referenzmodells und lassen die Kronenform vorerst unberücksichtigt, um die Vergleichbarkeit zu gewährleisten. Da zumindest die meisten Laubbäume eine mehr kugel- als zylinderförmige Krone besitzen, musste in dem Laumbaumbestand noch mit einem Abschlagsfaktor gearbeitet werden, der aus der mittleren Silhouette von Laubbäumen über die Statistik des Laubbaumbestandes der Stadt Dresden ermittelt wurde (0,63). Dieser Abschlagsfaktor wurde in das Fuzzymodell zur Berechnung der Zylinderhöhe integriert, wird allerdings nur für den Laubbaumbestand wirksam.

Die Datenprozessierung erfolgte für das gesamte Stadtgebiet Dresden. Zur Eliminierung anthropogener Objekte, wie Gebäude, Fahrzeuge etc. wurde eine Vegetationsmaske auf Basis eines Luftbildes erzeugt, und es wurden nur die Oberflächenpunkte übernommen, welche dem Typ Vegetation angehörten. Durch die geringe Höhe von Rasen und Wiese werden diese nicht im Lasersignal vom Bodensignal getrennt und somit nicht erfasst. Andererseits machen Rasen- und Wiesenflächen einen erheblichen Teil der Stadtfläche aus (im Mittel 50 % Flächenanteil in deutschen Kernstädten, Arlt 2003). Um auch diese Flächen im Grünvolumen zu berücksichtigen, wurden sie auf Basis des Vegetations-nDOM, der erzeugten Vegetationsmaske und der Stadtstrukturtypenkarte Dresden erfasst und mit einer konstanten Höhe von 0,1 m (Großmann 1984) versehen. Die Ackerschläge, die bei laubfreien Laserscanbefliegungen in ihrer Vegetationshöhe nicht erfassbar sind, wurden ebenfalls auf Basis des Vegetations-nDOM, der Vegetationsmaske und der Stadtstrukturtypenkartierung in ihrer Flächenausdehnung erfasst und mit einer konstanten Vegetationshöhe von 0,5 m versehen. Da in der Literatur kein mittlerer Vegetationshöhenwert für Ackerflächen gefunden werden konnte, entspricht der Wert einer Abschätzung, die sowohl die unterschiedlichen Fruchtarten als auch die starke saisonale Veränderung im Jahreslauf berücksichtigt. Das Vegetations-nDOM wurde für die entsprechenden Flächen mit den mittleren Vegetationshöhen beaufschlagt.

Der Arbeitsablauf erfolgte mithilfe von AML-Programmen (Arc Macro Language) in ArcGIS, welche die Prozessierungsschritte angesichts der 330 Mill. Laserpunkte blockweise abarbeiten. Den Verfahrensablauf zeigt Abbildung 2. Als Ergebnis liegt ein rasterbasiertes Vegetations-nDOM mit einer räumlichen Auflösung von 1 m vor. Durch Verschneidung der Geometrien der digitalen Blockkarte 1 : 5 000 wurden den Baublöcken die Attribute des Grünvolumens und der Grünflächenanteile übergeben.

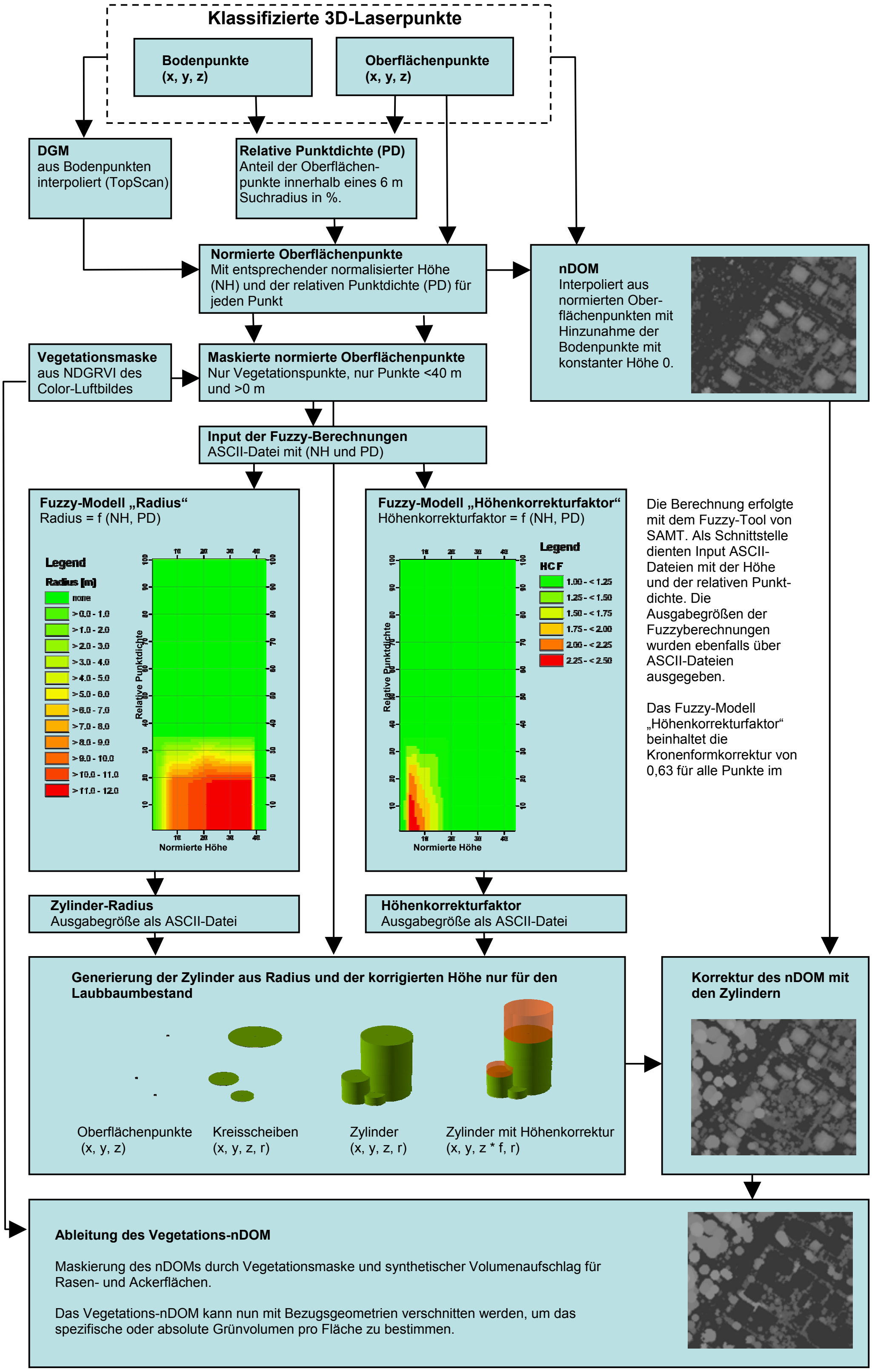


Abb. 2: Verfahren zur Berechnung eines Vegetations-nDOM auf Basis von Laserscannerdaten

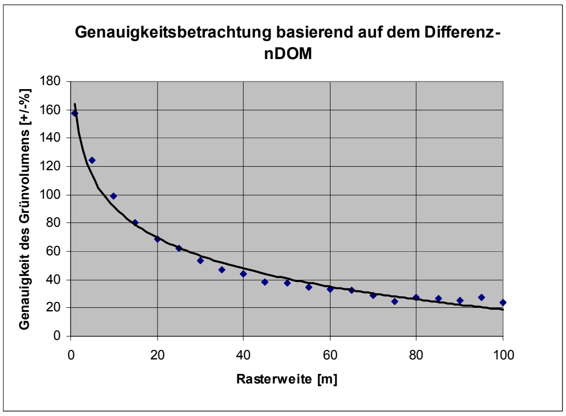
3 GENAUIGKEIT DER ERGEBNISSE DER GRÜNVOLUMENBESTIMMUNG

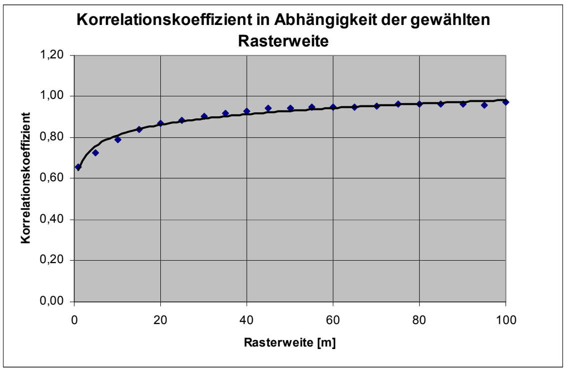
Die Bestimmung der Genauigkeit des Vegetations-nDOM ist angesichts der nur sehr begrenzt zur Verfügung stehenden Referenzdaten schwierig. So standen weder flächendeckende Daten einer Laserscanbefliegung aus der Vegetationsperiode zur Verfügung und das auf Luftbildbasis photogrammetrisch ermittelte Referenz-Vegetations-nDOM deckt nur 0,08 % der Gesamtfläche Dresdens ab. Die Verwendung dieses Referenzmodells für eine Teilfläche von 25 ha wurde zur Modellkalibrierung benutzt und war für die Genauigkeitsbestimmung darum nur bedingt einsetzbar. Genauigkeitskontrollen konnten aber auf Basis von verorteten Straßenbäumen des Baumkatasters durchgeführt werden. Hier kam es zu einer Unterschätzung des Grünvolumens in Höhe von 30 %, welche auf die in der Regel doch relativ niedrigen und kleinkronigen Bäume im Verkehrsraum zurückzuführen ist. Weiterhin wurden Vergleiche mit dem Forst-GIS (FGIS) und der gekoppelten Walddatenbank durchgeführt, die allerdings nur Daten für die Waldflächen der Stadt beinhaltet. Das Grünvolumen aus dem FGIS wurde aus den sehr komplex strukturierten Daten (Schichthöhen, mittlerer Bestandesschluss, Anteil bestandener Fläche) ermittelt und sind daher nur bedingt mit den Laserscannerdaten vergleichbar. Hier ergab sich eine Unterschätzung des Grünvolumens von 19,4 %.

Im Ergebnis der Untersuchungen muss festgestellt werden, dass durch die suboptimalen Aufnahmebedingungen des Laserfluges für die Vegetationsbestimmung keine sichere Erkennung und Rekonstruktion von Einzelbäumen erfolgen kann. Hier sind die Grenzen insbesondere bei den einzeln stehenden und häufig auch nur kleinen Straßenbäumen schnell erreicht (es wurden nur 3 478 der 6 809 Bäume erfasst, 51 %). Für eine sichere Erkennung auch dieses Baumbestandes müssen First- und Lastpulse einer Laserscanbefliegung (möglichst in der Vegetationsperiode) vorliegen.

Das Differenzmodell (Laser-Vegetations-nDOM – Referenz-Vegetations-nDOM) des Untersuchungsgebietes soll Aufschluss über die Genauigkeiten geben. Es wird dabei deutlich, dass in dem berechneten Vegetations-nDOM mit einer Rasterzellenauflösung von 1 m örtlich mit erheblichen Fehlern gerechnet wird. Über größere Flächeneinheiten aber mittelt sich hier der Fehler aus und es ist eine recht genaue Angabe des Grünvolumens möglich, wie Tabelle 3 zeigt.

Rasterweite [m]	Zellgröße [m²]	Standardabweichung des Differenz-nDOM [m³/m²]	Korrelationskoeffizient
1	1	6,2 (158 %)	0,65
5	25	4,9 (125 %)	0,73
10	100	3,9 (99 %)	0,79
15	225	3,2 (80 %)	0,84
20	400	2,7 (69 %)	0,87
25	625	2,4 (62 %)	0,89
30	900	2,1 (53 %)	0,91
35	1 225	1,9 (47 %)	0,92
40	1 600	1,7 (44 %)	0,93
45	2 025	1,5 (38 %)	0,94
50	2 500	1,5 (37 %)	0,94
55	3 025	1,4 (35 %)	0,95
60	3 600	1,3 (33 %)	0,95
65	4 225	1,3 (32 %)	0,95
70	4 900	1,2 (29 %)	0,95
75	5 625	1,0 (25 %)	0,97
80	6 400	1,1 (28 %)	0,96
85	7 225	1,0 (27 %)	0,96
90	8 100	1,0 (25 %)	0,96
95	9 025	1,1 (28 %)	0,96
100	10 000	0,9 (24 %)	0,97





Tab. 3: Standardabweichung des Differenz-nDOM und Korrelation zwischen dem Laser- und Referenz-Vegetations-nDOM in Abhängigkeit der Rasterweite

Sehr deutlich werden mit zunehmender Rasterweite (und damit gröberer geometrischer Auflösung) die Verringerung des Fehlers und die zunehmende Korrelation mit der Referenzerhebung. Ab einer Fläche von 1 ha ist der Fehler nur noch minimal. Darum ist eine sinnvolle Bezugseinheit für die Berechnung des Grünvolumens der Baublock mit seiner mittleren Größe von 1,5 ha, der als Basisgeometrie den Städten zur Verfügung steht und eine genügend kleinteilige Bestandsanalyse und Planung ermöglicht. Auch ist die Genauigkeit des ermittelten Grünvolumens stark von der vorliegenden Vegetation abhängig. Bei einer komplett mit Nadelbäumen oder Sträuchern bestandenen Fläche kann man mit sehr geringen Abweichungen rechnen, da für diese Flächen kaum Volumenkorrekturen notwendig sind. Abbildung 3 zeigt das Untersuchungsgebiet im Vergleich von Referenzerhebung und Endergebnis der laserscanbasierten Berechnung.

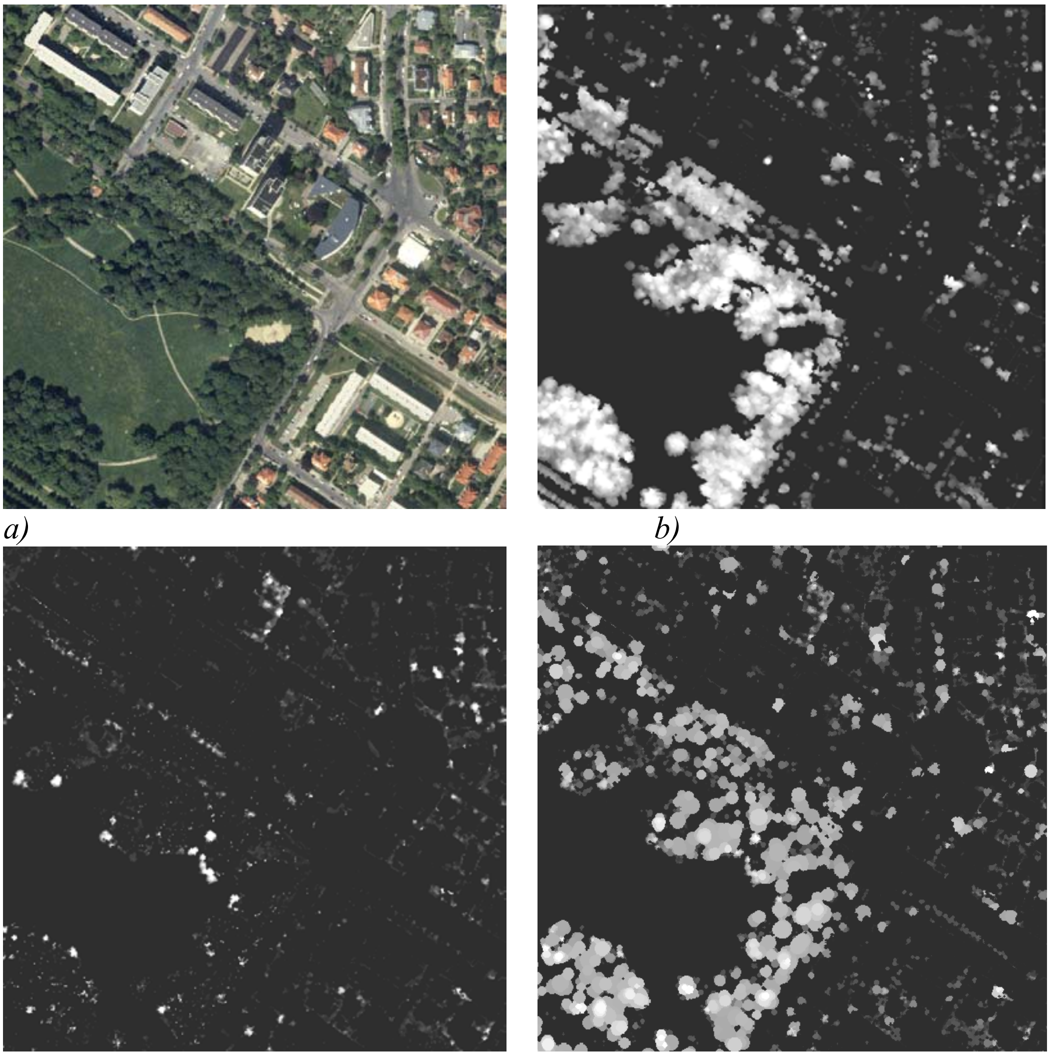


Abb. 3: Untersuchungsgebiet Bertolt-Brecht-Platz: a) Luftbild (August 2002), b) photogrammetrisch erhobenes Referenz-Vegetations-nDOM, c) unkorrigiertes laserbasiertes Vegetations-nDOM, d) korrigiertes laserbasiertes Vegetations-nDOM

4 GRÜNVOLUMEN STÄDTISCHER STRUKTURTYPEN

Im Ergebnis einer Verschneidung des rasterbasierten Vegetations-nDOM und der digitalen Baublockkarte der Stadt Dresden wurden für jeden der 16 743 Blöcke der Stadt das absolute und das spezifische (flächenbezogene) Grünvolumen sowie der Grünvolumen- und der Vegetationsflächenanteil getrennt für die Vegetationstypen Rasen/Wiese, Acker, niedrige (Sträucher), hohe lockere (Laubbäume) und hohe dichte (Nadelbäume) berechnet und auch in Kartenform ausgegeben.

Auf Basis der digitalen Blockkarte werden für stadtökologische Untersuchungen seit Jahren alle Blöcke im Auftrag des Umweltamtes der Stadt Dresden auf Basis von Satelliten- bzw. Luftbilddaten einem vorherrschenden Stadtstrukturtyp zugeordnet (Meinel & Hennersdorf 2004). Da hierbei das Flächendominanzprinzip Anwendung findet, können z. B. auch Ackerflächen geringe Bebauungsanteile oder Wasserflächen auch Grünflächen enthalten. Die Auswertung der Parameter für typische Stadtstrukturen zeigt Tabelle 4.

Stadtstrukturtyp	**Spez. GV [m³/m²]**	**SD spez. GV [m³/m²]**	**Max. spez. GV [m³/m²]**	**Min. spez. GV [m³/m²]**	**Flächenanteil hohe Vegetation [%]**	**Flächenanteil Vegetation gesamt [%]**
Geschlossene Blockbebauung	0,40	0,34	1,24	0,0	4,5	15,9
Offene Blockbebauung	1,20	0,91	6,85	0,08	13,9	37,3
Zeilen-/Reihenhausbebauung	0,96	0,71	5,47	0,0	11,5	44,3
Einzel-/Doppelhausbebauung	1,50	1,30	10,70	0,0	19,4	55,2

Mischformen[1]	1,17	1,10	8,96	0,0	14,1	42,6
Großflächige Bebauung	0,56	0,61	5,55	0,0	6,7	28,5
Sport-/Freizeitanlagen	1,79	1,53	8,80	0,39	16,2	56,5
Kleingärten	1,03	0,67	5,24	0,25	16,8	63,2
Gleisanlagen	1,05	1,62	10,59	0,0	11,8	47,4
Acker	1,20	1,16	7,05	0,47	6,9	98,5
Grünland/Gärtnereien	1,28	1,81	13,12	0,0	13,2	70,9
Parkanlagen/Zoo	3,76	2,58	13,63	0,17	32,8	79,6
Friedhöfe	4,08	1,67	8,94	1,12	39,8	83,3
Wald	7,90	4,31	19,71	0,26	58,1	91,4
Wasserflächen	2,30	3,21	19,54	0,0	21,2	33,1
Abgrabungen/Aufschüttungen	0,67	0,63	1,90	0,09	7,1	51,2
Baustellen	0,40	1,07	5,32	0,0	3,4	51,0
Verkehrsflächen, Garagen	0,45	0,88	7,85	0,0	5,2	31,8
Brachflächen	0,54	0,50	1,80	0,0	7,0	35,1
Blockrestflächen[2]	1,28	2,13	22,90	0,0	11,8	33,1

Tab. 4: Grünvolumen (GV) in Abhängigkeit vom Stadtstrukturtyp – Auswertung für die Stadt Dresden

Die Auswertung der Tabelle 4 führt zu folgenden Schlussfolgerungen:

- Der Grünvolumenbeitrag von Kleingärten ist mit einem mittleren spezifischen Grünvolumen von 1,02 m³/m² geringer als das vieler Bebauungstypen wie der offenen Blockbebauung (1,2 m³/m²), der Einzel-/Doppelhausbebauung (1,50 m³/m²) sowie von Mischformen der Bebauung (1,17 m³/m²).
- Das spezifische Grünvolumen der geschlossenen Bebauung ist erwartungsgemäß am geringsten (0,40 m³/m²), gefolgt von der großflächigen Bebauung (0,56 m³/m²).
- Das größte spezifische Grünvolumen erreichen Waldflächen (7,90 m³/m²).
- Das spez. Grünvolumen von Friedhöfen liegt mit 4,08 m³/m² noch über dem von Parkanlagen (3,76 m³/m²). Auch der Flächenanteil hoher Vegetation ist in Friedhöfen größer als in Parkanlagen, die häufig auch über Rasen- und Wiesenflächen verfügen.
- Das hohe spez. Grünvolumen von 2,3 m³/m² von Wasserflächen ist durch vegetationsbestandene Randflächen sowie dem Kronenüberstand bei baumbestandenen Ufersäumen schmaler Fließgewässer zu erklären.
- Das spezifische Grünvolumen von Ackerflächen beträgt 1,20 m³/m² und liegt damit über dem zu erwartenden von 0,5 [m³/m²]. Diese Abweichung nach oben wird wiederum durch die Integration auch von baumbestandenen Flächen in Ackerflächen erklärt (Flächendominanzprinzip).
- Auch der Wert für Gleisanlagen liegt mit 1,05 m³/m² unerwartet hoch und ist auf Begleitgrün am Rand der Gleisanlagen zurückzuführen.
- Das spezifische Grünvolumen der Blockrestflächen, die in Dresden aufgrund der Nettoblockabgrenzung nur Straßenflächen darstellen, ist mit 1,28 m³/m² ungewöhnlich hoch. Dieser Wert erklärt sich aus den sehr kleinen meist schmalen Straßenflächen, die häufig durch Straßenbäume überkront sind und so im Mittel zu hohen spezifischen Grünvolumenwerten führen.

Die Auswertung der Grünvolumenkarten für die Stadt Dresden ergab die folgenden Fakten:

Das spezifische Grünvolumen über die gesamte Stadtfläche Dresdens beträgt 3,08 m³/m². Das Grünvolumen der Stadt Dresden im Jahr 2002 setzt sich etwa aus 48 % Laub-, 46 % Nadelbäumen und 6 % Strauch-, Rasen- und Ackerflächen zusammen. Die grüne Lunge Dresdens ist die Dresdener Heide. Durch ihre große Fläche und ihrem Bestand an hohen Nadelgehölz stellt sie über 50 % des Vegetationsvolumens Dresdens, obwohl der Flächenanteil unter 25 % beträgt. 10 der 13 Blöcke mit dem größten absoluten Grünvolumen liegen in der Heide. Das Grünvolumen im Stadtzentrum Dresdens wird vom Großen Garten und vom Ostragehege gebildet, die über große baumbestandene Flächen verfügen. Andere Parkanlagen wie Wald- und Beutler Park sind lokale Grünoasen, tragen aber durch geringe Flächengrößen weniger zum städtischen Gesamtgrünvolumen bei. Die Elbewiesen tragen aufgrund weitestgehend fehlendem Baumbestand nur ganz unwesentlich zum städtischen Grünvolumen bei, sind aber natürlich für die Belüftung der Stadt ganz wesentlich. Interessant ist insbesondere der Vergleich des neuen Informationslayers Grünvolumen zu dem bekannten Layer Vegetationsflächenanteil. Während in einer Ansicht des zweidimensionalen Grünflächenanteils der Elbesaum durch eine sehr starke Begrünung gekennzeichnet ist, wird in der Grünvolumenansicht deutlich, dass der Uferbereich kaum zum Grünvolumen der Stadt beiträgt. Abbildung 4 zeigt eine 3D-Ansicht des spezifischen Grünvolumens und des Grünflächenanteils der Blöcke des Dresdner Stadtzentrums.

[1] Stadt- und Wohngebietszentren, alte Ortskerne, historische Gebäude, Bildung/Erziehung, Verwaltung, Medizin, Wohnheime

[2] Im Wesentlichen Straßenflächen

Abb. 4: 3D-Darstellung des spezifischen Grünvolumens (links) und des Grünflächenanteils (rechts) auf Baublockbasis des Stadtzentrums Dresdens

5 ANWENDUNG UND NUTZEN DER GRÜNVOLUMENINFORMATION FÜR DIE PLANUNG IN DRESDEN

Bisher standen flächendeckende Informationen zur Vegetation nur aus Biotoptypenkartierungen zur Verfügung und lieferten qualitative Angaben insbesondere zur Klassifizierung von Flächen, jedoch keine quantitativen zur Grünmasse oder dem Grünvolumen. Das spezifische Grünvolumen liefert somit in Verbindung mit dem Grünflächenanteil planerisch sinnvollere Daten. Mit der hier beschriebenen Grünvolumenbestimmung werden Beiträge für die Landschafts- und Flächennutzungsplanung für die Stadt Dresden erwartet.

Gegenwärtig wird für die Stadt ein neuer Flächennutzungsplan (FNP) erarbeitet, parallel dazu als ökologische Grundlage ein neuer Landschaftsplan (LP). Wesentliche Rahmendaten für den FNP liefern Bevölkerungsprognosen für die nächsten 15 Jahre, aus der der Flächenbedarf abgeleitet wird. Aus dieser Prognose ergibt sich ab etwa 2015 ein Rückgang der Bevölkerung. Dies erfordert bei dem schon jetzt hohen Wohnungsleerstand (Landeshauptstadt Dresden 2004) und einem Brachflächenanteil von 13,8 % bezogen auf die Bauflächen der Stadt (Landeshauptstadt Dresden 2005) eine klare planerische Antwort.

Eine prioritäre Option besteht in der Attraktivierung der inneren Stadtteile als Wohnstandorte. Geht man von den Umzugsgründen aus, die die Dresdner Bürger äußern (Landeshauptstadt Dresden 2003), stehen bezüglich Wohnumfeld „Ruhe und Naturnähe“ an erster Stelle, die bisher eher in Stadtrandbereichen gesucht wurde. Unabhängig von ökologischen Fragestellungen wird dieser Entwicklung durch die Kosten für die technische und soziale Infrastruktur (hoher Fixkostenanteil!) eine Grenze gesetzt.

Mit der blockbezogenen Grünvolumenbestimmung besteht nun die Möglichkeit, sowohl Defizite als auch Potenziale der Grünausstattung blockgenau zu identifizieren. Durch die ebenfalls vorliegende blockbezogene Strukturtypenkartierung können differenzierte Aussagen zu den jeweiligen Wohnformen getroffen werden. Neben den wohngebietsnahen „Grüninseln“ können Planungen für Brachflächen auf den Weg gebracht werden, die zu einem mehr vernetzten Grünsystem führen. Durch die Aufnahme des „Schutzgutes Mensch“ in die Umweltprüfungen des Landschafts- und Flächennutzungsplanes erlangen derartige Kenntnisse auch einen neuen verfahrensrechtlichen Wert.

Abgesehen von denkmalpflegerischen Aspekten gilt auch im Umweltbereich nicht uneingeschränkt die einfache Formel „je mehr Grün, desto besser“. So ist aus stadtklimatischen Gründen die Freihaltung von Kaltluftbahnen nicht nur von Bebauung, sondern auch von Großgrün erstrebenswert. In innerstädtischen Straßenschluchten kann ein hoher Großgrünanteil durchaus zur Verschlechterung der Durchlüftung und damit zu höheren Schadstoffkonzentrationen führen. Wichtig ist hier eine sorgfältige Abwägung, die durch entsprechendes Datenmaterial erst möglich gemacht wird.

Allerdings stößt die hier vorgestellte Methodik auch an ihre Grenzen, je mehr man sich kleinräumigen Fragestellungen widmet. Aus Tabelle 3 geht hervor, dass die Genauigkeit der ermittelten Werte deutlich zurückgeht, wenn die Bezugsgeometrien kleiner als 0,16 ha (entspricht einem Raster von 40 x 40 m) sind. Für grundstücksscharfe Aussagen können die Daten deshalb nur bedingt verwendet werden, da die Genauigkeit ebenfalls stark von der vorliegenden Vegetationsart abhängt.

Ein weiterer praktischer Aspekt seitens der Planung ist die Fortschreibung der Daten. So wichtig eine einmalige Erhebung auch ist, wichtiger ist eine regelmäßige Datenfortschreibung, die Trends erkennen lässt und Schlussfolgerungen für planerisches Handeln ermöglicht. So erfordert das BauGB eine Umweltprüfung (Monitoring) der durch die Planungen verursachten Umweltauswirkungen (§ 4c BauGB). Dies dient im Wesentlichen der frühzeitigen Ermittlung nachteiliger Umweltfolgen, um durch geeignete Gegenmaßnahmen Abhilfe zu schaffen. Wünschenswert wäre hier eine verbesserte Aufgabenstellung hinsichtlich der Prozessierung für weitere Laserscan-Aufnahmen.

6 ZUSAMMENFASSUNG UND AUSBLICK

Es wurde ein Verfahren zur Grünvolumenberechnung auf Basis von Laserscannerdaten vorgestellt. Gebunden an die Geometrie der digitalen Blockkarte wurden das absolute und spezifische Grünvolumen sowie der Flächen- und Volumenanteil getrennt für die fünf Vegetationstypen „niedrig“ (Sträucher), „hohe dichte“ (Nadelbäume), „hohe lockere“ (Laubbäume), „Rasen/Wiese“ und „Ackerfläche“ ermittelt. Die Unterscheidung dieser fünf Vegetationsarten war angesichts der sehr unterschiedlichen Lasersignalcharakteristik in diesen Beständen methodisch notwendig. Sie ist aber auch angesichts der unterschiedlichen ökologischen Wirkung dieser Bestände sinnvoll. Mit diesen die gesamte Stadtfläche Dresdens abdeckenden Informationen stehen nun erstmals 3D-Vegetationsinformationen zur Verfügung. Eine erste Auswertung der blockbezogenen spezifischen Grünvolumenwerte zeigt, dass der Informationsgehalt sehr viel höher ist als der allein flächiger Betrachtungen der Vegetation. Da die Stärke der ökologischen Wirkung unmittelbar mit der Vegetationshöhe korreliert, wird durch die dreidimensionale Erhebung überhaupt erst eine differenzierte örtliche Betrachtung möglich. Einerseits können allgemeine Aussagen zum mittleren Grünvolumen städtischer Strukturtypen getroffen werden, andererseits können Gründefizitbereiche in der Stadt ermittelt und darauf bauend planerische Ziele in Landschafts- und Grünordnungsplänen präzisiert werden. Die Daten sind darüber hinaus auch für die allgemeine Stadtentwicklungsplanung, den Naturschutz und die Landespflege interessant.

