Digital transformation in the South African built environment

Abstract

The built environment has major challenges in project performance due to multiple factors such as proper planning, collaboration and poor project information. Building Information Modelling (BIM) has revolutionised the built environment worldwide, offering a more efficient and effective way of managing the built process. BIM is a process that allows the creation and management of information about a building project throughout its entire life cycle. Although BIM presents potential benefits, its adoption remains a challenging endeavour in numerous countries, among them South Africa. The adoption of BIM has been slow due to a lack of awareness and understanding of BIM, limited government support and reluctance to invest in new technologies. This study examines the fundamental barriers to BIM adoption and proposes solutions to overcome these challenges. An online survey questionnaire was administered electronically through professional bodies, government, industry networks and academic institutions. The online survey was validated through semi-structured interviews and webinars. The survey revealed there are multiple factors hindering the implementation of BIM. The main barriers include low awareness and industry adoption, lack of client demand, training and funding opportunities, lack of governmental influence and lack of standardised guidelines. The study recommends for a coordinated and strategic approach to promote BIM adoption across the industry. The government to establish a national BIM task force comprised of industry experts, academia, and government representatives to drive BIM adoption in the country. This task force should be responsible for developing a national strategy for BIM adoption, identifying key challenges and opportunities, and coordinating efforts across different stakeholders.

Introduction

Building Information Modelling (BIM) has revolutionised the built environment worldwide, offering a more efficient and effective way of managing the built process. BIM is a process that allows the creation and management of information about a building project throughout its entire life cycle.

South Africa's built environment is undergoing significant changes with an increasing focus on the 4th industrial revolution, but the adoption of BIM has been slow due to a number of reasons. The built environment is a significant contributor to South Africa's economy and the adoption of BIM holds significant promise in enhancing productivity, reducing costs and improving infrastructure quality within the BE. This research report examines the fundamental barriers to adoption and proposes potential solutions to overcome these challenges.

Status of project performance in South Africa

The BE in South Africa has faced significant challenges in project performance due to various factors such as lack of proper planning, collaboration and poor performance. South Africa has also lagged in terms of information management, resulting in project failures and confirms the low level of adoption.

In many instances, projects are managed using manual processes which are often time-consuming and prone to errors and omissions. The existence of communication gaps among stakeholders amplifies the problem, resulting in misinterpretations, protracted timelines and inaccuracies that may significantly impede project outcomes. BIM provides a common platform where all project data is stored, ensuring stakeholders can access accurate and up-to-date information.

BIM technology helps manage project information by providing a 3D model that integrates data from different sources, including drawings, schedules, and specifications. Additionally, BIM helps manage project information by providing real-time information on project progress, costs and resource utilisation, enabling stakeholders to make informed decisions.

The study provides the status quo and roadmap forward towards digital transformation to improve the quality of infrastructure delivery and management in South Africa. The digital divide in the South African BE impedes the sector's competitiveness to successfully deliver on providing responsive and resilient infrastructure. Thus, the research advocates for the amelioration of the digital divide in this respect, which has the potency to propel digital transformation in the South African BE.

Methodology

A mixed method approach through a nationwide quantitative survey was conducted between May and November 2022. The survey involved BE stakeholders (government departments, professional bodies, built environment institutions) through semi-structured interviews and webinars. The online survey administered electronically received over 173 responses from sampled BE professionals across the nine provinces, while the quantitative feedback through the webinar had 168 valid responses for participants. The findings discussed below greatly influenced the position recommended in this study.

Research Findings

Professional and occupational distribution/ demography

The majority of the respondents were project / construction managers (29%), quantity surveyors (26%), while architects made up 16% of the population. Responses from contractors comprised about 15% of the survey feedback and academics were 15%.

Level of awareness of BIM in the South African BE

The survey revealed an average level of awareness of BIM, with about 32% indicating they are on average aware of it and 26% identifying a low level of awareness. 7% of the respondents identified a very low level of awareness as their experience. Only 16% and 17% of the respondents indicated a very high and high level of awareness respectively.

While not shocking, the uninspiring level of awareness further confirms the low level of adoption and implementation. The average level of awareness supports the need for this position paper to guide and proffer strategic approaches. The level of awareness is a far cry compared to what attains in developed countries such as the USA and the UK.

As a leading country on the 4th industrial revolution (4IR) drive in Sub-Saharan Africa, implementing the positions suggested with reinforcing and establishing South Africa's vision as central to utilising emerging digital technologies to improve socio-economic indices, empower people and increase the quality of life.

Modes of training adopted.

The modes of training respondents are exposed to was investigated to ascertain how professionals are being trained towards BIM. Feedback reveals that 37% of participants have had no training, 16% were self-taught while 17% indicated that they had attended seminars, conferences, etc, where BIM was discussed. Other modes of training included outsourced, instructor lead and on the job training. The prominence of no training and self-training indicates the lack of structured policies.

How organisations are using BIM.

The survey revealed project construction scheduling and sequencing, project monitoring, 3D visualisation of designs, BIM-based take-off and as-built documentation the most prominent uses adopted.

BIM project implementation in organisations

The survey revealed that most participants had not participated in at least one project where BIM was adopted. More than half (53,1%) affirmed they have not experienced any form of BIM project, whereas 33% have had some form of participation in a BIM project. These answers reflect the low level of BIM technical know-how in the industry.

