The Inclusive Role of Ekistics Elements in Earmarking Innovation Zones through a Balanced Distribution of Smart Development and Local Expression: Case of Kolkata Metropolitan Area (KMA)

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1 ABSTRACT

Today there is a need for more accessible, habitable, economically, and socially sustainable urban areas. Despite rapid urbanization and globalization, the metropolitan areas have exploded and become heterogeneous in such a manner that it has become challenging to comprehend a holistic and homogenous solution. Currently, metropolitan areas are under tremendous pressure for smart development on the one hand, and on the other hand, basic development needs dealing with population and environment more seriously is a high priority for enhancing the basic livelihood of marginalized areas and their dwellers. Therefore, it is essential to take both the aspects together. Hence, an inclusive methodology can be suggested in the form of a balanced development policy on innovation zones. To best conceptualize the inclusive approach, the concept of Ekistics i.e., the study of human settlements and its elements, has been incorporated, an idea formulated by C. A. Doxiadis. The concept explains the examination of both local expression and specific smart or higher development prerequisites, in the form of Ekistics elements which are nature, human, society, shell, and network. Initially, the paper forwards a summary of extensive theoretical research to position the Ekistics prerequisites for developing the inclusive methodology. The paper subsequently highlights how the smart development can be perceived in parallel with the expansion and networking along with a focus on nature, human, society, shell, and network in local areas. This needs for an induction of a metropolitan approach with the distribution of innovation zones to balance both sides of the opportunities and potentials. The case of Kolkata Metropolitan Area has been taken. Finally, the paper assesses the elements and their constituent indicators and attempts to analyze the potential clusters of possible innovation zones through cluster analysis. Thus, the paper provides a basis for the study of prerequisites of development of urban innovation zones (IZ) in context of the metropolitan area.

Keywords: Ekistics elements, globalisation, innovation zones, metropolitan area, smart development

2 INTRODUCTION

2.1 Research motivation

"Progress is more plausibly judged by the reduction of deprivation than by the further enrichment of the opulent."-Amartya Sen

A new global paradigm has emerged over the last decade focusing on smart, sustainable, resilient, innovative and inclusive development. These development concepts and processes deal with number of present as well as future expansion requirements looking into physical, social and economic issues. Moreover, several research shows that even these concepts and processes itself are evolving continuously according to the dynamism of the global and local needs. It is also observed that policymakers, stakeholders, and other actors are aligning their conception about a development being smart in a way that the whole idea of inclusive growth and improvement of the quality of life does not get lost while planning for the future expansion and welfare. Often it has been reflected in many research that social welfare can be achieved by the economic upliftment of the society and its people. Thus, rapid urbanization and its development demand for infrastructure and economic development have become one of the prime focus, especially in metropolitan areas.[1] The UN predicts that by 2050 the world's urban population will be as vast as the world's total population in 2002. The urban population of India has increased from 222 million (i.e., 26% of the population) in 1990 to 410 million (32%) in 2014 and is predicted to reach 814 million (50%) by 2050, however, India ranks second in the world in terms of urban population size. Present urbanization rate of India is lower in comparison to China (54%), Indonesia (53%), Mexico (79%), Brazil (85%) and Russia (74%)

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[1] Metropolitan area: it is an area comprising of a densely populated urban core and its less-populated surrounding territories, sharing industry, infrastructure, and housing. (Source: https://en.wikipedia.org/wiki/Metropolitan_area)

(Randhawa & Kumar, 2017). In a study, it is discussed that urbanization in India has a dual character - it is decelerating at the macro level on hand and on the other hand it is growing in class I cities, with the metropolitan area having the highest growth rates (Kundu, 2001). The metropolitan areas of India have emerged as economic growth engines and a pull factor for various new developments. Through several research based on economic clusters, special economic zones, innovation zones, innovation districts, innovation hubs[2] innovation ecosystem, and other similar concepts, it has been observed that these zones potentially deliver a concrete and significant concept to examine complex urban dynamics and an instrument to improve planning support for economic development of any area through networking of different actors (Dedehayir, Mäkinen, & Roland Ortt, 2016; Yang, Ottens, Cai, & Sliuzas, 2010). At metropolitan level, the infrastructural and economic demands have different requirements at different stages of development for knowing the innovation capability. In order to achieve these demands, there is an emerging consensus among the policymakers, stakeholders and other actors, to adopt a holistic approach. Hence, to plan and manage the complexity and multidimensional frameworks of metropolitan development, this paper has adopted the concept of Ekistics[3] introduced by C.A. Doxiadis.