Durch das große Potenzial der Laserscannerdaten und einer speziell entwickelten Korrekturmethodik ist es trotz der vegetationsfreien Aufnahmezeit und dem Fehlen der ersten Laserreflexion (Firstpulse) zu einem genauen Ergebnis gekommen, welches im Bereich der Baublockebene bedenkenlos angewendet werden kann. Die entwickelte Korrekturmethode zeichnet sich durch einen hohen Automatisierungsgrad aus und kann, sofern die Lasersystem- und Aufnahmeparameter übereinstimmen, auch leicht auf andere Gebiete übertragen werden. Die vorliegende Untersuchung hat gezeigt, dass aus einem Datenbestand, der für eine andere Aufgabenstellung, nämlich die Berechnung eines DGM und eines Gebäude-DOM, erhoben wurde, auch Daten zum Grünvolumen abgeleitet werden können. Dieses ist auch methodisch so interessant, da aus den immer noch sehr teuren Laserscannerdaten ein Mehrwert abgeleitet werden konnte und sich so eine separate Befliegung (Sommeraufnahme mit Firstpulse-Aufnahme und -prozessierung) erübrigt.

Die genausten Ergebnisse würde die Berechnung des Vegetations-nDOM aus dem DOM einer Sommerbefliegung und dem DGM einer Winterbefliegung liefern (Wagner et al. 2004). Aus akademischem Interesse wäre eine solche Studie ganz sicher interessant, ob aber die zu erwartende Genauigkeitsverbesserung im Verhältnis steht zu den Mehrkosten, ist eher unwahrscheinlich. Zudem würde aufgrund der geringeren Durchdringungsrate des Laserstrahls im Sommer im Laubbestand eine Unterscheidung des Laub- vom Nadelbaumbestand kaum mehr möglich sein. Der besondere Wert der Arbeit liegt eben genau in der Nutzung von Standarddatenmaterial der Städte, welches für die Stadtumweltplanung durch die Bestimmung der Vegetationshöhen und des Grünvolumens zusätzlich genutzt und in Wert gesetzt wird. In diesem Zusammenhang muss auch auf die hohe Dynamik der Grünvolumenänderung hingewiesen werden, die sich nicht nur durch den Jahreslauf ergibt, sondern auch durch Bau- und Pflegemaßnahmen. So werden z. B. in der Stadt Dresden jährlich rund 600 Bäume gefällt und ca. 1 000 neu gepflanzt. Da Grünflächen, aber insbesondere baumbestandene Flächen, eine starke wind- und temperatursenkende Wirkung haben, könnten die Ergebnisse einer flächigen Grünvolumenbestimmung auch Eingangsdaten für Umweltmodellierungen wie Wind- und Temperatursimulationen darstellen. Nicht zuletzt könnte die Vegetationstypen-, Vegetationshöhenaufnahme und Grünvolumenbestimmung durch das hohe Staubbindungsvermögen von Bäumen im Zusammenhang mit der EU-Luftqualitäts-Richtlinie Bedeutung gewinnen.

Die schnelle innovative Entwicklung der Laserscanneraufnahmesysteme wird in Zukunft weitere Genauigkeitssteigerungen erlauben. So wird heute teilweise schon mit einer Punktdichte von 10 Punkten/m² gearbeitet (hier noch 1,1 Punkte/m²), was natürlich die Präzision des Vegetations-nDOM wesentlich steigern würde. Die beginnende Aufzeichnung nicht nur von First- und Lastpulse sondern des gesamten Laserechos (Multi-Echo-Aufzeichnung) könnte die Erkennung vertikal gestaffelter Vegetationsschichten (insbesondere Strauchwerk unter Baumbeständen) ermöglichen. Letztlich ist eine spezielle Aufzeichnungstechnik mit einem sehr großen Laserspot (1,0 statt 0,2 m) besonders geeignet für Vegetationsaufzeichnungen, da so der Reflexionsanteil in Vegetationsbeständen wesentlich erhöht werden kann (z. B. Faserscanner der Firma TopoSys, www.toposys.de) und auch eine Winterbefliegung zu optimalen Ergebnissen führt. Eine weitere mögliche Weiterführung der Daten könnte auch durch den heutzutage vermehrten Einsatz digitaler Luftbilder sein. Diese auf Zeilenscanner basierte Erfassung (z. B. ADS40) erlaubt durch den 3-Seitenblick eine DOM-Erstellung auf Basis von Bildzuordnungsalgorithmen (Vozikis 2004). Diese könnten für die Anwendung einer Grünvolumenbestimmung getestet werden, enthalten aber keine Informationen über die Dichte der Vegetation.

7 LITERATUR

Arlt G. et al.: Stadtökologische Qualität und Vegetationsstrukturen städtischer Siedlungsräume, IÖR-Texte 139, 2002, Dresden.
Arlt G. et al.: Basisindikator Vegetationsvolumen. In: Stadtforschung und Statistik, 2/2003, 38-45.
Bundesweite Internetumfrage zur Messung der Bürgerzufriedenheit mit den kommunalen Grünflächen (2004): Internet: http://www.galk.de/arbeitskreise/ak_orga_betriebswirt/down/kgst_buergerumfrage_041027.pdf
Großmann M. et al.: Bodenfunktionszahl, Grünvolumenzahl, Grünzahl, Gutachten im Auftrag der Umweltbehörde Hamburg, 1984.
Heber B., Lehmann I.: Stadtstrukturelle Orientierungswerte für die Bodenversiegelung in Wohngebieten, IÖR-Schriften 05, 1993, Dresden.
Kenneweg H.: Neue methodische Ansätze zur Fernerkundung in den bereichen Landschaft, Wald und räumliche Planung. In: Dech S. et al. (Hrsg.): Tagungsband 19, DFD-Nutzerseminar, 15.-16.10.2002, 127-137.
Kraus K.: Laserscanning und Photogrammetrie im Dienste der Geoinformation. AGIT 2005 Angewandte Geographische Informationsverarbeitung XVII, Salzburg (invited); 07.06.-07.08.2005. In: „Angewandte Geoinformatik 2005 – Beiträge zum 17. AGIT-Symposium Salzburg", Strobl J., Blaschke T., Griesebner G. (ed.); Wichmann Verlag, 2005, ISBN 3-87907-422-4; 386-396. Internet: http://www.ipf.tuwien.ac.at/publications/kk_agit2005.pdf
Landeshauptstadt Dresden: Kommunale Bürgerumfrage 2002. 2003.
Landeshauptstadt Dresden: Gebäude und Wohnungen. Statistische Mitteilungen, 2004.
Landeshauptstadt Dresden: V0766-SB15-05. Beschluss des Ausschusses für Stadtentwicklung und Bau vom 31.08.2005 (unveröffentlicht), 2005.
Maas H.-G.: Akquisition von 3D-GIS-Daten durch Flugzeug-Laserscanning. Kartographische Nachrichten (Bielefeld), Jg. 55. No. 1, 3-11, 2005.
Meinel G., Hecht R.: Bestimmung des blockbezogenen Grünvolumens für die Fläche der Stadt Dresden auf Basis von Laserscannerdaten, Abschlussbericht für das Umweltamt der Stadt Dresden (unveröffentlicht), 2005.
Meinel G., Hecht R.: Determination of urban vegetation volume on the basis of laser scan data at non-leaf aerial flight times. In: Laser-Scanners for Forest and Landscape Assessment, Proc. of NATSCAN-Conference, Freiburg, 03.-06.10.2004, IAPRS Vol. XXXVI, PART 8/W2, ISSN 1682-1750, 334-339.
Internet: http://www.isprs.org/commission8/workshop_laser_forest/MEINEL.pdf
Meinel G., Hecht R.: Reconstruction of Urban Vegetation based on Laser Scan Data at Leaf-off Aerial Flight Times – First Results; Proceedings of the 31st ISRSE; Saint Petersburg, June 20-24, 2005.
Internet: http://www.isprs.org/commission8/workshop_laser_forest/MEINEL.pdf
Meinel G., Hennersdorf J.: Fortschreibung der Stadtstrukturtypenkarte der Stadt Dresden auf Basis von Ortholuftbilddaten der Jahre 2003/2004, Abschlussbericht für das Umweltamt der Stadt Dresden (unveröffentlicht).
Möller M., Blaschke T.: Urbanes Grün – Erfassung, Analyse und Bewertung aus Fernerkundungsdaten. CD-ROM der 25. Wissenschaftlich-Technischen Jahrestagung der DGPF. 21.-23. September 2005, Rostock, Publikationen der DGPF, Band 14, ISSN 0942-2870, 249-254, 2005.
TopScan, Projektbericht: Städtisches Vermessungsamt Dresden, 2002.
Vozikis G.: Urban Data Collection: An Automated Approach in Remote Sensing. Presentation: 24th Urban Data Management Symposium, Information Systems and the Delivery of Societal Benefits, Chioggia, Venice; 10-27-2004 – 10-29-2004. In: "Proceedings of UDMS'04", 2004.
Wagner W. et al.: Robust Filterung of Airborne Laser Scanner Data For Vegetation Analysis. In: Laser-Scanners for Forest and Landscape Assessment, Proc. of NATSCAN-Conference, Freiburg, 03.-06.10.2004, IAPRS Vol. XXXVI, PART 8/W2, ISSN 1682-1750, 334-339, 2004.
Wieland R.: Internetseite der SAMT-Software entwickelt vom Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF). Stand 2005. Internet: http://www.zalf.de/home_samt-lsa/index.html

Netzwerkanalyse von Stakeholdern im Kontext natur- und landschaftsbedingter Erholungsnutzung Ein Beitrag zum Schutzgebietsmanagement im EuRegionalen Erholungsgebiet Nationalpark Berchtesgaden / Salzburger Kalkhochalpen

Sabine HENNIG und Kai SCHRÖPFER

(Institut für Geographie der Friedrich-Alexander Universität Erlangen-Nürnberg, Kochstr. 4/4, D-91054 Erlangen, shennig@geographie.uni-erlangen.de
Institut für Geographie der Bayerischen Julius-Maximilian Universität Würzburg, Am Hubland, D-97074 Würzburg
kai.schroepfer@web.de)

1 ABSTRACT

Für Großschutzgebiete (Nationalparke, Naturparke und Biosphärenreservate) zeichnen sich im Hinblick auf Nachhaltigkeit und Zukunftsfähigkeit veränderte Rollen ab. Sie sind nicht mehr nur Naturschutzprojekte, sondern können auch Impulsgeber für die Region und deren Wirtschaft sein. Großschutzgebiete müssen sich folglich neben ihrer naturschutzfachlichen und -planerischen Komponente auch mit regionalpolitischen Fragen beschäftigen. Bewusstseinsbildung zu den bestehenden Abhängigkeiten zwischen Schutzgebiet und angrenzenden Gebieten sind eine wichtige Grundlage zur Konkretisierung und Beschreitung neuer Ziele und Wege für Schutzgebiet und Region. Besonderes Interesse kommt der Auseinandersetzung mit dem Themenkomplex (natur- und landschaftsbedingter) Erholungsnutzung zu, welche nach internationalen (IUCN-Richtlinie) und nationalen (BNatSchG) Vorgaben ein vorrangiges Managementziel in Großschutzgebieten ist. In diesem Kontext ist die Abstrahierung des Objekts „Erholungsnutzung" mit den Komponenten „Infrastruktur", „Besucher", „Aktivitätsformen" und „Stakeholder" ein wichtiger Schritt. Vor allem die Analyse der in der Großschutzgebietsregion relevanten Stakeholder ist von zentraler Bedeutung. Identifikation und Charakterisierung, Klassifizierung und Attributisierung der verschiedenen Stakeholder (Interessen, Zuständigkeiten, Handlungsrelevanz etc.) zur natur- und landschaftsbedingter Erholungsnutzung sind bedeutsam. Relevanz kommt auch der modellhaften Abbildung der vorliegenden Hierarchien und Netzwerke der Stakeholder unter Berücksichtigung ihrer Raumwirksamkeit im Schutzgebiet zu. Eine edv-gestützte Aufbereitung und Verwaltung der zugehörigen Daten kann Informationen und Wissen in der Großschutzgebietsregion zur Verfügung stellen. Arbeits- und Kommunikationsstrukturen zwischen Schutzgebietsverwaltung und Stakeholdern können erzeugt oder verbessert werden.

Seit September 2005 ist in der EuRegio Salzburg - Berchtesgadener Land - Traunstein für die Großschutzgebietsregion Nationalpark Berchtesgaden das Projekt „EuRegionales Erholungsgebiet Nationalpark Berchtesgaden / Salzburger Kalkhochalpen" in der Bearbeitung. Für eine entsprechend ausgerichtete Intensivierung zur grenzübergreifenden Zusammenarbeit natur- und landschaftsbezogener Erholungsnutzung in der EuRegio ist die Analyse der einzelnen Stakeholder, ihrer Hierachien und Vernetzungen eine wichtige Basis. Ziel ist es, in einer zukünftig intensiven Zusammenarbeit mit Gebietskörperschaft, Vereinen und Verbänden etc. in Österreich (Salzburg) und Deutschland (Bayern) Empfehlungen, Innovationen und Kreativität für zweckmäßige Leitbilder, Konzepte und Maßnahmen zur natur- und landschaftsabhängigen Erholungsnutzung zu realisieren. Diese sind Schlüsselelemente und Voraussetzung für eine zukunftsfähige und nachhaltige Entwicklung in der Großschutzgebietsregion.

2 DAS EUREGIONALE ERHOLUNGSGEBIETE NATIONALPARK BERCHTESGADEN/SALZBURGER KALKHOCHALPEN

In der EuRegio Salzburg - Berchtesgadener Land - Traunstein wird seit September 2005 das Projekt „EuRegionales Erholungsgebiet Nationalpark Berchtesgaden / Salzburger Kalkhochalpen" bearbeitet. Das transnationale Projektgebiet umfasst den Nationalpark Berchtesgaden mit (deutschem) Vorfeld sowie das angrenzende Gebiet der Salzburger Kalkhochalpen in Österreich. An dem von der EU geförderten Projekt sind sechs Partner aus beiden Ländern beteiligt: DAV, Z_GIS, Salzburger Landesregierung, Institut für Geografie der FAU Erlangen-Nürnberg, Nationalpark Berchtesgaden und die EuRegio Salzburg - Berchtesgadener Land - Traunstein. Der inhaltliche Schwerpunkt bezieht sich auf natur- und landschaftsbezogene Erholungsnutzung. Die Diskussion um die Großschutzgebietsregion Nationalpark Berchtesgaden - einschließlich des Gebiets der Salzburger Kalkhochalpen - ist ein weiterer zentraler Aspekt.

Nach dem heutigen Verständnis zum Management von Großschutzgebieten ist es unabdingbar, dass Nationalparke in regionale und kommunale Planungen soweit zu integrieren sind, dass die Schutzgebietsinteressen ebenso wie die kommunalen Interessen, insbesondere die der Anrainergemeinden, klar zum Ausdruck kommen (Dieploder & DWIF 2000; Hannemann & Job 2003). Grundlage hierfür und zentrales Projektanliegen sind Situationsaufnahme und -analyse zur natur- und landschaftsabhängigen Erholungsnutzung (Hennig & Künzl 2005). Die hierbei gewonnenen Daten und Informationen müssen auf Grund ihres Umfangs und ihrer Komplexität edv-gestützt zur Verfügung stehen. Wie von Neubert & Walz (2005) für grenzüberschreitende Schutzgebiete und Schutzgebietsregionen gefordert, wird die Schaffung eines grenzüberschreitenden Informationssystems als zentrale Grundlage für die allgemeine Verfügbarkeit der entsprechenden Informationen zur natur- und landschaftsbezogene Erholungsnutzung angestrebt. Der Datenerhebung und -verwaltung kommt dabei vor dem Hintergrund mangelnder Datendisponibilität und bestehendem Datendefizits in der Schutzgebietsregion besondere Bedeutung zu. Diese Umstände, die durchaus vergleichbar sind mit anderen europäischen Schutzgebieten gleicher räumlicher Lage (vgl. Denisiuk, Stoyko & Terray 1997), begründen sich zum einen in der grenzüberschreitenden Situation der Nationalparkregion. Zum anderen besteht bei der Herangehensweise zur qualitativen und quantitativen Erhebung, Verwaltung und Analyse von Daten zur Erholungsnutzung Forschungsbedarf (vgl. u.a. Giles 2003).

2.1 Der Nationalpark Berchtesgaden

Im Jahr 1978 wurde im Südosten des Freistaats Bayern der Nationalpark Berchtesgaden (IUCN-Kategorie II) eingerichtet (vgl. Abb. 1); 1992 wurde dieser zusammen mit seinem Vorfeld in die Liste der UNECSO Biosphärenreservate aufgenommen (vgl. StMLU 2001). Grundsätzlich dienen Nationalparke dem Naturschutz, andererseits bieten sie hervorragende Erholungsmöglichkeiten für

Menschen (ITR 2001). Internationale (IUCN-Richtlinien) und nationale (BNatSchG § 24) Vorgaben betonen das Managementziel Erholungsnutzung für den Nationalpark Berchtesgaden (vgl. StMLU 2002).

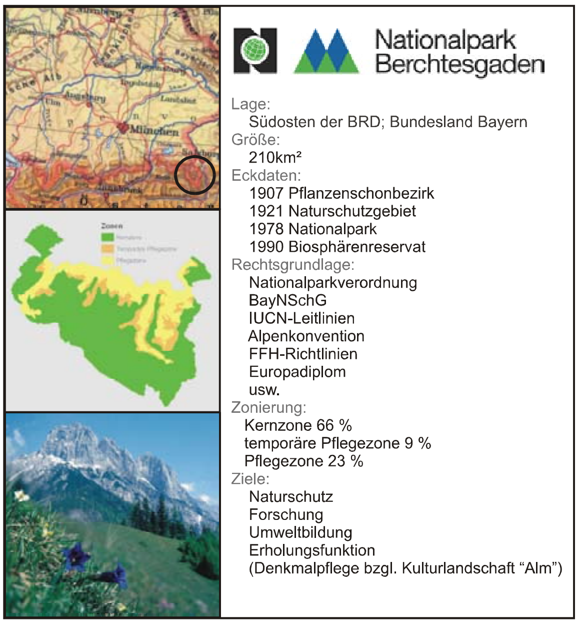


Abb. 1: „Steckbrief" Nationalpark Berchtesgaden (Quelle: Hennig 2003)

In seiner räumlichen Lage grenzt das deutsche Großschutzgebiet zu ca. 2/3 an das österreichische Bundesland Salzburg. Die Berchtesgadener Alpen bilden mit den sich im westlichen, südlichen und östlichen Umgriff des Schutzgebiets fortsetzenden Salzburger Kalkalpen einen gemeinsamen Naturraum (StMLU 2002). Zwischen beiden Gebieten bestehen seit der Peuplierung des bayerischen Gebiets im 12. Jahrhundert zahlreiche Verflechtungen wie z.B. durch den Salzhandel, die Bayerischen Saalachforste im österreichischen Pinzgau oder verschiedene Verträge der Almnutzung zwischen Berchtesgaden und Salzburg (vgl. Brugger, Dopsch, & Krammel 1993).

2.2 Die EuRegionale Nationalparkregion

Die EuRegio Salzburg - Berchtesgadener Land - Traunstein (vgl. Abb. 2) wurde 1995 als freiwilliger und partnerschaftlicher Zusammenschluss von Gemeinden aus dem Land Salzburg und aus den Landkreisen Berchtesgadener Land und Traunstein gegründet.

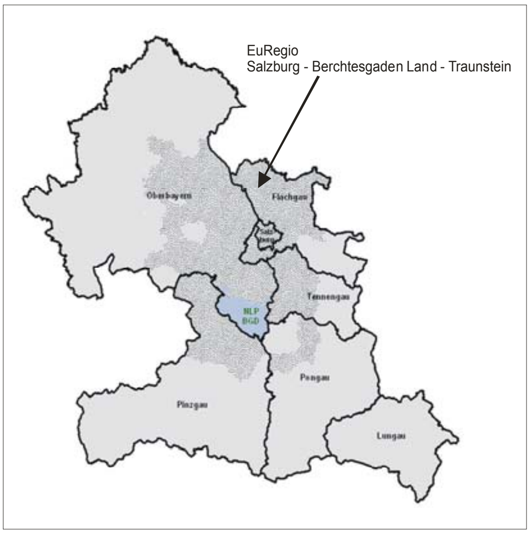


Abb. 2: Die EuRegio Salzburg – Berchtesgadener Land - Traunstein

Durch die EuRegio werden Möglichkeiten wahrgenommen, die sich durch die Überwindung der Grenze bieten. Im Interesse und zum Nutzen ihrer Mitglieder, ihrer Bevölkerung und ihrer Wirtschaft orientiert sich die EuRegio dabei an ihrem Leitbild, das aus den folgenden gleichberechtigten Leitvorstellungen besteht (vgl. URL1):

- Umsetzung des Europagedankens auf regionaler Ebene,

- Entwicklung der EuRegio als Arbeits- und Lebensraum für ihre Bewohner,
- Ausbau der EuRegio im Wettbewerb der Wirtschaftsräume und
- Entwicklung der Umwelt- und Lebensqualität in der EuRegio.

Das deutsche Großschutzgebiet mit seinem Vorfeld sowie die angrenzenden Gebiete in Österreichisch sind Bestandteile der EuRegio. Sowohl für den Berchtesgadener wie für den Salzburger Raum spielen Tourismus sowie natur- und landschaftsbezogene Erholungsnutzung eine entscheidende Rolle. Derzeit erfolgen Planungen und Entwicklungen auf beiden Seiten der Grenze weitgehend unabhängig von einander. Wie (eigene) Befragungen und Erhebungen zeigen, sind Bekanntheit und Bewerbung des deutschen Großschutzgebiets im österreichischen Teil der EuRegio als gering zu bezeichnen. Die wirtschaftliche Relevanz einer Inwertsetzung des Schutzgebiets im transnationalen Kontext sollte jedoch, insbesondere vor dem Hintergrund der oben genannten EuRegio-Leitvorstellungen, nicht ignoriert werden: Prinzipiell fungieren Nationalparke als Markenzeichen für eine intakte (Natur-)Landschaft. Die positive Besetzung des Prädikat Nationalpark gehört damit zu den wichtigsten Wettbewerbsfaktoren hinsichtlich Tourismus und Erholungsnutzung. Zudem werden diese Gebiete auf Grund ihres hohen Erlebnis-, Freizeit- und Erholungswertes zunehmend zu „Tourismusmagneten“ (vgl. Broggi, Staub & Ruffini 1999; Hannemann & Job 2003,). Dem Großschutzgebiet „Nationalpark Berchtesgaden“ kommt somit für diesen deutschen-österreichischen Bereich der EuRegio besondere Bedeutung zu. Trotz Grenzsituation und in Folge unterschiedlicher Bestrebungen bei Raumordnung und -planung sollte dieses EuRegionale Gebiet, zumindest hinsichtlich Erholungsnutzung, als Nationalparkregion verstanden werden. Eine entsprechende Bewusstseinsbildung in der Region ist zu fördern.

Bereits innerhalb Deutschlands ist die Definition von Nationalparkregionen ein schwieriges Unterfangen (vgl. Hannemann & Job 2003). Anhaltspunkte bietet das Destinationsmanagement: Destinationen werden definiert als ein geographischer Raum, der als Reiseziel ausgewählt wird und sämtliche für einen Aufenthalt notwendigen touristischen Einrichtungen (Beherbergung, Verpflegung, Unterhaltung, Beschäftigung) enthält. Im Gegensatz zu Naturparken und Biosphärenreservate sind Nationalparke – auch auf Grund ihrer Zielsetzung – innerhalb ihrer Grenzen weitgehend unbesiedelt. Sie beinhalten daher die für eine funktionsfähige Destination notwendige Infrastruktur nicht oder nur äußerst begrenzt. Das Reiseziel Nationalpark muss folglich auch die umliegende Region mit einschließen. Eine auf den Nationalpark ausgerichtete Destination sollte daher einerseits räumlich so weit gefasst sein, dass durch eine gewisse Angebotsvielfalt ein ganzheitlicher Gästenutzen erbracht werden kann. Andererseits hat sie so eng begrenzt zu sein, dass die primäre Ausrichtung auf das Alleinstellungsmerkmal Nationalpark deutlich bleibt. Aus Management-Gesichtspunkten kann eine pauschale Abgrenzung über die Außengrenzen der Anrainergemeinden erfolgen. Auch wenn in der Praxis sicherlich regionsspezifische Lösungen gefragt sind, bietet sich eine solche Definition als erste Arbeitsgrundlage an (vgl. WTO 1993; Bieger & Laesser 1998; Ziener 2001; Hannemann & Job 2003). In Konsequenz wird die Nationalparkregion Berchtesgaden / Salzburger Kalkhochalpen in Anlehnung an die Ausführungen von Hannemann & Job (2003) zunächst als pauschale Abgrenzung über die jeweiligen Anrainergemeinden verstanden (vgl. Abb. 3).

Abb. 3: Die Nationalparkregion in der EuRegio

3 NATUR- UND LANDSCHAFTBEZOGENE ERHOLUNGSNUTZUNG

Die Auseinandersetzung mit dem Thema „Natur- und Landschaftsbezogene Erholungsnutzung“ verlangt die genaue Betrachtung dieser modernen Landnutzungsform. Bestehende Anforderungen und Abhängigkeiten müssen identifiziert und analysiert werden (vgl. Hennig 2005). In Schutzgebieten bezieht sich die Beschäftigung mit Erholungsnutzung allerdings oft genug lediglich auf Besuchermanagement und -monitoring (vgl. Muhar, Arnberger, & Brandenburg 2002; Hennig & Laube 2005). Das Untersuchungsobjekt „Natur- und Landschaftsbezogene Erholungsnutzung" darf jedoch nicht nur auf den Aspekt „Besucher" reduziert werden, wie zahlreiche Arbeiten belegen (vgl. z.B. Gätje 2003, Haider et al. 2004, Türk et al. 2004, Wegelin 2005). Für die natur- und landschaftsbezogene Erholungsnutzung im Großschutzgebiet können, wie Abb. 4 zeigt, die vier Kategorien-Bereiche „Besucher", „Infrastrukturen", „Aktivitätsformen" und „Stakeholder", die in engem Zusammenhang stehen, identifiziert und charakterisiert werden.

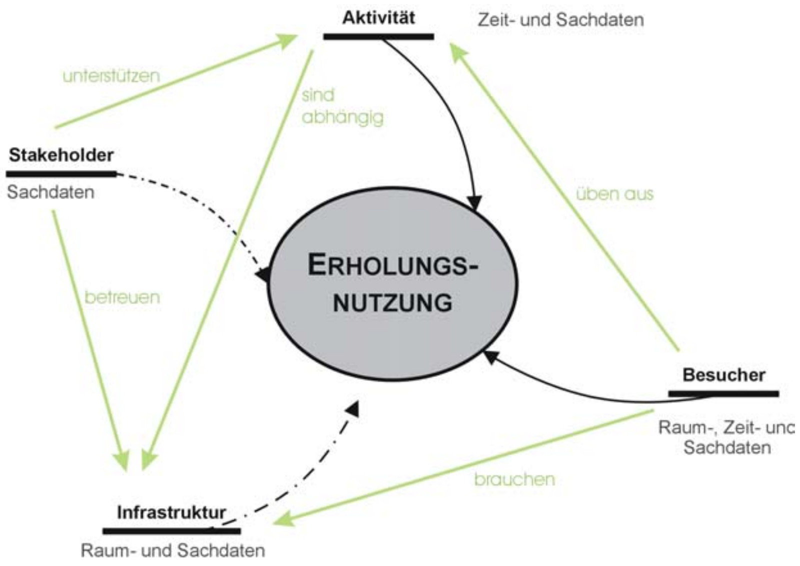


Abb. 4: Komponenten der natur- und landschaftsabhängigen Erholungsnutzung

Besucher

Natur- und landschaftsbezogene Erholungsnutzung wird durch die Zahl der Ausübenden beschrieben. Ungeachtet der Art der ausgeführten Erholungsnutzung sind sie prinzipiell Schutzgebietsbesucher. Sie nutzen das Gebiet entsprechend der jeweiligen Aktivität orts- und zeitgebunden unterschiedlich. In den meisten Fällen sind sie in Abhängigkeit der ausgeübten Aktivität an Infrastrukturen gebunden. Generell können Schutzgebietsbesucher neben der aktivitätsformabhängigen Besucheranzahl anhand verschiedener Eigenschaften, d.h. sozioökonomische und demographische Parametern sowie Aufenthalts- und Nutzungsmerkmale, beschrieben werden.

Aktivitätsformen

Unterschiedliche Aktivitäten wie z.B. Radfahren, Wandern, Skiwandern erfolgen in Großschutzgebieten. Sie stellen Anforderungen an die Infrastruktur und sind charakterisiert z.B. durch Zeit- und Orts-Bindung (Skitouren im Winter; Wandern auf dem Wegenetz). Die jeweiligen Aktivitätsformen werden von verschiedenen Stakeholdern in Abhängigkeit ihrer Interessen und Handlungsfelder gefördert.

Infrastruktur

Schutzgebietsbesuch sowie Aktivitätsausübung benötigen stets Infrastrukturen (Natur, Geländeerschließung, Einrichtungen etc.). Die Erfassung der infrastrukturellen Ausstattung im Gelände vermittelt einen Einblick über potentiell mögliche Nutzungen sowohl hinsichtlich Besucheraufkommen als auch Aktivitätsform. Dabei stehen die verschiedenen Infrastrukturelemente im Schutzgebiet sowie der zugehörigen Region unter Verantwortung verschiedener Akteure bzw. Stakeholder (Gemeinden, Vereine und Verbände etc.).

