

Exploring the role of digitalisation and technology uptake in the construction industry: Lessons from Johannesburg, South Africa

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Introduction

The construction industry was late to the tea party where the beneficial nature of information technology was discussed. Industries such as retailing, banking, and manufacturing were quick to see that digitisation and information technology can ensure efficiency and competitive advantages (Ikuabe et al., 2020, March). The construction industry is yet to completely enjoy the benefits that the above mentioned industries have enjoyed because Information and Communications Technology (ICT) is currently in the early stages with a major focus on the utilization of software (Osunsanmi et al., 2018). The fight to achieve global sustainable development is a great fight and one worth winning (Osburg and Lohrmann, 2017). Over the years, many countries, South Africa included, have joined the sustainability bandwagon so as to ensure that the earth's resources are being used in a manner that benefits both the current and future generations. South Africa has experienced challenges with resource wastage, pollution, rising unemployment, housing backlogs, project delays, and financial shortages to name a few (Ikuabe et al., 2020, March and Osunsanmi et al., 2018). There are multiple remedies to the above mentioned issues but the question is, is digitalisation one of them? This research endeavor sought to explore the role of digitalisation and technology uptake in South Africa's construction industry. The manuscript started by presenting an introduction and conceptual framework which illustrated that South Africa's construction sector is in need of a technology boost so as to create a better future for the country. The paper, like this presentation, goes on to briefly discuss how the study was conducted in the research methodology, presents the findings, and concludes by summarizing the findings and recommending a future course of action.



Research Questions and Objectives

Questions

- What are the stages and ways of applying Construction 4.0 technologies in South Africa?
- What are the advantages and disadvantages of using Construction 4.0 technologies in South Africa?
- How can Construction 4.0 technologies be used in a way that ensures the sustainable development of South Africa?

Objectives

- Highlighting the stages and ways of applying Construction 4.0 technologies in South Africa.
- Assessing the advantages and disadvantages of using Construction 4.0 technologies in South Africa.
- Proposing a viable scheme for the utilization of Construction 4.0 technologies in ways that ensure the sustainable development of South Africa.



Conceptual framework

Digitisation

- The process of converting analogue items such as pictures, documents, or sounds into digital files.

Digitalisation

- The process of using digitised files, social resources, and digital technologies to make fundamental changes to the operations of a business or a project to ensure their success.

Digital transformation

- The process of using digital technologies to modify an organization's model to elevate the organization and society



Conceptual framework continued

- The phrase "Construction 4.0" was largely inspired by the 4th Industrial Revolution (Industry 4.0), it has achieved great success in the manufacturing sector and necessitates the amalgamation of the virtual and physical world by utilizing the Internet of Things, virtualization, and simulation (Osunsanmi et al., 2018).
- Construction 4.0 has two primary focuses, first, the transition from physical to digital, second, the transition from digital to physical.
- The aforementioned transitions assist with coordinating, designing, and executing built environment infrastructures in a more efficient and effective manner. Construction 4.0 intends to fashion a digital construction site that utilizes different methods to follow the progression of the life cycle of the project (Taher, 2021).
- One can view digital construction as a consolidated approach to state-of-the-art technologies which aim to make building safer and increase productivity. The construction industry has employed a variety of technological innovations which will be mentioned in the research findings section.



Methodology

The inquiry followed the interpretivist paradigm which believes that reality is constructed socially and relies heavily on the various views and opinions that people have (Ngozwana, 2018). This study is an instrumental case study which means that Johannesburg played a supporting role to the phenomenon that is being studied (Crowe et al., 2011 and Lune and Berg, 2017). The research is qualitative in nature and was guided by qualitative methods. Some of the qualitative inquiries took place at various construction sites around Johannesburg while others took place telephonically and via email. The researchers sought out and relied heavily on the words of the interviewees in order to make inferences. Homogeneous sampling was used to select eight construction workers that were interviewed to gather data about their lived experiences. Homogeneous sampling ensured that the people who were interviewed would be the best people to assist with answering the research questions (Shaheen and Pradhan 2019). The eight construction industry specialists who were interviewed were found through Snowball sampling. The primary data collection tool was semi-structured interviews. They are flexible interviews that should yield a lot of deep and rich information (Alshenqeeti, 2014). Journals, memos, company documents, and other forms of documentation were used as secondary data sources. The data was analyzed by using categorical aggregation and content analysis, both of which reduced, categorized, and clarified the data so as to yield answers to the research questions. Various methods such as member checking, peer debriefing, and reflexive journaling were utilized to ensure that the research findings are valid and reliable. Lastly, the researchers ensured, to the best of their ability, that ethical procedures were adhered to at all times to ensure the success of the inquiry.



Stages and ways of applying Construction 4.0 technologies

Pre-design phase	Design/Engineering phase	Construction phase	Operation and maintenance
<ul style="list-style-type: none">• Big data• Virtual Reality (VR)• Robotics and Automation• Internet of Things (IoT)• Building Information Modeling (BIM)	<ul style="list-style-type: none">• Virtual Reality (VR)• 3D printing• Robotics and Automation• Internet of Things (IoT)• Building Information Modeling (BIM)	<ul style="list-style-type: none">• Artificial Intelligence (AI)• Drones• 3D printing• Robotics and Automation• Internet of Things (IoT)• Building Information Modeling (BIM)	<ul style="list-style-type: none">• Sensors• Big data• Augmented Reality (AR)• 3D printing• Internet of Things (IoT)• Building Information Modeling (BIM)



Advantages of using Construction 4.0 technologies

1 Productivity improvement

Construction 4.0 innovations facilitate the improvement of business productivity. Businesses should investigate how their employees utilize their time and execute a mechanism that improves the proficiency of systems. A software that schedules tasks can assist a business with fulfilling its obligations.