2.2 Interpretation of smart development globally and acknowledging it as per local expression

In current planning practices and discussions, the concepts based on the terms-smart, sustainable, liveable or inclusive has made its identity so strong in the planning process that every other approach or concept introduced today is associated with these. For example, are the concepts like Smart Growth, Smart Cities, Sustainable development, Smart development, etc. As the definition of these concepts has a different dimension to the researchers, it becomes difficult to comprehend it to a singular definition or understanding. For instance, in context of Smart development, some concepts suggest it as the coherence of infrastructure, the significance of learning, innovation, and networks (Allwinkle & Cruickshank, 2011), while some regard it as the incorporation of Information and Communication Technology (ICT) into day to day life and state function (Komninos, 2011).

However, these concepts and approaches provide the policymakers, stakeholders, and most importantly the dwellers, an assurance that the issues faced by the cities in day to day life will be somehow addressed smartly and more effeciently. Therefore, what is important here to realize is that where we are demanding modern facilities and services in global context, but in reality, there is a huge disconnect while tackling the local or territorial demands of the society. Thus, even so, the approach is promising to be a good fit of the model by being smart and sustainable, but sometimes it remains to be a poor fit in practice while dealing with the urban local issues. By local expression, Doxiadis' meant particularity of the context, i.e., specific development needs of each nation-state, emphasizing on the spatial logic of practice in developing areas (Khan Mahsud, 2010). Hence, the integration of local expression in the global conception as suggested by Doxiadis' will provide the solution in terms of inclusiveness of the context-specific development needs making it more sustainable.

Generally, in urban areas, the development gets driven by a number of elements, considering the multifaceted needs of its people, infrastructure, and environment. There is a growing responsiveness among policymakers that innovative movement is one of the key drivers of economic development and well-being in meeting global challenges. While dealing the people, infrastructure, and its environment, the idea of development based on the concept of innovation has both scientific and practical significance for the socio-economic and physical growth of an urban area. It is commonly adopted and practiced in modern discourses on urban economic development policies in many developed nations. In this research, the concept of innovation zones has been taken, which is one of the leading theory as well as a practice among other concepts.

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[2] Example: 'Arabianranta' in Helsinki/Finland, 'One-North' in Singapore and 'The Digital Hub' in Dublin/Ireland. 'There is a growing consensus among both academics and politicians that the innovation processes have a pronounced regional dimension and that the relevance of region-specific features for innovation processes is indeed increasing'.

[3] Ekistics: concerns the science of human settlements, including regional, city, community planning and dwelling design; Ekistics elements: Nature; human; society; shell; network.

2.3 Understanding the concept of Innovation Zones

There are number of definitions and conceptual basis provided in the wide array of literature. To best contemplate the idea of innovation, first, the definition of innovation has been specified. And then, the objective and elements of Innovation Zones have been discussed further.

2.3.1 Defining innovation

The term 'innovation' serves different definition to Innovation Zone concept. The definition selected in the study is explained as, "It is a ubiquitous phenomenon in the modern economy. In practicality all parts of the economy, and at all times, it is expected to find on-going processes of learning, searching and exploring, which results in new products, new techniques, new forms of organization and new markets" (Mikroglou & Khan, 2009). The paper provides a number of contribution to the literature on the development based on innovation applications. Generally, the application of innovation zones in economic and spatial policies worldwide is unusual. However, Innovation zones potentially provide a concrete and important concept to analyze complex urban dynamics and an instrument to improve planning support for economic development of any area (Yang et al., 2010). Hence, there is a need for more research on innovation-driven economic zones and its underlying elements in regard to the growing urbanization and population. The UN predicts that by 2050 the world's urban population will be as big as the world's total population in 2002. In the global economy, cities and metropolitan regions are the main fields for organizing economic activities and for managing with exogenous developments.

The key objective of Innovation Zones is to foster business creation and innovations, and thus making innovative use of knowledge, legislatures, and available resources. The concept of IZ came from the development of clusters (Mikroglou & Khan, 2009). It is observed that these clusters or common knowledge groups are formed by a structured and geographical mixture of firms having resemblance in highly harmonizing competences for common research and development (Maskell & Lorenzen, 2003). Furthermore, research suggests that the collective nature of the learning processes inside these special places is characterized by concentrated local associations and interpersonal interactions among the industrial districts or milieus and the cities, where the learning process embeds into a close system of small and medium enterprises (SMEs) as well as into the local labor market (Camagni & Capello, 2013; Keeble & Wilkinson, 1999). It is stressed that innovation is stimulated and influenced by many actors[4] and factors, both internal and external to the firm. Research shows that the social aspect of innovation refers to the collective learning process between several departments[5] of a company as well as to external collaborations with other firms, knowledge providers, financing, training, etc (Doloreux & Parto, 2005). It is argued that from regional science and socio-institutional environment point of view, innovation is localized and a locally embedded, not placeless, process.