Stakeholder

Stakeholder sind Personen, Personengruppen und Organisationen, die von einem Projekt betroffen sind, interessiert sind oder es beeinflussen, einschließlich Auftraggebern und Benutzern (URL3; URL4). Im einen auf Nationalparkregionen übertragenen Sinne sind dies alle Personen, Personengruppen und Organisationen, die von natur- und landschaftsbezogener Erholungsnutzung im Nationalpark betroffen sind, interessiert sind oder diese beeinflussen. Den Stakeholder in Großschutzgebietsregionen kommt dabei im Hinblick auf natur- und landschaftsbezogene Erholungsnutzung in vielfacher Weise Bedeutung zu. Zum einen stehen zahlreiche Infrastrukturen, die sich sowohl im Schutzgebiet als auch in den angrenzenden Gebieten befinden, unter ihrer Verantwortung. Insbesondere Einrichtungen außerhalb der Schutzgebietsgrenzen ermöglichen durch ihr Vorhandensein bzw. ihre Ausstattung erst Schutzgebietsbesuch und Aktivitätsausübung – sie komplettieren die Destination Nationalpark. Zum anderen beeinflussen ihre Existenz und Handlungen die Besucherzahlen. Infolge kommt einer Integration von Stakeholdern in die Planungsprozesse von Schutzgebieten steigende Bedeutung zu (vgl. Hannemann & Job 2003).

Im Hinblick auf die vier genannten Komponenten der natur und landschaftsbezogenen Erholungsnutzung kann für die Nationalparkregion Berchtesgaden / Salzburger Kalkhochalpen das Folgende zusammenfassend festgestellt werden: Die Managementmaßnahmen zur Erholungsnutzung im Nationalpark Berchtesgaden beziehen sich derzeit nur auf die Fläche des Schutzgebietes. Alleiniger Akteur ist vielfach die Nationalparkverwaltung. Ausgegangen wird von 1,13 Mio. Schutzgebiets-Besuchern, vorrangig in den Sommermonaten (Job, Metzler & Vogt 2003). Eine weitergehende Differenzierung nach Raum, Zeit und Aktivitätsform der Besucher liegt bisher nicht vor. Ermittelt wird diese Zahl vorwiegend aus den Informationsstellen-Besuchern sowie dem Zahlenmaterial unterschiedlicher Stakeholder vor Ort wie z.B. der Königssee-Schifffahrt (Fahrkarten), der Jenner-Bergbahn (Fahrkarten), dem DAV (Hütten-Übernachtungen) sowie den Gemeinden (Parkplatzbelegungen). Dem Besucherzugang aus den angrenzenden österreichischen Gebieten kommt bislang keine Beachtung zu. Im GIS der Nationalparkverwaltung ist derzeit zudem lediglich eine Auswahl an im Schutzgebiet verorteten Infrastrukturelementen vorhanden. Eine Attributisierung dieser hinsichtlich Zuständigkeit und Betreuung durch andere Stakeholder (die Nationalparkverwaltung ausgenommen) ist nicht erfolgt. Des Weiteren steht keine zusammenfassende Verwaltung und Darstellung der in der Nationalparkregion relevanten Akteure im Sektor Tourismus- und Erholungsnutzung zur Verfügung.

Das Berchtesgadener Land blickt auf eine lange Zeit touristischer Nutzung zurück. Auf Grund dessen und der Bedeutung der touristischen Wertschöpfung im EuRegionalen Erholungsgebiet sind zahlreiche Einrichtungen (Kurverwaltung, Tourismus GmbH Berchtesgadener Land, Gemeinden, Königssee-Schifffahrt, Jenner-Bergbahn, DAV, Naturfreunde, RVO usw.) tätig (vgl. Hennig 2005). Die Handlungen der einzelnen Stakeholder haben wegen der Abhängigkeiten zwischen den einzelenen Komponenten „Besucher“, Infrastrukturen“ und „Aktivitätsformen“ Einfluss auch auf das Schutzgebiet. Die Identifikation, Charakterisierung und Analyse bzgl. Organisationsstruktur und (räumlicher) Zuständigkeiten der Stakeholder ist relevant. Vielfach sind zudem das Zusammenspiel und die Abhängigkeiten der Stakeholder untereinander von Bedeutung. In der Nationalparkregion herrschen jedoch sowohl in Deutschland wie auch in Österreich - vor allem im Hinblick auf die Situation jeweils jenseits der Grenze - Defizite vor. Um „grenzen-übergreifende“ Planungen zu ermöglichen, sind nicht nur Information und Wissen um die relevanten Stakeholder von Bedeutung, sondern auch zu ihre Beziehungen untereinander. Diese können als sachlich-inhaltlich aber auch als räumlich verstanden werden. Die Auflistung, hierarchische Organisationsform und räumliche Einbettung der Stakeholder in die Region sind die erste Basis für entsprechende Kooperationen zur weiteren Entwicklung der Region gemäß der EuRegio-Leitvorstellungen.

4 ANALYSEANSATZE FÜR STAKEHOLDER: NETZWERKE UND IHRE ANALYSE

Um für Kooperationen und Zusammenarbeit mit den sehr zahlreichen Stakeholdern in der Nationalparkregion ein entsprechendes „Stakeholdermanagement“ (vgl. URL5) zu betreiben, müssen die Daten und Informationen zu diesen in vergleichbaren Zusammenhang gesetzt werden. Das Gebiet der Nationalparkregion muss näher untersucht werden. Bei Bedarf sind Abstufungen oder Zonierungen zur Schutzgebietsrelevanz zu definieren. Bevor mittels sozialempirischer Verfahren (Interviews, Befragungen etc.) die sachlich-inhaltlichen „relations“ zwischen einzelnen Stakeholdern zum Nationalpark geklärt werden (vgl. Nechodom 2005), ist es sinnvoll, zuvor ein konkretes Bild über die räumlichen Beziehungen („area-to-area-contact“) zwischen den Stakeholdern und speziell mit dem Schutzgebiet zu gewinnen. Dies erst kann die Grundlage für weitere Untersuchungen sein. Für Analyse und Darstellung der räumlichen Beziehungen zwischen den Akteuren bzgl. ihrer Bedeutung für den Nationalpark wird sich der Netzwerkanalyse bedient.

4.1 Netzwerkanalyse der Stakeholder

Der Begriff des Netwerks lehnt sich dem Verständnis in der Ethnosoziologie an. Ein „soziales Netzwerk" ist hier eine Deskription sozialer Interaktionen beliebigen Typs. Das Nützliche des Ansatzes ist, dass "soziale Netzwerke" gerade keine 'Ziele' haben, sondern sehr disparate Ziele einzelner Akteure und Gruppen verknüpfen (Schnegg & Lang 2002; URL 6). Netzwerke werden durch die Verfahren der Netzwerkanalyse[1] untersucht. Sie versuchen die Aufklärung sozialer Ordnung und Strukturen, die als wesentliche soziale Eigenschaften begriffen und formal beschrieben werden (Jansen 1999). Die verschiedenartigen Beziehungen zwischen einzelnen Individuen und Gruppen werden hierfür betrachtet. Die primäre Untersuchungsaufgabe der Netzwerkanalyse lautet folglich: Welche Beziehung unterhält (oder unterhält nicht) jeder Akteur einer bestimmten Untersuchungsmenge von Akteuren mit jedem anderen Akteur der Menge (Schneeg & Lang 2002).

Prinzipiell werden in der Netzwerkanalyse zwei Arten von Netzwerken unterschieden: die persönlichen und die Gesamtnetzwerke. In beiden Fällen wird zunächst eine bestimmte Menge an Akteuren und bestimmten Arten von zu untersuchenden Beziehungen zwischen Akteuren festgelegt. Bei der Untersuchung von Gesamtnetzwerken wird zu jedem Akteur ermittelt, ob Beziehungen zu jedem anderen Akteur der untersuchten Menge bestehen oder nicht. Bei persönlichen Netzwerken hingegen wird für jeden Akteur der Menge festgestellt, mit welchen Akteuren Beziehungen der vorgegeben Art bestehen. Bei der Untersuchung von Gesamtnetzwerken werden Beziehungen außerhalb der untersuchten Menge nicht berücksichtigt (Schneeg & Lang 2002).

Der größte Unterschied zwischen konventionellen Daten und Netzwerkdaten ist, dass konventionelle Daten sich auf Akteure und Attribute fokussieren, Netzwerkdaten hingegen auf Akteure und Beziehungen. Es werden zwei Teile von Netzwerkdaten unterschieden: „nodes“ und „edges“. Die erste Komponente umfasst die so genannten Akteure, das können einzelne Personen sein, aber auch Aggregate von Personen wie etwa Haushalte oder ganze ethnische Gruppen. Die zweite Komponente besteht aus den (sozialen) Beziehungen, d.h. den Relationen zwischen den Akteuren. Ein Typ der Netzwerkanalyse ist die egozentrische Netzwerkanalyse (EgoNet). Sie stellt einen minimalen netzwerkanalytischen Zugang zur Realität dar. Es werden nur Daten über einzelne fokale Akteure, nicht aber über Gruppen und Gesamtnetzwerke erhoben (Jansen 1999).

Für die Nationalparkregion bezieht sich die Datenerhebung zur Netzwerkanalyse auf die Erfassung aller im Gesamtnetzwerk der Schutzgebietsregion mit Fokus auf die Nationalpark-relevanten Akteure sowie ihrer Beziehungen untereinander. Hier wird der Ansatz der Soziologie hinsichtlich sozialer Beziehungen auf den „Raumanspruch“ der Geographie übertragen: Als Beziehungen zwischen den Akteuren werden räumliche Bezüge, d.h. „area-to-area-contact“ herangekommen. Die gemeinsame Raumlage ist eine wichtige Grundlage für potentiell mögliche und sinnvolle Interaktionsbeziehungen. Von Knippschild & Liebe (2004) wird als Faktor für das Zustandekommen von (grenzüberschreitenden) Kooperationen neben gleichberechtigten Interessenlagen der Akteure auch die räumliche Nähe genannt: Nicht alle Stakeholder in der Nationalparkregion sind allein schon von ihrer räumlichen Verortung und ihren räumlichen Beziehungen von gleicher Bedeutung für Schutzgebiet und Region bzw. einzelne Teilbereiche. Eine Differenzierung muss erfolgen.

[1] Einblick in die Netzwerkanalyse geben z.B. Jansen (1999), Schnegg & Lang (2002), Hannmann & Riddle (2005).

4.2 Hierarchienabbildende Datenbank „Stakeholder“

Der erste Schritt zur Netzwerkanalyse ist die Aufnahme aller in der Nationalparkregion relevanten Stakeholder. Verschiedene Kategorien mit Handlungsschwerpunkt Planung, Kommunen, Naturschutz, Tourismus, Alpine Vereine usw. werden zur natur- und landschaftsbezogenen Erholungsnutzung berücksichtigt. Die Stakeholder werden in ihrem Kontext insbesondere zur Erholungsinfrastruktur in einer ihrer hierarchischen Organisationsform entsprechenden Datenbank (in MS Access 2003) mit Verweis auf Geometriedaten (in ArcGIS 8.3) verwaltet. Einen Einblick in das Datenbankschema gibt Abb. 5.

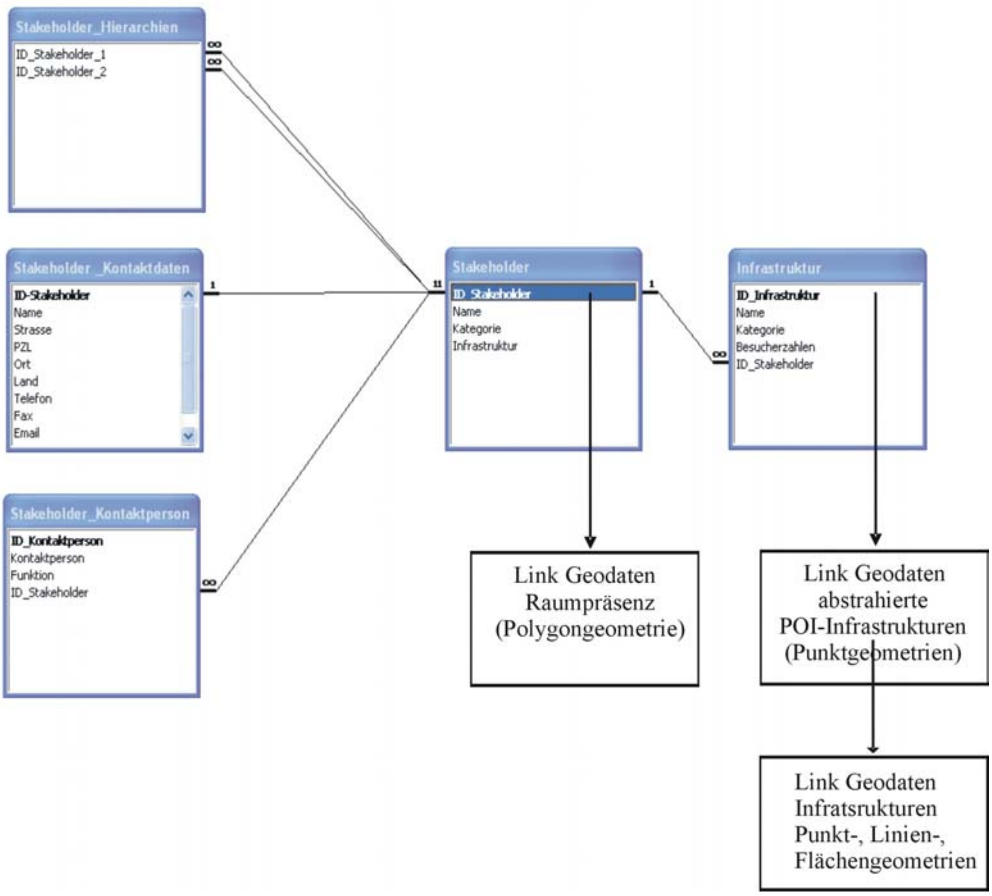


Abb. 5: Datenbankschema der hierarchischen Stakeholder in der Nationalparkregion

Umsetzung und Anwendung des Datenbankschemas verdeutlicht das Beispiel „ Alpine Vereine“ (vgl. Abb. 6). Sowohl der DAV wie der OeAV unterhalten in der Nationalparkregion Unterkunftshäuser und verwalten unter ihrer Zuständigkeit große Flächen (u.a. Wegeunterhalt). Die Unterkunftshäuser werden von Hüttenwirten und –referenten betreut und unterstehen unterschiedlichen Sektionen. Die Sektionen des DAV sind in der Hauptgeschäftstelle in München, die des OeAV in der Hauptgeschäftsstelle in Innsbruck organisiert. Planungsüberlegungen für das Schutzgebiet, die im Kontext der Unterkunftshäuser stehen, bedürfen der Zusammenarbeit mit den Hüttenwirten, den Hüttenreferenten, den zuständigen Sektionen und in manchen Fällen der jeweiligen Hauptgeschäftstelle. Entsprechende Daten zu den Zuständigkeiten, der Organisation und den Kontaktdaten müssen als Sachinformationen (MS-Access-Datenbank) und Rauminformationen (ArcGIS) vorliegen.

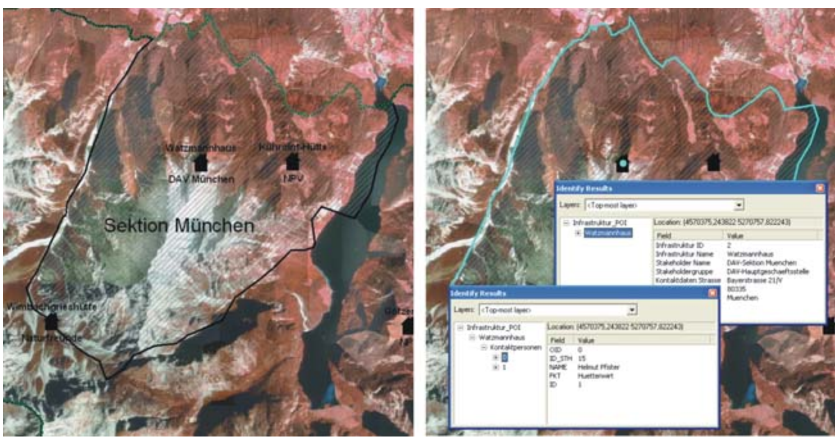


Abb. 5: Das Beispiel „Alpine Vereine“: Watzmann der DAV-Sektion München

4.3 Bewertung der räumlichen Beziehungen der Stakeholder

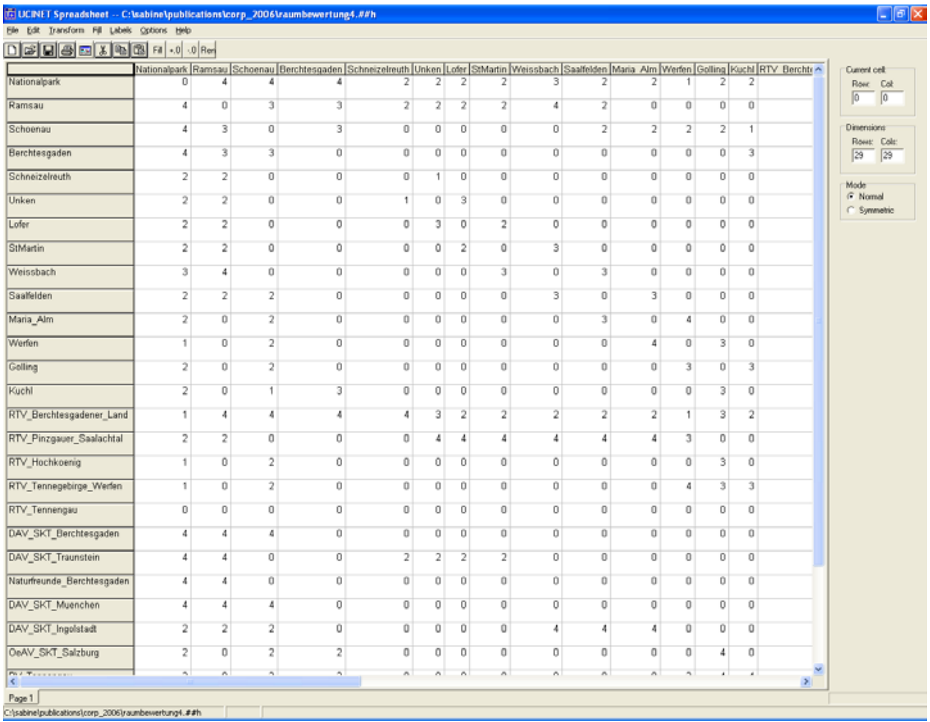
Für die Netzwerkanalyse kommt das Programmpaket UCINET 6 (URL 2) zur Anwendung. Eine Unterscheindung der Art des „area-to-area-contacts“ zwischen den einzelnen Akteuren ist möglich. Für die Beziehungsbewertung wird der Art des Zugangs und der räumlichen Integration der Stakeholder herangezogen. Für die Bewertung der räumlichen Beziehungen werden Expertenwissen, Literatur- und Kartenanalysen sowie im Gelände gewonnene Informationen herangezogen. Fünf Kategorien werden unterschieden, wie sie Tab. 1 zeigt.

Kategorie	Bewertung „area-to-area-contact“	Beispiel
0	Keine Nachbarschaft	DAV Sektion Traunstein / Werfen
1	Nachbarschaft, aber „kein“ Zugang	Nationalpark / Gemeinde Werfen
2	Nachbarschaft, schwieriger/langer Zugang („alpin“)	Nationalpark / Gemeinde Saalfelden
3	Nachbarschaft, guter/leichter Zugang	Nationalpark / Gemeinde Weißbach
4	„beinhaltet“	Nationalpark / Sektionsgebiet München

Tab. 1: Kategorien der räumlichen Beziehungen („area-to-area-contact“) in der Nationalparkregion

4.4 Erholungsnutzungsrelevante Stakeholder im EgoNet „Nationalpark“

Die ermittelten Stakeholder, deren Angaben per Datenbank verwaltet werden, sind hinsichtlich ihres „area-to-area-contacts“ (vgl. Tab. 1) bewertet. Wie für die Netzwerkanalyse nötig, werden die Stakeholder und die Merkmale zu den Beziehungen als Matrix umgesetzt (vgl. Abb. 6).



	Nationalpark	Ramsau	Schoenau	Berchtesgaden	Schneizelreuth	Unken	Lofer	StMartin	Weissbach	Saalfelden	Maria_Alm	Werfen	Golling	Kuchl
Nationalpark	0	4	4	4	2	2	2	2	3	2	2	1	2	2
Ramsau	4	0	3	3	2	2	2	2	4	2	0	0	0	0
Schoenau	4	3	0	3	0	0	0	0	0	2	2	2	2	1
Berchtesgaden	4	3	3	0	0	0	0	0	0	0	0	0	0	3
Schneizelreuth	2	2	0	0	0	1	0	0	0	0	0	0	0	0
Unken	2	2	0	0	1	0	3	0	0	0	0	0	0	0
Lofer	2	2	0	0	0	3	0	2	0	0	0	0	0	0
StMartin	2	2	0	0	0	0	2	0	3	0	0	0	0	0
Weissbach	3	4	0	0	0	0	0	3	0	3	0	0	0	0
Saalfelden	2	2	2	0	0	0	0	0	3	0	3	0	0	0
Maria_Alm	2	0	2	0	0	0	0	0	0	3	0	4	0	0
Werfen	1	0	2	0	0	0	0	0	0	0	4	0	3	0
Golling	2	0	2	0	0	0	0	0	0	0	0	3	0	3
Kuchl	2	0	1	3	0	0	0	0	0	0	0	0	3	0
RTV_Berchtesgadener_Land	1	4	4	4	4	3	2	2	2	2	2	1	3	2
RTV_Pinzgauer_Saalachtal	2	2	0	0	0	4	4	4	4	4	4	3	0	0
RTV_Hochkoenig	1	0	2	0	0	0	0	0	0	0	0	0	3	0
RTV_Tennegebirge_Werfen	1	0	2	0	0	0	0	0	0	0	0	4	3	3
RTV_Tennengau	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAV_SKT_Berchtesgaden	4	4	4	0	0	0	0	0	0	0	0	0	0	0
DAV_SKT_Traunstein	4	4	0	0	2	2	2	2	0	0	0	0	0	0
Naturfreunde_Berchtesgaden	4	4	0	0	0	0	0	0	0	0	0	0	0	0
DAV_SKT_Muenchen	4	4	4	0	0	0	0	0	0	0	0	0	0	0
DAV_SKT_Ingolstadt	2	2	2	0	0	0	0	0	4	4	4	0	0	0
OeAV_SKT_Salzburg	2	0	2	2	0	0	0	0	0	0	0	0	4	0

Abb. 6: Ausschnitt Stakeholder-Matrix für das EgoNet „Nationalpark“

Die Abb. 7 zeigt das entsprechende Ego-Network (Egozentrum Nationalpark), umgesetzte in UCINET 6. Verschiedene Darstellungsmöglichkeiten zur Auswahl und Sichtbarkeit der Stakeholder oder Stakeholderkombinationen sowie Beziehungen und Beziehungskombinationen sind wählbar. In Abb. 7 finden sich z.B. auszugsweise Gemeinden und Alpine Vereine mit ihren räumlichen Beziehungen (Kategorie 1 – 4) visualisiert.

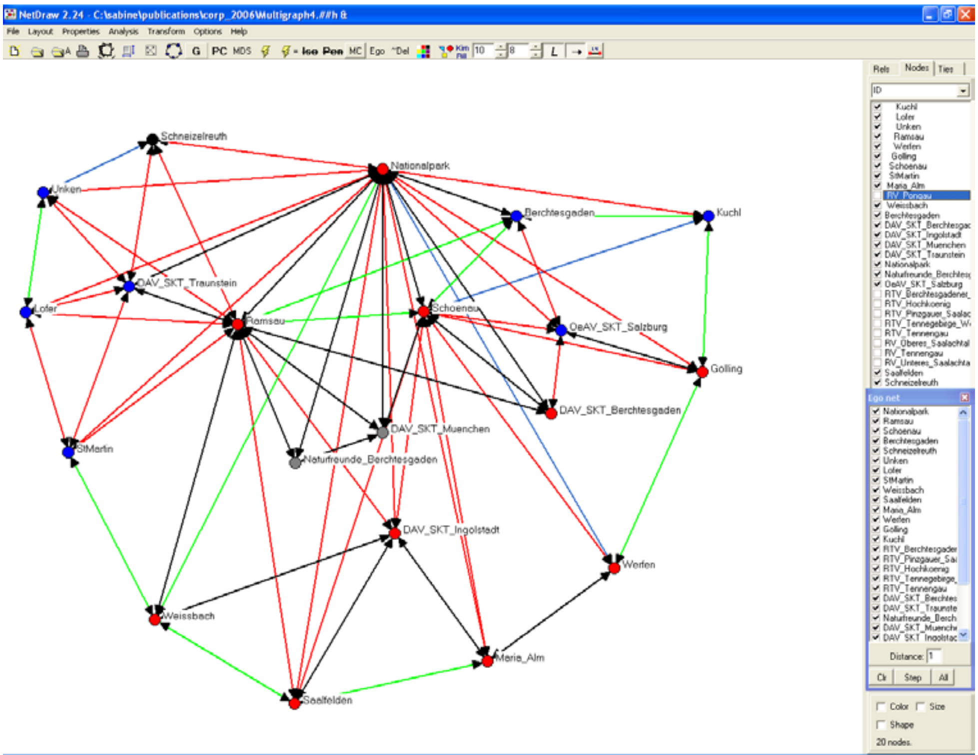


Abb. 7: Stakeholder im EgoNet „Nationalpark“ (Kategorien der räumlichen Bewertung: 4 (schwarz), 3 (grün). 2 (rot), 1 (blau); Stakeholder ähnlichem Zentraltitätsgrad sind in gleichen Farben dargestellt: hoch (rot), (blau), (grau), gering (schwarz))

Neben dem Erkenntnisgewinn aus der Betrachtung der graphischen Darstellung des Netzwerks stehen für die Analyse des Netzwerks verschiedene graphentheoretische Verfahren zur Verfügung. Konzepte die einen genaueren Einblick in die Struktur von Netzwerken erlauben sind z.B. die Konzepte der Dichte (Anteil der tatsächlichen „relations“ bezogen auf die möglichen), der Verbundenheiten, das Konzept der Zentralität (Anzahl der ein- und ausgehenden Beziehungen der einzelnen Akteure) und verschiedene Konzepte von Subgruppen (Jansen 1999; Schnee & Lang 2002). Die verschiedenen berechneten Kennzahlen (Verbundenheit, Zentralität) stellen unter den Akteursgruppen (Gemeinden, Tourismus, Planung, Alpine Vereine) die in Tab. 2 genannten Stakeholder als für das „Räumliche Netzwerk“ um das Egozentrum Nationalpark besonders bedeutsam heraus. Im Hinblick auf die „Qualität und Quantität“ ihrer „arae-to-area-contacts“ sollte ihre Funktion und Position im Stakeholdermanagement der Nationalparkregion überprüft und eventuell hinterfragt werden.

Kategorie	Bedeutsame Stakeholder
Gemeinden	Ramsau, Schönau, Golling, Weissbach, Saalfelden
Tourismus	Regionaler Tourismusverband Berchtesgadener Land, Regionaler Tourismusverband Pinzgauer Saalachtal
Planung	Regionalverband Oberes Saalachtal, Regionalverband Unteres Saalachtal,
Alpine Vereine	DAV Sektion Ingolstadt, DAV Sektion Berchtesgaden

Tab. 2: Kategorien der räumlichen Beziehungen in der Nationalparkregion

4.5 Kritische Diskussion zur Anwendungsrelevanz

Während Verwaltung und Zugang zu Stakeholderdaten als unbestrittene Grundlage für ihr Management gewertet werden können, bietet der in diesem Beitrag vorgestellte Ansatz zur Stakeholderanalyse mittels ihres räumlichen Beziehungsnetzwerkes („area-to-area-contact“) Diskussionsmöglichkeiten: Können die Stakeholder für einen bestimmten Bereich der Nationalparkregion nicht durch Karten oder kartographischen Darstellungen identifiziert werden? Ist eine solche Bewertung der „area-to-area-contacts“ in der vorgenommen Form zulässig und sinnvoll?

Die Bestandsaufnahme der Stakeholder zur natur- und landschaftsbezogenen Erholungsnutzung in der Nationalparkregion zeigt bereits anhand des Umfangs der identifizierten Akteure die bestehenden Schwierigkeiten auf. Obwohl bisher nur kommunale und öffentliche Einrichtungen sowie anerkannte Vereine erfasst wurden - Serviceanbieter und private Einrichtungen sind noch nicht berücksichtigt – ist es bereits problematisch, Verortung und Raumbezug der einzelnen Stakeholder zu einander in richtigen Kontext zu setzen. Zumal in manchen Fällen kein oder nur schlechtes Kartenmaterial vorliegt (z.B. Wirkungsbereich der einzelnen Sektionen der Alpinen Vereine).

Die Grenzsituation des Nationalparks Berchtesgaden und die hier vorgenommene Definition der Nationalparkregion mit österreichischen und deutschen Gemeinden bedeutet eine Hürde für die dringend benötigte Wissens- und Informationsbasis: Zum einen bestehen unterschiedliche Rechts- und Verwaltungsformen in beiden Ländern. Zum anderen beginnt erst in den letzten Jahren - seit Österreichs Beitritt zur EU (1995) – sich die „Grenze im Kopf“ der Betroffenen abzubauen. Folgende Antwort auf die Frage für den Grund der bisher mangelnden Zusammenarbeit zwischen dem deutschen Schutzgebiet und den angrenzenden österreichischen Gemeinden, verdeutlicht dies: „ Die Zeit ist vielleicht jetzt erst reif!“. In diesem Zusammenhang ist auch das Wirken der EuRegio

Salzburg – Berchtesgadener Land – Traunstein zusehen. Sowohl auf deutscher wie auf österreichischer Seite bestehen Wissenslücken um die Zustände und Zuständigkeiten beim jeweiligen Nachbarn - und dies auch im Hinblick auf „Raumwirksamkeit“ und „Raumrelevanz“. Das räumliche Zusammenwirken der Stakeholder in Deutschland, Österreich und im konkreten Grenzbereich ist daher von besonderem Interesse.

Für die zahlreichen Akteure müssen die Informationen aufbereitet werden. GIS als Werkzeug kann eine erste Datengrundlage liefern, eine analytische Zusammenschau der Verhältnisse, wie durch die Netzwerkanalyse möglich, jedoch nicht. Hier bietet die Überprüfung und Bewertung des „area-to-area-contacts“ der Stakeholder in der Nationalparkregion durch die strategische Vorgehensweise der „Matrix-Konstruktion“ und im Weiteren die Visualisierung der Matrixdaten in Form eines Netzwerks (Graphen) die Möglichkeiten subjektives Wissen zu „Objektivieren“. Indexe und Kennzahlen der Netzwerkanalyse geben die Möglichkeit der Vergleichbarkeit. Jedem einzelnen wird damit, im Hinblick auf die eigene „mental map“ zur Nationalparkregion, die Gelegenheit geboten diese zu überprüfen. Der Dialog zwischen den Akteuren kann angestoßen werden. Eine Bündelung und Vernetzung der Akteure kann durch (grenzüberschreitendes) Wahrnehmen von Funktionen und Aufgaben erfolgen. Die vorgenommene Kategorisierung ist dabei als eine erste Gliederung zu werten, die sicher weiterentwickelt werden muss. Basierend auf den Erkenntnissen der räumlichen Netzwerkanalyse sollten unbedingt sozialempirische Erhebungen zur Akzeptanz, Bekanntheit und Kooperation der Stakeholder mit dem Schutzgebiet erfolgen (vgl. Nechodom 2005).

