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BIM implementation model from the standpoint of concern-based adoption theory

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Abstract

Purpose – This study investigated the concerns and plans of construction professionals about building information modeling (BIM) implementation, found the acceptable BIM implementation driving forces and strategies for them and developed a prescriptive BIM implementation model to help understand how BIM implementation concerns, intentions, driving forces and strategies are connected.

Design/methodology/approach – This study employs a positivist paradigm with a hypothetico-deductive research strategy as well as concern-based adoption theory as a conceptual lens to distinguish construction professionals (CPs)' BIM implementation concerns and intentions. This implies that the forces driving BIM implementation intentions and concerns are related to BIM implementation methods and that their concentrations are proportional to the intensity of BIM implementation strategies. A 16-item questionnaire tailored to the operations of CPs was used for data collection. The data collected from respondents were utilized to evaluate the proposed model using structural equation modeling (SEM) techniques.

Findings – Findings from the data collected from the respondents revealed that CPs are concerned about the impact of BIM deployment on their time and service quality. Their main purpose was to take drives to learn more about BIM in order to pique their curiosity. Embracing the latest digital technology and beginning self-initiated BIM training are two strategies that would be quite effective in boosting BIM deployment.

Research limitations/implications – The study identifies promising directions for future BIM implementation research and development. The study's findings imply that more theoretically motivated research, rather than just empirical research, is required to refine BIM implementation concerns.

Practical implications – The study has implications for the professional development of CPs as well as understanding the process of implementing BIM change. The study's findings will help to understand the resource system for assessing CPs' needs and concerns and selecting personalized BIM implementation strategies.

Originality/value – Before this study, BIM-related studies had ignored the concerns and goals of the CPs when it came to implementing BIM. Using the CPs' concerns and hopes for BIM implementation, a systemic BIM implementation model was developed that would help and speed up BIM adoption.

Keywords Building information modeling (BIM), Implementation, Strategies, Prescriptive, Model, Concern-based adoption theory, Nigeria

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1. Introduction

BIM (building information modeling) implementation is the process of making BIM a formal or acceptable way to work in the construction industry (Olugboyega and Windapo, 2019). Zomer *et al.* (2020) and Liao *et al.* (2021) maintained that the best way to get people to use BIM is to require public projects to use it. On the other hand, the use of mandatory BIM adoption for public projects is an ineffective strategy that has resulted in non-value-adding BIM (NVA-BIM) implementation experiences and practices. The ubiquity of NVA-BIM implementation practices in Singapore influenced Liao *et al.*'s (2021) analyses of factors leading to NVA-BIM implementation practices. The study discovered that non-useful design models and costly design changes are the most influential factors causing NVA-BIM implementation practices and experiences in Singapore. As per the report, construction professionals are hesitant to improve design-construction integration, consider incremental changes and underestimate the difficulty of performing value-added BIM diffusion operations.

Liao *et al.* (2021) found that the BIM implementation model used in Singapore did not take into account the concerns and intentions of construction professionals (CPs). This led to a poor understanding of BIM, more NVA-BIM implementation activities and less construction productivity. Viana and Carvalho (2021), Chan *et al.* (2022), Malik *et al.* (2021), Zomer *et al.* (2020) and Siebelink *et al.* (2021) all made similar observations. This means that CPs will need ongoing assistance if they are to fully implement BIM, and they will require different sorts of assistance as their needs evolve. Furthermore, the CPs would have distinct needs, different reservations about BIM and vastly varied needs for assistance and support on the road to BIM implementation (Liao *et al.*, 2021). Before accepting BIM implementation, CPs must understand what it entails for them and the risk it poses to their competence, comfort, control and confidence (Viana and Carvalho, 2021).

Because the CPs are at the heart of BIM implementation, these issues are valid and should be investigated in order to suggest a roadmap for BIM implementation (Viana and Carvalho, 2021). Similarly, the activities required to get the CPs to push BIM implementation into their work processes and professional growth must be identified. The truth is that until their concerns are addressed, the CPs will be resistant to BIM adoption, whether through dragging their feet or plain belligerence. The only way to reduce CPs' resistance to BIM deployment is to promote a BIM implementation model that addresses their BIM implementation concerns (Chan *et al.*, 2022). Such a model would take into account the CPs' BIM implementation concerns and aspirations, as well as correlate them with the appropriate BIM driving factors and tactics (Chan *et al.*, 2022; Liao *et al.*, 2021). This is the void that this research aims to fill. The study's motivation is to use concern-based adoption theory (CBAT) to develop a systemic BIM implementation model that promotes and accelerates BIM adoption among CPs. Thus, the goal of this study is to investigate BIM implementation concerns and intentions among construction professionals, identify the appropriate BIM implementation driving forces and strategies for them and develop a prescriptive BIM implementation model for understanding the interconnections between BIM implementation concerns, intentions, driving forces and strategies.