Number of elements have been studied in several research giving an idea on which the assessment for potential innovation can be done. To name a few from studies, elements like- availability of workforce, local interaction and cooperation in order to achieve reduction of uncertainty (especially relating to the behaviour of contenders and partners) and of information irregularities (thus reducing mutual suspicion among partners); trust, sense of belonging, place-loyalty, and social sanctioning in order to reduce opportunistic behaviour are all territorial elements typical of the innovative milieus that increase the capacity of a region to speed up innovation and take full advantage of collective learning processes, as confirmed by many regional economics schools (Camagni & Capello, 2013). Recently in India NITI[6] Aayog has launched Indian Innovation Index in 2017, in regard to the success of GII since 2007 which works on a set of indicators to assess a nation's capacity for innovation and its global ranking. But prior to the analysis of the capacity of innovation, one must go through the existing indicators with holistic model and elements to envisage the potentials and strength of areas to become innovative further.

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[4] Several researches deliver the set of actors as: government; universities; industry; supporting institutions; entrepreneurs; financial investors; customers; civil society and many others. (Rabelo & Bernus, 2015)

[5] For example, R&D, production, marketing, commercialization, etc.

[6] NITI Aayog- National Institution for Transforming India: where 'NITI' means 'policy' and 'Aayog' means 'commission', it is the premier policy 'Think Tank' of the Government of India, providing both directional and policy inputs.

2.3.2 Learning from Innovation Zones and similar case studies

The concept of innovation recently has become a center of discussion globally that has captured the attention of several public officials and policy-makers around the world as an unconventional tool for taking decisions. However, the definition of innovation includes a wide range of issues that are underlined by a common set of guiding principles such as involvement of public and private entities, resource availability, and job creations, all of which can define innovation at many different levels.

	Study area	Objective/focus	Findings/results	Source
London Case Study	London	A set of control variables for other characteristics potentially predictive of London's specialization in the activity is concerned.	• Factors significantly associated with a concentration of employment in London included: market areas; supply areas; market type; establishment size; product innovation; establishment function; product cycle	(Cooke, Uranga, & Etxebarria, 1997)
Newark Innovation zone	Newark	Growth rate of employment in all the sectors of the region.	• Higher employment growth rate. • Newark's rate is equal to, or even higher than the growth of the rest of the region	(Mikroglou & Khan, 2009)
European Regional Innovation Survey	Vienna, Stockholm, Barcelona, Alsace, Baden, Lower Saxony, Gironde, S. Holland, Saxony, Slovenia, S. Wales	Innovation survey and results based on qualitative and quantitative determinants for innovation potential of any region and their linkages and network	• The activities based on innovation and business innovation process can be observed as a network process. • Interaction with other stakeholders and partners, and business played a vital role.	(Sternberg, 2000)
Nordic SMEs and regional innovation systems	13 Nordic regions (Oslo, Stockholm, Malmo /Lund, Aalborg, Jyvaskyla, Helsinki, Gothenburg, Linkoping, Stavanger, Horten, Jaeren, Salling, Icelandic regions	To explore the existence of similarities and differences between regional clusters of SMEs in different regions in the Nordic Countries	• Social networking arrangements proven to be successful for boosting & securing social capital and trust. • SMEs that draw on an analytical knowledge base and innovate through science-driven R&D tends to interact with global partners.	(Asheim & Coenen, 2005)
Regional innovative clusters	10 European regional clusters: ICT regional clusters in Finland, Ireland, Denmark, Spain, Flanders, and Netherlands; mature regional clusters: agro-food cluster (Norway) and construction clusters (Denmark. Netherland, Switzerland).	To seek the significance of regional clusters in innovation policy.	• Regional clusters in every country/region have unique cluster blends; • Regional clusters are in variation and have selection environments that are inherently different; • Regional clusters may go beyond geographical levels.	(Doloreux & Parto, 2005)

Table 1: Case studies with similar concepts like innovation zones

A study suggests innovation as a partly territorial phenomenon, which to a great extent, is based on the successes of specialized industrial agglomerations or regionally concentrated networks of SMEs and

industrial clusters. This concept emphasizes region as a locus of innovation (Doloreux & Parto, 2005). To have a conceptual and application understanding of innovation based development, several case studies through literature are sorted in Table.1, giving examples of innovation related case studies with the key points on its focus, findings and the study area.