Digital twins' implementation in organisations

The transition to digital twins' adoption to improve real-time information management on projects was examined. Digital twins use data collected from sensors, simulations and other sources to create a

digital representation of the physical system. The survey revealed that most participants had not participated in at least one project where digital twins were adopted. More than half (59%) of respondents affirmed not having experienced any form of digital twins on a project, whereas 22% had some experience.

BIM adoption stages

Regarding BIM implementation, 44% of respondents revealed they were at the non-usage stage, 20% were at the trial phase, while only 5% had fully adopted and integrated BIM into daily BE operations.

Organisational digital workflow

Most respondents relied much on traditional BE processes as against adopting digitalised approaches. This is demonstrated by most respondents revealing that they largely rely on computer-aided design (CAD) tools to create drawings. Similarly, most respondents exchange project information via emails, dropbox and hard drives, instead of using a common data environment.

Use of a common data environment / central digital depository.

The high rate of unavailable asset information to manage infrastructure is central to the need to digitalise the BE. Respondents were asked if they have a central digital repository for each project, that can be accessed anytime. 42,1% disagreed with using such a system, while, surprisingly, 48,2& indicated they have such a system in place. It is however, unclear what kind of systems participants use to manage data.

Organisational authoring & analysis platforms

The tools mostly used by respondents were Autodesk BIM360, Autodesk Revit and Bentley ProjectWise

Data exchange standards

The need to ensure interoperability of systems to enable seamless adoption and use of tools in digitalisation efforts is central to enabling implementation. From the results, the prominent data exchange standards commonly used were PDF (DWF, DWG and DXF), XML and IFC respectively.

Collaboration platforms

Respondents were asked to indicate which is mostly used at the inception, concept and viability design development stages. Tools mostly indicated were Autodesk BIM360, OneDrive, Google Drive, Dropbox and Bentley ProjectWise.

BIM applications

Participants were asked if they have created any models in their current or recent projects. The most commonly utilized models were the Project and Asset Information ones, while most participants reported not having utilized any models on projects.

BIM standards

BIM standards are a set of guidelines, protocols and best practices that ensure consistent and efficient use of BIM technology across the construction industry. The primary goal of BIM standards is to enable effective communication and collaboration among project stakeholders. Some of the most widely used BIM standards include ISO 19650 and the National BIM Standard-United States (NBIMS-US) that provides guidelines for BIM use in the USA.

BIM maturity in South Africa (self-assessed)

BIM maturity is typically assessed on a scale of 0 to 3 or 4. At level 0, there is no use of BIM, and all information is exchanged using 2D drawings. At level 1, BIM is used for simple visualization and basic coordination, but there is little integration between stakeholders. Level 2 involves the use of collaborative BIM processes, with shared models and standardized data formats. Level 3 represents full integration of BIM across the project lifecycle.

To measure perspective of BIM maturity in South Africa, a self-assessed question revealed that 45,8% of respondents indicated level 1, 26,5% indicated level 2, and 23,9% mentioned level 0. Only 3,9% of the participants indicate level 3.

BIM adoption barriers.

With the low level of BIM adoption as indicated, respondents were asked to indicate barriers that, from their experience, impede BIM adoption. Capital availability (53,1%) was the biggest barrier, followed by training (47,5%), lack of client demand (39,5%), low awareness (38,9%) and lack of financial resources (37%). Based on the quantitative responses for the survey, participants in a webinar were asked to discuss and give feedback in order to validate the survey results. As most of the feedback was similar to that of the survey, only additional comments are indicated below.

Limited/slow & reluctance to adopt.

Professional's responses demonstrated reluctance to adopt BIM due to costs and fears related to the

livelihood of workers. The misconception that digitalisation signals job loss is rampant among professionals.

Prioritising and re-skilling

This theme highlights the need for further education on digital processes. Stakeholders, including top management need further education on digital processes to facilitate adoption.

Interoperability

The interoperability of software across the BE processes was also a key element that informed utilisation of tools. The lack of integration between different software was identified as a challenge and some respondents suggested that different software should be integrated to improve collaboration and efficiency. One key lesson for comparing BIM adoption across different countries is that there is no one-size-fits-all approach. BIM adoption needs to be tailored to specific needs and challenges of the local context. Another important consideration is the role of public-private partnerships in driving BIM adoption. In many countries, public sector agencies have taken a lead role in promoting BIM.

Recommendations

The BE in South Africa is poised for transformational changes as BIM technology and applications become increasingly prevalent. however, there is a need for a coordinated and strategic approach to promote BIM adoption. Key action areas:

- Establish a national BIM task force and a centre of excellence
- Develop BIM standards and guidelines
- Provide funding for BIM research and development
- Capacity development to upskill the workforce
- Pilot BIM projects
- BIM maturity roadmap for BE companies
- BIM affordability and incentives
- Legislation and policy change.

Conclusion

The roadmap for promoting BIM adoption in South Africa is a comprehensive and coordinated approach that aims to drive progress and competitiveness in the BE. By following the roadmap, South Africa can establish a strong foundation for BIM adoption that supports innovation, collaboration and competitiveness across the industry. It is hoped that the adoption of BIM will help to address the challenges facing the BE in South Africa and support sustainable growth in the industry.

Areas for Future Research

The government should provide funding for research and development in BIM technology and applications. This can help to drive innovation and support the development of new tools and applications that are specifically designed for the South African market.

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