5 AUSBLICK

Speziell Grenzräume sind seit den 1990er Jahren verstärkt in das Blickfeld von Politik und Wissenschaft gerückt. Für die europäische Raumentwicklung sind sie eine große Herausforderung. Für die grenzüberschreitende Kooperation bilden potentiell konfliktärmere Themen (wie Bildung, Kultur) und Handlungsfelder gemeinsamer Potenzialbereiche (wie Tourismus, Infrastruktur) Ansatzpunkte. Zudem ist grenzübergreifende Zusammenarbeit besonders im Umweltbereich von Interesse (Knippschild & Liebe 2004). Im Rahmen der Auseinandersetzung „Erholungsnutzung in Großschutzgebieten“ im transnationalen Kontext der Nationalparkregion Berchtesgaden / Salzburger Kalkhochalpen kann versucht werden, Antworten auf zeitgemäße Fragen auch für andere Regionen zu geben. Wichtig ist die Verfügbarkeit einer entsprechend guten Informationsgrundlage. Schwerpunkt in dem Projekt war bisher die Analyse von Stakeholdern und Infrastrukturen. Im weiteren Projektverlauf kommt der Untersuchung der Besucherzahlen und ihrer Aktivitätsformen verstärktes Interesse zu. Daten zu beiden sollen zukünftig in dem erweiterten Modell der Stakeholder und Infrastrukturen integriert werden. Entsprechend können in der Nationalparkregion umfassende Informationen zur natur- und landschaftsbezogenen Erholungsnutzung zugängig gemacht werden. Für Managementmaßnahmen gerade für großflächigen Schutzgebiete - in denen die verschiedenen Nutzungsinteressen im Raum aufeinander treffen - ein wichtiger Aspekt.

6 LITERATUR

Broggi, M.F.; Staub, R. & Riffini, F.V. (1999); Großflächige Schutzgebiete in den Alpen: Daten, Fakten, Hintergründe. Europäische Akademie Bozen, Fachbereich Alpine Umwelt. Blackwell Wissenschaftsverlag. Berlin, Wien.
Brugger, W., Dopsch, H. & Krammel, P.F. (1993): Geschichte von Berchtesgaden. Verlag Anton Plenk, Berchtesgaden.
Denisiuk, Z. , Stoyko, S. & Terray, J. (1997): Experience in Cross-Border Cooperation for National Park and Protected Areas in Central Europe. In, J.G. Nelson & R. Serafin (eds.), National Parks and Protected Areas. Keystones for Conservation and Sustainable Development. Springer. 145 - 150.
Gätje, C. (2003): Tourismus und Erholung in der Wattenmeerregion. In, J.L. Lozán, E. Rachor, K. Reise, J. Sündermann. & von H. Westerhagen (eds.), Warnsignale aus der Nordsee. Neue Folge. Vom Wattenmeer bis zur offenen See. Wissenschaftliche Auswertungen, Hamburg. 117 – 121.
Giles, W. (2003): GIS Applications in Tourism Planning. www.cnc.bc.ca/gis/Documents/340TourismTermPaper.pdf
Haider, W., Anderson, C., Beardmore, B. & Anderson. D.A. (2004): Recreational Trail Use of Residents in Jasper National Park, Canada. Working Papers of the Finnish Research Institute 2. http://www.metla.fi/julkaisut/workingpapers/2004/mwp002.html.
Hannmann, A. & Riddle, M. (2005): Introduction to social network methods. http://faculty.ucr.edu/~hanneman/
Hannemann, T. & Job. H. (2003): Destination "Deutsche Nationalparke" als touristische Marke. In: Zeitschrift für Tourismus, 58. 6-17.
Hennig, S. (2003): Interaktive Bildschirmkarte – „Schnittstelle Wissen“. Dissertation am Institut für Geographie und Angewandte Geoinformatik Paris-Lodron Universität Salzburg. Online Bibliothekskatalog ALEPH, Universitätsbibliothek, Salzburg. www.sbg.ac.at/plus/plus_2_04/diss.htm
Hennig, S. (2005): Monitoring-System „Recreational Use“ – Das Beispiel Nationalpark Berchtesgaden. In, Schrenk, M. (Hrsg.): Tagungsband CORP 2005 Geo Multimedia 05, Wien.
Hennig, S. & Künzl, M. (2005): Toward a Guiding Principle “Recreational Use” The Protected Area Berchtesgaden National Park within the Region. Conference Volume 3rd Symposium of the Hohen Tauern National Park for Research in Protected Areas. 15.-17. September 2005. Castle of Kaprun.
Hennig, S. & Laube, M. (2005): Besuchermonitoring in Nationalparken. Eine Bestandsaufnahme in Deutschland, Österreich und der Schweiz. In: Standort – Zeitschrift für Angewandte Geographie 4/2005.
ITR Institut für touristische Raumplanung (2001): Nationalparks und Tourismus in Österreich 2001. Studie verfasst im Auftrag des Bundesministeriums für Wirtschaft und Arbeit.
Knippschild, R. & Liebe, J. (2004): Umweltorientiertes Regionalmanagement in Grenzräumen. IÖR-Schriften / Band 44, Dresden.
Jansen, D. (1999): Einführung in die Netzwerkanalyse. Grundlagen, Methoden, Anwendungen. Leske Budrich, Opladen.
Job, H., Metzler, D. & Vogt, L. (2003): Inwertsetzung alpiner Nationalparke. Eine regionalwirtschaftliche Analyse des Tourismus im Alpenpark Berchtesgaden. Münchner Studien zur Sozial- und Wirtschaftsgeographie, Band 43. Verlag Michael Lassleben Kallmünz, Regensburg.
Muhar, A., Arnberger, A. & Brandenburg, C. (2002): Methods for Visitor Monitoring in Recreational and Protected Areas: an Overview. In, A. Muhar, A. Arnberger & C. Brandenburg (Hrsg.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Institut for Landscape Architecture and Landscape Management Bodenkultur University Vienna 2001: 1-6, Wien.
Nechodom, M. (2005): Institutional and Policy Contexts of Biosphere Reserves:Potential Roles for Social Science in Sustainable Development Strategies. Glochamore – Projecting Global Change Impacts and Sustainable Land Use and Natural Resources Management in Mountain Biosphere Reserves. Sierra Nevada Biosphere Reserve, Spain. 14. – 17. März 2005.
Neubert, M. & Walz, U. (2005): Monitoring der Landschaftsentwicklung in grenzüberschreitenden Nationalparkregionen - Beispiel aus dem EU-Projekt SISTEMaPARC. 4th Sächsisches GIS-Forum – GI2005 – Symposium. 12. – 13. Mai 2005.
Schnegg, M. & Lang, H. (2002): Netzwerkanalyse. Eine praxisorientierte Einführung. In, Methoden der Ethnographie. Heft 1.
StMLU Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen (Hrsg.) (2001): Nationalparkplan. http://www.nationalpark-berchtesgaden.de
Türk, S., Jakob, E., Krämer, A. & Roth, R. (2004): Outdoor recreation activities in nature protection areas – situation in German. Working Papers of the Finnish Research Institute 2. http://www.metla.fi/julkaisut/workingpapers/2004/mwp002.html.
Wegelin, F. (2005): Neue Gesprächskultur für den Alpenraum. In, Themenheft II des NFB 48 „Landschaften und Lebensräume der Alpen“. Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung. 3-7.
URL1: http://www.euregio.sbg.at/euregio.asp?ID=82
URL2: http://www.analytictech.com/ucinet.htm
URL3: http://www.ogc.gov.uk/sdtoolkit/reference/roles/stakeholder.html
URL4: http://www.siegfried-seibert.de/Wissensspeicher/PMGlossar
URL5: http://www.competence-site.de/projektmanagement.nsf/0/c0b12f1c51cf6e4ac1256e45003e528b?OpenDocument
URL6: http://de.wikipedia.org/wiki/Soziales_Netzwerk

Tourismus und Erholung in Natura-2000-Gebieten im Alpenraum

Valerie KOCH, Petra STERL, Thomas BAUER, Ulrike PRÖBSTL, Veronika WIRTH

(Institut für Vermessung, Fernerkundung und Landinformation, Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur, Peter-Jordan-Straße 82, 1190 Wien, valerie.koch@boku.ac.at)
(Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung, Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur, Peter-Jordan-Straße 82, 1190 Wien, petra.sterl@boku.ac.at)

ZUSAMMENFASSUNG

Der Alpenraum zeichnet sich durch eine einzigartige Naturnähe und eine große Anzahl seltener Tier- und Pflanzenarten aus. Um diese besondere biologische Vielfalt zu erhalten, wurden große Teile dem europäischen Schutzgebietssystem Natura 2000 unterstellt. Die Alpen werden von rund 120 Millionen Touristen und Erholungssuchenden1 jährlich besucht - der Tourismus gehört somit zu den wichtigsten Wirtschaftsfaktoren der gesamten Region. Im Zusammenhang mit einer nachhaltigen Entwicklung alpiner Natura-2000-Gebiete stellt sich vielfach die Frage, wie die Bedürfnisse sensibler Arten und Lebensräume berücksichtigt werden können und die touristische Nutzung erhalten bleiben kann. Ein Instrument dafür sind Natura-2000-Managementpläne, die in den jeweiligen Gebieten die Ansprüche unterschiedlicher Nutzungs- und Interessensgruppen integrieren sollen. Ziel des Interreg IIIB-Projektes AlpNaTour ist die Entwicklung eines Leitfadens, der die Erstellung von Managementplänen in touristisch genutzten Natura-2000-Gebieten erleichtern soll. Ein weiterer Schwerpunkt des Projektes sind unterschiedliche Möglichkeiten der Partizipation im Planungsprozess. Grundlage für den Leitfaden bilden Erfahrungen in Testgebieten in Deutschland, Italien, Österreich und Slowenien. In den Testgebieten werden unterschiedliche Methoden der Bestandsaufnahme und Bewertung von Tourismus angewandt und auf ihre Effizienz überprüft.

Eines der österreichichen Testgebiete ist der Schneeberg, ein beliebtes Ausflugsziel in der Nähe der Großstadt Wien. Dort wurden im Sommer und Herbst 2005 unterschiedliche Methoden der Besuchererfassung erprobt. Mit Hilfe eines Modells zur Risikoanalyse werden in weiterer Folge Gebiete ausgewiesen, die ein hohes Risiko der Beeinträchtigung des Erhaltungszustandes der Schutzobjekte2 durch intensive touristische Nutzung aufweisen. Die Eingangsgrößen für das Modell sind einerseits die Ergebnisse der Besuchererfassung und andererseits die Empfindlichkeit der Schutzobjekte in Hinblick auf Tourismus. Die praktische Umsetzung erfolgt im Rahmen einer GIS-Analyse, ebenso werden GIS-Modellierungen von Besucherströmen durchgeführt.

Das Interreg IIIB-Projekt AlpNaTour soll zu einer kooperativen Umsetzung der FFH- und Vogelschutzrichtlinie und zur einer nachhaltigen Entwicklung im Alpenraum beitragen.

1 EINLEITUNG

1.1 Natura 2000

Das Schutzgebietssystem Natura 2000, ein europaweites Netzwerk zum Erhalt des gemeinsamen europäischen Naturerbes, hat den dauerhaften Schutz und die Erhaltung der biologischen Vielfalt in Europa und damit die Erhaltung wildlebender Tier- und Pflanzenarten sowie bedrohter Lebensräume zum Ziel. Etwa 25.000 Schutzgebiete mit einer Gesamtfläche von etwa 950.000 km2 (Natura-2000-Barometer) werden derzeit von den EU-Mitgliedsstaaten eingerichtet. Rechtliche Grundlage für Natura 2000 ist die Fauna-Flora-Habitat-Richtlinie (Office for Official Publications of the European Communities 1992) und die Vogelschutzrichtlinie (Office for Official Publications of the European Communities 1979). Die Fauna-Flora-Habitat-Richtlinie regelt den Schutz der biologischen Vielfalt und die Erhaltung natürlicher Lebensräume und wild lebender Tier- und Pflanzenarten. Etwa 400 bedrohte Arten sowie etwa 250 bedrohte Lebensräume, Natur- und Kulturlandschaften werden in dieser Richtlinie angeführt. Die Vogelschutzrichtlinie dient dem Schutz von etwa 180 wild lebenden, in Europa heimischen Vogelarten.

Ziel des europäischen Schutzgebietsnetzes Natura 2000 ist die Sicherung eines günstigen Erhaltungszustandes der Arten und Lebensräume und somit die Vermeidung einer Verschlechterung desselben. Ein Instrument dafür ist der Natura-2000-Managementplan. Von besonderer Bedeutung ist dabei die Berücksichtigung wirtschaftlicher, kultureller und regionaler Bedürfnisse sowie die Integration der Ansprüche unterschiedlicher Nutzer- und Interessensgruppen.

1.2 AlpNaTour

Der Alpenraum weist eine besonders hohe Biodiversität auf, die zu einem großen Teil auf traditionellen Kulturlandschaften beruht. Jährlich besuchen etwa 120 Millionen Touristen die Alpen, die damit einen bedeutenden Wirtschaftsfaktor für die gesamte Region darstellen. Die Berücksichtigung der Ansprüche seltener und bedrohter Lebensräume, Tier- und Pflanzenarten und die Erhaltung der Möglichkeit einer touristischen Nutzung stellt hier eine große Herausforderung dar.

Es herrscht Konsens über die Notwendigkeit, den Faktor Tourismus in der Managementplanung von Natura-2000-Gebieten mehr zu berücksichtigen. Unsicherheiten und Forschungsdefizite bestehen vor allem in der Frage, wie diese Integration praxisnah umgesetzt werden kann. Hier stellen sich viele Fragen: Wie können Belastungen und Störungen durch die Erholungsnutzung effizient erfasst werden? Wie können die Interessen von Besuchern berücksichtigt werden, die nur kurze Zeit im Gebiet sind? Welchen Beitrag kann der Managementplan zum Bestandsschutz von Einrichtungen und zur Planungs- und Investitionssicherheit von Betrieben leisten?

Ziel des Projektes AlpNaTour ist es, in einem Leitfaden zur Natura-2000-Managementplanung Anworten auf diese und weitere Fragen zu liefern. Grundlage für den Leitfaden bilden Erfahrungen in Testgebieten in Deutschland, Italien, Österreich und

---

[1] Im folgenden Text umfasst der Begriff „Touristen“ sowohl Touristinnen und Touristen als auch Erholungssuchende. Ebenso steht der Begriff „Tourismus“ sowohl für touristische Nutzung als auch Erholungsnutzung.

[2] Der Begriff „Schutzobjekt“ ist ein Sammelbegriff für Lebenraumtypen und Arten in Natura-2000-Gebieten.

Slowenien. Auf Basis eines Vergleichs von Arbeitshilfen zur Managementplanung in Natura-2000-Gebieten in den Alpenstaaten werden unterschiedliche Konzepte beschrieben. In den Testgebieten werden verschiedene Methoden der Bestandsaufnahme touristischer Nutzungen erprobt und auf ihre Effizienz untersucht. Ein weiterer Schwerpunkt des Projektes widmet sich der Partizipation von Akteuren im Tourismus im Natura-2000-Managementplanungsprozess.

1.3 Beeinträchtigungen und Störungen von Lebensräumen und Arten

Die Beeinträchtigung und Störung von Schutzobjekten beruht vor allem auf der Zerstörung, Fragmentierung und Verschlechterung von Lebensräumen und damit der Verschlechterung der Lebensgrundlagen von Arten (Schemel und Erbguth 2000). Gerade hierzu können touristische Nutzungen einen erheblichen Beitrag leisten, und einen günstigen Erhaltungszustand beeinträchtigen oder gefährden.

Die Beeinträchtigung von Arten erfolgt entweder mittelbar durch eine Veränderung gewisser Bestandteile ihres Lebensraumes oder unmittelbar durch Störungen. Durch Störungen werden Aktivitäten der Wildtiere, die zum Beispiel mit Ernährung, Jungenaufzucht oder Ruhezeiten in Zusammenhang stehen, unterbrochen oder verändert. In Abhängigkeit von der Intensität der Störung weichen die betroffenen Tiere räumlich aus, flüchten oder bleiben dem betroffenen Lebensraum fern. Die Empfindlichkeit von Tieren gegenüber Störungen ist räumlich und zeitlich sehr unterschiedlich (Ingold 2005; Schemel und Erbguth 2000). So sind zum Beispiel Tiere in Gebieten, die selten von Menschen besucht werden, sensibler hinsichtlich Störungen, als in Gebieten, wo Tiere immer wieder die Gelegenheit haben, sich von der „Harmlosigkeit“ der Menschen zu überzeugen. In diesem Zusammenhang spricht man vom „Nationalparkeffekt“ (Wille und Bergmann 2001), wobei hier auch die Art der unterschiedlichen menschlichen Aktivitäten (z.B. Jagd) eine Rolle spielt.

1.4 Erfassung und Modellierung von Besuchern in Natura-2000-Gebieten

Um den Faktor Tourismus, und damit den negativen Einfluss auf Schutzobjekte, in der Natura-2000-Managementplanung berücksichtigen zu können, sind Informationen über das Besucheraufkommen bzw. die Nutzungsintensität notwendig.

Die Auswahl der Methode zur Besuchererfassung ist von verschiedenen Faktoren abhängig. Neben finanziellen, personellen und materiellen Ressourcen spielen die Größe des Schutzgebietes, die touristische Infrastruktur und die Art der touristischen Nutzung eine wesentliche Rolle. Weiters gilt es zu klären welche räumliche, zeitliche und thematische Auflösung der Daten benötigt wird. Verschiedene Methoden der Besuchererfassung wurden bereits vielfach diskutiert (Cessford und Muhar 2003; Hornback und Eagles 1999; Muhar et al. 2002; Watson et al. 2000). Dazu gehören Befragungen, direkte Beobachtungen mittels Feldbeobachtern, indirekte Beobachtungen mit Videokameras, Erfassung von Zutrittskarten, Besucherregistrierung (z.B. Gipfelbücher), mechanische und elektronische Zählvorrichtungen sowie die Erfassung von Nutzungsspuren. Neuere Untersuchungen beschäftigen sich mit dem Einsatz von Luftbildern für die Besuchererfassung (Star et al. 1997; Kammler und Schernewski 2004; Ronkholz 2003) bzw. mit der Erfassung von Routen mittels Aufzeichnung durch GPS-Geräte (Yoshimura n.d.; Visschedijk 2005). Da die meisten Methoden zur Besuchererfassung mit hohen Kosten verbunden sind, kommt der effizienten Nutzung bereits vorhandener Daten und der Kombination von Daten aus unterschiedlichen Quellen eine hohe Bedeutung zu. Eine Zusammenführung der Daten erfolgt in Form einer Modellierung des Besucheraufkommens. Hier ist die räumlich-zeitliche Struktur von besonderem Interesse. Daher bieten sich diverse GIS-Analyse-Methoden an. Agenten-basierte Verfahren erscheinen besonders geeignet (Itami et al. 2003). Sie werden generell zur Untersuchung komplexer Systeme verwendet, in denen menschliches Verhalten von Bedeutung ist. Soziale und natürliche Prozesse werden ausgehend von autonom handelnden Individuen, den so genannten Agenten, simuliert. Mit solchen Verfahren können auch zukünftige Entwicklungen des Besucheraufkommens abgeschätzt und die Wirksamkeit von Managementmaßnahmen evaluiert werden (Schneider et al. 2005).

2 METHODIK

2.1 Ökologische Risikoanalyse für Natura-2000-Managementpläne

Das Konzept der ökologischen Risikoanalyse ist seit den 70er Jahren, vor allem im Rahmen von Umweltverträglichkeitsprüfungen, in Anwendung. Sie wurde entwickelt um die ökologische Verträglichkeit von Planungen bewerten zu können (Scholles 1997).

Im Rahmen des Projektes AlpNaTour wurde das Konzept der ökologischen Risikoanalyse adaptiert, um das Risiko einer Beeinträchtigung des Erhaltungszustandes der Schutzobjekte durch Tourismus und Erholung zu bewerten. Der Fokus der Managementplanung richtet sich auf Gebiete mit einem hohen Risiko der Beeinträchtigung. Um die effiziente Bearbeitung von Gebieten, die einen hohen Handlungsbedarf aufweisen, gewährleisten zu können, wird im Rahmen einer Risikoanalyse das Risiko der Verschlechterung des Erhaltungszustandes durch touristische Nutzungen bewertet. In partizipativen Prozessen sollen für Bereiche des Natura-2000-Gebietes, die ein mittleres und hohes Risiko der Beeinträchtigung aufweisen, Lösungsmöglichkeiten und Maßnahmen erarbeitet werden.

Eingang in das Modell finden einerseits die Empfindlichkeit der Schutzobjekte in Hinblick auf eine spezifische touristische Nutzung und andererseits die Beeinträchtigungsintensität der jeweiligen Nutzung. Da sowohl die Empfindlichkeit der Schutzobjekte als auch die Beeinträchtigungsintensität in räumlicher und zeitlicher Hinsicht bewertet werden, bezieht sich auch das Ergebnis der Analyse, das Risko, auf bestimmte Räume und Zeiten. Da jedes Schutzobjekt eine andere Empfindlichkeit gegenüber unterschiedlichen touristischen Nutzungen aufweist, ist bei der Riskoanalyse jeweils ein Schutzobjekt in Zusammenhang mit einer spezifischen touristischen Nutzung zu betrachten.

Im Folgenden wird das Konzept der Risikoanalyse erläutert (Abb. 1). Die Genauigkeit der Ergebnisse der Risikoanalyse ist von den vorhandenen Datengrundlagen abhängig. So ist zum Beispiel in Niederösterreich die Abgrenzung der Vorkommen der Schutzobjekte bereits vorhanden, was eine Ausweisung von Risikoflächen wesentlich erleichtert.

2.1.1 Screening

Vor Beginn der eigentlichen Risikoanalyse wird ein Screening durchgeführt. Auf Basis einer Literaturrecherche und unter Heranziehung von naturschutzfachlichen Experten wird die Relevanz touristischer Nutzungen für jedes einzelne Schutzobjekt bewertet. Auf Grundlage dieser Bewertung werden in den Untersuchungsgebieten jene relevanten Schutzobjekte und Nutzungen ausgewählt, für die eine Risikoanalyse durchgeführt werden soll. Alle Schutzobjekte, die durch die vorhandenen touristischen Nutzungen nicht beeinträchtigt sind, werden aus der weiteren Bearbeitung ausgeschlossen.

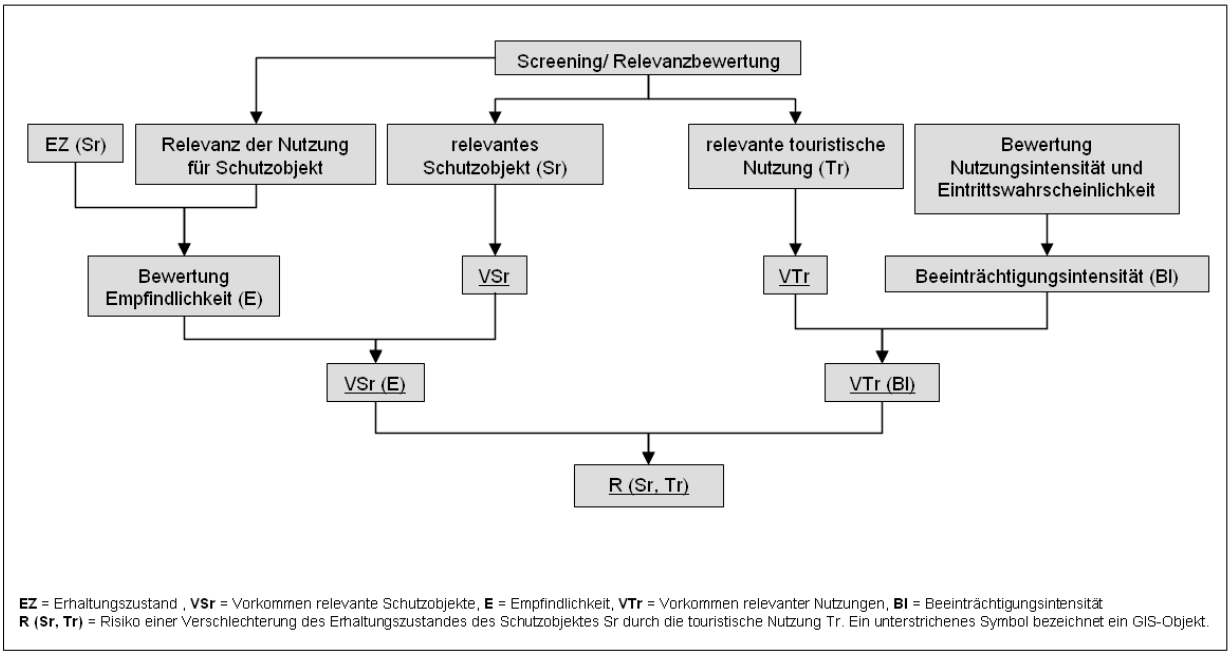


Abb. 1: Konzept Risikoanalyse AlpNaTour

2.1.2 Empfindlichkeit der Schutzobjekte

Die Empfindlichkeit der Schutzobjekte ergibt sich aus dem Erhaltungszustand der Schutzobjekte, der im Rahmen der Kartierung der Natura-2000-Gebiete erhoben wurde und aus den Standarddatenbögen entnommen werden kann. Eine weitere Eingangsgröße ist die Relevanz der spezifischen touristischen Nutzung für das Schutzobjekt. Die Empfindlichkeit der Schutzobjekte bezieht sich je nach vorhandenen Ausgangsdaten auf das gesamte Natura-2000-Gebiet oder auf die abgegrenzten Vorkommen der Schutzobjekte, wie sie zum Beispiel für Niederösterreich bereits vorliegen.

2.1.3 Beeinträchtigungsintensität der Nutzungen

Die Beeinträchtigungsintensität setzt sich aus der Nutzungsintensität und der Eintrittswahrscheinlichkeit der Beeinträchtigung zusammen. Um die Nutzungsintentsität bewerten zu können, benötigt man Daten zum Besucheraufkommen. Dabei sind verschiedene Datenquellen heranzuziehen und die unterschiedlichen Informationen sinnvoll zu integrieren. Neben der Erfassung neuer Daten spielt die Analyse und Auswertung von bereits vorhandenen Daten wie z.B. Nächtigungszahlen, Infrastrukturdaten, Daten der Verkehrszählung usw. eine wesentliche Rolle.

Die Bewertung der Nutzungsintensität kann auf unterschiedliche Arten erfolgen. Ist z.B. auf Grund der Größe des Schutzgebietes die Durchführung detaillierter Erhebungen zu aufwändig, so erfolgt die Bewertung der Nutzungsintensität durch Experten bzw. mittels einer Analyse bereits vorhandener Daten, wobei sich diese Bewertung jeweils auf den gesamten Untersuchungsbereich bezieht (Abb. 2).

Sind detaillierte Daten über Besucherzahlen und Besucherströme bereits vorhanden bzw. werden sie im Rahmen der Risikoanalyse erhoben, so erfolgt die Bewertung der Nutzungsintensität auf Basis der Besucherzahlen. Diese Zahlen beziehen sich auf eine gewisse touristische Infrastruktur (z.B. Wanderwege, Hütten, Aussichtpunkte usw.) über die ebenfalls Daten vorhanden sein müssen (Abb. 3).

Um gebietsspezifische Besonderheiten zu berücksichtigen, die die Nutzungsintensität beeinflussen können, wird der Begriff der Eintrittswahrscheinlichkeit eingeführt. Selbst bei einer hoher Nutzungsintensität kann die Beeinträchtigungsintensität in Abhängigkeit von der Eintrittswahrscheinlichkeit gering sein, weil z.B. hohe Besucherzahlen durch gute Lenkungsmaßnahmen nur zu geringen Beeinträchtigungen führen.

2.1.4 Risiko

Nach der Bewertung der Empfindlichkeit und der Nutzungsintensität erfolgt die Verknüpfung dieser beiden Werte in einer so genannten Risikomatrix. Ebenso erfolgt eine räumliche Verschneidung (Abb. 2 und 3). Es werden drei Risikostufen ausgewiesen: geringes, mittleres und hohes Risiko. Ein Handlungsbedarf besteht im Rahmen der Managementplanung für Gebiete mit mittlerem und vor allem hohem Risiko.

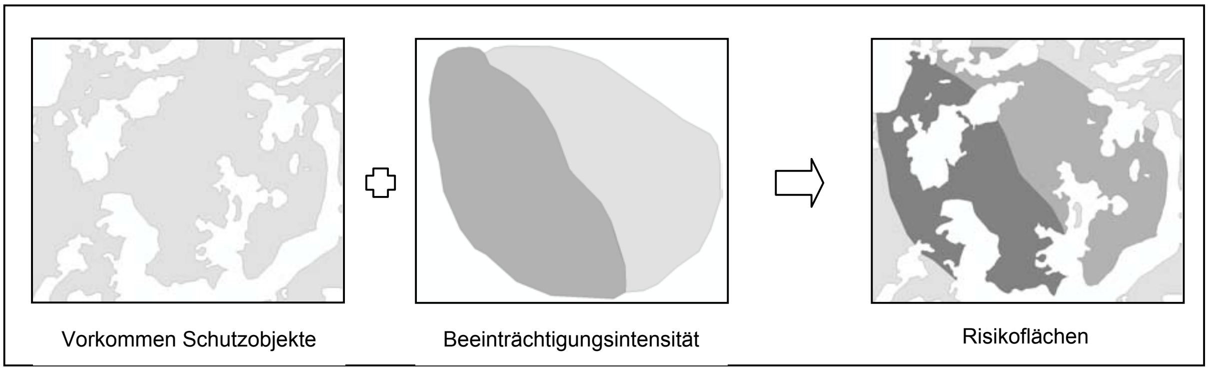


Abbildung 2: Risikoanalyse Variante 1 (schematische Darstellung)

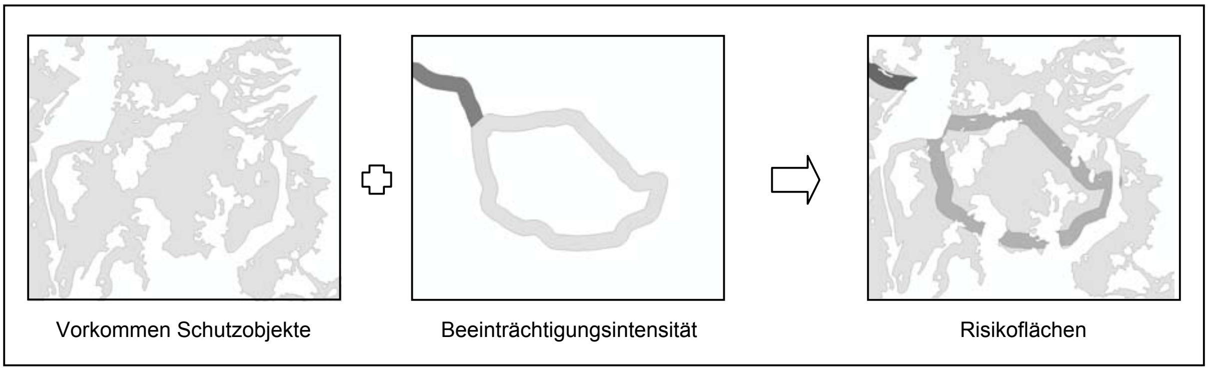


Abbildung 3: Risikoanalyse Variante 2 (schematische Darstellung)

2.2 Untersuchungsgebiet

Die österreichischen Testgebiete des Projektes AlpNaTour sind die drei alpinen Natura-2000-Gebiete Niederösterreichs, „Nordöstliche Randalpen", „Wienerwald-Thermenregion" und „Ötscher-Dürrenstein". Der Schneeberg wurde daraus als eines der Gebiete ausgewählt, in denen detaillierte Untersuchungen der touristischen Nutzung stattfinden.

