

Readiness of Facilities Management Organisations for BIM Adoption in Facilities Management Functions

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Abstract

This study aimed to understand the policy challenges stakeholders face in implementing sustainable construction practices in the Nigerian construction industry. The research aim was achieved through the literature review and semi-structured interviews conducted among eleven built environment professionals in both Lagos and Abuja cities. Thematic analysis was conducted using NVivo 14, resulting in seven themes. The findings reveal a need for improved regulatory policies to support sustainable construction with strict implementation. Adequate awareness of this policy is stressed before its enforcement. Results also suggest that to achieve the maximum result in the application, the government, policymakers, and professionals should effectively synergise on innovation and improved policy adaptation mechanisms for the industry. The study is of value to researchers within the built environment, as it provides insights into the policy formation and implementation challenges faced by the Nigerian construction industry, particularly in relation to sustainable construction practices.

Keywords: Policy implementation, professionals, stakeholders, sustainable construction.

1. Introduction

The adoption of Building Information Modelling (BIM) in facility management (FM) offers significant benefits, including enhanced asset management, energy efficiency, and optimised spatial planning (Naghshbandi, 2016). However, its application in FM remains underutilised, particularly in South Africa, where Facilities Management Organisations (FMOs) face challenges such as technological, financial, and capacity constraints. This reluctance hinders BIM adoption, which is crucial for improving FM operations. The concept of 'readiness' refers to an organisation's preparedness to embrace BIM technology, focusing not only on technical proficiency but also on attitudes toward digital transformation. While research on BIM has mainly focused on the design and construction phases, less attention has been given to its role in the post-construction phase, particularly FM, which is the most cost-intensive stage of a building's lifecycle. Despite various frameworks to assess organisational readiness for BIM adoption, including those by Deloitte (2017) and Haron (2013), there is limited research on BIM readiness in South African FMOs. This study aims to evaluate the technological readiness of FMOs in South Africa and propose a framework to facilitate the adoption of BIM, addressing barriers and offering practical strategies for integration. Using the Technology Readiness Index (TRI) framework, this research seeks to contribute to the understanding of BIM adoption readiness in the South African context, enabling FMOs to leverage BIM for enhanced efficiency and sustainability.

2. Literature Review

The TRI, developed by Parasuraman and Colby (2014), provides a structured framework for evaluating the preparedness of organisations and individuals to adopt new technologies. The TRI, comprising Optimism, Innovativeness, Discomfort, and Insecurity dimensions, has been widely applied across industries to analyse digital transformation (Allen Consulting Group, 2010). In the context of FMOs, technological advancements such as Building Information Modelling (BIM) are redefining operational efficiencies, asset management, and lifecycle planning. BIM enhances building performance by integrating real-time data to support predictive maintenance, energy efficiency, and space optimisation (Eastman et al., 2011). Despite these advantages, BIM adoption in FMOs, particularly in South Africa, has been inconsistent due to several readiness challenges (Calitz & Wium, 2022). A primary impediment to BIM adoption in FMOs is resistance to change, closely linked to the Discomfort and Insecurity dimensions of the TRI. Organisations exhibiting high levels of discomfort towards digital tools often perceive them as complex and challenging to implement, which discourages investment in necessary training and infrastructure (Durdyev et al., 2021). Additionally, concerns regarding data security and a lack of trust in digital platforms further hinder adoption (Dixit et al., 2019). Similar challenges are observed in Nigeria, where organisations face significant hurdles related to perceived complexity and high initial costs (Abubakar et al., 2014).

