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# Strategies to Improve BIM Usage Among Professionals in the Construction Industry

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## ABSTRACT

BIM is an emerging technology in the construction sector used by construction professionals for the collaborative process of using a computer-generated model that manages information for the entire construction project lifecycle. This study assesses strategies to improve BIM usage among professionals in the construction industry. Structured questionnaires were distributed through random sampling techniques to 70 construction professionals within Gauteng province in South Africa to collect data on factors affecting BIM usage among professionals in the construction industry. Data collected through the questionnaire were computed using a descriptive statistical approach. Using a statistical data equation, a valid mean item score was determined in the study. The result of the study indicated that providing continuous training, BIM skills development programmes, Education of construction personnel, effective implementation of acquired BIM skills and embracing BIM requirements in construction activities were the highest-ranked strategies to improve BIM usage among professionals in the construction industry. The study concluded that professionals in the construction industry should consider attending local and international workshops on BIM to better understand new areas in its applications for construction activities.

**Keywords:** Building information modelling, Construction, Construction professional, South Africa

## INTRODUCTION

The construction industry is dynamic, unique, and complex (Ogunbayo et al., 2022). The efficient output of the construction industry requires proper planning and management throughout the entire project lifecycle (Moreno et al.). With the high competition and increasing demand, professionals must consider developing strategies to keep up with the competition and high demand (Ogunbayo et al., 2023). To this end, many technologies introduced in the current construction era make the working process much easier and deliver the best quality product (Abina et al., 2023; Gheisari & Irizarry, 2016). Firms in the construction industry in most countries saw the need to develop strategies to survive in times like this. BIM was introduced as a technological tool to mitigate the problems encountered during the project life

 

cycle in the construction industry (Gheisari & Irizarry, 2016). The study by Adekunle et al. (2024) indicated that the construction industry in developing countries was very slow in adopting and using BIM among its professionals (Adekunle et al., 2022). This makes it difficult for construction industry professionals in most developing countries to connect with other professionals in more advanced countries, especially in construction activities and processes using BIM (Akinradewo et al., 2023). In the dynamic landscape of the construction industry, the effective implementation of BIM is a pivotal factor for improved construction project outcomes (Gheisari & Irizarry, 2016; Akinradewo et al., 2023). Hence, this study delves into strategic approaches to elevating BIM usage among professionals, fostering a more widespread and proficient integration of this transformative toward improving BIM usage among construction professionals for construction processes and activities.

## LITERATURE REVIEW

Building information modelling (BIM) over the years has strongly impacted the construction industry as one of the technologies tools used by the industry (Boton et al., 2018). Construction professionals in the industry use BIM for 3D visualisation, constructability review, clash detection, feasibility analysis, quantity take-off and cost estimate, 4D/scheduling, environmental/LEED analysis, creating shop drawings, and facility management (Gheisari & Irizarry, 2016; Kim et al., 2016). The use of BIM has the potential to improve construction efficiency (Kim et al., 2016). BIM usage can improve construction process efficiency, enhance knowledge sharing and collaboration among construction professionals and support construction-related tasks (Eastman et al., 2011). Cefrio (2019) posits that to ensure accuracy and reliability, using BIM throughout a project reduces risks by promoting efficiency, minimising errors among relevant construction professionals and contractors, and requiring collaboration and knowledge sharing among all parties. However, improving BIM usage among construction professionals is vital for maximising the benefits of innovative technology in the construction industry (Moreno et al., 2019). In the construction industry, improving BIM usage among construction professionals and other stakeholders requires combining different strategic projections (Sun et al., 2017). These strategies aim to enhance skills, overcome difficulties, and nurture a culture of efficient BIM usage and implementation in the construction industry (Moreno et al., 2019; Adekunle et al., 2023). According to Wortmann, Root and Venkatachalam (2016), the low maturity and use of BIM among professionals in the developing countries' construction industry are mainly because of a lack of push and support from the professional registration councils and a lack of support from the government. There is also a lack of understanding of BIM among construction industry professionals (Wortmann et al., 2016). Hence, strategies should be implemented to overcome this low level of BIM usage among construction industry professionals. Odubiyi, Aigbavboa, Thwala, and Netshidane (2019) posit that encouraging stakeholder collaboration is a strategy that can be used to improve the low maturity of BIM usage in the