2. Literature review

Scholars' recommended models for fruitful BIM implementation include industry stakeholders and government BIM policies; BIM institutes; BIM implementation enforcement bodies; BIM curriculum in undergraduate built environment programs; BIM-based capacity building and cultural re-orientation; BIM seminars and workshops; and BIM-based construction management (Olarenwaju *et al.*, 2021; Aka *et al.*, 2021). The models, as convenient and energizing as they are, appear to have overlooked basic BIM implementation concerns such as BIM adequacy, BIM value, BIM viability and project qualities, BIM application and project assumptions, and the viability of BIM implementation for small and medium-sized businesses (Olugboyega *et al.*, 2021).

The proposed models also overlooked the impact of the implementation policies and programs on construction professionals' time, skills, salary, training, development and preferred methods. Failure to incorporate BIM users' concerns into the BIM implementation plan, as mentioned by Shukor *et al.* (2021), will have a detrimental influence on BIM implementation productivity and overall performance. This is due to the fact that construction professionals have varying backgrounds, expertise, drawbacks, disciplines and interests, which lead to varying worries about BIM deployment. Furthermore, BIM adoption in the construction sector and organizations implies BIM acceptability by construction experts (Shukor *et al.*, 2021). This is due to the fact that BIM processes rely on collaboration among building professionals and the standardization of their work processes (Olugboyega and Windapo, 2021).

According to Malik *et al.* (2021), without the availability of BIM professionals, organizations would be hesitant to deploy BIM. This means that BIM implementation would be a pipe dream without BIM-competent construction professionals (CPs) and their support. This is especially true in developing nations with limited resources and focused programs to promote BIM capabilities among current and future CPs. Another indication of the significance of CPs' concerns in BIM adoption is the lack of sufficient BIM competency among CPs, which has been cited as a major issue influencing BIM implementation (Shukor *et al.*, 2021). As stated by Chan *et al.* (2022), BIM adoption in the Sarawak construction industry has failed to meet the expectations of CPs across project lifecycles and stages. As per Malik *et al.* (2021), the availability of technological resources and the BIM experience are essential success factors in BIM deployment. This places CPs at the forefront of BIM implementation due to their capacity to employ BIM technology tools and participate in interdisciplinary collaborative procedures.

Siebelink *et al.* (2021) maintained that BIM implementation does not take into account the motivation, competency and time capacity of CPs at all levels of an organization. Zomer *et al.* (2020) say that BIM deployment affects CPs because of contradictions, multiple-layer activity systems, BIM development and operational costs, changes in technology and new ways of doing work. These problems have created NVA-BIM implementation activities. For example, Viana and Carvalho (2021) say that Brazil's mandatory BIM implementation policy is causing many CPs to implement BIM processes incorrectly without understanding its foundation and rules. This puts them at risk of not having enough relevant knowledge and experience, problems with interoperability and cultural resistance. As a result, it is necessary to evaluate CPs' BIM implementation concerns and objectives, as well as the proper BIM implementation driving forces and solutions for dealing with them. This would allow the development of a prescriptive BIM implementation model for comprehending the relationships between BIM implementation concerns, intentions, driving forces and strategies.

Some BIM experts (Olugboyega, 2020; Olugboyega and Windapo, 2019) have tried to understand the CPs' concerns and intentions regarding their insufficient BIM capacity. Olugboyega (2020), for example, suggested a BIM implementation model for South Africa that emphasizes BIM capacity development, BIM motivations, BIM commitments, and BIM utilization as tactics for boosting BIM adoption in South Africa. These studies have developed a theoretical understanding of the complexity of BIM implementation as well as the linked connections and critical aspects, providing the conceptual foundation for describing, exploring and comprehending BIM implementation. Similarly, these studies have provided the resources needed to solve BIM implementation challenges, recognize basic BIM implementation questions and contextual components and base BIM implementation inquiries on established knowledge.