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Despite these barriers, some FMOs have successfully implemented BIM, highlighting the role of the Optimism and Innovativeness dimensions of the TRI in fostering a positive attitude toward technology (Lin, Shih & Sher, 2007). Research indicates that proactive investment in training and digital infrastructure significantly enhances BIM adoption (Atkinson et al., 2014). Research suggests that organisational readiness for BIM adoption extends beyond technical capacity, encompassing cultural and strategic dimensions (Haron, 2013). Organisations with proactive digital strategies are better positioned to overcome barriers related to cost, training, and interoperability (Atkinson et al., 2014). However, studies indicate that the absence of government enforcement and industry-wide standards significantly contributes to slow adoption rates (Alshawi, 2007). In South Africa, BIM adoption is further hampered by skills shortages and fragmented

Currently, industry-wide collaboration in BIM adoption within the South African FM sector remains limited, impeding the full realisation of BIM's potential. Integration with other digital tools, such as Geographic Information Systems (GIS) and the Internet of Things (IoT), is still in its early stages, with fragmented implementation across organisations. This lack of seamless data exchange and interoperability presents significant barriers.

Additionally, leadership and change management approaches vary considerably, with many organisations lacking structured strategies to address resistance and drive innovation. Consequently, cultural transformations necessary for a fully digital FM environment are progressing at an uneven pace. Table 1 summarises the key technology readiness dimensions influencing BIM adoption, categorised according to the

Table 1: Key psychological factors influencing BIM adoption

Category	Description	Implications for BIM Adoption	Source
Optimism	The belief that technology enhances control, efficiency, and flexibility in personal and professional life.	Encourages a positive attitude towards adopting BIM tools	(Parasuraman and Colby, 2014); (Syamfithriani et al., 2021).
Innovativeness	Tendency to be forward-thinking and willing to embrace new technologies.	Fosters an environment conducive to the integration of BIM	(Parasuraman and Colby, 2014); (Syamfithriani et al., 2021).
Discomfort	Feelings of being overwhelmed by technology and a lack of control over it.	Acts as a barrier to the acceptance and use of BIM systems.	(Parasuraman and Colby, 2014); (Syamfithriani et al., 2021).
Insecurity	Mistrust in technology and its capabilities.	Contributes to the reluctance to adopt BIM and related technologies	(Parasuraman and Colby, 2014); (Syamfithriani et al., 2021).

(Source: Syamfithriani et al., 2021)

industry practices, resulting in inconsistent implementation across FMOs (Adebawale, 2018). A study by Charef, Alaka, and Emmitt (2018) underscores the significance of an organisation's digital ecosystem maturity in determining its readiness for BIM. Organisations with integrated digital workflows are better equipped to leverage BIM for improved decision-making and long-term asset management. However, the lack of standardised BIM protocols and inconsistent regulatory frameworks exacerbates challenges to widespread adoption (Genesis Analytics et al., 2020).

Another critical factor influencing BIM adoption in FMOs is the perceived return on investment (ROI). Agha-Hossein et al. (2013) argue that organisations hesitant to implement BIM often cite high initial costs and uncertainty regarding tangible benefits as primary concerns. Although BIM has the potential to improve cost efficiency and operational effectiveness, many FMOs struggle to justify the short-term financial outlay required for software acquisition, training, and workflow adjustments (Abubakar et al., 2014).

TRI framework. While Optimism and Innovativeness facilitate adoption, Discomfort and Insecurity present substantial barriers. Findings from FMOs in Nigeria suggest that high initial costs and complexity hinder the adoption of these initiatives. In contrast, proactive training and a digital strategy enhance adoption, offering valuable insights for the South African context.

3. Research Methodology

This study adopts a quantitative research approach to generate numerical data that can be analysed. A quantitative approach is appropriate because it enables the objective measurement of technology readiness characteristics across different FMOs (Creswell, 2014). Unlike qualitative methods, which explore subjective experiences in depth, the quantitative approach ensures a structured and replicable assessment of BIM readiness, making it well-suited for identifying generalisable patterns within the industry (Bloomfield & Fisger, 2019). A structured, closed-ended survey

questionnaire was chosen as the primary research strategy to gather participants' perspectives on the readiness of FMOs to adopt BIM for maintenance functions. The structured nature of the questionnaire ensures consistency in responses and enables efficient data analysis. Alternative methods, such as interviews, were considered but deemed less practical due to time constraints and the need for a large dataset. The questionnaire utilised a five-point Likert scale, where respondents rated their level of agreement with statements regarding technology readiness characteristics related to BIM.