2.4 Understanding the concept of Ekistics

In search of a holistic concept, Ekistics have been considered as one of the inclusive approaches. It is the science of human settlements, and is concerned with social, economic, cultural, technical, administrative, and other problems of human communities of all sizes and types (Khera, 1973). The basis of the Ekistics elements is explained initially, then later the inclusive nature of the Ekistics concept has been discussed.

2.4.1   Foundation of Ekistics Elements

The study focuses on the five elements of Ekistics, shown in Fig. 1, given by C. A. Doxiadis. First element is Nature, it provides a foundation for the development of settlements. It is the framework within which settlement functions and flourishes. It explains the aspects related to geological and topographical resources, soil and water resources, plant and animal life, and the climate. Second element is Human, initially this element was termed as Anthropos. It is the major demand seeker among other elements. Directed by moral values, and influences the environment in an attempt to fulfil his biological and emotional needs and his senses. Third element is Society, it is formed by the second element human. It consists of indicators such as population composition and density, social stratification, cultural patterns, education, health and welfare, economic development, law, and administration. Fourth element is Shells, it is structures created by human. The purpose is to provide housing, community services, shopping, recreation, civic and business needs, industry, and transportation. And fifth element is Networks, it is mainl the natural and man-made links. Facilitating the functioning of the settlements and developments. It comprises of water and power supply systems, sewage and drainage, and communication and transportation systems.
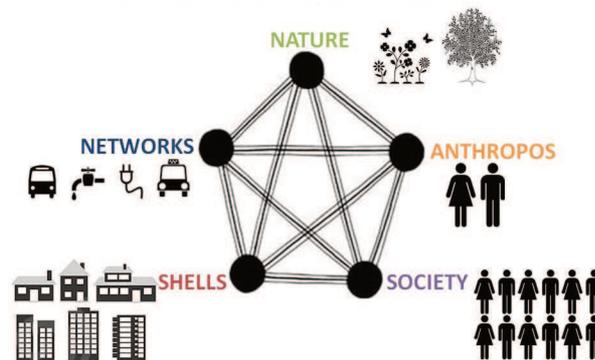

Fig.1 Five elements of Ekistics as designed initially by C.A. Doxiadis in 1947, (Fookes, 2008)

The concept works on the five principles which are: maximization of human potentials; minimization of efforts (in terms of time, energy, resource, routes); optimization of human's protective space; optimization of human's relation with his environment; and optimization in the synthesis of previous principles (Pertsemlidis, 2007). In the study of human settlement (Papaioannou, 2013; Zhang, 2017), it is suggested that the main objective of ekistics is to develop insights into the physical distribution, form, and structure of settlements, taking into account the variety of functions that they provide (John Peponis, 1968). According to Doxiadis, in order to comprehend settlements focused at their apparent spatial morphology, the underlying spatial patterns and indicators associated with human activities and behavior, as well as the functional and organizational structure have been suggested.

2.4.2   Inclusive nature of Ekistics in smart development

Discussion on benefits of adoption of the five Ekistics elements as the preliminary base for the development of generic framework for the urban sustainability, Fookes, 2008, describes that in context of 'sustainable communities and development', reviewing the steps of Doxiadis' efforts to develop an integral science of human settlement has considerable positive impact. In addition to the study of Ekistics, its relation with business and government study has shown the need of a universal application to major plans and action of industry and government (Khera, 1973). Studies suggest that planners can adapt the ekistics framework to

society's needs, as well as the global view for the urban development (Gottmann, 1976). Some concepts of ekistics have already been successfully employed in several major European cities (A. Doxiadis, 1969; C. a Doxiadis, 1970). In a study done by Pertsemlidis, 2007, a more organised explaination of the Ekistics concept has been discussed (shown in Fig. 2), where a system of two sets was proposed. In which one set comprised of nature and human (that time known as anthropos) which is naturally formed, and other set comprising of shells, networks, and society modified as institutions, which is culturally formed interconnected through natural function i.e., ecological aspect, and cultural function i.e., economic, social and political.
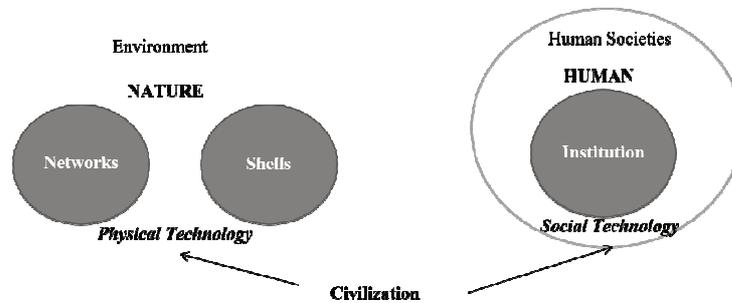