construction industry. These strategies include providing a clear understanding of BIM application. Ahn, Kwak and Suk (2016) state that professionals need proper training to appreciate BIM usage and application. Pikas, Sacks and Hazzan (2013) argued that it is important to provide an extensive skill development programme to avoid misuse and potential errors while adopting BIM. Bryde, Broquetas and Volm (2013) further stated that personnel in the construction industry should be educated on the BIM application for construction activities and processes. Odubuyi et al. (2019) noted that strategies that can be used to improve BIM usage among professionals in the construction industry include encouraging integration of BIM project delivery and commitment through investment in BIM. Azhar, Khalfan, and Maqsood (2012) assert that awareness through professional workshops and implementation of acquired BIM skills by professionals in the construction industry are strategies that can help improve BIM usage for construction activities. Improving the interoperability of construction activities among stakeholders in the construction industry is an effective strategy for BIM adoption (Love et al., 2013). Miettinen and Paavola (2014) indicate that a clear understanding of BIM application and commitment through investment in BIM software and application are strategies to improve its usage in construction activities. The study of Khosrowshahi and Arayici (2012) indicated that embracing the BIM requirements and collaboration among stakeholders in the construction industry's public and private sectors are strategies to improve BIM usage within the industry. The study of Ahamed Mohideen, Ramchandran and Narasimmalu (2011) established that BIM software standardisation for construction activities should be improved, especially in developing countries. Douglas, Arensmanand Ozbek (2012) postulated that encouraging the integration of BIM project delivery Hence, in achieving this toward improving BIM usage within the construction industry, national government and policymakers should enact relevant laws or policies for its adoption for construction activities and processes (Moreno et al., 2019; Ogunbayo et al., 2022). Toward this end, the strategies to improve BIM usage among professionals in the construction industry need to be identified toward its effective adoption and success rate for construction activities (Adekunle et al., 2022). Additionally, it is critical to identify these strategies as they can help improve construction preparation, procedure and operations (Moreno et al., 2019; Won et al., 2013). This study aims to affirm these strategies as they can help improve the adoption of BIM among construction professionals in developing countries' construction industry.

## METHODOLOGY

This study was carried out within Gauteng province among construction professionals working on construction projects within the South African construction industry. The respondents were construction professionals, specifically from construction industries within Gauteng, South Africa. Respondents for this study were selected based on their involvement and experience with BIM usage for construction activities. The province was chosen for this study because of the many ongoing BIM-aided construction projects in

Gauteng province. Through the system random sampling method, 100 questionnaires were administered to the respondents, and 70 were retrieved. This study used the systematic random sampling method because it is more direct and eliminates the opportunity of clustering when used than cluster sampling, which breaks the population into diverse clusters and takes a simple random sample from each cluster (Rea & Parker, 2014) and covers all the elements evenly (Ogunbayo et al., 2023). Using Strongly Disagreeing = 1, Disagreeing = 2, Neutral = 3, Agreeing = 4, and Strongly Agree = 5, the questionnaire was designed on a 5-point Likert scale and recorded a 70% response rate. SPPS software was used to analyse the data for this study. The SPSS software generated the mean item score, the standard deviation, Cronbach's alpha, and the ranks from the Excel spreadsheet obtained from the Google form with a total of 70 respondents (Pallant, 2020). Before analysing the data collected, the data collected were screened and cleaned to identify errors and, if possible, correct them. The respondents were asked questions about their highest qualifications, profession, and years of experience in the construction industry. Through the questionnaire, respondents were further asked about fourteen strategies to improve BIM usage among professionals in the construction industry identified from the literature. The study conducted descriptive analysis, including percentage, frequency, mean item score, and standard deviation. This was conducted to examine the outcomes of the Likert inquiries about this research questionnaire. After computation, the strategies to improve BIM usage identified were sorted from the highest to lowest. The computation was based on the weighted responses from the survey participants for each question. It was also aligned with the scores chosen by the respondents that were deemed collectively as the analytically agreed indicators of comparative significance. This helped this study assess the strategies to improve BIM usage among professionals in the construction industry. Similarly, Cronbach's Coefficient Alpha determines the consistency, which then determines the reliability of the measuring instrument. The coefficient is most effective when the Likert scale is used, and in this study, the Likert scale is used to get responses from the relevant respondents. The Cronbach's coefficient ranges from 0 to 1, and a Cronbach's Alpha score closer to 1.00 is acceptable. Hence, a Cronbach's value of 0.968 obtained in this study is suitable.