The scale consisted of 1 – Strongly Disagree (SD), 2 – Disagree (D), 3 – Neutral (N), 4 – Agree (A), and 5 – Strongly Agree (SA). The key dimensions assessed included Optimism, Innovativeness, Discomfort, and Insecurity, as defined by the TRI framework. The target population for this study consisted of 209 registered members of the South African Facilities Management Association. A non-probability sampling technique, specifically convenience sampling, was employed due to accessibility constraints and the voluntary nature of participation. While convenience sampling may introduce selection bias, it was deemed suitable for obtaining insights from a diverse set of industry professionals. The survey was distributed to 150 respondents across 64 organisations. A total of 51 fully completed questionnaires were returned, yielding a 34% response rate. The 34% response rate could be attributed to challenges associated with online surveys, including potential survey fatigue and the time commitment required from a specific professional target group. Data collection was conducted via an online survey administered through Google Forms to enhance accessibility and streamline the response process. Statistical analysis was performed using SPSS version 28, a widely used software for quantitative research in the built environment. Descriptive statistics, specifically mean scores (MSs) and Standard Deviations (SDs), were used to interpret the data. The MSs of constructs were employed to rank the factors influencing BIM readiness, providing a clear indication of which dimensions had the most significant impact. To ensure instrument validity, a pilot study was conducted with three industry experts, who reviewed the survey for relevance, clarity, and alignment with BIM readiness factors. Their feedback led to minor refinements in wording to enhance comprehension. Reliability was reinforced by grounding the survey in established literature and industry standards. The methodological choices in this study ensure a systematic and objective assessment of BIM readiness among FMOs in South Africa.

4. Findings and Discussion

Table 2 presents the demographic characteristics of the respondents, offering insights into the workforce composition and BIM adoption trends within the South

African construction industry. The majority of respondents (37%) are aged between 31 and 40 years, followed by 25% in the 25–30 age group and 20% in the 41–45 category. The least represented groups include those over 51 years (12%) and those under 25 years (6%). This distribution suggests that individuals aged 25–40, who collectively constitute 62% of the sample, are the most actively engaged in the industry. When including those aged 41–45, this figure rises to 82%, indicating a strong presence of mid-career professionals.

The limited representation of respondents under 25 may reflect the time required to gain industry experience, aligning with prior studies that highlight challenges faced by younger professionals in establishing themselves within the construction sector (Adebowale, 2018). Conversely, the lower participation of individuals over 51 could be attributed to reduced engagement with emerging technologies such as BIM (Alshawi, 2007). Regarding industry experience, respondents with 0–5 years form the largest group (37%), followed by those with 6–10 years (27%) and 11–15 years (20%). The least represented are individuals with 16–20 years (12%) and over 21 years (4%). This indicates that 84% of respondents have between 0 and 15 years of industry experience, further reinforcing the dominance of early- to mid-career professionals in the sample. Previous research has suggested that professionals with fewer years of experience tend to be more open to digital transformation initiatives, including BIM adoption (Charef, Alaka & Emmitt, 2018). In terms of BIM adoption, 76% of respondents reported that their organisations would require 1–5 years for

Table 2: Demographic characteristics of respondents

Characteristic	Category	Percentage (%)
Age Group	Under 25	6
	25–30	25
	31–40	37
	41–45	20
	Over 51	12
Experience (Years)	0–5	37
	6–10	27
	11–15	20
	16–20	12
	Over 21	4
BIM Adoption Timeframe (Years)	1–5	76
	6–10	6
	BIM Already in Use	6

implementation, while 6% estimated a timeframe of 6–10 years. An additional 6% indicated that BIM is already in use within their organisations. These findings suggest that 88% of respondents anticipate a 1–10-year period for BIM adoption, reflecting a slow transition within the facilities management and construction sectors in South Africa. The low proportion (12%) of organisations that have already implemented BIM is consistent with previous studies that highlight challenges such as cost and a lack of technical expertise. Expertise and resistance to change are identified as barriers to BIM adoption (Durdyev et al., 2021; Calitz & Wium, 2022). The gradual pace of adoption underscores the need for strategic interventions to facilitate a smoother digital transition, including targeted training and policy support (Atkinson, Amoako-Attah & B-Jahromi, 2014).