The recommended models, on the other hand, did not take into account the concerns of construction professionals who would have to figure out BIM, look into adoption options and manage implementation procedures. Because of this, there are not a lot of theory-based models for BIM implementation that specifically address BIM implementation problems from the standpoint of the people who will implement the BIM process and use BIM software technologies. This kind of BIM implementation model is important to make sure there is a lot of variety and a good design that can lead to strategic and cost-effective BIM adoption. Furthermore, there is a lack of awareness of how BIM implementation barriers manifest themselves in CPs jobs and how BIM implementation impacts CPs services and careers. These worries are valid because BIM implementation extends well beyond promises and frameworks. The resources allocated to BIM implementation may result in economic liability for indigenous construction businesses and overburden the CPs (Olugboyega and Windapo, 2019).

3. Methods

This research employs a positivist-deductive philosophy with a hypothetico-deductive research strategy and adopts CBAT as a conceptual lens to distinguish the BIM implementation concerns and intentions of CPs. CBAT is a theory of change that can be used to plan and carry out innovations (Sultana, 2015). CBAT looks at how the person feels about the innovation (their mindset, preoccupations, thoughts and reflections), how the innovation is taught or used, how the innovation changes for the person and how it affects their performance (Sultana, 2015).The theory provides insights into people's susceptibility to change, change facilitator styles, organizational culture and role orientations and phases of concern that appear to be useful for working with change processes and bringing innovation into everyday professional practice. Individual views of the change that the innovation will bring, organisational management and change facilitators' perceptions of the change, and its implementation in organisations are all addressed by the phases of concerns in CBAT.

Scholars have used CBAT in the construction sector and other sectors to investigate the concerns of vocational educators (Saunders, 2012), innovators (2019), technology users (Robertson, 2018) and smart construction system users (Liu *et al.*, 2018). These studies concluded that CBAT provides an effective framework for better understanding the concerns of innovation stakeholders. CBAT is used in this study to differentiate between BIM implementation concerns and intentions and to support appropriate BIM implementation driving factors and tactics for meeting concerns and driving objectives. CBAT is also employed as a theoretical framework to identify the CPs' BIM implementation concerns and objectives, as well as provide insights into how these may be handled to achieve a successful BIM implementation. The CBAT was chosen because of its utility in resolving CPs' concerns regarding BIM, the specific manner in which it is given or implemented and its incorporation into the work process (Liao *et al.*, 2021). The selection of CBAT was also influenced by its capacity to accommodate the concerns and objectives of implementation stakeholders (Sultana, 2015).

Figure S1 presents the flowchart for the research methodology. Based on CBAT, this study assumes that (1) BIM deployment is a process. This shows that BIM deployment is progressing slowly; (2) construction professionals (CPs) play an important role in BIM implementation. They implicitly assume their role as BIM implementers in the construction business since they always strive to improve their professional expertise. As a result, their BIM concerns should serve as the foundation for any BIM implementation suggestions, methods or models; (3) BIM implementation is a significant personal and professional experience. It consists of tension and sensitivity, and learning new skills, practice, criticism, and conceptual shifts around "why BIM works better"; (4) BIM adoption needs progress in abilities and skills; (5) BIM implementation will be successful when the concerns of construction professionals are addressed with appropriate techniques.

Understanding individual perspectives or orientations toward organizational roles appears to be important for influencing long-term change in professional practice; and (6) BIM driving factors emerge from BIM implementation methodologies. The greater the number of strategies, the more intense the driving forces. The greater the number of strategies, the greater the degree of BIM implementation intentions and concerns. These assumptions shed light on the assertion that the forces driving BIM implementation intentions and concerns are subsidiary to BIM implementation methods, and the intensities of BIM intentions and concerns are proportional to the intensity of BIM implementation strategies. This proposition is represented in Figure 1 and captured in the hypotheses that follow.

H1. BIM implementation driving forces and methods are inextricably linked.

H2. BIM implementation intentions and concerns are inextricably linked.

H3. BIM implementation strategies intercede between BIM implementation intentions and concerns.

H4. The connection between BIM implementation intentions and concerns is strengthened by factors that drive BIM implementation.