Fig. 2 Ekistics elements revisited

Thus, through different research it is clear that the objective of ekistics is to achieve a balance among these elements in the dimensions of time, space, and scale. The disbalance, among other elements, seems to have been caused by the exceptional increase in population; the tremendous rate of urbanization; the great increase in the average per capita income; the unexpected technological progress; and the social and political influences that these forces have had on the life of human (Kunzmann & Wegener, 1991; J. Peponis, Hadjinikolaou, Livieratos, & Fatouros, 1989).

2.5 Induction of metropolitan approach

In order to enhance the present study, the need of an induction of a metropolitan approach with a distribution of innovation zones to balance both sides of opportunities and potentials needs to be established. Several type of research have been conducted to analyze the innovation zones on a different scale from strong to weak so as to better understand a region's possibilities and productivity for economic development. There is a debate on the appropriate scale for studying regional innovation. Cities increasingly realize that in order to thrive they must expand beyond merely providing exceptional basic services, by also placing a strong focus on resource efficiency and start-up (American Institute of Architects, 2014). Urban areas that are best able to attract these types of businesses create more opportunity for the people already living there and draw new people in search of jobs. Similar arguments are made for metropolitan regions as sites of innovation systems (Doloreux & Parto, 2005). Studies on metropolitan innovation systems has concluded that metropolitan areas are the most important location for innovation (Feldman & Audretsch, 1999) and may possess high innovation potential (Brouwer, Budil-Nadvornikova, & Kleinknecht, 1999) because they offer firms spatial, technological, and institutional proximity and specific resources. In the present study, the case of Kolkata Metropolitan Area have been taken up, to look at the possibility of innovation zoning based on the assessment of potential indicators.

2.5.1   Case of Kolkata Metropolitan Area (KMA)

The third largest metropolitan area, in state of West Bengal, India, after Delhi and Mumbai, is a continuous linear urban agglomeration of areas along both sides of river Hooghly. KMA as shown in Fig. 3, (Paul & Sen, 2017)) comprises of areas taken from the six districts, namely, South and North 24 Paraganas, Nadia, Hooghly, Howrah, and Kolkata. The economic base of KMA contributes substantially to the total revenue collection of both the central and state governments. Kolkata city alone shares about 82 percent of annual sales tax collection and about 98 percent of annual income tax collection of West Bengal (Uttam & Roy, 2005). The history of Kolkata's foundation can be traced back to 1690 when British East India Company selected Kolkata (then Calcutta) for establishing a trade and business zone in the Eastern-India (Kundu, 2001).
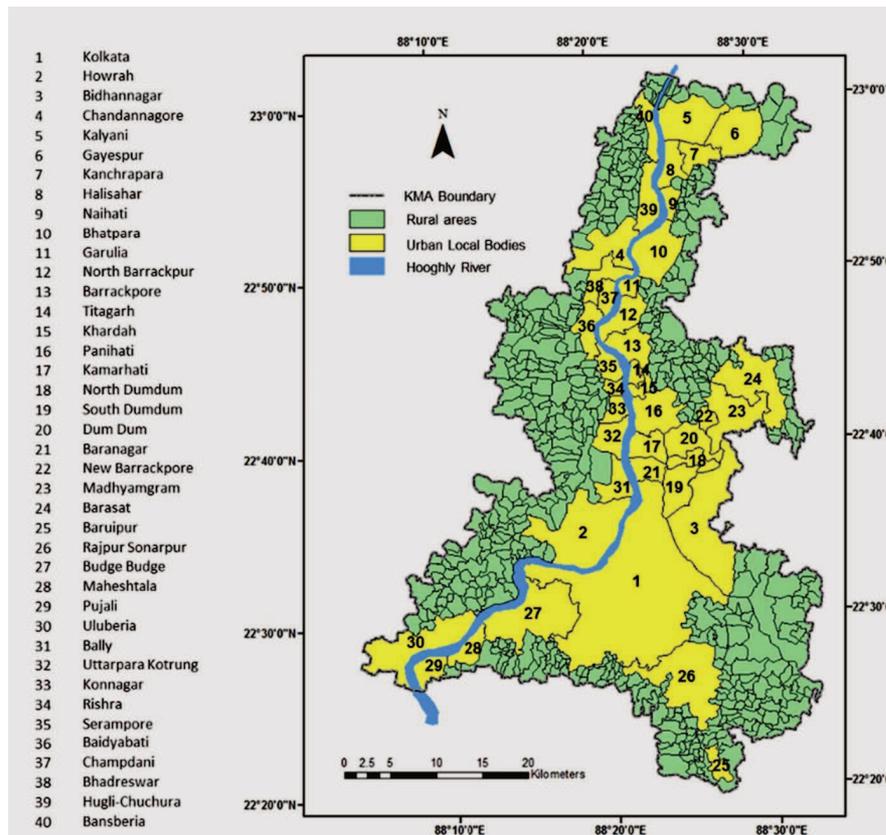
Fig. 3 Constititution of KMA