4.1 Readiness of organisations to adopt BIM

The TRI model, based on Parasuraman and Colby (2014), was used to assess the readiness of FMOs to adopt BIM (see Table 1). The TRI value was determined using four factors: Optimism (OPT), Innovativeness (INN), Discomfort (DIS), and Insecurity (INS), each weighted at 25% (Syamfithriani et al., 2021). Each factor's weight was distributed equally across its respective equations:

$$\text{OPT} = 25\% \div 4 = 6.25\%$$

$$\text{INN} = 25\% \div 4 = 6.25\%$$

$$\text{DIS} = 25\% \div 4 = 6.25\%$$

$$\text{INS} = 25\% \div 4 = 6.25\%$$

Table 3 (see Appendix 1) presents the TRI values for each statement. The weight of each section (6.25%) was multiplied by the average score of the corresponding questions. The average score was obtained by dividing the total score by the number of respondents (Table 4). The total scores for each category in Table 4 were obtained by summing the values of their respective statements. For Optimism, the four statements yield: OPT 1 (0.25) + OPT 2 (0.25) + OPT 3 (0.25) + OPT 4 (0.23), resulting in a TRI value of 0.98. For Innovativeness, the calculation is INN 1 (0.21) + INN 2 (0.20) + INN 3 (0.22) + INN 4 (0.20), totalling 0.83. Discomfort is derived from DIS 1 (0.16) + DIS 2 (0.17) + DIS 3 (0.16) + DIS 4 (0.17), amounting to 0.66. Insecurity is calculated as INS 1 (0.17) + INS 2 (0.14) + INS 3 (0.14) + INS 4 (0.25), equalling 0.70 (Table 3).

4.2 Total TRI per category

The results in Table 4 show that Optimism holds the highest value (0.98), indicating that FMOs are confident in their readiness to adopt BIM for facilities management. This aligns with Osunsanmi et al. (2018), who reported a high readiness level for a virtual reality tool in South Africa. Innovativeness scores 0.83,

Table 4: TRI Values by category

Variable	TRI Value (Sum of categories)	Rank
Optimism	0.98	1
Innovativeness	0.83	2
Insecurity	0.70	3
Discomfort	0.66	4
Total TRI Score	3.15	

Authors' field data (2024)

indicating receptiveness to new technologies. However, Insecurity and Discomfort scored lower at 0.66 and 0.70, respectively. The results highlight that these are barriers to adopting innovative technologies. Despite these challenges, the higher Optimism and Innovativeness scores indicate a generally positive attitude toward technological advancements. The cumulative TRI value of 3.15 (Table 4), based on the thresholds established by Syamfithriani et al. (2021) in Table 5, reflects a medium level of readiness for BIM adoption in FM functions within South Africa.

insecurity. Strategic policy development and technological investment are necessary to create an enabling environment for BIM adoption.

Additionally, strong leadership commitment can drive digital transformation, while phased implementation allows FMOs to build confidence and capability gradually. Finally, fostering collaboration and knowledge sharing among the FMO industry through workshops, professional networks, digital platforms, and academic-industry partnerships can facilitate best

Table 5: Technology readiness thresholds

Level of technology readiness	TRI Value
Low Technology Readiness Index	If the TRI value ≤ 2.89
Medium Technology Readiness Index	If the TRI value is between 2.90 and 3.51
High Technology Readiness Index	If the TRI value >3.51

(Syamfithriani et al.,2021)

5. Conclusion and Further Research

This study investigated the technological readiness of FMOs in South Africa to adopt BIM for their operations, utilising the TRI framework. The findings reveal a complex picture: while FMOs demonstrate significant Optimism and Innovativeness regarding BIM, indicating a positive attitude towards technological advancement, they also experience considerable discomfort and insecurity, suggesting apprehensions about implementation challenges and potential skill gaps. The resulting medium overall TRI score of 3.15 underscores this mixed readiness. This suggests that while FMOs recognise the potential benefits of BIM, they are not yet fully prepared to integrate it effectively into their workflows.