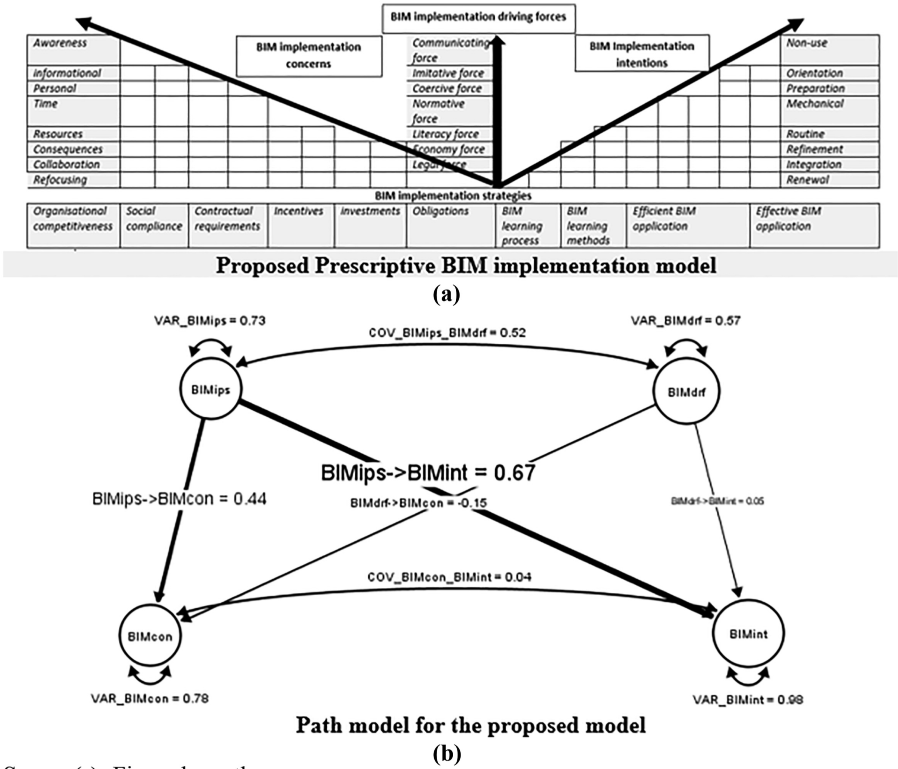

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Figure 1.
(a) Proposed prescriptive BIM implementation model, (b) path model for the proposed model

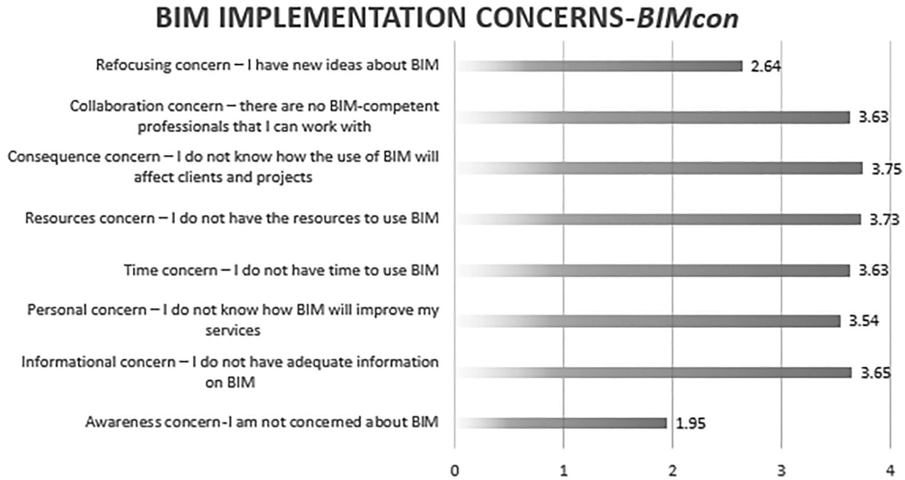
The main goal of the study is to test these predictions using a sample of CPs from Lagos State, Nigeria, who were chosen at random. CPs were considered the key BIM stakeholders in this study due to their involvement as BIM authors in the BIM process (Olugboyega and Windapo, 2021). The CPs were required to be familiar with BIM, but they were not required to have worked on a BIM-based project in order to participate in this study. Clients, subcontractors, suppliers and other construction stakeholders were excluded from this study since there is no formal list from which their information could be obtained and they are not required to author BIM models.