3 Potential provider of new opportunities

Digitalisation uses innovative digital technologies to better capitalise on current opportunities.

2 Less negative impacts on the environment

Construction 4.0 produces less waste than traditional systems. The rapid assembly speed reduces the amount of time that surrounding areas have to tolerate the noise and air pollution that comes from the construction site.

4 Enhanced worker safety

The construction sector is responsible for over 20% of deadly accidents. Construction 4.0 technologies are safer because they reduce the amount of physical and outdoor labor that is needed, both of which are extremely dangerous.



Disadvantages of using Construction 4.0 technologies

High requirements

Lack of knowledge

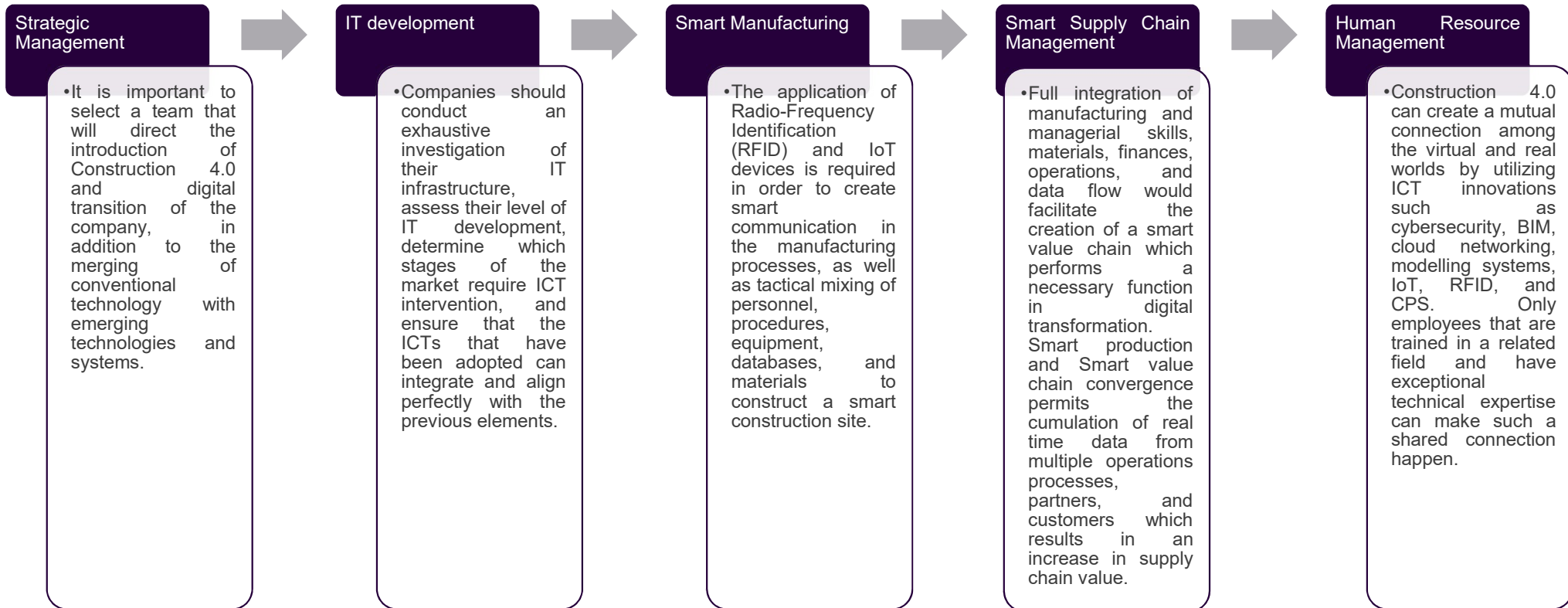
Technology acceptance

Implementation cost

- A qualified employee will be needed to use the new technologies so as to facilitate the transition and progression of Construction 4.0. Introducing Construction 4.0 technologies requires recruiting and preparing workers, in addition to acquiring integration expertise.
- While there are plenty qualified workers within the sector that are open to implementing the emerging technologies, others may not share the same sentiments because they lack the expertise or desire to learn new techniques.
- There is concern about workers becoming redundant. Worried workers will hesitate to implement and utilize Construction 4.0 technologies.
- A lot of money and time goes into purchasing these innovative technologies and training employees to use them.



A viable scheme for the utilization of Construction 4.0 technologies



Conclusions and Recommendations

Remiss of the value of the construction industry to South Africa, developments inside the industry are characterized by conventional methods and small-scale implementation of ICT that yields the construction of substandard infrastructures, thus, affecting the general conduct of the construction industry. The paper acknowledged that Construction 4.0 will be guided by a call for the creation of a smart construction site, in addition to adopting simulation software and virtualization for construction processes. The endeavor came to the conclusion that digitalisation cannot be taken advantage of fully in South Africa's construction industry without key transformations and adaptations of procurement arrangements, business models, and improving the construction industry. The above mentioned advances are imperative to realize the sustainable development of South Africa through the implementation of Construction 4.0. The researchers determined that the advantages of Construction 4.0 can, in theory, remedy some of the challenges that are faced by the construction sector in South Africa, as they far outweigh the disadvantages. Nevertheless, research within this area is still limited and multiple problems with implementation remain. Specifically, there is a lack of case studies that are centered around or related to the topic at hand. This inquiry recommends the endorsement of Construction 4.0 by construction stakeholders to enhance the general performance of South Africa's construction sector and create awareness about the endeavor. In addition, an investment should be made in research which focuses on the implementation of innovative ideas and technologies that can be utilized by the South African construction industry. Lastly, a proactive thinking approach should be adopted by construction sector professionals when tackling their projects.