Der Schneeberg ist Teil des Natura-2000-Gebietes „Nordöstliche Randalpen". Durch die Nähe zum Ballungsraum Wien und durch die leichte Erreichbarkeit auch aus Ungarn und der Slowakei ist er ein beliebter Ausflugsort. Eine Zahnradbahn führt auf ein Hochplateau in einer Höhe von etwa 1800 Metern. Auf diesem Hochplateau können auch ältere Personen und Familien mit kleinen Kindern leichte Wanderungen unternehmen, ebenso gibt es Routen und Klettersteige für anspruchsvollere Besucher. Schutzobjekte, die durch die Nutzungen Wandern und Klettern beeinträchtigt werden können sind Lebensraumtypen wie z.B. alpine Kalkrasen oder Kalkfelsen mit Felsspaltenvegetation.

2.3 Erfassung der touristischen Nutzung und Erholungsnutzung

In einem ersten Schritt wurde im Rahmen eines Screenings die Relevanz der im Untersuchungsgebiet Schneeberg vorkommenden Nutzungen für die dort vorkommenden Schutzobjekte bestimmt. Alle Schutzobjekte, die auf die Ausübung der vorkommenden Nutzungen (Wandern, Lagern, Sammeln, Mountainbiken, Klettern) nicht empfindlich reagieren, wurden aus dem weiteren Arbeitsprozess ausgeschlossen. Die Lebensraumtypen am Schneeberg-Hochplateau „Karbonat-Latschengebüsch" (4070), „Alpine Kalkrasen" (6170) und „Kalkfelsen mit Felsspaltenvegetation" (8210) können durch diese Nutzungen beeinträchtigt werden. Aufgrund der vorkommenden Schutzobjekte sind vor allem die Anzahl der Besucher und deren räumliche Verteilung von Interesse.

Im Sommer und Herbst 2005 wurde am Schneeberg eine Besuchererhebung durchgeführt (Tabelle 1). Neben einer direkten Zählung der Besucher an vier Standorten am Schneeberg wurden im Tal die Anzahl der PKWs und Autobusse auf sieben Parkplätzen erhoben. Gleichzeitig mit den Zählungen wurden an zwei Tagen Luftbilder des Gebietes aufgenommen. An den Zählstandorten wurden Photos gemacht, um besser abschätzen zu können, welcher Anteil der Besucher sich abseits der Wege aufhält. Zusätzlich wurden die Besucher befragt und ihre Routen mittels GPS-Geräten aufgezeichnet. Außerdem wurden lokale Experten, wie Hüttenwirte, nach ihrer Einschätzung des Besucheraufkommens am Schneeberg befragt.

Methode	Erhebungsumfang
Direkte Beobachtung Zählung der Besucher an vier Standorten am Schneeberg	Zählungen an 5 Tagen
Indirekte Beobachtung Zählung der Pkws und Busse auf sieben Parkplätzen im Tal	Zählungen an 4 Tagen
Indirekte Beobachtung Luftbilder	Befliegungen an 2 Tagen
Indirekte Beobachtung	

Photos der Nutzer zur Erfassung der Abweichung der Besucher von den Wegen	Zählungen an 5 Tagen
Befragung der Besucher Befragung der Besucher an vier Standorten am Schneeberg sowie in zwei Hütten	Befragungen an 5 Tagen
Befragung von lokalen Experten Befragung der Hüttenwirte	Befragungen an 2 Tagen
Besucherregistrierung Aufzeichnung der Routen der Besucher mittels GPS-Geräten	Ausgabe der Geräte an 3 Tagen
Erfassung von Zutrittskarten Fahrkarten der Schneebergbahn	verkaufte Fahrkarten/Monat

Tabelle 1: Methodik der Besuchererfassung am Schneeberg

3 ANALYSE

Die am Schneeberg erhobenen Daten dienen als Grundlage für die Risikoanalyse, die durchgeführt werden kann, sobald die Auswertung der Ergebnisse abgeschlossen ist. Weiters sollen die unterschiedlichen, eingesetzten Methoden (Tabelle 2) auf ihre Eignung für den Einsatz in der Risikoanalyse im Rahmen der Natura-2000-Managementplanung überprüft werden.

Angewandte Methode	**Erfasste Parameter**
Zählung der Besucher	Besucherzahlen, Bewegungsrichtung, Routen, Verteilung im Gebiet, mitgeführte Hunde
Zählung der Pkws und Busse	Rückschlüsse auf Besucherzahlen, Herkunft der Besucher
Luftbildauswertung	Besucherzahlen, Routen, Verteilung im Gebiet, Verhalten der Besucher (Gehen abseits von Wegen)
Photoreihen zur Erfassung der Abweichung der Besucher von den Wegen	Verhalten der Besucher (Gehen abseits von Wegen)
Befragung der Besucher	Charakteristika der Besucher, Routen
Befragung von lokalen Experten	Rückschlüsse auf Besucherzahlen, Verteilung im Gebiet, Verhalten der Besucher, Charakteristika der Besucher
Aufzeichnung der Routen der Besucher mittels GPS-Geräten	Routen, Verteilung im Gebiet
Fahrkarten der Schneebergbahn	Rückschlüsse auf Besucherzahlen, Jahresverlauf

Tabelle 2: Methodenvergleich (vgl. Cessford und Muhar 2003, modifiziert)

Die Anwendbarkeit sowie Vor- und Nachteile von unterschiedlichen Methoden der Besuchererfassung wurden bereits vielfach beschrieben (Cessford und Muhar 2003; Hornback und Eagles 1999; Muhar et al. 2002; Watson et al. 2000). Zu den Nachteilen vieler dieser Methoden gehört die Tatsache, dass zwar sehr genaue Informationen über die Anzahl der Besucher erfasst werden, jedoch zur Verteilung im Raum keine oder nur unzureichende Angaben vorliegen. Für die Analyse gestörter Räume ist vor allem die Abweichung von Wegen und die Nutzung von Abkürzungen relevant, da sich daraus unmittelbare Hinweise auf den Bedarf von Managementmaßnahmen ableiten lassen. Insbesondere, um für Natura-2000-Gebiete unerlässslichen Informationen zur räumlichen Verteilung zu erhalten, wurden im Rahmen des Forschungsprojektes AlpNaTour der Einsatz von GPS-Geräten und Befliegungen als ergänzende Methoden eingesetzt.

3.1.1 Einsatz von Befliegungen

Die besonderen Vorteile einer Befliegung liegen vor allem in der Erfassung der räumlichen Verteilung der Besucher. Weiters können ausgetretene Wege und Trampelpfade erfasst werden. Der Nachteil besteht in der geringen zeitlichen Auflösung bzw. den hohen Kosten. Die Durchführung von Luftbildaufnahmen ist stark von der Wettersituation abhängig, was im Gebirge, wo es häufig zu Nebel- oder Wolkenbildung kommt, eine Einschränkung darstellt. Diese Methode ist nur für Offenland, Gebiete mit geringem Waldanteil oder oberhalb der Baumgrenze geeignet. Die Eignung im Winter wird derzeit im Rahmen des Projektes AlpNaTour untersucht.

3.1.2 Einsatz von GPS-Geräten zur Routenerfassung

Der Einsatz von GPS-Geräten dient der Erfassung von Routen (Abb. 4), wobei die Lagegenauigkeit von den verwendeten Geräten abhängig ist. Vorteile liegen in der hohen zeitlichen Auflösung und der Möglichkeit, das Verhalten der Besucher zu erfassen (z.B. Pausen). Die Anwendbarkeit ist auf Rundwege und Rundwanderungen bzw. auf Orte, wo Erhebungspersonal (zur Rückgabe des Gerätes) positioniert ist, beschränkt. In bewaldeten Gebieten ist der Einsatz von GPS-Geräten auf Grund der Abschirmung durch Bäume eingeschränkt. Bei der Datenanalyse ist zu berücksichtigen, dass das Verhalten der Besucher durch die Mitnahme der Geräte beeinflusst werden kann, und dass nur gewisse Besuchergruppen bereit sind ein Gerät mitzunehmen.

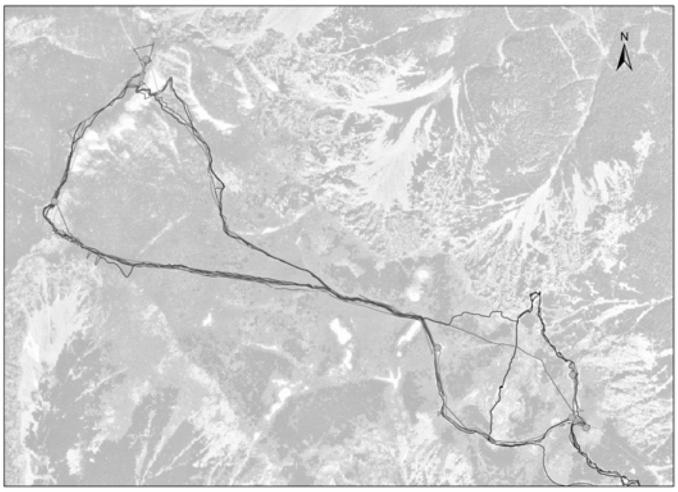


Abb. 4: Räumliche Verteilung der Besucher am Schneeberg-Hochplateau

4 AUSBLICK

Erste Ergebnisse zeigen, dass die Bearbeitung unterschiedlich großer Natura-2000-Gebiete eine Herausforderung darstellt. Während in kleineren Gebieten eine detaillierte zeitliche und räumliche Erfassung der Nutzungsintensität möglich ist, sind in größeren Gebieten Befragungen von Experten und indirekte Methoden der Besuchererfassung (z.B. Analyse touristischer Infrastruktur) zur Beurteilung der Nutzungsintensität von Bedeutung.

Das Modell der ökologischen Risikoanalyse wird in verschiedenen Testgebieten des Projektes AlpNaTour angewandt. Im Rahmen von partizipativen Prozessen können anschließend die Ergebnisse der Risikoanalyse der Bevölkerung und Fachbehörden besser veranschaulicht werden.

Für Winter und Frühling 2005/06 ist die beispielhafte Bearbeitung weiterer Testgebiete geplant. Die praktische Umsetzung der Risikoanalyse erfolgt im Rahmen einer GIS-Analyse. Die Ergebnisse des Projektes fließen in die Bearbeitung der Managementpläne ein.

5 LITERATUR

Bergmann, H. H., Wille, V.: Flüchten oder gewöhnen? – Feindabwehrstrategien wildlebender Tiere als Reaktion auf Störsituationen, in: Störungsökologie Laufener Seminarbeiträge 1/01, Bayrische Akademie für Naturschutz und Landschaftspflege, Laufen: 17-21, 2001.

CESSFORD, G., MUHAR, A.: Monitoring options for visitor numbers in national parks and natural areas. Journal for Nature Conservation, 11: 240-250, 2003.

EUROPEAN COMMISSION: Managing Natura 2000 Sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Belgien, 2000.

HORNBACK, K.E., EAGLES, P.F.J.: Guidelines for Public Use Measurement and Reporting at Parks and Protected Areas. IUCN, Gland, 1999.

INGOLD, P.: Freizeitaktivitäten im Lebensraum der Alpentiere - Konfliktbereiche zwischen Mensch und Tier. Haupt Berne, Basel, 2005.

ITAMI, R., Raulings, r., MacLaren, G., Hirst, K., Gimblett, R., Zanon, D., Chladek, P.: RBSim2: simulating the complex interactions between human movement and the outdoor recreation environment. Journal for Nature Conservation 11: 278-286, 2003.

KAMMLER, M., SCHERNEWSKI, G.: Spatial and temporal analysis of beach tourism using webcam and aerial photographs. In: Schernewski, G., Löser, N. (eds.) 2004. Managing the Baltic Sea. Coastline Reports 2: 121-128, 2004.

MUHAR, A., ARNBERGER, A., BRANDENBURG, C.: Methods for Visitor Monitoring in Recreational and Protected Areas. Proceedings of the Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas, Vienna: 1-6, 2002.

Natura-2000-Barometer: www.http://europa.eu.int/comm/environment/nature/nature_conservation/useful_info/barometer/ barometer.htm (30.11.2005).

Office for Official Publications of the European Communities: Council Directive 79/409/EEC on the conservation of wild birds, 1979.

Office for Official Publications of the European Communities: Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, 1992.

RONKHOLZ, S.: Überprüfung der Erholungsnutzung im Hinblick auf die Gewährleistung eines guten Erhaltungszustandes. Diplomarbeit Technische Universität München, 2003.

SCHEMEL, H.J., ERBGUTH, W.: Handbuch Sport und Umwelt. Meyer & Meyer, Achen, 2000.

Schneider, w., Bauer, T., Koch, V.: Modellierung und Erfassung von touristischen Nutzungen in Schutzgebieten. Tagungsband Tourismus und Schutzgebiete – Hemmschuh oder Partner?, Wien: 12-13, 2005.

SCHOLLES, F.: Abschätzen, Einschätzen und Bewerten in der UVP. Weiterentwicklung der Ökologischen Risikoanalyse vor dem Hintergrund der neueren Rechtslage und des Einsatzes rechnergestützter Werkzeuge. Dortmunder Vertrieb für Bau- und Planungsliteratur, Dortmund, 1997.

STAR, J. L., ESTES, J. E., MC GWIRE, K. C.: Integration of Geographic Information Systems and Remote Sensing. Cambridge University Press, 1997.

VISSCHEDIJK, P.: Personal information (Project Progress http://www.progress-eu.info/), 2005.

Watson, A.E., Cole, D.N., Turner, D.L., Reynolds, P.S.: Wilderness Recreation Use Estimation: A Handbook of Methods and Systems. United States Department of Agriculture. General Technical Report RMRS-GTR-56, 2000.

Yoshimura, T., Hasegawa, N., Nakashima, T.: Monitoring Visitor Use Density and Degradation of Wilderness for Sustainable Mountain Tourism. http://bg66.soc.i.kyoto-u.ac.jp/forestgps/doc/malaysia.pdf, not dated.

Realisierung eines objekt-relationalen Datenmodells für Planung und Management der Freizeit- und Erholungsinfrastruktur

Julia MOSER, Sebastian JUNGHANNS

(Universität Salzburg, FB Geographie, Geologie und Mineralogie, Hellbrunnerstr. 34, A-5020 Salzburg, julia.moser@sbg.ac.at
Technische Universität Graz, Institut für Geoinformation, Steyrergasse 30, A-8010 Graz, sjung@sbox.tugraz.at)

ZUSAMMENFASSUNG

Im Rahmen dieser Arbeit wird ein konkreter Vorschlag für ein georeferenziertes, objekt-relationales Datenmodell für Planung und Management der Freizeit- und Erholungsinfrastruktur vorgestellt. Das unter Verwendung einer modernen Modellierungssprache (Unified Modeling Language) entwickelte Datenmodell wurde prototypisch in Form einer Geodatenbank (ESRI Personal Geodatabase) realisiert, auf die über ein gängiges Geoinformationssystem (ESRI ArcGIS) zugegriffen werden kann. Die bei der Realisierung des Datenmodells gewonnenen Erkenntnisse werden vorgestellt. Der Schwerpunkt liegt dabei auf logischen Problemen zur strukturierten Beschreibung des komplexen Beziehungsgeflechts von Infrastrukturelementen. Methodik und Werkzeuge (CASE Tools) der Datenmodellierung und des Datenbankentwurfs werden unter dem Gesichtspunkt der Geodatenmodellierung beleuchtet. Abschließend wird die Praxisrelevanz des Datenmodells anhand von Einsatzmöglichkeiten im Bereich von Schutzgebieten umrissen.

1 EINLEITUNG

Zunehmende Veränderungen im Freizeitverhalten der Gesellschaft und in den Anforderungen an Infrastrukturelemente (ISE) stellen eine große Herausforderung für Planung und Management von Freizeit- und Erholungsnutzung dar. Neben der Bereitstellung von Infrastrukturelementen besteht insbesondere in Schutzgebieten großer Planungsbedarf aufgrund zunehmender Belastungen des Naturhaushalts durch den Menschen und den daraus resultierenden Konflikten.

Der Entscheidungsprozess für die in diesem Kontext relevanten planerischen Maßnahmen bzw. die Inventarisierung existierender Infrastrukturelemente können durch digitale Planungsgrundlagen wesentlich unterstützt werden. In der Literatur wird allerdings der praktische Einsatz digitaler Planungsgrundlagen, wie Geodatenbanken bzw. Geoinformationssysteme, im Bereich der Freizeit- und Erholungsnutzung bisher als gering bewertet. Neben dem immer noch offensichtlichen Mangel an exisitierenden Datenbanklösungen zur computergestützten Abbildung räumlicher, zeitlicher und nutzungsspezifischer Formen der Freizeit- und Erholungsnutzung liegen verfügbare Datenbestände zumeist auch in inkosistenter Form vor (vgl. GILES 2003). Aktuelle Veröffentlichungen im Bereich der angewandten Geowissenschaften bieten aber mittlerweile fundierte Überlegungen theoretischer und praktischer Art, um die Realisierung einsatzfähiger digitaler Planungsgrundlagen zu ermöglichen (vgl. u. a. FECHT 2005, HENNIG 2005a, HENNIG 2005b).

Das im Folgenden präsentierte Datenmodell soll einen weiterführenden Beitrag zur Diskussion leisten, wie Infrastrukturelemente für Freizeit- und Erholungsnutzung modelliert werden können. Es stellt eine Prototyprealisierung einer digitalen Planungsgrundlage dar. Als konzeptuelle Basis für die Modellierung dienten facheinschlägige Literatur, Expertenwissen aus Gemeinden und Tourismusverbänden, Kartenmaterial, Studien sowie Beschreibungen zu vorhandenen Projekten. Davon ausgehend erfolgte eine Bestandsaufnahme relevanter Infrastrukturelemente der Freizeit- und Erholungsnutzung. Diese wurden im Rahmen der Datenmodellierung so abgebildet, dass anhand des resultierenden Datenmodells planungsrelevante Information generiert werden kann. Relevante Daten können somit wohlstrukturiert abgelegt und nutzbringend in den Planungsprozess eingebracht werden.

Eine ausführliche Argumentation der Thematik bzw. Vorstellung des Datenmodells ist bei MOSER (2005) zu finden.

2 METHODIK UND WERKZEUGE

Die in dieser Arbeit vorgestellte digitale Planungsgrundlage wurde konzeptuell als objekt-relationales Datenmodell entwickelt. Der objekt-relationale Ansatz führt Konzepte der Objektorientiertheit mit dem klassischen relationalen Ansatz zur Modellierung von Daten zusammen (vgl. BARTELME 2005, S. 332 – 347). Objektorientierte Konzepte eignen sich besser zur Abbildung komplex strukturierter Daten, wie dies insbesondere bei Geodaten der Fall ist, wo einzelne Entitäten sowohl über geometrische, als auch rein semantische Information verfügen. Andererseits gewährt eine strikte Einhaltung relationaler Konzepte einen hohen Grad an Redundanzfreiheit und Konsistenz. Der aus der Verbindung beider Konzepte resultierende objekt-relationale Ansatz bildet die konzeptuelle Basis für die Mehrzahl der aktuell verfügbaren Geodatenbanksysteme bzw. Datenbanksysteme mit Erweiterungen für das Management räumlicher Daten.

Das für die digitale Planungsgrundlage konzeptuell erarbeitete Datenmodell sollte praktisch in Form einer Geodatenbank realisiert werden. Zunächst verfolgten die Autoren dabei den Ansatz, die Datenmodellierung möglichst unabhängig hinsichtlich des letztendlich zu verwendenden Datenbanksystems durchzuführen. In der Praxis stellte sich dies als nur begrenzt machbar heraus. Während die Grundüberlegungen des Modells systemunabhängig übertragbar sind, zeigte sich bei der detaillierten Beschreibung einzelner Entitätsklassen und Beziehungen die Notwendigkeit, Rahmenbedingungen des Zielsystems zu berücksichtigen. Dies betrifft sowohl rein technische Aspekte bzgl. der zu verwendenden Software-Werkzeuge, als auch inhaltliche Aspekte bzgl. der konkreten Art und Weise, wie Datenstrukturen im jeweiligen Zielsystem wiederzugeben sind.

Im Rahmen des Datenmodellierungsprozess von der Konzeption, über Modellierung bis hin zur physischen Umsetzung der Datenbank kam es zu einem intensiven Einsatz der Unified Modeling Language (UML). UML ist ein de facto Notationsstandard für eine graphische Modellierungssprache, die zur Spezifikation, Visualisierung und Dokumentation von Softwaresystemen, aber auch Geschäftsmodellen und anderen nicht-softwarespezifischen Systemen dient (vgl. OMG 2005a,b, JECKLE ET AL. 2004, S.175 – 198). Konkret für den Kontext dieser Arbeit wurden UML-Use-Case-Diagramme im Rahmen der Informations- und Anforderungsanalyse und UML-Klassendiagramme für die Beschreibung der logischen Datenbankstrukur verwendet.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

Das vorgeschlagene Datenmodell wurde in Form einer ESRI Personal Geodatabase (PGDB) realisiert. Es handelt sich dabei um eine objekt-relationale, einzelnutzerorientierte Geodatenbank, deren Daten auch über das gängige Desktop-Datenbanksystem Microsoft Access zugegriffen werden können. Für Details zur PGDB sei auf ZEILER (1999) verwiesen. Die Autoren entschieden sich u. a. aufgrund der folgenden Punkte für den Einsatz einer PGDB:

einfache und schnelle Integration mit einem CASE-Tool, wie Microsoft Visio, das UML unterstützt;

einfache Integration mit einem gängigen Geoinformationssystem, wie ESRI ArcGIS;

geringe Einarbeitungszeit bzw. geringer technischer Aufwand, um erste Ziele zu erreichen;

Interaktion mit Datenbank über graphische Schnittstelle relativ einfach möglich (via ESRI ArcGIS);

freie Verfügbarkeit von UML-Templates bzw. Add-ons für semantische Prüfung und XMI-Export.

Offensichtliche Defizite der PGDB bzgl. Authentifikation, Autorisierung, Mehrfachnutzerzugriff, Versionierung bzw. Kurz- und Langzeittransaktion sind den Autoren wohl bewusst. Allerdings war es im Rahmen dieses Projekts notwendig, mit geringem technischen Aufwand prototypische Lösungen schnell erstellen zu können. Somit konnte der Fokus der Arbeit verstärkt auf die inhaltliche Arbeit am Datenmodell gelegt werden.

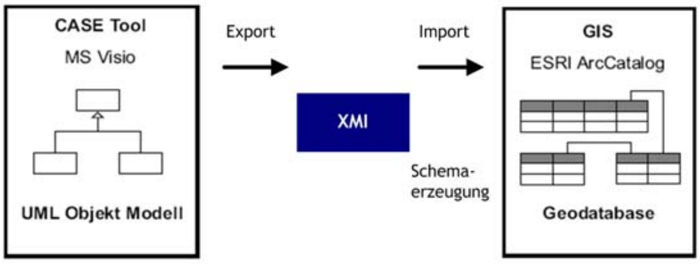


Abb. 5 Arbeitsablauf vom UML Modell zur Datenbank mit MS Visio (nach MCGRAY 2003)

Das Vorgehen für die Realisierung orientierte sich sehr stark am klassischen Datenbankentwurfsprozess (vgl. u. a. KEMPER & EICKLER 2004, S. 32, MOSER 2005, S. 57). Anforderungen potenzieller Nutzer wurden durch persönliche Gespräche und Literaturrecherchen ermittelt und in Form von Use Cases beschrieben. Mittels Use Cases kann generell das funktionale Verhalten eines Systems aus der Sicht der Nutzer („Akteure“) formuliert, sowie anhand der Systeminteraktion der beteiligten externen Akteure bestimmt werden. Die erstellten Use Cases wurden letztendlich graphisch in UML wiedergegeben. Somit waren die Nutzeranforderungen überschaulich dokumentiert, konnten zur Diskussion mit Endanwendern eingesetzt werden bzw. dienten zur wiederkehrenden Selbstkontrolle während des Modellierungsprozesses, um Abweichungen von Zielsetzungen möglichst rechtzeitig vermeiden zu können.

Anhand des erstellten Anforderungsprofils erfolgte mittels Computer Aided Software Engineering (CASE) die Entwicklung des logischen Datenmodells bis hin zur physisch realisierten PGDB. Microsoft Visio – mit integriertem UML-Support erweitert um die von ESRI frei erhältliche UML-Templates und Werkzeuge für semantische Prüfung und XMI-Export – erwies sich in diesem Kontext als mächtiges CASE-Tool für Modellierung von ESRI Geodatabases. Das graphisch in Microsoft Visio entwickelte logische Datenmodell wurde über die XMI (XML Metadata Interchange)-Schnittstelle exportiert. Das so in XML repräsentierte Datenmodell konnte auf semantische Korrektheit geprüft werden, bevor der Import über die XMI-Schnittstelle von ESRI ArcGIS zur Generierung der entsprechenden PGDB erfolgte. Dieser hiermit kurz umrissene Prozess durchlief mehrere Iterationen. Datenmodelländerungen wurden prinzipiell im CASE-Tool in UML vorgenommen, niemals direkt an der physischen Datenbank. Somit wurden graphische Dokumentation und Datenbank konsistent weitergeführt.

3 VORSTELLUNG DES DATENMODELLS

Wie bereits erwähnt, wurde das Datenmodell als ESRI Personal Geodatabase umgesetzt. Für die diesbezüglich relevanten Fachtermini und Informationen zu Kernkomponenten und Datenstrukturen einer PGDB wird auf ZEILER (1999, S. 76 – 99) verwiesen.

Infrastrukturelemente (ISE) für Freizeit- und Erholungsnutzung mit eigener Geometrie werden im Datenmodell in einem so genannten Feature Dataset (`ISEFeatureDataset`) zusammengefasst abgelegt. Damit wird die Verwendung eines einheitlichen räumlichen Bezugssystems für diese ISEs gewährleistet.

Den Kern dieses Feature Dataset bildet ein Wegenetz (`ISEWegenetz`), das in Form eines geometrischen Netzwerkes (`<<GeometricNetwork>>`) realisiert wird (vgl. Abb. 6). Die Kanten des so gebildeten Graphs werden durch die Feature Class `ISEWeg` beschrieben bzw. die Knoten durch `ISEKreuzung`. Jede Kante repräsentiert eine spezifische Art von Weg mit eigener Geometrie. Verschiedene Wegarten werden im Datenmodell durch so genannte Subtypes modelliert und umfassen u. a. Straßentypen, Pfade und Steige, aber auch lineare ISEs wie Bahntrassen, Schifffahrtswege, Lift- und Seilbahnstrecken (vgl. Abb. 7).

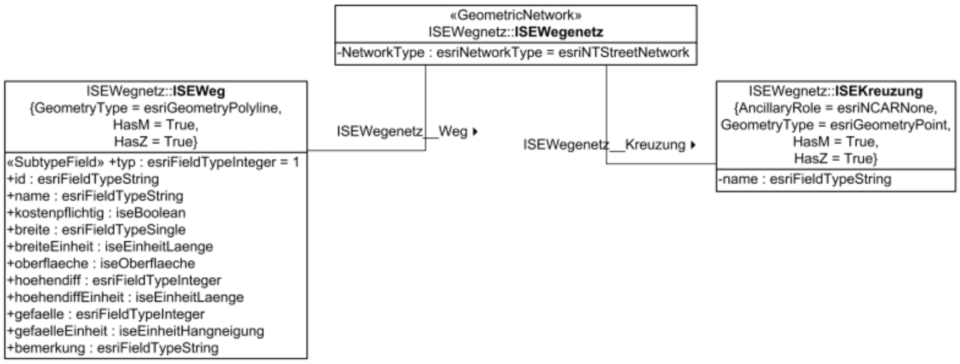


Abb. 6 Datenmodellausschnitt: Wegenetz

Eine besondere Art von Weg bilden die so genannten „Weglosen Abschnitte“ (`ISEWegloserAbschnitt`). Es handelt sich dabei um Kanten des Wegenetzgraphs, die zwar in der Realwelt nicht physisch vorhanden, aber für die Routenplanung von Bedeutung sind. Ein typisches Beispiel stellen die Verläufe von Skitouren dar.

Mangels fehlender Referenzen wurde keine spezifische Kantenbewertung vorgenommen, keine Festlegung von Verbindungsregeln aufgestellt (vgl. ZEILER 1999, S. 133), sowie Aspekte der Netzwerkverfolgung nicht einbezogen (vgl. ZEILER 1999, S. 139 – 144). Diese endnutzerspezifischen Punkte sind im Rahmen einer speziellen Anpassung des Datenmodells zusammen mit dem konkreten Endnutzer zu definieren. Das Datenmodell ist dahingehend flexibel gestaltet, als dass diese Punkte einfach integriert werden können.