From the list of registered CPs in Lagos State, a total of 5,137 CPs were chosen as the study's target group. To enable purposeful and stratified random sampling and selection, the CPs were grouped according to their professional undertakings (architects: 604, builders: 410, quantity surveyors: 764, structural/civil engineers: 613, facilities managers: 255, land surveyors: 275 and building services engineers: 2,216). The study's sample size was determined by taking 7% of the research participants from each of the professional categories. The 7% was selected based on a precision level of +5% and confidence level of 95% (Singh and Masuku, 2014). This brings the total sample size to 357. Figure S2 shows the demographics of the CPs who took part in this study.

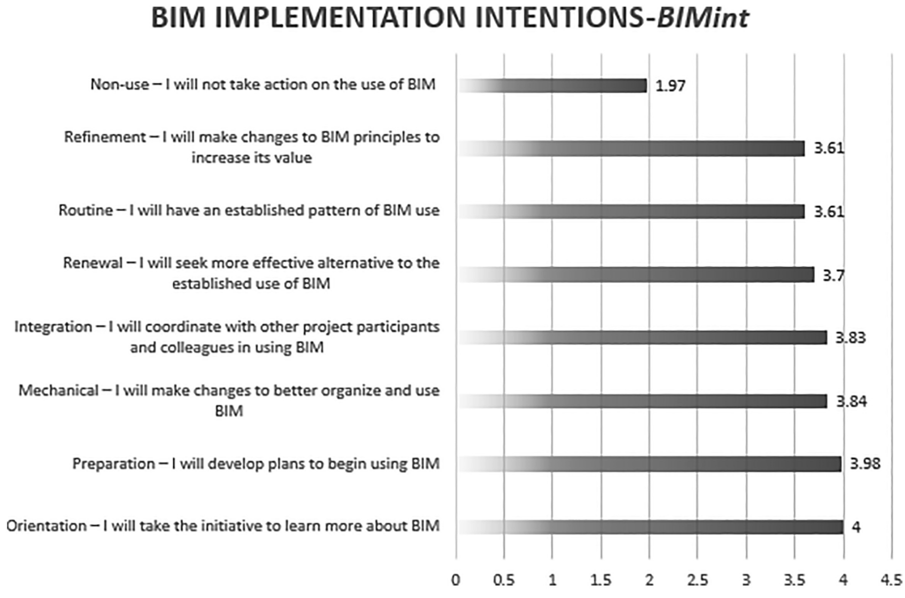
As shown in Figure S2, the majority of the respondents are construction managers (32.95%) and directors (16.8%). Most of the respondents have a BSc (53.41%) or MSc (28.14%) degree. In terms of profession, the majority identified as architects (29.55%), builders (27.27%), quantity surveyors (12.5%) and structural and civil engineers (11.36%). About 70% of the respondents have less than 5 years of experience, 36.36% have gathered 5–10 years' experience and 12.5% have gathered 11–15 years' experience. The number of projects executed by the respondents are less than 5 projects (40.9%), 5–10 projects (32.95%) and 11–15 projects (15.9%). This profile shows that the respondents have the required knowledge and skills to provide useful and relevant information for the study.

A 16-item questionnaire was made to ask CPs how much they agreed with different statements about the goals, concerns, strategies and driving forces of BIM implementation. Based on the goal of the study, we turn the variables in the conceptual model into questionnaire items. The model's principles were transformed from abstract notions into concrete measures. This was done to guarantee that each item in the questionnaire addressed a specific goal and served a specific purpose. In the questionnaire, short, easy-to-answer questions with 5-point Likert scales were employed. The questionnaire was piloted by the postgraduate students. Their recommendations informed the customizing of the questions to the CPs' activities in order to ensure that all respondents understood the questions in the same way and to quantify precisely what we were interested in. Hard copies of the questionnaire were distributed to the CPs between March 2021 and July 2021. The response rate for the survey was 76.47%, with a total of 273 totally completed questionnaires.