The high scores for Optimism and Innovativeness provide a strong foundation upon which to build. However, the identified discomfort and insecurity must be addressed to unlock the full potential of BIM in FM. These findings have significant implications for FMOs and policymakers in South Africa. The findings suggest that targeted interventions, such as training programs focused on BIM implementation and management, along with clear demonstrations of BIM's practical benefits, are essential for mitigating discomfort and

practices and accelerate BIM readiness. This study contributes to the limited body of knowledge on BIM readiness in the South African FM sector by providing empirical evidence of key drivers and barriers.

Future research could further explore these findings. Qualitative studies, involving interviews and case studies, could provide richer insights into the specific challenges faced by FMOs and the strategies they employ to overcome them. Longitudinal research tracking the progress of FMOs as they implement BIM would be valuable in understanding the long-term impact of readiness factors. While inferential statistics were not the primary focus, future research could expand on this study by incorporating regression analysis or hypothesis testing to examine causal relationships. No formal reliability test (e.g., Cronbach's alpha) was conducted in this study; therefore, future research could validate the instrument's internal consistency.

Finally, comparative studies with other developing economies could offer valuable lessons and best practices for promoting BIM adoption in the South African context.

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Appendix 1

Table 3: TRI values per item

TRI Values
Optimism
BIM contributes to a better quality of life. $OPT\ 1 = \frac{202}{51} \times 6.25\% = 0.25$
BIM has the potential to give me more freedom of mobility $OPT\ 2 = \frac{204}{51} \times 6.25\% = 0.25$
BIM gives people more control over their daily lives $OPT\ 3 = \frac{202}{51} \times 6.25\% = 0.25$
BIM technology makes me more productive in my personal life $OPT\ 4 = \frac{186}{51} \times 6.25\% = 0.23$
Innovativeness
Other people come to me for advice on new technologies such as BIM. $INN\ 1 = \frac{171}{51} \times 6.25\% = 0.21$
In general, I was among the first in my circle of friends to acquire BIM technology when it was available. $INN\ 2 = \frac{164}{51} \times 6.25\% = 0.20$
I can usually figure out new high-tech BIM products and services without help from others. $INN\ 3 = \frac{177}{51} \times 6.25\% = 0.22$
I keep up with the latest technological developments in the field of BIM. $INN\ 4 = \frac{186}{51} \times 6.25\% = 0.20$
Discomfort
When I get technical support from a provider of a high-tech product such as BIM, I sometimes feel as if I am being taken advantage of by someone who knows more than I do. $DIS\ 1 = \frac{127}{51} \times 6.25\% = 0.16$
Technical support lines for BIM are not helpful because they explain things using excessive jargon and technical terminology. $DIS\ 2 = \frac{138}{51} \times 6.25\% = 0.17$
Sometimes, I think that technology systems are not designed for use by ordinary people. $DIS\ 3 = \frac{130}{51} \times 6.25\% = 0.16$
There is no such thing as a manual for a high-tech product or service that's written in plain language. $DIS\ 4 = \frac{140}{51} \times 6.25\% = 0.17$
Insecurity
People are too dependent on technology, such as BIM, to do things for them. $INS\ 1 = \frac{136}{51} \times 6.25\% = 0.17$
Too much BIM technology distracts people to a point that is harmful. $INS\ 2 = \frac{112}{51} \times 6.25\% = 0.14$
BIM lowers the quality of relationships by reducing personal interaction. $INS\ 3 = \frac{118}{51} \times 6.25\% = 0.14$

Whenever a technology gets automated, e.g. BIM, you need to check carefully that the system is not making mistakes.

$$INS\ 4 = \frac{200}{51} \times 6.25\% = 0.25$$

Authors' field data (2024)