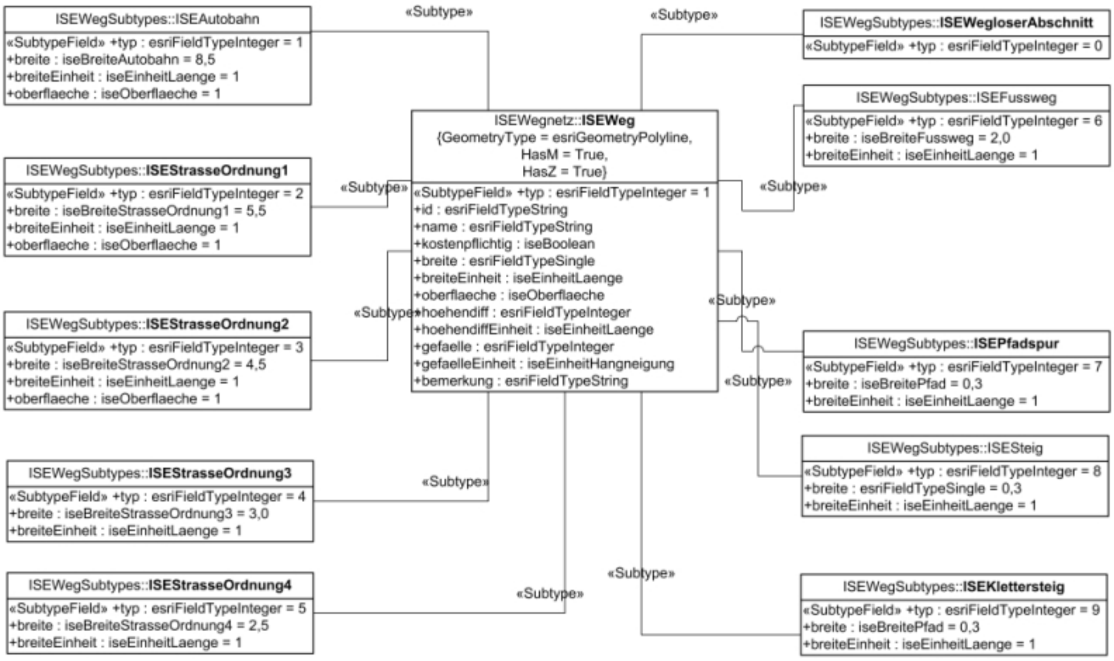


Abb. 7 Datenmodellausschnitt: Auswahl an Subtypes für Wege

Für einen Weg im Wegnetz kann das Potenzial für die Ausübung von einer oder mehreren verschiedenen Erholungsaktivitäten angegeben werden (vgl. Abb. 8). Neben der Fortbewegung auf Verkehrswegen, werden auf Wegen Formen landschaftsgebundener Freizeit- und Erholungsnutzung ausgeführt. Diese Formen werden im Datenmodell in einer so genannten Object Class `ISEAktivitaet` abgebildet. Aktivitäten, die auf Wegen ausgeübt werden können, stehen dabei in Abhängigkeit vom Nutzungszeitraum. Dieser wird im Datenmodell durch das Attribut „Verfügbarkeit“ (`verfuegbarkeit`) angegeben. Beispielsweise ist die Aktivität Skitourengehen auf einem Weg theoretisch nur im Winter möglich. Die Aktivität Wandern kann auf bestimmten Wegen ganzjährig möglich sein.

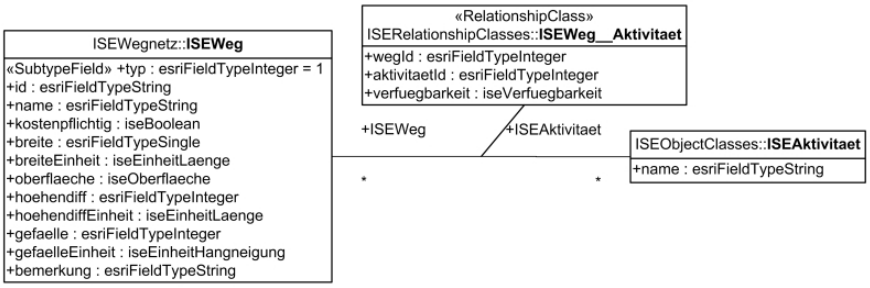


Abb. 8 Datenmodellausschnitt: Beziehung Weg – Aktivität

Des Weiteren können für Wege Angaben zu Qualitätsmerkmalen wie Ausstattung (Object Class `ISEAusstattung`) und den Weg beeinflussende Hindernisse (Object Class `ISEHindernis`) gemacht werden. So kann z. B. angegeben werden, ob ein Weg rollstuhlgerecht ist bzw. ob er von Weidezäunen in seinem Verlauf gequert wird. Darüber hinaus bieten die Attribute der Klasse `ISEWeg` Möglichkeiten zur detaillierten Beschreibung eines Weges.

Das Wegenetzwerk bildet die Basis für die Abbildung von Routen (Object Class `ISERoute`). Im Gegensatz zu Wegen verfügen Routen über keine eigene Geometrie. Vielmehr beziehen Routen diese aus den Geometrien der Wege, entlang derer sie verlaufen. Routen verlaufen von einem Startpunkt zu einem Endpunkt. Die geometrisch identische, aber entgegengesetzt orientierte Strecke entspricht einer separaten Route.

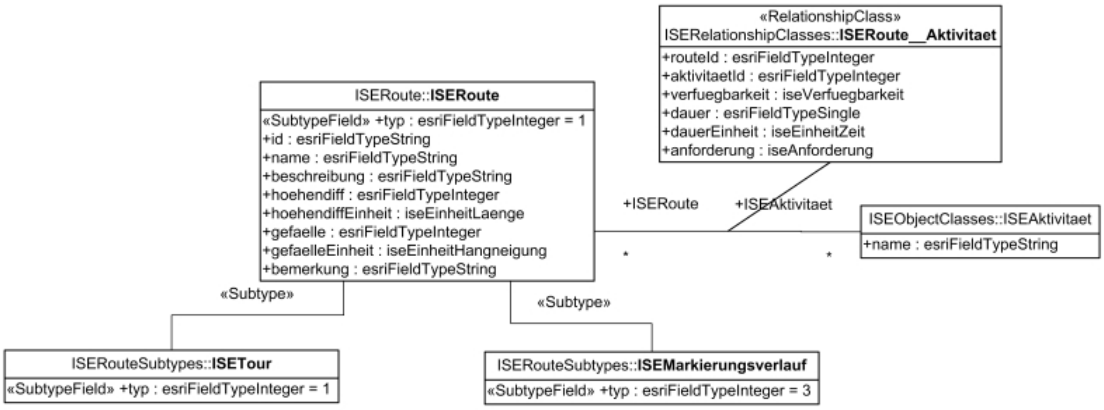


Abb. 9 Datenmodellausschnitt: Subtypes für Route / Beziehung Route – Aktivität

Für Routen werden im vorgeschlagenen Datenmodell die Subtypes „Tour“ (`ISETour`) und „Markierungsverlauf“ (`ISEMarkierungsverlauf`) unterschieden (vgl. Abb. 9). Routen vom Subtype „Tour“ sind z. B. Wanderrouten von einem Ausgangspunkt auf einen Gipfel, eine Schitour, aber auch ein Stadtrundgang. Eine „Tour“ kann gleichzeitig für mehrere Aktivitäten von Bedeutung sein (`ISEAktivitaet`, `ISERoute__Aktivitaet`) (vgl. Abb. 9). Dabei ergeben sich die Aktivitäten aus dem Aktivitätenpotenzial der Wege (`ISEWeg__Aktivitaet`), entlang derer die „Tour“ verläuft. Wichtig ist, dass die Angabe der Aktivität für Routen den Zweck zum Ausdruck bringt, wohingegen die Angabe der Aktivität bei Wegen potenziell mögliche Aktivitäten für dieses ISE aufzeigt. Dauer, Schwierigkeitsgrad und Verfügbarkeit einer „Tour“ hängen von der jeweiligen Aktivität ab (`ISERoute__Aktivitaet`). So kann z. B. ein und dieselbe Tour zu Fuß, mit Mountainbike oder mit Tourenski absolviert werden. Allerdings variieren dabei die zuvor genannten Parameter entsprechend.

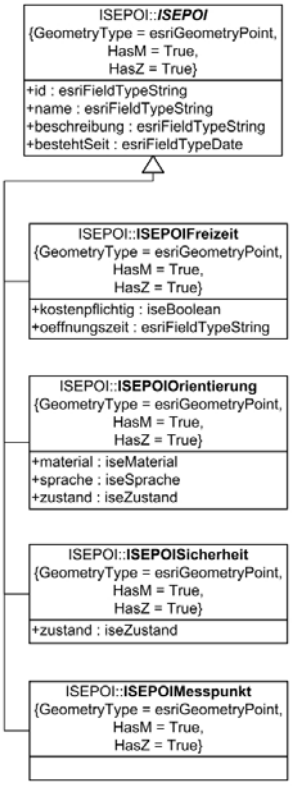


Abb. 10 Datenmodellausschnitt: Subtypes für Points of Interest

Alternativ zur „Tour“ kann eine „Route“ im vorgeschlagenen Datenmodell als „Markierungsverlauf“ (ISEMarkierungsverlauf) beschrieben werden (vgl. Abb. 9). „Markierungsverläufe“ dienen zur Beschreibung des Verlaufs von Markierungen, wie z. B. Alpenvereinswegen. Dabei ist rein der nicht an eine Richtung gebundene Verlauf von Interesse. Für „Markierungsverläufe“ sind Angaben zur Höhendifferenz, Dauer, Schwierigkeitsgrad und Verfügbarkeit nicht relevant. Assoziation mit Aktivitäten kann erfolgen.

Neben linearen ISEs wie Routen werden lokale ISEs in Form von Points of Interest (ISEPOI) mit dem Wegenetzgraphen assoziiert. Im Gegensatz zu Routen verfügen Points of Interest über eigene Geometrien. Im Datenmodell werden für Points Of Interest die Kategorien Points of Interest der Freizeit- und Erholung (ISEPOIFreizeit), Orientierungsinfrastrukturelemente (ISEPOIOrientierung), Sicherheitsinfra-strukturelemente (ISEPOISicherheit) und Messpunkte (ISEPOIMesspunkt) unterschieden. Points of Interest werden allgemein in einer abstrakten Klasse beschrieben (ISEPOI). Durch entsprechende Vererbung werden die zuvor genannten Kategorien in Form von Unterklassen realisiert (vgl. Abb. 10).

Points of Interest spielen eine wichtige Rolle im Zusammenhang mit Routen. So können sowohl am Start- und am Zielpunkt, als auch entlang einer Route eine Vielzahl von Points of Interest liegen. Anhand der für eine Route relevanten Points of Interest können Aussagen zur Qualität der Route getroffen werden. Umgekehrt dienen Points of Interest als Input zum Entwurf neuer Routen. Points of Interest werden im Datenmodell mit dem Wegenetz assoziiert (ISEWeg, ISEKreuzung). Die Verbindung zwischen Points of Interest und Routen wird somit transitiv über das Wegenetz erreicht. Points of Interest müssen immer über den Wegegraphen erreichbar sein. Eine Assoziation mit dem Wegegraphen kann zum einen durch die direkte Lage an einem Weg oder einer Kreuzung bzw. durch die Relevanz für einen Weg oder eine Kreuzung begründet sein. So liegt z. B. eine Lawinenschutzverbauung nicht direkt an einem Weg, ist aber dennoch für die Nutzung eines Weges von Bedeutung.

Für die Points of Interest der Freizeit wird postuliert, dass diese prinzipiell an einem Weg (Kante) oder einer Kreuzung (Knoten) liegen. Liegen Points of Interest der Freizeit jenseits physisch vorhandener Wege, dann müssen sie unter Verwendung der Wegeart „Wegloser Abschnitt“ im Graph „erreichbar gemacht“ werden.

Des Weiteren bietet das Datenmodell die Möglichkeit, für alle Points of Interest, wie auch für Wege und Routen Aussagen über Zuständigkeiten (ISEZustaendigkeiten) zu treffen. Es ist möglich, für ein ISE mehrere Zuständigkeiten zu beschreiben. In diesem Kontext agierende Akteure (Personen, Organisationen) können ebenfalls beschrieben werden.

Um Planungsmaßnahmen wie z. B. Besucherlenkungskonzepte oder die Einrichtung von zusätzlichen ISEs festlegen zu können, muss die existierende Nutzungsintensität von ISEs erfasst werden. Nutzungsintensität kann anhand von Messungen ermittelt werden. Das vorgeschlagene Datenmodell ermöglicht es, für ISEs vorgenommene Messungen flexibel zu integrieren. Messungen (ISEMessung) werden beschrieben durch Angaben zu Messgröße (Wert, Einheit, Messzeitraum), relevantem ISE, Zielgruppe und Aktivität (vgl. Abb. 11). Da in ausgelagerten Object Classes verfügbar, können Zielgruppe (ISEZielgruppe) und Aktivität (ISEAktivitaet) detaillierter beschrieben werden.

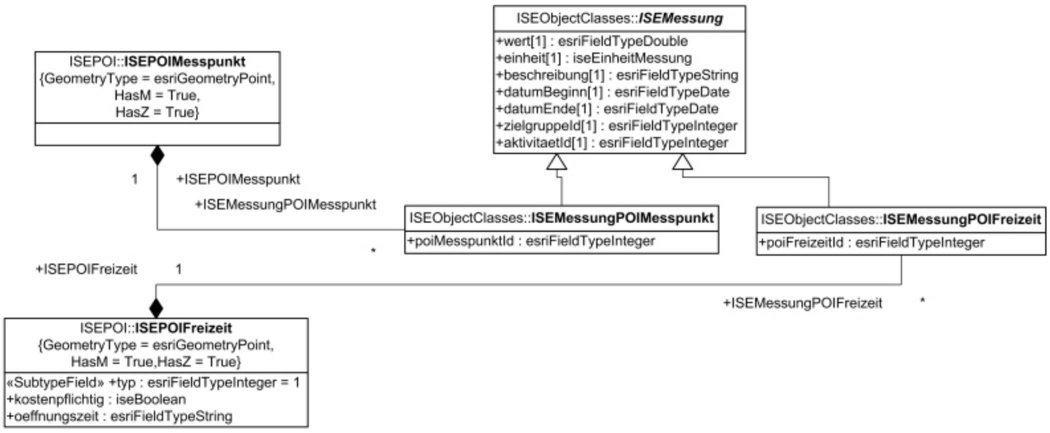


Abb. 11 Datenmodellausschnitt: Beziehung Messungen – Points of Interest

Messungen werden mit Points of Interest – in den meisten Fällen Points of Interest der Freizeit – so assoziiert, dass für einen bestimmten Point of Interest beliebig viele Messungen erfasst werden können (vgl. Abb. 11). Messungen sind somit räumlich verortet. Beispiele dafür sind die Erfassung von Besucherzahlen eines Ausflugszieles oder Nächtigungszahlen einer Herberge. Allerdings können Messungen auch an Orten vorgenommen werden, die jenseits vorhandener Points of Interest liegen. Handelt es sich z. B. um die Ermittlung der Frequentierung von Routen, dann werden entlang der zu messenden Strecken Zählstellen eingesetzt. Zur Modellierung dieses Umstandes führt das Datenmodell so genannte Messpunkte (ISEPOIMesspunkt) ein. Damit wird die Verortung von Messungen ermöglicht, die nicht an einen physisch existierenden Point of Interest gebunden sind. Neben Points of Interest der Freizeit und Messpunkten kann das Datenmodell jederzeit so erweitert werden, dass auch Messungen mit anderen Arten von Points of Interest assoziiert werden können.

Für eine detaillierte Beschreibung des Datenmodells inklusive Repräsentation in UML wird auf MOSER (2005, S. 66 – 84, 97 - 121) verwiesen. UML-Repräsentation und Realisierung des Datenmodells als PGDB kann auf Anfrage von den Autoren bereitgestellt werden.

4 EINSATZMÖGLICHKEITEN AUS DEM BEREICH SCHUTZGEBIETE

Anhand der folgenden Einsatzmöglichkeiten soll die Praxisrelevanz des in dieser Arbeit prototypisch vorgeschlagenen Datenmodells beleuchtet werden.

4.1 Schutzgebietsmanagement

Schutzgebiete haben eine besondere Funktion als Erholungsraum (vgl. HENNIG 2005b). Daher spielt ihre Planung und ihr Management eine wichtige Rolle für die Freizeit- und Erholungsplanung. In diesem Kontext soll das vorgeschlagene Datenmodell als Basis für Überlegungen zu Planungsmaßnahmen bzw. als Entscheidungshilfe für das Schutzgebietsmanagement dienen. Dies ist vor allem in Hinblick auf die Vereinbarkeit von Naturschutz und Freizeit- und Erholungsnutzung von besonderer Bedeutung. Siehe exemplarische Use Cases für Schutzgebietsmanagement, vgl. Abb. 12.

Zur Aufdeckung von Konfliktpotenzialen, die aus der Überschneidung von Naturschutz und Freizeitaktivitäten resultieren, kommen naturschutzfachliche Bewertungen der verschiedenen Formen von Freizeit- und Erholungsnutzung zum Einsatz. Bewertungen erfolgen auf Basis von Messungen. Diese geben Auskunft über die zeitliche, räumliche und quantitative Verteilung von Nutzungsformen (vgl. HENNIG 2005a). Diese Informationen bieten Möglichkeiten für entsprechende Planungsmaßnahmen wie z. B. Lenkungseinrichtungen zur „Sicherung empfindlicher Standorte vor Trittschäden" (STMLU 2001) oder die Bündelung von Besuchereinrichtungen in einem bestimmten Abschnitt, um großräumige Auswirkungen zu vermindern. Die im Folgenden angeführten exemplarischen Fragen aus dem Schutzgebietsmanagement, können mittels einer auf dem vorgeschlagenen Datenmodell basierenden Geodatenbank effizient beantwortet werden.

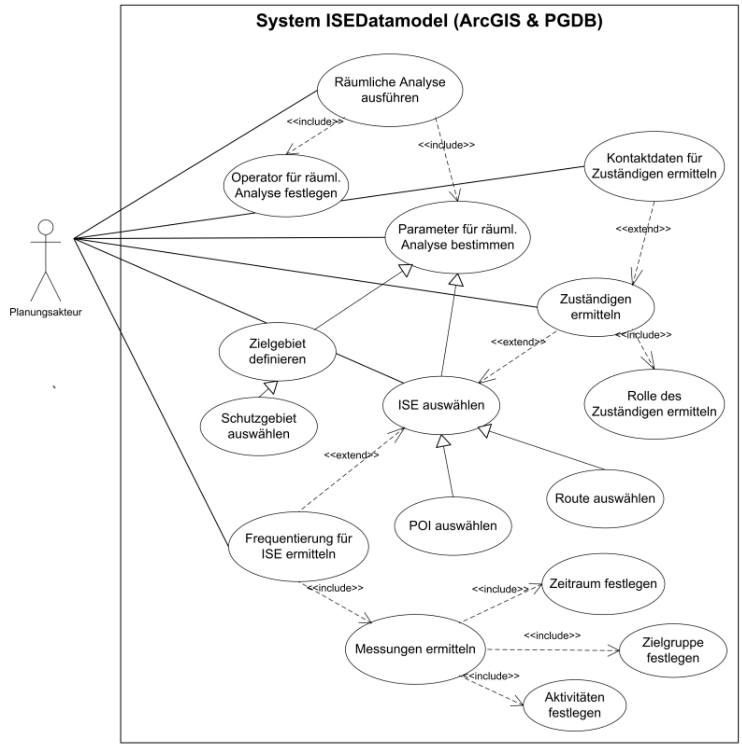


Abb. 12 Exemplarische Use Cases für Schutzgebietsmanagement und Zuständigkeiten

Welche Erholungsformen werden generell im Schutzgebiet ausgeübt? Welche Routen sind diesbezüglich vorhanden?

Welche Routen sind ganzjährig verfügbar? Welche nur saisonweise?

Welche Routen verlaufen durch die Kernzone des Schutzgebietes bzw. durch Wildschutzgebiete?

Führt der Routenverlauf der vorhandenen Skirouten durch ökologisch schützenswerte Gebiete?

Verlaufen Wanderrouten durch besonders schützenswerte Vegetationskomplexe bzw. störanfällige Schutzgebiete?

Wie viele Wegweiser und Hinweisschilder liegen an der Route X?

Welche Mountainbikerouten gibt es bzw. auf welchen Wegen verlaufen die Mountainbikerouten?

Welche Informationsstellen gibt es bzw. liegen diese an stark frequentierten Routen?

Welche Sicherheitseinrichtungen gibt es?

Welche Zahlen gibt es über die Intensität der Nutzung?

- Welche Route wird wann am stärksten frequentiert?
- Wie verteilen sich die Besucherzahlen auf den Wegen?
- Durch wen wird die Route X am häufigsten genutzt?
- Welche Parkplätze sind am besten ausgelastet?
- Welche Einstiegspunkte bzw. Ausflugsziele sind am meisten frequentiert?
- Welche Hütten im Schutzgebiet sind am besten ausgelastet? Liegen diese Hütten in der Kernzone des Nationalparks?

4.2 Erholungsvorsorge

Im Rahmen der Erholungsvorsorge beschäftigt sich die Freizeit- und Erholungsplanung mit der Bereitstellung und Aufrechterhaltung von ISEs. Dahingehend ist die Bestandsaufnahme von vorhandenen ISEs eine wichtige Basis. Die Bestandsaufnahme soll Aufschluss über Qualität und Quantität an vorhandenen ISEs geben. Anhand dieser Information kann eine ausgewogene Ausstattung des Erholungsraumes mit ISEs im Einklang mit dem Naturschutz gewährleistet werden (siehe Use Cases für Anlegen einer Radroute, Abb. 13). Das vorgeschlagene Datenmodell unterstützt Planer bei der Entscheidungsfindung für folgende, in diesem Kontext relevante Fragestellungen.

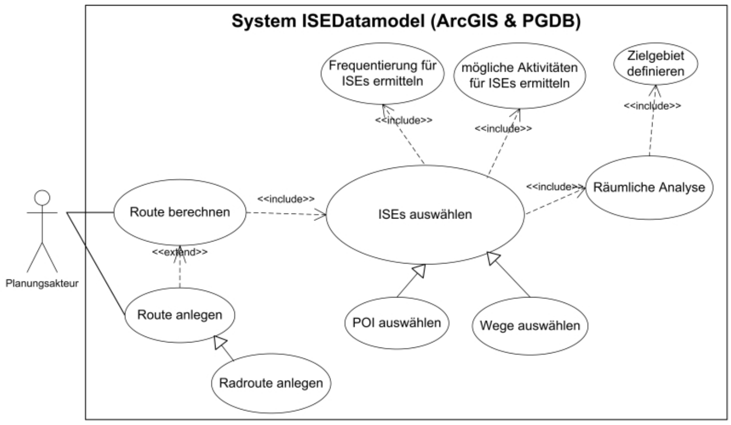


Abb. 13 Erholungsvorsorge – Beispiel für Use Cases zum Anlegen einer Radroute

Welche Optionen gibt es für den Verlauf einer attraktiven, neu anzulegenden Route, die bestimmten Aktivitäten und Zielgruppen gewidmet ist?

Welche Attraktionen und Sehenswürdigkeiten gibt es und wie können diese erreicht werden? Sind ausreichend Parkplätze bzw. Bushaltestellen vorhanden?

Gibt es ausreichend Informationsstellen?

Welche Themenwege bzw. Lehrpfade gibt es?

Welche kulturgeschichtlich interessanten ISE gibt es und seit wann bestehen diese?

Welche natürlichen oder touristischen Einrichtungen liegen entlang Route X?

Wo beginnt und wo endet Route X?

Welche rollstuhlgerechten Wege gibt es?

Welchen Bekanntheitsgrad haben Themenwerge bzw. Lehrpfade? Sind diese eher für Einheimische oder Touristen interessant?

Welche Bildungsinfrastrukturelemente (z. B. Lehrgärten, Informations- und Schautafeln) gibt es?

4.3 Zuständigkeit

Zuständigkeiten informieren, welcher Akteur, mit welcher Rolle für welches ISE verantwortlich ist. Diese Informationen sind für Planungsstellen hinsichtlich Kooperation im Rahmen der Erholungsvorsorge und zum Planen von Datenerhebungen von Relevanz. Für letzteres werden die Kontaktinformationen der jeweiligen Akteure benötigt. Siehe exemplarische Use Cases für Zuständigkeit, vgl. Abb. 12. In diesem Kontext sind folgende, mögliche Fragestellungen relevant, die mit Hilfe einer auf dem Datenmodell basierenden Geodatenbank beantwortet werden können.

Von welcher Person oder Organisation werden die Hütten im Untersuchungsgebiet gepachtet?

Welche Vereinshütten bzw. -wege gibt es?

Welche Routen sind vom Tourismusverband ausgeschildert?

Welche Vereinssektion ist für Instandhaltung der Klettersteige und Wanderrouten verantwortlich?

Wer ist für die Beschilderung der Routen zuständig?

Wer ist für Parkplatz X zuständig, inklusive Angabe der Kontaktadresse?

Wer kümmert sich um die Lawinensicherung auf Weg X?

5 FAZIT UND AUSBLICK

Anhand des vorgestellten Datenmodells wurde demonstriert, wie moderne Architekturen und Systeme der Geoinformatik im Sinne der Nachhaltigkeit es ermöglichen, komplexe Sachverhalte für Planer überschaubarer zu gestalten und somit zu einer vereinfachten und optimierten Entscheidungsfindung beitragen. Die Speicherung von kostenaufwendig erhobenen Infrastrukturdaten in adäquaten Geodatenbanken ist Voraussetzung für langfristige Wertsicherung der Daten, da somit effiziente und flexible Generierung von relevanter Information für den Planungsprozeß ermöglicht wird.

Bei der Entwicklung des Datenmodells wurde nicht nur auf eine möglichst realitätsnahe Abbildung der Infrastrukturelemente, sondern auch auf einen flexiblen Datenmodellentwurf geachtet. Letzterer soll es ermöglichen, das Datenmodell auch in anderen Anwendungskontexten jenseits des reinen Schutzgebietsmanagements einsetzen zu können. Um den entwickelten Prototyp in eine ausgereifte Implementierung für ein einsetzbares System zu überführen, sind weiterführende Entwicklungen notwendig.

Aus datenmodellspezifischer Sicht werden folgende Verbesserungsvorschläge gemacht:

Das im Datenmodell integrierte Wegenetzwerk (`<<GeometricNetwork>>`) wurde der Einfachheit halber vorläufig mittels unbewerteter Kanten und einheitlichem Knotentyp realisiert. Großes Potenzial für weiterführende Entwicklungen bietet die Erarbeitung eines komplexen Wegenetzwerkmodells mit Berücksichtigung von Kantengewichtung und Kantenverbindungsregeln bzw. Möglichkeiten zur Netzwerkverfolgung.

Für die flexible Beschreibung von Zuständigkeiten und ISE-Eigenschaften wird die Entwicklung von Profilen angedacht, welche sich an gängigen Konzepten der Nutzerverwaltung / Rechtevergabe in der EDV orientieren kann. Es werden dabei mehrere Entitäten in Gruppen zusammengefasst, für die wiederum Eigenschaften definiert werden. Dadurch soll Konfigurationsaufwand verringert und eine Wiederverwendung vorgenommener Einstellungen ermöglicht werden.

Software- und systemspezifisch sind Ausbaumöglichkeiten in folgenden Bereichen zu sehen:

Verbesserung von Interaktion und intuitiver Nutzerführung, sowie verstärkte Plausibilitätsprüfung von Nutzereingaben über das in ArcGIS bereitgestellte GUI für das Management der ESRI Personal Geodatabase. Beispielsweise werden durch die standardmäßig vorhandenen ArcGIS-Werkzeuge komplexe Datenbankabfragen – wie Abfragen über mehrere Joins hinweg – nur eingeschränkt im GUI unterstützt. Dafür ist die Entwicklung zusätzlicher in ArcGIS zu integrierender Softwarekomponenten erforderlich. Da des Weiteren die Editierbarkeit von Objekten bzw. Objektbeziehungen nicht sehr intuitiv gehalten wird, sollten hier spezifische Dialoge zur Objektbearbeitung entwickelt werden bzw. vorhandene Komponenten entsprechend modifiziert und erweitert werden.

Bei der Festlegung des zu verwendenden Datenbanksystems bestanden im Rahmen dieser Arbeit nur eingeschränkte Möglichkeiten zur detaillierten Analyse der technischen und funktionalen Nutzeranforderungen. Aussagen zur vorhandenen IT-Landschaft von potentiellen Endanwendern konnten kaum getroffen werden. Beide Faktoren sind allerdings unerlässlich, um eine längerfristig einsatzfähige Lösung zu implementieren. Wesentliche Parameter für die Systementscheidung sollten Anforderungen an die Datenbank bzgl. Mechanismen wie Authentifikation, Autorisierung, Mehrfachnutzerzugriff, Versionierung, sowie Kurz- und Langzeittransaktion umfassen. Die in dieser Arbeit eingesetzte ESRI Personal Geodatabase ist eher für den Einsatz in kleineren Benutzergruppen bei relativ statischem Datenbestand geeignet. Hingegen bei größeren Organisationen, wo die Datenbank aktiv in den Planungsprozess einbezogen wird, und somit sehr dynamische Datenbestände vorliegen, sollte eine Lösung basierend auf ArcSDE in Verbindung mit leistungsfähigen Datenbanksystemen wie Oracle eingesetzt werden.

6 DANKSAGUNG

Ein Dankeschön geht an die Nationalparkverwaltung Berchtesgaden, sowie die EuRegio Salzburg – Berchtesgadener Land – Traunstein für inhaltliche Anregungen und Bereitstellung relevanter Information. Des Weiteren sei Univ.-Prof. Josef Strobl, Fachbereich Geographie, Geologie und Mineralogie der Universität Salzburg gedankt, für seine konstruktiven Anmerkungen im Zuge der Datenmodellierung.

7 LITERATUR

BARTELME N.: Geoinformatik – Modelle, Strukturen, Funktionen. 4. Auflage, Springer, Berlin - Heidelberg, 2005.

FECHT M.: Edelweiss – sicher unterwegs. Unveröffentlichte Spezifikation. Firma GRID-IT Gesellschaft für angewandte Geoinformatik mbH, Innsbruck, 2005.

GILES W.: GIS Applications in Tourism Planning. URL: www.cnc.bc.ca/gis/documents/340TourismTermPaper.pdf, 2003. [Stand: 2005-11-23].

HENNIG S.: Objektorientiertes (Daten-)Modell „Recreational Use“. – In: J. STROBL, T. BLASCHKE & G. GRIESEBNER, Hrsg., Angewandte Geographische Informationsverarbeitung. Beiträge zum AGIT Symposium Salzburg 2005. Wichmann Verlag, Heidelberg, 2005a.

HENNIG S.: Monitoring moderner Landnutzungsformen in Großschutzgebieten – Das Beispiel Nationalpark Berchtesgaden. – In: SCHRENK, M., Hrsg., CORP 2005 Geo Multimedia 05, Wien, 2005b.