Eight criteria were used to assess the intent to implement BIM. To measure BIM implementation driving forces, communication, imitation, coercion, prescriptiveness, literacy, economy and legal forces were used. BIM implementation methodologies were designed with ten sub-constructs in mind. Figure 2 details the nuances of the measured variables for each of the important components. The data were analyzed using a structural equation modeling (SEM) approach that included model pre-development, development, testing, estimation and change. SEM is a research approach and data analysis system used to investigate and analyze complex statistical research data. The power analysis of SEM is preferred for finding target effects in complex interrelationships. The structural model was built by extracting and connecting all of the constructs and their hypothesized relationships from the conceptual model. The model was tested and estimated by creating a path model for SEM analysis. The



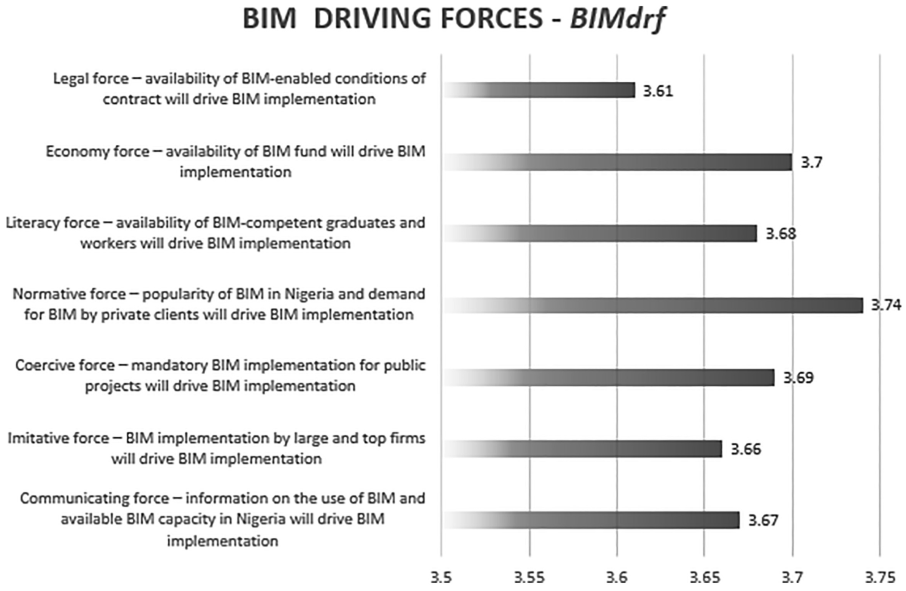
(a)



(b)

Figure 2.
Measured variables and their significance (a) BIM implementation concerns – BIMcon; (b) BIM implementation intentions – BIMint; (c) BIM driving forces – BIMdrf; (d) BIM implementation strategies – BIMips)

(*continued*)



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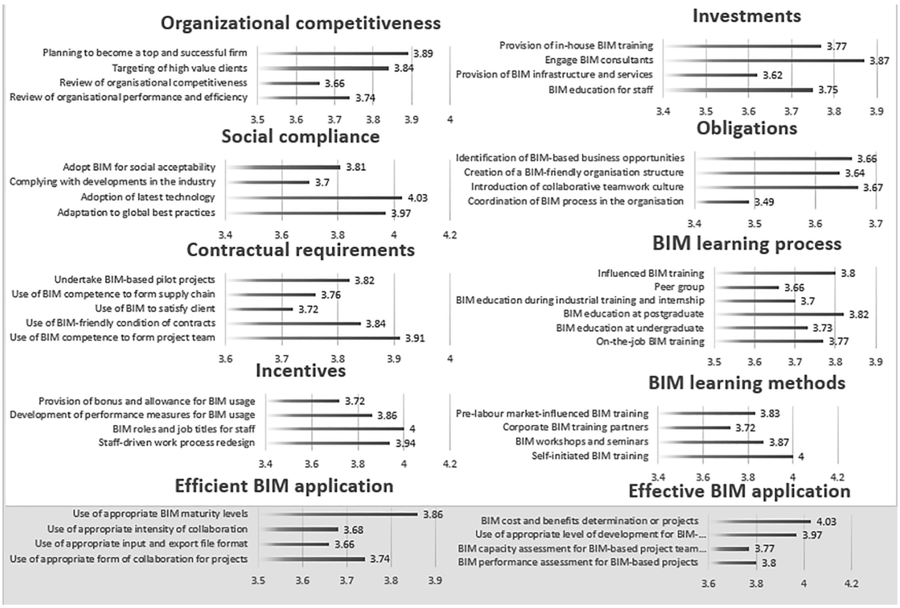

(d)

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Figure 2.

mean score was used to test the significance of the measured variables used in the SEM analysis. The mean score evaluates the average score in the total score to determine the reliability of a variable (Klopack and Wickrama, 2020).