## RESULTS

The demographic information of the seventy (70) respondents who participated in the study whose demographic profile is reported in Table 1. Summary analysis reveals that 17.14% (12) of the respondents have Master's degrees as their highest qualification, 34.29% (24) have Bachelor's degrees, 27.14% (19) have honour's degrees while 21.43% (15) have national diplomas as their highest qualifications. Moreover, the findings reveal that 30% (21%) of the respondents were quantity surveyors as their profession, 12.86% (9) were architectures, 21.43% (15) were construction managers, 17.14% (6) were construction project managers, 8.57% (6) were contractors

and 10% (7) were engineers (civil mechanical and electrical) as their profession in the construction industry. Further, the findings show that 21.43% (15) had 0–5 years of experience in the construction industry, 40% (28) had 6–10 years of experience in the construction industry, 22.86% (16) had 11–15 years of experience in the construction industry, while 15.71% (11) had 16-over 20 years in the construction industry.

**Table 1.** Respodent's demographic information.

| Respondents' demographic information | Frequency ($n = 70$) | Percentage (%) |
|---|---|---|
| **Highest qualifications** | | |
| Bachelor's degree | 24 | 34.29 |
| Honour's degree | 19 | 27.14 |
| Master's degree | 12 | 17.14 |
| National Diploma | 15 | 21.43 |
| **Total** | **70** | **100** |
| **Profession in the construction industry** | | |
| Architecture | 9 | 12.86 |
| Contractor | 6 | 8.57 |
| Construction Manager | 15 | 21.43 |
| Construction Project Manager | 12 | 17.14 |
| Engineers (Civil, mechanical, electrical) | 7 | 10.00 |
| Quantity Surveyor | 21 | 30.00 |
| **Total** | **70** | **100** |
| **Years of experience in the construction industry** | | |
| 0 - 5 Years | 15 | 21.43 |
| 6 -10 Years | 28 | 40.00 |
| 11- 15 Years | 16 | 22.86 |
| 16 – over 20 years | 11 | 15.71 |
| **Total** | **70** | **100** |

Table 2 below illustrates the respondents' ranking of strategies to improve BIM among professionals in the construction industry. The outcomes indicated the top and low-ranked strategies to improve BIM among professionals in the construction industry. The variable that was ranked first was 'continuous training' with a mean item score of 4.34 and SD of 0.946; 'Skills development programmes' was ranked second with a mean item score of 4.33 and SD of 0.912; 'education of construction personnel' was ranked third with a mean score of 4.27 and SD of 0.947; 'implementation of acquired BIM skills', was ranked fourth with a mean score of 4.24 and SD of 0.842; 'embrace BIM requirements' was ranked fifth with a mean score of 4.23 and SD of 0.966; 'awareness through professional workshops' was ranked sixth with a mean score of 4.20 and SD of 0.957. Table 2 further reveals that 'collaboration between public and private sector was ranked seventh with a means score of 4.19 and SD of 0.906, 'commitment through investment in BIM ranked eighth with a mean score of 4.19 and SD of 0.92, 'encouraging stakeholders' collaboration' was ranked ninth with a mean score of 4.19 and SD of 0.997, 'improve the interoperability was ranked tenth with a mean score of 4.14 and SD of 0.997, 'provide clear understanding of the procurement process using BIM' was ranked eleventh with a mean score of 4.14 and

SD of 1.011; 'improve on BIM software standardisation' was ranked twelfth with a mean score of 4.13 and SD of 0.977, 'encourage the integration of BIM project delivery' was ranked thirteenth with a mean score of 4.09 and SD of 0.989; and 'enactment of relevant laws/policies' was ranked fourteenth with a mean score of 4.04 and SD of 1.122.

**Table 2.** Ranking of strategies to improve BIM among professionals in the construction industry.

| Strategies to Improve BIM Usage | MIS | SD | R |
|---|---|---|---|
| Continuous training | 4.34 | 0.946 | 1 |
| Skills development programmes | 4.33 | 0.912 | 2 |
| Education of construction personnel | 4.27 | 0.947 | 3 |
| Implementation of acquired BIM skills | 4.24 | 0.842 | 4 |
| Embrace BIM requirements in construction activities | 4.23 | 0.966 | 5 |
| Awareness through professional workshops | 4.20 | 0.957 | 6 |
| Collaboration between the public and private sector | 4.19 | 0.906 | 7 |
| Commitment through investment in BIM | 4.19 | 0.921 | 8 |
| Encouraging stakeholders' collaboration | 4.19 | 0.997 | 9 |
| Improve the interoperability | 4.14 | 0.997 | 10 |
| A clear understanding of the BIM application | 4.14 | 1.011 | 11 |
| Improve BIM software standardisation | 4.13 | 0.977 | 12 |
| Encourage integration of BIM project delivery | 4.09 | 0.989 | 13 |
| Enactment of relevant laws/policies | 4.04 | 1.122 | 14 |