JECKLE M., RUPP C., HAHN J., ZENGLER B. & QUEINS S.: UML 2 glasklar. 1. Auflage, Hanser, München, 2004

KEMPER A. & EICKLER A.:Datenbanksysteme – Eine Einführung. 5. Auflage, Oldenbourg, München, 2004

MCGRAY P.: Using CASE Tools (for ArcEditor and ArcInfo), Workshop, ESRI Virtual Campus.- Redlands, 2003.

MOSER J.: Entwicklung eines objektrelationalen Datenmodells für Infrastrukturelemente der Freizeit- und Erholungsnutzung (am Beispiel Euregionales Erholungsgebiet Nationalpark Berchtesgaden / Salzburger Kalkhochalpen). – Salzburg, Magisterarbeit, Universität Salzburg. URL: http://www.users.sbg.ac.at/~9920103/datenmodell/ magisterarbeit_moser_datenmodell.pdf, 2005. [Stand 2005-11-27]

OMG – OBJECT MANAGEMENT GROUP: Unified Modeling Language Version 2.0. URL: www.omg.org/technology/documents/formal/uml.htm, 2005a. [Stand: 2005-11-23].

OMG – OBJECT MANAGEMENT GROUP: Objektorientierte Grundbegriffe / Begriffe UML / UML-Notationsübersicht. URL: www.oose.de/uml, 2005b. [Stand: 2005-11-23].

STMLU STAATSMINISTERIUM FÜR LANDESENTWICKLUNG UND UMWELTFRAGEN: Nationalparkplan. URL: www.nationalparkplan.de, 2001. [Stand: 2005-11-27].

XMI – XML METADATA INTERCHANGE: MOF 2.0 / XMI Mapping Specification, v2.1. URL: www.omg.org/technology/documents/formal/xmi.htm, 2005. [Stand: 2005-11-23].

ZEILER M.: Modeling Our World – The ESRI Guide to Geodatabase Design. ESRI Press, Redlands, 1999.

Prognose von Nutzungsmustern einzelner Besuchergruppen in urbanen Erholungsgebieten

Christiane BRANDENBURG, Arne ARNBERGER, Andreas MUHAR

(DI Dr. Christiane Brandenburg, DI Dr. Arne Arnberger, Ao.Prof. DI Dr. Andreas Muhar, Universität für Bodenkultur, Department für Raum, Landschaft und Infrastruktur, Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung, Peter Jordan Str. 82, 1190 Wien, christiane.brandenburg@boku.ac.at)

KURZFASSUNG

Städtische oder stadtnahe Erholungsgebiete werden von den unterschiedlichsten Nutzergruppen aufgesucht und genutzt. Jede einzelne Nutzergruppe hat ihr eigenes Aktivitätsmuster. In zeitlicher Hinsicht unterliegen die Nutzungsmuster wohlbekannten Gesetzmäßigkeiten wie Ferien, Schul- und Arbeitszeiten, etc. Derart grobe Kenntnisse dieser Verhaltensweisen und Aktivitätsmuster sind jedoch oftmals nicht ausreichend, um als Grundlage für Stadtplanungsaufgaben und ein nachhaltiges Gebietsmanagement zu dienen. Im Rahmen dieses Beitrages werden in zwei Erholungsgebieten die Aktivitätsmuster von vier Nutzergruppen genauer analysiert. Mittels einer Kombination der Ergebnisse verschiedenster Erhebungsmethoden (quantitativ, qualitativ, Langzeit-, Kurzzeiterhebungen) und unter Berücksichtigung potenzieller Einflussfaktoren werden diese Aktivitätsmuster interpretiert. Modelle zur Prognostizierbarkeit des zeitlichen Auftretens einzelner Nutzergruppen werden erstellt und deren Anwendungsmöglichkeiten im Rahmen von Managementaufgaben diskutiert.

1 EINLEITUNG

1.1 Besucheraktivitäten in urbanen Erholungsgebieten

Die wesentliche Funktion von Erholungsgebieten ist es, Raum für Aktivitäten im Freien zur Verfügung zu stellen. Ferner erfüllen diese Erholungsgebiete etliche stadtökologische Funktionen und dienen darüber hinaus als Durchzugsräume und als Verkehrsträger.

Freizeit und Erholung – das ist für Städter von heute ein sehr weites Feld. Und doch bilden in Wiener Erholungsgebieten gerade die klassischen Aktivitäten – Wandern/Spazierengehen und Radfahren – den größten Anteil unter den landschaftsgebundenen Freizeitbeschäftigungen (Arnberger et al. 2002). Österreichweit geben 60% der befragten Personen an, in der Freizeit Fahrrad zu fahren, 40% nennen „Ausflüge machen", 45% wandern (Statistik Austria 2001). „Joggen" mit 16%, sowie „mit Kindern unterwegs sein" und „Hunde ausführen" stellen einen weiteren nennenswerten Anteil der Freizeitaktivitäten der österreichischen Bevölkerung. Diese Beschäftigungen sind weitgehend unabhängig von einer spezifischen Jahreszeit und Infrastruktur. Ihnen stehen Freizeitaktivitäten gegenüber, die witterungsbedingten Restriktionen unterliegen oder sogar explizit auf bestimmte Wetterverhältnisse angewiesen sind, wie Skilanglauf und Baden. Andere Bewegungsformen sind an eine spezifische Gestaltung der Wege gebunden: so ist Inline-Skaten beispielsweise nur auf asphaltierten Wegen möglich. Die letztgenannten Aktivitäten werden aber in die nun folgenden Betrachtungen nicht miteinbezogen.

Vielmehr wird in diesem Beitrag ein besonderes Augenmerk dem Radfahren und dem Spazierengehen/Wandern gelten. Gibt es ausgesprochene Radfahrländer – in Europa z.B. die Niederlande –, so ist Wien eher nicht als klassische Radfahrregion zu bezeichnen. Erst in den letzten zwei Jahrzehnten verzeichnet das Freizeitradfahren in Wien, wie in vielen anderen Industrieländern, einen enormen Anstieg. So stellt Nankervis 1999 fest, dass ein Anstieg der Anzahl der Radfahrern zwar in allen Alternsklassen stattgefunden hat, aber dass das Radfahren überwiegend dem Freizeitverkehr und nicht so sehr dem Alltagsverkehr (Berufsverkehr, Ausbildungsverkehr, Erledigungsverkehr, vgl. SNIZEK et al. 2004) dient. (Nankervis 1999). 1985 gaben bei einer österreichweiten Befragung 28% der befragten Personen an, in der Freizeit aufs Rad zu steigen, 1992 waren es 45%, und 1998, wie oben erwähnt, rund 60% (Statistik Austria 2001). Recherchen über die Hintergründe des Anstieges wären interessant. So kann zur Diskussion gestellt werden, ob die Errichtung von Erholungsgebieten, die für das Radfahren besonders geeignet sind – etwa die Donauinsel, der Marchfeldkanal, das Radwegenetz im städtischen Bereich – in Wien diese Entwicklung gefördert hat. Es liegt auf der Hand, dass die meisten Radfahrer nach Straßenverbindungen suchen, die möglichst arm an Auto- und Schwerverkehr sind – so bieten sich ihnen Radrouten, Radwege und auch Erholungsgebiete an. Radfahrer sind dem Wetter ausgesetzt. Eis, Schnee, Regen und vor allem Kälte – durch den Fahrtwind wird das Kälteempfinden erheblich erhöht – sind für etliche Wiener Radfahrer ein Grund, ihr Gefährt zu Hause zu lassen. Für den Alltagsverkehr haben ganzjährige Radfahrererhebungen ergeben, dass an einzelnen Stationen der durchschnittliche tägliche Verkehr in der kalten Jahreszeit auf bis zu 12% des durchschnittlichen täglichen Verkehrs der warmen Jahreszeit absinkt (SNIZEK et al. 2004, A-21). Jedoch kann anhand der Dauerbeobachtungsstellen an verschiedenen Standorten in Wien sehr gut abgelesen werden, dass das Verhalten der Radfahrer je nach Art des Verkehrs, je nachdem, ob es sich um Alltags- oder Freizeitverkehr handelt, sehr unterschiedlich ist und dass sehr wohl auch bei niedrigen Temperaturen und Niederschlägen das Fahrrad als Transportmittel genommen wird.

Spazierengehen und Wandern haben als klassische Freizeitaktivitäten eine lange Tradition. Zwischen 1985 und 1998 ist in Österreich ein Anstieg von 10% bei dieser Freizeitaktivität zu verzeichnen. Zwar sind die Spaziergänger und Wanderer ebenfalls sehr dem Wetter ausgesetzt. Dem subjektiven Kälteempfinden kann jedoch mit Kleidung gut entgegnet werden. Problematischer sind für diese Freizeitaktivität Wetterbedingungen mit extremer Wärmebelastung.

Auch das Joggen hat an Beliebtheit gewonnen und hat zwischen 1985 bis 1998 um rund 10% zugenommen. 1998 nennen rund 16% befragte Personen Joggen als Freizeitaktivität. Sportliche und gesundheitliche Aspekte sind es, die die Läufer antreiben. Als rein lustbetonte Aktivität indes kann das Joggen nicht so sehr angesprochen werden. Dies mag auch der Grund dafür sein, dass diese Aktivität relativ unabhängig vom Wetter ausgeübt wird. Infrastrukturelle Ansprüche richten sich im wesentlichen an die Bodenbeschaffenheit. Jogger meiden, wenn möglich, Asphalt und bevorzugen weichen Untergrund wie Wiesen, unbefestigte Wege etc. In einigen städtischen Parkanlagen Japans wird diesem Bedürfnis mit einem spezifischen Belag für Laufrouten Rechnung getragen.

Proceedings / Tagungsband; Editor / Herausgeber: Manfred SCHRENK
ISBN: 3-9502139-0-2 (from 2007: ISBN 978-3-9502139-0-4)

Unter den weiteren Besuchern von Erholungsgebieten gelten die Hundebesitzer als weitgehend anspruchlos in Hinblick auf Infrastruktur und Wetter. Dies ergibt sich aus der schieren Notwendigkeit, das Tier auszuführen. Eng mit dieser Notwendigkeit verbunden ist das tageszeitliche Auftreten von Hunden in städtischen Freiräumen. In Wien werden in 8,3% der Haushalte Hunde gehalten. So kommen etwa 2,9 Hunde auf 100 Einwohner. Am höchsten ist die Hundedichte (Anzahl der gemeldeten Hunde pro km²) in den eng bebauten und besiedelten Bezirken, insbesondere in den Bezirken 4 bis 8 sowie 15 und 20. In den locker besiedelten Bezirken Wiens, wie dem 13., 14. oder 22. Bezirk, ist die Hundedichte hingegen relativ gering. Dies wird besonders deutlich, wenn man die Hundezahlen in Beziehung zur Nettogrünfläche der jeweiligen Bezirke setzt. Hier weisen die „grünsten" Bezirke die niedrigsten Hundedichten auf. So ist die Zahl der Hunde pro Hektar Nettogrünfläche im Bezirk mit den wenigsten Grünflächen (Mariahilf) fast 60-mal höher als jene im Bezirk mit dem höchsten Grünflächenanteil (Hietzing) (Purtscher 2001).

Im folgenden wird auf die Wetterabhängigkeit der beschriebenen Nutzergruppen näher eingegangen und auf dieser Basis eine Prognostizierbarkeit von Nutzergruppen und Besucherzahlen untersucht.

Damit können – dies ist der Hintergrund der vorliegenden Untersuchung – Konfliktpotentiale aufgezeigt werden, die durch eine Überlagerung verschiedener Erholungsaktivitäten entstehen, um so eine Hilfestellung für Konfliktlösungen im Rahmen der Stadtplanung, eines Gebietsmanagements sowie zur Bewusstseinsbildung der Besucher (CESSFORD 2002, LINDSEY 1999) zu geben.

2 UNTERSUCHUNGSGEBIETE

Die Lobau, der Wiener Anteil des Nationalparks Donau-Auen, ist ein traditionelles Erholungsgebiet und liegt im Südosten der Stadt Wien, siehe auch Abbildung 1. Das Gebiet ist geprägt von Auwäldern, Offenland und einem weit verzweigten Altarmsystem. Die etwa 2.400 Hektar sind durchzogen von einem dichten Netz (insgesamt 140 km) aus Forst- und Wartungswegen, sowie von Wegen, welche die Hochwasserschutzdämme begleiten. Führung und Befestigung der Wege sind somit sehr vielfältig. Die Möblierung entspricht dem Charakter eines Nationalparks, ist damit sehr gering und beschränkt sich vornehmlich auf die Eingangsbereiche. Die Lobau wird in weiten Teilen umgeben von einem sehr dynamischen Stadterweiterungsgebiet - rund 15.000 Personen leben derzeit in einer Gehdistanz von 15 Minuten - und agrarisch intensiv genutzten Flächen. Die gesamte Gebietsnachbarschaft zeichnet sich durch ein starkes Defizit an öffentlichen oder halböffentlichen Grün- und Freiräumen aus. So wird die Lobau für vielfältige Wohnumfeld- und Naherholungsaktivitäten u.a. wie Radfahren, Wandern, Spazierengehen, Joggen, Baden und auch Hunde ausführen, genutzt. Die Verwaltung des Nationalparks steht vor dem Problem, einerseits die Schutz- und Bildungsziele eines Nationalparks bedienen zu müssen, und andererseits dem Erholungsbedürfnis der Bürger der angrenzenden Gebiete gerecht zu werden.

Das ca. 120 ha große Erholungsgebiet Wienerberg wurde in den späten achtziger Jahren im Süden der Stadt Wien errichtet (siehe Abbildung 1) und wird von der städtischen Forstverwaltung betreut. Das Erholungsgebiet ist geprägt von Wald- und Wiesenflächen. Diese werden von etwa 30 km meist unbefestigten Wegen durchzogen. Der Park unterliegt einer vielfältigen Nutzung. So dient der Teich im Zentrum des Parks zum Angeln und Baden, im Winter zum Eislaufen. Einige Durchzugswege sind für eine nächtliche Nutzung beleuchtet. Radfahren ist auf zwei Wegen erlaubt; im gesamten Park herrscht Leinenpflicht für Hunde. Neben der sehr naturnahen Gestaltung gibt es Kinderspielbereiche sowie Sportplätze. Auf eine starke Möblierung wurde verzichtet. Tisch-Bank-Kombinationen und Mülleimer stellen den wesentlichen Anteil dar. Der waldartige Park ist umgeben von Wohnsiedlungen (Geschosswohnungsbau, Einfamilienhäuser, Schrebergärtensiedlungen) sowie von einem großen Industriegebiet. In einer Gehdistanz von 15 Minuten leben über 53.000 Personen. Das Parkmanagement steht vor großen Herausforderungen, denn schon heute wird dieses Gebiet intensiv für Wohnumfeld- und Naherholungsaktivitäten genutzt, und in unmittelbarer Zukunft werden weitere Hochhäuser mit Wohnungen und Büros fertig gestellt. Mit einer Zunahme des schon bestehenden Nutzungsdruckes ist somit zu rechnen.

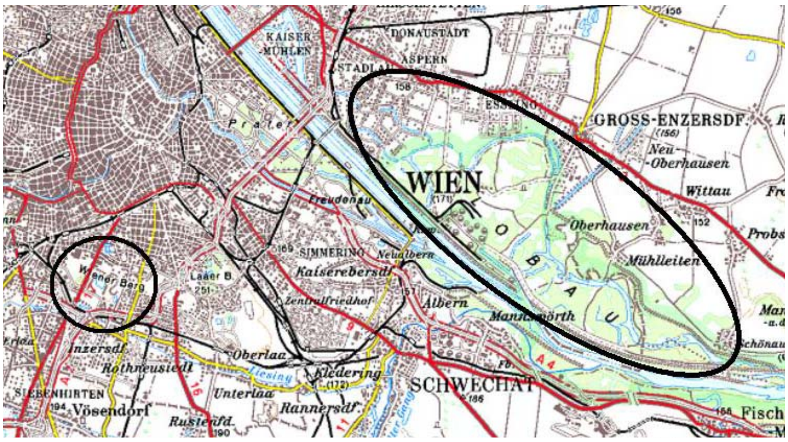


Abb. 1: Lage der Untersuchungsgebiete in Wien (ohne Maßstab, AMAP, Version 2)
– kleiner Kreis = Erholungsgebiet Wienerberg, große Ellipse = Lobau

3 MONITORING- UND ANALYSEMETHODEN

Die im vorliegenden Beitrag diskutierten besucherbezogenen Daten wurden mittels verschiedener Erhebungsmethoden gewonnnen, einerseits aus einer nichtteilnehmenden Langzeitbeobachtung mittels Videokamera und andererseits aus Zielgebietsbefragungen mittels standardisierten Interviews.

Die Befragungen fanden zu jeweils verschiedenen Jahreszeiten an jeweils vier Wochentagen und an den unmittelbar darauf folgenden Wochenenden statt. Um einen adäquaten Stichprobenumfang zu erreichen, wurde an Tagen mit gutem Wetter befragt. Die Befragungen erstreckten sich jeweils über einen ganzen Tag, vom Morgen bis in die Abendstunden. Befragungsorte waren die wesentlichen Eingangsbereiche. Im Erholungsgebiet Wienerberg wurde zusätzlich noch an Hauptnutzungsorten gefragt. Die Befragungen erfolgten mittels standardisierter Fragebögen mit überwiegend geschlossenen Fragen. Abgefragt wurden neben sozio-demographischen Daten vornehmlich Motivation, Aufenthaltscharakteristika und Aktivitäten (Arnberger 2003, Brandenburg 2001).

Die nichtteilnehmende Langzeitbeobachtung erfolgte mittels Videokameras. Diese wurden in den jeweiligen Untersuchungsgebieten in Haupteingangsbereichen aufgestellt. Um sie vor Wettereinflüssen und vor Vandalismus zu schützen, wurden die Kameras in eine Art Vögelhäuschen eingebaut und entweder an Gebäuden oder an Strommasten befestigt. Eine Videostation bestand aus einer Schwarzweiß-Kamera und einem Timelapse-Rekorder. Die Aufstellung der Kameras, die Beschränkung auf Schwarzweißbilder sowie die Auflösung der Kameras und die Auswertung der Videobänder durch gebietsfremde Personen gewährleistete die Anonymität der Erholungsuchenden. Ausgewertet wurde je nach Erholungsgebiet nach Datum und Zeit; ermittelt wurden dabei u.a. die Bewegungsrichtung jeder registrierten Personen, die Fortbewegungsart, die Gruppengröße, ob es sich um Erwachsene oder Kinder handelte und ob Hunde mit oder ohne Leine mitgeführt wurden (Arnberger 2003, Brandenburg 2001).

Zusätzlich zu der Erfassung der Personen wurden für vertiefende Untersuchungen meteorologische Daten, wie Lufttemperatur, Niederschlag, Sonnenscheindauer etc. herangezogen. Diese Daten stammten für jedes Erholungsgebiet von der nächstgelegenen meteorologischen Station der Zentralanstalt für Meteorologie und Geodynamik in Wien.

Für die genannten zwei Untersuchungsgebiete kann mittels univariater Varianzanalyse die Abhängigkeit der Erholungsaktivitäten vom Wetter dargestellt werden. Das Wetter fließt als unabhängige Variablen mit der Komplexgröße PET (Physiologic Equivalent Temperature) und dem Niederschlag in die Modellierungen ein (vgl. Tab. 1). PET ist ein Klimaindex, der die thermische Umwelt unter Berücksichtigung der thermophysiologischen Zusammenhänge beschreibt und das subjektive Wärme- und Kälteempfinden des Menschen angibt. PET ist für sich bewegende Personen im Außenraun und für den gesamten Jahresverlauf gültig (vgl. HÖPPE 1999). Die Werte der Komplexgröße PET werden mit dem Programm „Ray Man: Modelling the Mean Radiation Temperature in Urban Structures“ von Andreas Matzarakis berechnet (MATZARAKIS et al. 2000). Eingangsgrößen für die Berechnung des PET sind die Lufttemperatur (°C), Dampfdruck (hPa), Windgeschwindigkeit (m/s), Bedeckungsgrad (in 1/8) und Globalstrahlung (W/m2). PET geht angelehnt an die ASHRAE-Skalierung skaliert in die Berechnungen ein (MATZARAKIS et al. 1996) (vgl. Tab. 1). Bei der unabhängigen Variablen Niederschlag werden zwei Kategorien – regnerisch und niederschlagsfrei – unterschieden. Die Grenze zwischen den beiden Kategorien wird in Anlehnung an WAKONIGG (1981) bei 1 mm Niederschlag angesetzt (vgl. Tab.1). Sehr geringe Niederschlagsmengen werden vom Besucher zwar wahrgenommen, sind jedoch nicht als Entscheidungsgrundlage für die Ausübung oder Nichtausübung einer Erholungsaktivität relevant.

Abhängige Variable	**Werte**
Wanderer/Spaziergänger	Anzahl der Personen
Fahrradfahrer	Anzahl der Personen
Jogger	Anzahl der Personen
Personen mit Hunden	Anzahl der Personen
Unabhängige Variable	**Werte**
Tag der Woche	Werktag = falls Montag bis Freitag ein Arbeitstag ist, Wochenendtag = falls Samstag, Sonntag oder Feiertag
PET	sehr kalt, kalt, kühl, leicht kühl, behaglich, leicht warm, warm, heiß, sehr heiß
Niederschlag	niederschlagsfrei wenn < 1mm, Niederschlag wenn > 1mm

Tabelle 1: Variablen zur Modellierung von Besucherfrequenzen in den Untersuchungsgebieten

4 ERGEBNISSE

Die Auswertung der Videobeobachtung ergibt, dass im Gesamtjahresverlauf in der Lobau die Radfahrer mit rund 58% und die Fußgänger mit rund 37,2% als Hauptnutzergruppen angesprochen werden können. Dies entspricht den Angaben, die im Rahmen der Mikrozensusbefragung 1998 (Statistik Austria 2001) erhoben wurden. Jogger sind mit 3,4% im Vergleich zu den landesweit angegebenen 16% unterrepräsentiert. Knappe 6% der Besucher führen einen Hund mit. Baden (0,68%) spielt wie auch andere Nutzungen eine untergeordnete Rolle in der Lobau.

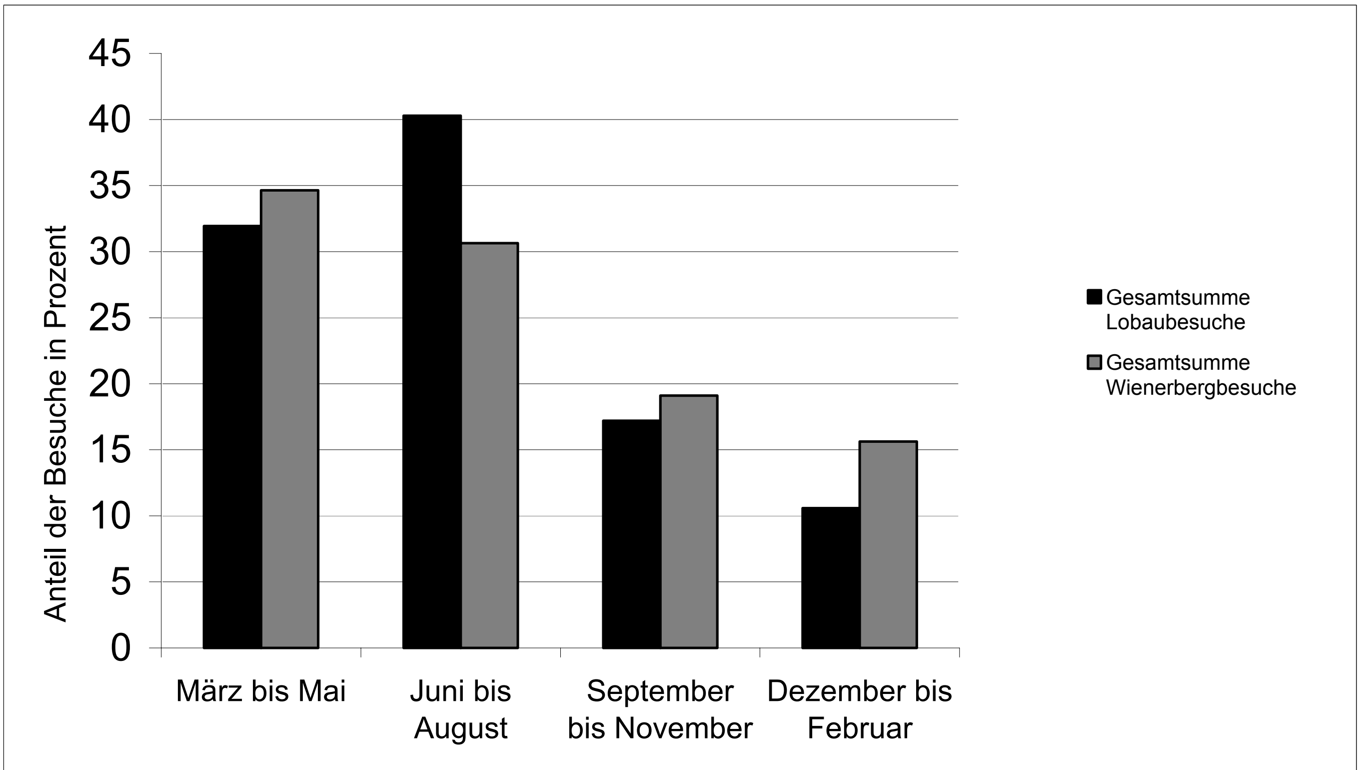
Die Auswertung der 1998 bis 1999 in der Lobau erhobenen 780 Fragebögen ergibt, dass 90% der Erholungssuchenden aus den benachbarten Siedlungsbereichen kommen. Kennzeichnend für das Untersuchungsgebiet ist der hohe Anteil von Stammgästen. Drei Viertel aller Befragten geben an, die Lobau regelmäßig aufzusuchen; 60 % betreten die Lobau mindestens einmal in der Woche. Befragt nach dem Hauptbesuchsmotiv nennen die Befragten das Bedürfnis nach Sport und Erholung. Natur- und Landschaftserlebnis sowie die Nähe zum Wohnort sind weitere wichtige Gründe für den Besuch. Die Institution Nationalpark wird als Besuchsmotiv fast nicht erwähnt. Eine Analyse der Tagesgänge ergibt, dass in der Lobau fast ausschließlich Freizeitverkehr stattfindet, Alltagsverkehr spielt keine Rolle. Durch die Lage der Lobau kommt dieses Gebiet nur für einen sehr geringen Anteil an Besuchern als Durchzugsgebiet in Frage. Fast 80% aller Besucher verweilen zwischen einer und vier Stunden in der Lobau. Die Verknüpfung von Aufenthaltsdauer und Befragungsdatum zeigt, dass die Länge eines Lobaubesuchs nicht vom Wochentag, sondern von der Jahreszeit und der ausgeübten Aktivität abhängt. Radfahrer verweilen länger in der Lobau als Fußgänger. Der angegebene Wohnort lässt eine Gliederung der Einzugsbereiche zu. Die erste Zone bilden die unmittelbar an die Lobau grenzenden Siedlungsgebiete bis zu einer Distanz von etwa 1,5 km. KERSTIN-KOEBERLE (1979) beschreibt dieses Gebiet als engeren Wohnumfeldbereich, der bei 15 – 20

Minuten maximaler Gehzeit in der Regel mindestens einmal pro Woche aufgesucht wird. Die zweite Zone entspricht einem Gürtel von durchschnittlich vier Kilometern Breite um die Lobau. Die dritte Zone umfasst alle Siedlungsgebiete, die mindestens 5,5 km von der Lobau entfernt liegen. Hauptbesucher der Lobau sind der „Naherholungstypus" und der „Wohnumfeldtypus". Knapp 40% aller Besucher sind dem Naherholungstypus, fast 25% dem Wohnumfeldtypus zuzuordnen. Zwischen den beiden Haupttypen ist ein Übergangstypus zu erkennen, dessen Quellgebiet zwischen den Einzugsbereichen der beiden Hauptbesuchertypen liegt. Der Typus „Nationalparkbesucher", dessen vorrangiges Anreisemotiv die Institution Nationalpark ist, stellt nur 2% des gesamten Besucheraufkommens dar. Die Lobau spielt somit hauptsächlich eine Rolle als Wohnumfeld- und Naherholungsgebiet (Brandenburg 2001).

Im Erholungsgebiet Wienerberg ergibt die Auswertung der Videobeobachtung 2002 bis 2003, dass die Nutzergruppe der Fußgänger mit 67% klar dominiert. 50% der Fußgänger sind ohne Hunde unterwegs, knapp 17% mit Hund. Dieser Wert liegt weit über dem Durchschnitt in Wien und ist wesentlich höher als in der Lobau. Radfahrer sind im Erholungsgebiet Wienerberg im Vergleich zur österreichweiten Befragung mit rund 17% deutlich unterrepräsentiert. Hingegen entsprechen die registrierten knapp 16% Jogger im Erholungsgebiet Wienerberg dem landesweiten Durchschnitt. 3% der registierten Personen sind der Nutzungsaktivität Baden zu zuordnen.

Im Erholungsgebiet Wienerberg wurden 890 Befragungen vorgenommen. Knapp 59% der befragten Personen legen eine Distanz von 15 Gehminuten zurück, um zum Erholungsgebiet Wienerberg zu kommen; sie sind folglich dem Wohnumfeldtypus zuzuordnen. Weitere 30% kommen aus angrenzenden Gebieten und bilden den Übergangstypus. 8% sind als Naherholungstypus anzusprechen, und 2% der Befragten reisen aus gänzlich anderen Gebieten an. Mehr als 70% der Befragten kommen mindestens einmal pro Woche in das Erholungsgebiet. Als Grund für den Besuch werden u.a. genannt: Erholung, den Hund ausführen, Sport. Der Wienerberg ist somit ein Erholungsgebiet mit einem hohen Stammgastanteil und einem hohen Anteil an Wohnumfeldnutzung (Arnberger 2003).