3 APPROACH FOR ASSESSING THE ELEMENTS AND ITS UNDERLYING INDICATORS

In order to understand and examine the current preparedness of an area, firstly there is a need to study the existing condition based on the list of indicators selected under the Ekistics elements.

Likert-type scale	
1	Least important
2	Somewhat important
3	Moderately Important
4	Very Important
5	Extremely Important

Nature	Human	Society	Shell	Network
Water resources	Temperature	Population density	School	Road
Natural Heritage	Workforce	Population composition	Hospital	Power Supply
Open Spaces	Creativity and inherited skill Knowledge	No. of literates	Recreational facility	Water Supply
		Economic equality	Market & shopping Centre	Communication System
		Technological acceptance	Commercial & business Centre	
			Transportation Centre	
			Warehouse	
			Industry	
			Skill Development Centre	

Table.2 List of selected indicators

The set of siginificant indicators will work as a basis for further earmarking potential clusters of innovation zones. Initial study was done on extracting the elements and its potential indicators through extensive literature review giving a pool of data which have been examined through a pilot and expert opinion survey[7], the output is shown in Table.2. For identifying significant indicators, a questionnair based on Likert-type scale of five on importance level have been developed. The experts were asked to select the indicators which they consider to have impact on the development of innovation zones in a metropolitan area. The indicators with median values 3 or above were selected based on pool of indicators extracted through literature review. Based on this selected list of indicators, the experts ranked three indicators to be most important for the study of potential clusters, they are population density, workforce, and number of literates available in each ULBs. Further, to demonstrate the analysis for potential clusters these indicators were selected. To observe the existing variation and status of the ULBs of the metropolitan area into clusters of high, medium, and low grouping based on each indicator's values, there is a methodology to assess potential clusters.

4 RESULTS AND DISCUSSION

4.1 Assessment of potential clusters

To assess the clusters, first the k-mean for the cluster analysis was carried out. The number of clusters were given three for the k-mean cluster analysis. As the output was focused on three range of high, medium, and low groupings. In Table. 3 the Initial and Final Cluster Centers represent the Euclidean distances between the cluster centers. Greater distances between two cluster centers indicate more dissimilarities within the algorithm. In this analysis, the groups are formed purposely in according to the distances between them. The data were standardized before undergoing the analysis by calculating their Z- scores.

	Initial Clusters			Final Clusters		
	1	2	3	1	2	3
Population_density	1.26528	2.68526	-1.45453	1.26528	2.00455	-.33200
Workforce	5.91470	-.28325	-.33931	5.91470	.21563	-.20567
No._of_literates	5.86374	-.30096	-.36225	5.86374	.25942	-.21061