## DISCUSSION OF FINDINGS

The study assessed strategies to improve BIM usage among professionals in the construction industry. The result of the study indicated that continuous training, BIM skills development programmes, Education of construction personnel, implementation of acquired BIM skills and embracing BIM requirements in construction activities were the highest-ranked (1st–5th) strategies to improve BIM among professionals in the construction industry. The findings align with Odubiyi et al. (2019) and Ahn et al. (2016) that continuous training, skill development and educating construction personnel on using and applying BIM for construction activities were strategies to improve BIM usage among professionals in the construction industry. The findings are similar to Pikas et al. (2013) and Bryde et al. (2013) study findings that implementing and embracing BIM requirements through acquired BIM skills and on-job training during construction operations and processes were strategies to improve BIM usage among professionals in the construction industry. The findings imply that strategies such as continuous construction personnel training and on-the-job training on the use and application, which can trigger personnel skill development, will help improve BIM usage in construction industry activities.

The findings also indicated that awareness through professional workshops, collaboration between public and private sectors, commitment through investment in BIM, encouraging stakeholders' collaboration, and

improving the interoperability and clear understanding of BIM application were mediumly ranked (6th–11th) strategies to improve BIM among professionals in the construction industry. The study asserts Odubuyi et al. (2019) and Azhar et al. (2012) that professional workshops on BIM application for construction activities, constant continuous stakeholder collaboration, especially between public and private construction organisations with a clear theme on BIM usage and application on construction activities were strategies to improve BIM usage among professionals in the construction industry. The study also aligns with Love et al. (2013) and Miettinen and Paavola (2014) that stakeholder collaborations, together with improving the interoperability of the BIM for construction activities with a clear understanding of the usage and application were strategies to improve BIM among professionals in the construction industry. The study findings imply that strategies such as collaboration among stakeholders will expose construction professionals to the appropriate usage of BIM information for construction activities with clear procedures for its application for construction operations.

Further, the findings revealed that improving BIM software standardisation, encouraging the integration of BIM project delivery, and enacting relevant laws/policies were the least ranked (12th–14th) strategies to improve BIM among professionals in the construction industry. The findings support Ahamed et al. (2011) and Douglas et al. (2012) that the standardisation of the BIM software and its integration with construction projects were strategies to improve BIM among professionals in the construction industry. Also, the findings affirm Moreno et al. (2019) and Ogunbayo et al. (2022) that enacting relevant laws and policies for BIM usage and application in construction work by the national government and policymakers on construction activities were strategies to improve BIM among professionals in the construction industry. This finding implies that policies enacted by relevant government agencies should support the standardisation of BIM software and its integration into construction activities. This will help enhance the entire lifecycle of construction activities, from planning and design to construction and facility management.

## CONCLUSION

The study assessed the strategies to improve BIM usage among professionals in the construction industry. It identified continuous training, skills development programmes, education of construction personnel, implementation of acquired skills, and embracing BIM requirements in construction activities as major strategies to improve BIM usage among professionals in the construction industry. The study established that these strategies would help improve BIM usage among construction professionals for construction activities within the industry. The study emphasised that continuous training of stakeholders by relevant agencies and construction organisations will increase the usage of BIM for procedures and processes, lead to economic gains, and reduce production time. It established that skill development on BIM usage and its applications for construction activity's purpose would help guide construction stakeholders toward smart construction. The study

indicated that apart from personal training, there is a need to inculcate education on BIM in the academic curriculum of construction education to expose future construction personnel to its usage, application, and advantages. The study further asserted that BIM as the foundation of digital transformation in the architecture, engineering, and construction industry, when implemented through acquired skills and stakeholders embracing BIM requirements and guidelines, will help achieve effective construction operations, processes, and outputs. The use of BIM for construction activities will continue to expose construction professionals to items in construction activities that require details and attention at every stage of construction work. The study suggested that to improve the usage of BIM among professionals within the construction industry, the government and policymakers on construction activities need to develop a strategy to encourage the use of digital technologies such as BIM for construction operations and processes. Also, subjects on digital technologies should be included in the academic programme to expose construction students to digital construction, such as BIM. Construction professionals should also endeavour to use BIM for construction activities in the design and production. The study concluded that government and construction professionals should enforce BIM usage and application at the tender stage of construction projects. Professionals in the construction industry should also consider attending local and international workshops on BIM to understand new areas of its application for construction activities. Also, required training and re-training should be provided to stakeholders toward integrating construction projects with BIM, aiming to leverage digital technology for improving efficiency, collaboration, efficiency, and decision-making among stakeholders throughout the entire lifecycle of a construction project.

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