Eine Untersuchung nach Jahreszeiten im Hinblick auf die Besuchfrequenzen ergibt, dass in beiden Erholungsgebieten die Gesamtbesuchsfrequenzen im Frühjahr und Sommer deutlich am höchsten sind. Die Lobau wird zu 40% im Sommer frequentiert; der Winter ist die Saison mit der niedrigsten Besucherfrequenz (10%). Der Wienerberg ist ein Erholungsziel für das Frühjahr und den Sommer: 35% und rund 31% der Besuche fallen in diese Jahreszeiten. Der Winter ist auch hier mit gut 16% die an Besuchen ärmste Jahreszeit. Die Spannweite zwischen den stärksten und den schwächsten Besuchsfrequenzen ist im Erholungsgebiet Wienerberg mit 20% deutlich geringer als in der Lobau mit einer Spannweite von 30% (siehe auch Grafik 1)



Grafik 1: Saisonale Verteilung der Besuche der Lobau und des Wienerberges, Videobeobachtung 1998-1999, 2002-2003

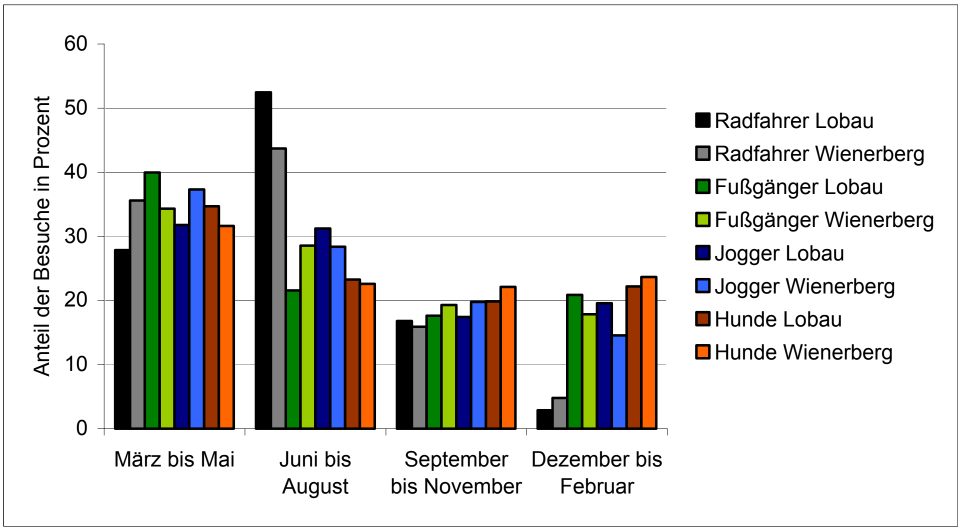
Im Folgenden wird die saisonale Frequentierung für die einzelnen Nutzergruppen betrachtet. Die saisonale Verteilung der Radfahrer ist mit der Gesamtverteilung aller Besucher vergleichbar. Lediglich im Frühjahr sind in der Lobau, gemessen an der Gesamtsumme der Besuche, deutlicher weniger Radfahrer anzutreffen. Sehr groß ist in der Lobau die Differenz zwischen dem Anteil an Radfahrern im Winter mit unter 5% und im Sommer mit über 50%. Die Differenz zwischen der von Radfahrern am stärksten und schwächsten frequentierten Jahreszeit zeigt ein vergleichbares jedoch leicht abgeschwächtes Bild wie in der Lobau.

Sehr unterschiedlich zu den bisherigen saisonalen Verteilungen sind die Frequenzen der Fußgänger. In der Lobau sind die meisten Fußgänger im Frühjahr unterwegs; an zweiter Stelle folgt die kalte Jahreszeit, erst an dritter Stelle der Sommer. Im Herbst ist die geringste Anzahl an Fußgängern unterwegs. Auch im Erholungsgebiet Wienerberg sind im Frühjahr die höchsten

Fußgängerfrequenzen zu verzeichnen, die nächst stärkere Saison jedoch ist hier der Sommer. Herbst und Winter haben vergleichbare Fußgängerfrequenzen wie die Lobau.

Das Joggen unterliegt, ebenfalls in beiden Erholungsgebieten, einem saisonalen Verlauf (vgl. Grafik 2). Im Herbst und Winter sind die Frequenzen der Jogger deutlich geringer als im Frühjahr und Sommer. Im Erholungsgebiet Wienerberg sinkt im Winter die Frequenz der Jogger deutlich unter die Häufigkeit der Jogger in der Lobau. Während jedoch im Frühjahr die Zahl der Jogger am Wienerberg höher ist.

Wie zu vermuten war unterliegt das Ausführen der Hunde in beiden Erholungsgebieten einem weniger ausgeprägten saisonalen Verlauf. Lediglich im Frühjahr sind die Frequenzen um rund 10% höher als zu den anderen Jahreszeiten.



Grafik 2: Saisonale Verteilung der Nutzergruppen der Lobau und des Wienerberges, Videobeobachtung 1998-1999, 2002-2003

Um einen Einblick in die Zusammenhänge zwischen den einzelnen beschriebenen Aktivitäten und dem Wetter zu bekommen, wurden die Nutzerfrequenzen der Komplexgröße PET gegenübergestellt.

Bei den Radfahrern ist eine deutliche Abhängigkeit vom thermischen Empfinden zu verzeichnen. Die Radfahrer im Erholungsgebiet Wienerberg sind im Vergleich zu jenen der Lobau etwas häufiger im thermischen Empfindungsbereich „leicht kühl bis sehr kalt" unterwegs. Die von Radfahrern bevorzugten thermischen Verhältnisse liegen jedoch in beiden Gebieten im thermischen Empfindungsbereich „behaglich" und darüber.

Fußgänger sind in jeder thermischen Empfindungsstufe stark vertreten bis auf Tage mit einer extrem starken Wärmebelastung. Die Fußgänger des Wienerberges reagieren sehr wenig mit Frequenzänderungen auf die thermischen Veränderungen, in der Lobau hingegen gibt es eine eindeutige Präferenz der Fußgänger für kühlere Tage.

Das Ausführen der Hunde ist nahezu unabhängig vom thermischen Empfinden. Lediglich in der Lobau gibt es – wie schon bei den Fußgängern – eine Präferenz für die kühleren und sogar kalten Tage; heiße Tage werden in der Lobau eher gemieden.

Es fällt auf, dass das Wetter die Jogger am Wienerberg wesentlich stärker beeinflusst als die Jogger in der Lobau. Am Wienerberg steigt die Anzahl der Jogger stetig bis zur thermischen Empfindungsstufe „behaglich" und sinkt dann wieder leicht an den heißen und sehr heißen Tagen. Bei den Joggern in der Lobau hingegen lässt sich keine Wetterabhängigkeit erkennen.

Nach dieser deskriptiven Analyse der Wetterabhängigkeit wird die Vorhersagbarkeit der jeweiligen Nutzergruppe mittels univariater Varianzanalyse bestimmt. Abhängige Variable ist die Anzahl der registrierten Personen der jeweiligen Nutzergruppe, unabhängige Variablen sind der Wochentag als „Werktag" oder als „Wochenende bzw. Feiertag", die Klassen des thermischen Empfindens sowie das Vorhandensein bzw. Nichtvorhandensein von Niederschlag.

	Wienerberg Radfahrer	Lobau Radfahrer	Wienerberg Fußgänger	Lobau Fußgänger	Wienerberg Jogger	Lobau Jogger	Wienerberg Hunde	Lobau Hunde
Modell mit den externen Faktoren PET, Niederschlag, korrigiertes R^2	,616	,476	,298	,078	,335	,031	,100	,017
Modell mit den externen Faktoren PET, Niederschlag, Wochentag korrigiertes R^2	,636	,643	,460	,511	,357	,260	,248	,356

Tabelle 2: Wetter- und Wochentagabhängigkeit einzelner Nutzergruppen in den Erholungsgbieten Wienerberg und Lobau (Signifikanzniveau $p < 0.05$)

Zur Prognose der Besuchsfrequenzen der jeweiligen Nutzergruppen wurde ein Modell ausschließlich mit dem externen Einflussfaktor Wetter erstellt. Die schlechte Modellgüte vor allem für die Nutzergruppen in der Lobau sind ein Hinweis dafür, dass in diesem Gebiet ein zusätzlicher externer Einflussfaktor die Zahl der Erholungssuchenden bestimmt. Wird in der Modellierung zusätzlich der Wochentag berücksichtigt, können für die Lobau Modelle mit einer entsprechenden Modellgüte erzielt werden. So ist in der Lobau in der Tat der Wochentag entscheidend für die Anzahl der Erholungssuchenden; das Wetter hat für die Modellgüte im Hinblick auf die Nutzergruppen Fußgänger, Jogger und Hundeausführende in der Lobau eine geringere Bedeutung als für die Nutzergruppe Radfahrer. Im Erholungsgebiet Wienerberg hingegen kann für die Nutzergruppen Radfahrer und Jogger nur über die Modellierung mit Wetterwerten eine entsprechende Modellgüte erreicht werden. Bei den Nutzergruppen Hundeausführende und Fußgänger wird die Modellgüte durch Hinzuziehen des Wochentages wesentlich erhöht. Der Wochentag spielt für diese Nutzergruppen eine bedeutende Rolle. Im Vergleich dazu hat der Wochentag für die Modellgüte der Nutzergruppen Radfahrer und Jogger am Wienerberg einer sehr geringeren Einfluss.

5 DISKUSSION DER ERGEBNISSE

Der sehr unterschiedliche Anteil der Radfahrer an der Gesamtbesuchsfrequenz in den zwei Erholungsgebieten kann wie folgt begründet werden: Im Erholungsgebiet Wienerberg sind nur zwei Wege für das Radfahren freigegeben, auf den restlichen Wegen sind die Radfahrer illegal unterwegs. Dies kann als ein gewisses Hemmnis für das Radfahren in diesem Gebiet angesehen werden. In der Lobau hingegen sind alle Wege mit dem Rad befahrbar. Die Lobau ist ein wesentlich größeres Gebiet (20 mal so groß wie das Erholungsgebiet Wienerberg), und somit für das Radfahren schon auf Grund der Ausdehnung attraktiver – abgesehen natürlich von der reichen Auswahl an Radrouten verschiedenster Länge und Qualität. Die Lobau ist ein Auwald mit hohem Anteil an Offenland und Altarmresten; die Wegführung basiert auf einem Netz an Forst- und Wartungswegen. Die Wegführung ist damit nicht, wie im Erholungsgebiet Wienerberg, auf eine kleinräumige Abwechselung ausgerichtet. Vielmehr sind die Distanzen zwischen den verschiedenen Attraktionen in der Lobau groß. Das Spazierengehen oder Wandern ist somit im Vergleich zum Erholungsgebiet Wienerberg in weiten Teilen nicht so abwechlungsreich. Für die Lobau scheint das Rad das geeignetere Transportmittel zu sein.

Ein weiterer Aspekt, der die geringe Anzahl an Radfahrern im Erholungsgebiet Wienerberg begründet, ist die hohe Gesamtbesucherdichte. Im Erholungsgebiet Wienerberg ist die Besuchsdichte vierzigmal (28 Besuche pro ha und Tag) höher als in der Lobau (0,7 Besuche pro ha und Tag) (Arnberger et al. 2006). Hohe Besuchsdichten mit vielen verschiedenen sich mischenden Nutzergruppen (Fußgänger, Hundeausführende, Skater etc.) senken die Attraktivität des Radfahrens (Arnberger 2003). Die Fahrgeschwindigkeit muss reduziert werden, das Fahren selbst verlangt eine erhöhte Konzentration, um Gefahrensituation zu vermeiden, der Aspekt des Genießens tritt in den Hintergrund.

Ein weiterer Grund für den hohen Anteil an Radfahrern in der Lobau ist die gute Anbindung an weitere Erholungsgebiete sowie die geringen Höhenunterschiede in der Geländemorphologie. Da die Lobau auf eher verkehrsberuhigten Routen gut erreichbar ist, reist ein hoher Anteil (31%) der Befragten schon mit dem Fahrrad an. Im Erholungsgebiet Wienerberg hingegen nennen nur 7% der Befragten das Fahrrad als Anreisemittel. Dies ist auf das hohe Verkehrsaufkommen rund um den Wienerberg und auf die wenig verkehrsberuhigten Anfahrtsmöglichkeiten zurückzuführen. Wobei nicht unerwähnt bleiben soll, dass es schwer ist, die Nutzergruppe der Radfahrer zu befragen - vor allem diejenigen, die schon mit dem Rad angereist sind und die die Radtour nicht erst auf dem Parkplatz beginnen. Eine Ansprache der Radfahrer bei höheren Geschwindigkeit ist schwierig, und zusätzlich bedeutet ein Interview eine Unterbrechung der ausgeübten Tätigkeit.

Die starke Wetterabhängigkeit der Radfahrer wurde in der Vergangenheit schon untersucht und soll an dieser Stelle nicht weiter vertiefend diskutiert werden (Nankervis 1999, Goldsmith 1992, Niemeier 1996, Brandenburg et al. 2003, Brandenburg et al. 2004, SNIZEK et al. 2004). Die vergleichbare Wetterabhängigkeit der Radfahrer in den Erholungsgebieten Lobau und Wienerberg wird darauf zurückgeführt, dass in beiden Gebieten ein beträchtlicher Anteil an Besuchen der Naherholung zuzuordnen ist und sich somit eine Wetterabhängigkeit eher bemerkbar macht als bei Personen aus dem Wohnumfeld. Je weiter die Entfernungen sind, die Personen zu einem Erholungsgebiet zurücklegen, umso eher schrecken die Personen vor schlechtem Wetter zurück. Personen hingegen, die in unmittelbarer Nähe wohnen, sich somit im erholungsbezogenen Wohnumfeld bewegen, waren auch bei nicht sehr gutem Wetter mit dem Rad anzutreffen (Brandenburg et al. 2003, Brandenburg et al. 2004), da ein schneller Rückzug nach Hause möglich ist.

Ein weiterer Grund für die hohe Wetterabhängigkeit der Radfahrer in den Untersuchungsgebieten liegt in der Art des Radverkehrs begründet. In beiden Gebieten handelt es sich überwiegend um Freizeitverkehr, und der ist im Vergleich zu Alltagsverkehr wetterabhängiger (Nankervis 1999, Goldsmith 1992, Niemeier 1996, Brandenburg et al. 2003, Brandenburg et al. 2004, SNIZEK et al. 2004). Am Wienerberg kann anhand der morgendlichen Spitze bei den Tagesgängen der Wochentage ein Alltagsverkehr von rund 13 % und in der Lobau keinerlei Alltagsverkehr identifiziert werden (Brandenburg et al. 2004).

Der geringe Einfluss des Wochentages auf die Anzahl der Radfahrer im Erholungsgebiet Wienerberg kann damit erklärt werden, dass der Park am Wochentag eine hohe Bedeutung als Erholungsgebiet im Wohnumfeld hat und am Wochenende zusätzlich als Naherholungsgebiet fungiert. Die Anzahl der Alltagsradfahrer wird am Wochenende durch naherholungsuchende Freizeitradfahrer kompensiert. In die Lobau hingegen kommen zu den Wohnumfeld- und Naherholungssuchenden unter der Woche zusätzliche Naherholungssuchende am Wochenende.

Das Erholungsgbiet Wienerberg wird von der Nutzergruppe der Fußgänger dominiert. Dies liegt in der Wohnumfeldnutzung sowie in der Ausgestaltung des Parks begründet. Aufgrund der Größe des Parks ist das Erholungsgebiet Wienerberg am Wochenende zusätzlich zur Wohnumfeldnutzung ein Anziehungspunkt für Naherholungssuchende, die den innerstädtischen, kleineren Parkanlagen entfliehen wollen. Dieser Anteil ist jedoch nicht so stark ausgeprägt wie in der Lobau. Dies begründet den geringeren Einfluss des Wochentages auf die Anzahl der Besuche im Erholungsgebiet Wienerberg im Vergleich zur Lobau. Die starke Abhängigkeit der Spaziergänger vom Wochentag in der Lobau ist u.a. mit dem im Vergleich zum Erholungsgebiet Wienerberg höheren Anteil an Naherholungssuchenden zu begründen. So finden in der Lobau 70% der Naherholungsbesuche am Wochenende statt.

Sowohl im Erholungsgebiet Wienerberg als auch in der Lobau bevorzugen Fußgänger die kühleren Jahreszeiten und meiden extreme Wärmebelastungen. In beiden Gebieten sind die Wege wenig beschattet, so dass im Sommer ein Spaziergang wenig attraktiv ist. Es ist anzunehmen, dass – dies gilt vor allem für die Lobau – die Fußgänger auf das Rad umsteigen und eine Abkühlung durch den Fahrtwind bevorzugen. Der sehr hohe Anteil an Fußgängern in der Lobau bei kalten Wetterbedingungen liegt in der Schneeglöckchenblüte begründet. Etliche der Befragten geben Blumenpflücken als eine in der Lobau ausgeübte Tätigkeit an. Die etwas geringere Wetterabhängigkeit der Spaziergänger im Erholungsgebiet Wienerberg ist auf den höheren Anteil an Wohnumfeldnutzung zurückzuführen. Die Besucher gehen auch bei schlechterem Wetter los, da man aufgrund der räumlichen Nähe notfalls schnell wieder zu Hause ist.

Deutlich bemerkbar macht sich der unterschiedliche Anteil der Wohnumfeldnutzung der beiden Untersuchungsgebiete bei der Wetterempfindlichkeit jener Personen, die Hunde ausführen. Die Hundeausführenden am Wienerberg können als nahezu wetterunempfindlich eingestuft werden. Dies ist – wie bei den Fußgängern – in der geringen Distanz zur eigenen Wohnung begründet. Bei extremen Kälte- oder Wärmebelastungen hingegen meiden die Hundeausführenden die Lobau und weichen sichtlich auf wohnungsnahe Gebiete aus.

In beiden Gebieten stellt sich für diese Nutzergruppe eine deutliche Abhängigkeit vom Wochentag heraus, auch wenn diese in der Lobau etwas höher ist. Befragungen im Erholungsgebiet Wienerberg haben ergeben, dass Hundebesitzer aus entfernten Gebieten kommen, um ihren Hund in einem größeren Park auszuführen. Für beide Gebiete wird am Wochenende eine Überlagerung der Wohumfeldnutzung mit einer Naherholungsnutzung der Hundeausführenden angenommen.

Ein sehr unterschiedliches Bild ergibt die Analyse der Jogger in den beiden Erholungsgebieten. Die Jogger am Wienerberg sind nahezu unbeeinflusst vom Wochentag – ganz anders als die Sportler in der Lobau. Dem steht die geringe Wetterempfindlichkeit der Jogger in der Lobau im Vergleich zu jenen am Wienerberg gegenüber. Am Wienerberg kann somit ein Joggerclientel identifiziert werden, das äußerst regelmäßig kommt, jeden Tag also, das aber sehr heiße Witterungsbedingungen meidet. Auch die Jogger in der Lobau meiden extreme Wärmebelastungen, weitere Zusammenhänge zwischen dem Auftreten von Joggern und dem Wetter sind jedoch nicht ablesbar. Die Jogger in der Lobau sind stark vom Wochentag abhängig. Dies wird wieder auf die größeren Distanzen zum Wohnort zurückzuführen sein.

Zusammenfassend kann festgestellt werden, dass die Wetterabhängigkeit der Besuchsfrequenzen in der Lobau deutlich geringer ist als die Abhängigkeit vom Wochentag. Im Erholungsgebiet Wienerberg hingegen spielt der Wochentag für die Frequenz der Erholungsuchenden eine deutlich geringere Rolle auf Grund des höheren Anteils an Personen mit Wohnumfeldnutzung. Am stärksten vom Wetter abhängig sind in beiden Gebieten die Radfahrer, gefolgt von den Fußgänger. Je nach Erholungsgebiet ist die Wetterabhängigkeit von Joggern und Hundeausführenden unterschiedlich. Beide Gruppen sind deutlich unempfindlicher gegenüber dem Wetter als die Hauptnutzergruppen Radfahrer und Fußgänger. Besucherzahlen sind nur vorhersagbar für die Nutzergruppen Fußgänger und Radfahrer. Das „nur" kann jedoch relativiert werden, da die beiden genannten Nutzergruppen in beiden Erholungsgebieten den überwiegenden Teil der Erholungssuchenden stellen.

6 RESÜMEE

Ein wesentliches Ergebnis dieser Modellierung ist die Bereitschaft der Erholungsuchenden, längere Wege bei schönem Wetter zum Erholungsgebiet zurückzulegen. Dies kann mit der Größe der untersuchten Gebiete begründet werden. Ein längerer Anmarsch ist zumeist mit einem längeren Aufenthalt und dem Wunsch nach einer abwechslungsreichen Gestaltung und einer Abwechselung zum alltäglich Erlebten verbunden (Brandenburg 2001, Arnberger et al. 2001). Aus dieser Tatsache kann für die Stadtplanung abgeleitet werden, dass in den Einzugsbereichen der Erholungsgebiete Wienerberg und Lobau zu wenige, zu wenig attraktive und/oder nur kleine Erholungsgebiete vorhanden sind. Um die für beide Gebiete hohen Besucherzahlen – gut 1,2 Millionen Besuche pro Jahr im Erholungsgebiet Wienerberg und 600.000 Besuche in der Lobau – zu reduzieren bzw. nicht zu steigern, müssen verstärkt Maßnahmen im Einzugsgebiet der Erholungsgebiete getätigt, weitere Naherholungsgebiete erschlossen, vorhandene Gebiete attraktiviert und/oder besser erreichbar gemacht werden. Für die Stadterweiterungsgebiete im Osten von Wien stellt sich die Frage, warum nicht großflächige Hundezonen, wie z.B: im Prater, geschaffen werden. Zonen in denen keine Anleinpflicht besteht, Einrichtungen wie Hundetränken etc. vorhanden sind. Es stellt sich die Frage, warum der Grüngürtel im Osten der Stadt - seit der Regulierung der Donau wurde die Lobau in den Wald- und Wiesengürtel der Stadt Wien einbezogen – nicht massiv vergrößert wird und zwar nicht nur als Gürtel sondern auch mit breiten Verzweigungen, die in die Stadterweiterungsgebiete hineinreichen und die verschiedenen Stadtteile verbinden – somit ein weitverzweigtes Netz an Verkehrswegen für den nichtmotorisierten Verkehr ermöglichen.

Konfliktträchtig ist die starke Überlagerung der Wohnumfeldnutzung mit der Naherholungsnutzung in den Untersuchungsgebieten. Die im Zusammenhang mit einer Wohnumfeldnutzung zu nennenden Stammgäste werden durch eine starke Naherholungsnutzung verdrängt. So führt in der Lobau räumlich und zeitlich nicht gelenktes Ausweichverhalten zu einer Gefährdung von Flora und Fauna. Hoher Nutzungsdruck führt ebenfalls zu Ausweichverhalten Naherholungsuchender. Noch weitere Wege werden zurückgelegt zumeist mit motorisierten Verkehrsmitteln, mit all den bekannten negativen Einflüssen auf die Umwelt. Können Personen zeitlich oder räumlich nicht ausweichen, kommt es zur Unzufriedenheit (ARNBERGER 2003). Erhöhte Vandalismusschäden im Gebiet selbst sind ebenfalls auf starken Nutzungsdruck zurückzuführen.

In Wien kann ein anhaltender Trend zum Radfahren festgestellt werden. Das Rad wird zu einem hohen Teil als Freizeitverkehr aber auch als Alltagsverkehrsmittel benutzt (vgl. SNIZEK et al. 2004). Äußere Rahmenbedingungen wie das Wetter, die Morphologie der Stadt schränken das Radfahren ein. Als äußere Rahmenbedingung ist aber auch das Angebot an Radwegen zu sehen. In diesem Zusammenhang ist die Bedeutung von Erholungsgebieten als Durchzugsgebiete für den nichtmotorisierten Verkehr nicht zu vernachlässigen. Der Wienerberg wird schon jetzt für den Alltagsverkehr genutzt und es stellt sich die Frage, ob nicht durch eine

Erweiterung des Angebotes von Radrouten in dem Gebiet die Radfahrfrequenzen erhöht werden könnten. In diesem Zusammenhang ist die Planung des Wegesystems des Marchfeldkanals zu nennen. Vorausschauend wurden Anbindungen an Infrastruktureinrichtungen wie Schulen, Einkaufszentren etc. berücksichtigt, so dass vom Zeitpunkt der Eröffnung an das Gebiet als Alltagsverkehrsverbindung für Radfahrer diente (NEUDORFER 2002). Heute hat der Marchfeldkanal einerseits eine hohe Bedeutung als Alltagsverkehrsverbindung andererseits als überregionale Verbindung für den Freizeitverkehr erlangt.

Anhand der oben diskutierten Ergebnisse erscheinen in beiden Erholungsgebieten nach dem Wochentag unterschiedliche Besucherlenkungs- und –informationmaßnahmen sinnvoll. Während der Woche dominiert die Wohnumfeldnutzung, am Wochenende die Naherholung. Stammgäste sind mit gänzlich anderen Informationen zu versorgen als z.B. Personen, die das erste Mal im Gebiet unterwegs sind. Erstere sind auch an Arbeitstagen im Gebiet anzutreffen, brauchen keine Orientierungshilfen, sind dafür aber vielleicht an umfassenden aktuellen Informationen, über im Gebiet anfallende Managementmaßnahmen interessiert. Die Naherholungsnutzung unterliegt einer stärkeren Wochentags- und Wetterabhängigkeit (Brandenburg et al. 2004). Informationskampagnen, die naherholungsuchende Personen erreichen sollen, müssen ihren Schwerpunkt am Wochenende haben. Dem kann das Gebietsmanagement mit einem erhöhten Personaleinsatz an Wochenend- und Feiertagen mit schönem Wetter begegnen.

7 DANKSAGUNG

Die Magistratsabteilung 49, Forstamt der Stadt Wien, beauftragte das Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung, Department für Raum, Landschaft und Infrastruktur, Universität für Bodenkultur, Daten über die Erholungsnutzung in den beiden Erholungsgebieten zu erheben.

8 LITERATURVERZEICHNIS

Arnberger, A., Brandenburg, Ch., MUHAR, A: Besuchererfassungstechnologien als Beitrag für eine nachhaltige Erholungsgebiets- und Stadtentwicklung, CORP 2006, Wien, 2006

Arnberger, A., Brandenburg, Ch.: Video monitoring forest visitors: An approach to gain more insightful data. Austrian Journal of Forest Science - Centralblatt für das gesamte Forstwesen, 1, 19-35, 2005

ARNBERGER, A.: Modellierung sozialer Tragfähigkeitsgrenzen von Erholungsgebieten. Dissertation an der Universität für Bodenkultur, Wien, 2003.

ARNBERGER, A., BRANDENBURG; Ch.: Visitor Structure of a Heavily Used Conservation Area: The Danube Floodplains National Park, Lower Austria. In: Arnberger, A., Brandenburg, C., Muhar, A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas; Proc., 7-13; published by Institute for Landscape Architecture and Landscape Management, 2002.

Arnberger, A., Brandenburg, Ch.: Der Nationalpark als Wohnumfeld und Naherholungsgebiet - Ergebnisse der Besucherstromanalyse im Wiener Anteil des Nationalpark Donau-Auen.. Naturschutz und Landschaftsplanung, 33, 5, 157-161, 2001.

Brandenburg, Ch., Matzarakis, A., Arnberger, A.: Visitor Motivation and dependence on the weather of recreationists in Viennes recreation areas. Berichte des Meteorologischen Institutes der Universität Freiburg, 12, 189-197, 2004.

Brandenburg, Ch., Arnberger, A.: Besuchsmotivation und Wetterabhängigkeit von Radfahrern in Wiener Erholungsgebieten. In: Bernhofer: 5. BIOMET-Tagung, Mensch-Pflanze-Atmosphäre, 3. – 5.12.2003, Dresden; Tharandter Klimaprotokolle, 9, 232-23, 2003.

Brandenburg, Ch.: Erfassung und Modellierung von Besuchsfrequenzen in Erholungs- und Schutzgebieten - Anwendungsbeispiel Nationalpark Donau-Auen, Teilgebiet Lobau.. Dissertation, Institut für Freiraumgestaltung und Landschaftspflege, Universität für Bodenkultur Wien, 2001.

CESSFORD, G.: Perception and Reality of Conflicts: Walkers and Moutain Bikes on the Queen Charlotte Track in New Zealand. In: Arnberger, A., Brandenburg, C., Muhar, A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas; Proc., 7-13; published by Institute for Landscape Architecture and Landscape Management, 2002.

Goldsmith, S. A.: National Bicycling and Walking Study, Case Study, No. 1: Reasons Why Bicycling and Walking Are and Are Not Being Used More Extensively as Travel Modes. FHWA-PD-92-041: FHWA, U.S. Department of Transportation, 1992.

HÖPPE, P.: An Universal Index for the Assessement of the thermal environment – The Phyiological Equivalent Temperature PET, in Proceedings of the 15th International Congress of Biometeorology and International Conference on Urban Climatology, Sydney, ohne Seitenangabe, 1999.

KERSTIN-KOEBERLE, E.: Freizeitverhalten im Wohnumfeld, innerstädtische Fallstudien, Beispiel München. Münchner Studien zur Sozial- und Wirtschaftsgeographie, Hrsg. Ruppert, K., Haas, H.-D., Band 19, Verlag Lassleben Kallmünz, Regensburg, 1979.

LINDSEY, G.: Use of urban greenways: insights from Indianapolis, Landscape and Urban Planning, 45, 145-157, 1999.

MATZARAKIS, A., MAYER, H.: Another Kind of Environmental Stress: Thermal Stress. Newsletters No. 18, 7-10. WHO Colloborating Centre for Air Quality Management and Air Pollution Control, 1996.

MATZARAKIS, A., RUTZ, F., MAYER, H., 2000: Estimation and calculation of the mean radiant temperature within urban structures. Biometeorology and Urban Climatology at the Turn of the Millenium (ed. by R.J. de Dear, J.D. Kalma, T.R. Oke and A. Auliciems): Selected Papers from the Conference ICB-ICUC'99, Sydney, WCASP-50, WMO/TD No. 1026, S. 273-278.

Nankervis, M.: The effect of weather and climate on bicycle commuting. Transportation Research Report A 33. 417-431.1999

Neudorfer, W. [Red.]: Wasserschatz und Lebensader Marchfeldkanal, 10 Jahre Flutung des Marchfeldkanals - Beginn der Grundwasserbewirtschaftung, Deutsch-Wagram, 2002.

Niemeier, D.: Longitudinal Analysis of Bicycle Count Variability: Modelling Implications. Journal of Transportation Engineering. 200-206, 1996.

Purtscher, C: Tiergerechte Hundehaltung und Auslaufmöglichkeiten in Wien, Studie des Campa!gning Office Entrup&Richter, im Auftrag der Wiener Umweltanwaltschaft, Wien, 2001

WAKONIGG, H.: Wetter und Witterung als komplexe Erscheinung. (Ein Vorschlag zur Darstellung der örtlichen Witterung durch Mehrfachkombination im Sinne echter Witterungsklimatologie) Teil 1 und 2, Wetter und Leben, Zeitschrift für angewandte Meteorologie, Jahrgang 33, Heft 1 und 2, Wien, 1981.

SNIZEK, S., SCHACHENHOFER, H.: Radverkehrserhebung 2002-2005, Automatische Dauerzählung des Radverkehrs in Wien, Zwischenbericht 2004, http://www.wien.gv.at/stadtentwicklung/radwege/erhebung02/dauer.htm

Statistik Austria: Freizeitaktivitäten, Ergebnisse des Mikrozensus September 1998, Verlag Österreich GmbH, Wien, 2001.