Table. 3 Initial and Final Cluster Centers

The grouping of ULBs into clusters of high, medium, and low, shows the variation among the clusters based on the indicators.
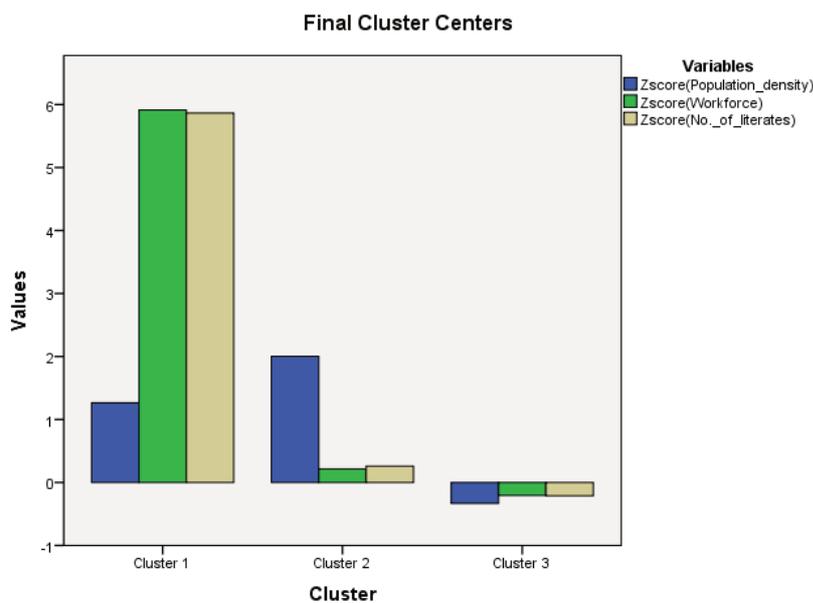

Fig.4 Cluster wise distribution of selected indicators

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[7] Taking 15 experts from different relevant fields, a survey based on questionnaire on Likert-type scale of one to five points describing importance level. The experts comprised of different stakeholders, decision makers and academicians, like mayor of ULBs, chairperson of municipalities, professors, and etc.

The significant difference in cluster one from the other two clusters is visibly as shown in Fig. 4, high due to the high population size of Kolkata city. Since Kolkata is the core city on the west bank of the river Hooghly, with range of physical and social infrastructure as well as economic opportunities. Most of the ULBs with huge gap in meeting these physical, social, and economic infrastructure and opportunities fall in Clusters 2 and 3. This shows clearly the disbalance in the opportunities among the urban areas through out KMA. Howrah-Bally, Baranagar, Titagarh, South Dum Dum, and Kamarhati falls in Custer 2. And rest of the ULBs fall in Cluster 3.

As shown in Table. 4, the selected indicators have an impact in cluster formation and the population density has the least impact in it. In Table 4, the positive and large F values of the selected indicators denote the higher impact of indicators to the separation and in classifying the clusters.

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Population_density	12.720	2	.366	37	34.707	.000
Workforce	18.327	2	.063	37	289.107	.000
No._of_literates	18.114	2	.075	37	241.790	.000

Table. 4 ANOVA[8]

The F tests are normally used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

5 CONCLUSION

In the age of dynamic urban needs for smart development and global demands, somewhere the loophole still remains to meet the basic needs of an urban area. In order to address the needs on the grassroots level, first, there should be the realization that without taking bottom needs hand in hand in development programs and policies, it is hard to achieve smart development for urban areas. Where the population is connected with high-tech informatic society, there is still a huge disconnection in meeting the infrastructure needs, economic welfare and basic quality of life. The research shows that in developing country like India, approach to smart development needs more attention on solutions based on the local expression i.e., the indicators considered to be responsible to best understand the potential of an urban area like availability of workforce, no. of literates showing the knowledge groups and the gap. In this case, three indicators i.e., poulation density, workforce, and number of literates, were analyzed, since it gives a initial picture of the area how potential or weak it is in terms of the preparedness for potentcial clusters of innovation zones. The physical and socio-economic development will be more effective and sustainable if an inclusive approach is taken into account. Therefore, the purpose of the paper was to address and emphasize on the need for considering an inclusive concept like Ekistics, to envisage the development and augmentation of innovation zones in metropolitan areas. The paper argues that the need of modification based on the context and scale of cases should also be taken in to account while preparing for the innovation zone development. In addition, it also suggested through literature reviews that the indicators varies from context to context, thus the local expression of an area must be taken into account, as some area may be potential in terms of Nature element, or Shell. And thus, the indicators underlying to it must be taken into consideration for the study.

5.1 Limitation and scope

The study was limited with the demonstration of the selected indicators as governed by Ekistics elements, extracted for initial conceptualization. This research is not an attempt to replace any of the more commonly known indicators but instead present alternative holistic approach. In this paper, we have selected three indicators under Ekistics elements for the analysis, i.e., population density, workforce, and no. of literates based on expert's opinion. This is one of the limitations of the research. And initial clusters were identified, and with the help of these clusters further scope of analysis to identify level of augmentation and

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[8] Analysis of Variance: used to analyze the differences among group means.

development prerequisites for innovation zones can be assessed. The paper has scope and implications for a array of stakeholders, including researchers, policymakers, industries, and government and private bodies, which are in the long run, concerned with the development of innovation zones to augment economic prosperity and social welfare with a inclusive approach for the identification of indicators based on local context.

6 REFERENCES

AMERICAN INSTITUTE OF ARCHITECTS: Cities as a Lab: Designing the Innovation Economy. 2014

BROUWER, E., BUDIL-NADVORNIKOVA, H., & KLEINKNECHT, A.: Are Urban Agglomerations a Better Breeding Place for Product Innovation? An Analysis of New Product Announcements. Regional Studies, Vol. 33, Issue 6, pp. 541–549. 1999

CAMAGNI, R., & CAPELLO, R: Regional innovation patterns and the eu regional policy reform: Toward smart innovation policies. Growth and Change, Vol. 44, Issue 2, pp. 355–389. 2013

DEDEHAYIR, O., MÄKINEN, S. J., & ROLAND ORTT, J: Roles during innovation ecosystem genesis: A literature review. Technological Forecasting and Social Change. 2016

DOLOREUX, D., & PARTO, S: Regional innovation systems: Current discourse and unresolved issues. Technology in Society, Vol. 27, Issue 2, pp. 133–153. 2005

DOXIADIS, A: Books 373, pp. 373–374. 1969

DOXIADIS, C. A: Ekistics, the Science of Human Settlements. Science, Vol. 170, Issue 3956, pp. 393–404. 1970

FELDMAN, M. P., & AUDRETSCH, D. B: Innovation in cities:: Science-based diversity, specialization and localized competition. European Economic Review, Vol. 43, Issue 2, pp. 409–429. 1999

FOOKES, T. W: A Generic Policy Framework For Urban Sustainability. Shaping the Sustainable Millennium, CA, vol. 1, Issue 22. 2008

GOTTMANN, J: Megalopolitan systems around the world. Ekistics. Athens Center of Ekistics. 1976

KEEBLE, D., & WILKINSON, F: Collective Learning and Knowledge Development in the Evolution of Regional Clusters of High Technology SMEs in Europe. Regional Studies, Vol. 33, Issue 4, pp. 295–303. 1999

KHAN MAHSUD, A. Z: Rethinking Doxiadis: Ekistical Urbanism. University of Minnesota Press. 2010

KHERA, P: Business , Government , And The Science Of Human Settlements The application of ekistic criteria. 1973

KOMNINOS, N: Intelligent cities: Variable geometries of spatial intelligence. Intelligent Buildings International, Vol. 3, Issue 3, pp. 172–188. 2011

KUNDU, N: Understanding Slums Reports: The case of Kolkata India. Understanding Slums: Case Studies for the Global Report on Human Settlements. 2001

KUNZMANN, K. R., & WEGENER, M: The pattern of urbanization in Western Europe. Ekistics. Athens Center of Ekistics. 1991

MASKELL, P., & LORENZEN, M: The Cluster-and other current forms of Market Organization. 2003

MIKROGLOU, E., & KHAN, T. H: The Role of Innovation Zones in Regional Development. 2009

PAPAIOANNOU, J. G: Environment and the Role of Ekistics, Vol. 2. 2013

PAUL, A., & SEN, J: Livability assessment within a metropolis based on the impact of integrated urban geographic factors (IUGFs) on clustering urban centers of Kolkata. Cities. 2017

PEPONIS, J: EKISTICS - An introduction to the science of Human Settlements / C.A.DOXIADIS. Ekistics The Problems And Science Of Human Settlements, pp. 1–6. 1968

PEPONIS, J., HADJINIKOLAOU, E., LIVIERATOS, C., & FATOUROS, D. A: The spatial core of urban culture. Ekistics. Athens Center of Ekistics. 1989

PERTSEMLIDIS, C. R: The foundations of ekistics An attempt to test the validity of Anthropocosmos model in the context of modern evolutionary theory Purpose : The Anthropocosmos, pp. 1–15. 2007

RABELO, R. J., & BERNUS, P: A Holistic Model of Building Innovation Ecosystems. IFAC-PapersOnLine, Vol. 48, Issue 3, pp. 2250–2257. 2015

RANDHAWA, A., & KUMAR, A: Exploring sustainability of smart development initiatives in India. 2017

UTTAM, A., & ROY, K: Development of New Townships: A Catalyst in the growth of rural fringes of Kolkata Metropolitan Area (KMA). In In Annual Conference of HUDCO. 2005

YANG, Z., OTTENS, H. F. L., CAI, J., & SLIUZAS, R. V: Role of economic clusters in improving urban planning support. ITC Dissertation, Vol. 170. 2010

ZHANG, J. : Sustainable Degrowth and Relocalizing our Economies. 2017