The statistical tests and fit indices covered in the SEM analysis included the root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI) and the chi-square difference test (Xia and Yang, 2019). Fit indices provide helpful information about the data-model fit (Xia and Yang, 2019). The test results were utilized to establish and validate the model's explanatory power, predictive power and simplicity. The reliability and consistency of the questionnaire used in this study were assessed prior to conducting SEM. The test findings demonstrated that the extracted average variance, internal consistency, Cronbach's alpha and correlation of the major constructs are all within the acceptable limits recommended by Xia and Yang (2019). The results of the reliability and consistency tests are shown in Figure S3. The parameter estimates for the path analysis were used to decide whether to accept or reject the model and how well the structural model suited the observed data. To improve the model, it was modified.

4. Results and discussions

The impact and severity of BIM implementation concerns and intentions are related to the intensity of BIM implementation tactics, according to this study's hypothesis. This means that construction professionals will not worry about BIM implementation and will not take their BIM implementation goals seriously until BIM implementation strategies are in place. To put this statement to the test, four hypotheses were devised. The hypotheses interact with the theory's critical variables. Figure 1b depicts the path model used to evaluate the assumptions using SEM analysis. Table 1 displays the parameter estimations from the SEM investigation. Table 1 shows that hypotheses 1–3 were totally supported. The results supported hypothesis 4 in that BIM implementation driving forces had a negative impact on BIM implementation issues ($r = -0.147$, $z = -0.347$). The findings revealed that BIM implementation driving forces significantly influenced BIM implementation intention ($r = 0.049$, $z = 0.128$). Hypothesis 1 proposes that BIM implementation drivers and BIM implementation methodologies are inextricably linked. The results in Table 1 confirmed this hypothesis ($r = 0.524$, $z = 4.893$).

It was found that there was a positive and significant link between BIM implementation concerns and the intention to use BIM ($r = 0.036$, $z = 0.307$). As predicted in hypothesis 3, the role of BIM implementation strategies in the relationship between BIM implementation concerns ($r = 0.440$, $z = 1.269$) and BIM implementation intentions ($r = 0.666$, $z = 2.068$) was established. For additional affirmation of the outcomes, we explored pertinent alternative

Hypothesis	Hypothesized relationships	Estimates (r)	Standard error	Significance of the relationship (z)	Interpretation
H1	COV_BIMips_ BIMdrf	0.5241237379162876	0.1071117865706173	4.893240554537293	Fully supported
H2	COV_BIMcon_ BIMint	0.036895952161118774	0.12004575020272731	0.3073490906492793	Fully supported
H3	BIMips → BIMcon	0.4400513347184923	0.3466229299165494	1.2695390198924117	Fully supported
	BIMips → BIMint	0.6662413445153959	0.32203005824205955	2.068879371547993	
H4	BIMdrf → BIMcon	−0.14786748999078436	0.4253568586843748	−0.34763161089758204	Partly supported
	BIMdrf → BIMint	0.04981833934416631	0.38763362434078924	0.12851913821688588	

Source(s): Table by authors

Table 1. Parameter estimation for the proposed structural equation model

models (see Figure S4). In alternative model 1, the covariance between BIM implementation strategies and driving forces was changed to a direct path. The covariance between BIM implementation concerns and intentions was changed to a direct path in alternative model 2. In alternative model 3, the covariance between BIM implementation strategies and driving forces was eliminated, and no path was added. The path between BIM implementation concerns and intentions was totally removed in alternative model 4.

The fit statistics for the alternative models were contrasted with those of the proposed model in Table 2. The results from the table revealed that every one of the models has a similar chi-square statistic (x2 = 638.598). Alternative model 4 was found to have the most noteworthy Tucker–Lewis index (0.915), the least root mean square error of approximation (0.113) and the most noteworthy comparative fit index (0.932). Alternative model 4 was additionally found to have improved the strength of the hypothesized relationships [BIM implementation strategies and driving forces ($r = 0.524$), BIM implementation strategies and concerns ($r = 0.447$), BIM implementation strategies and intentions ($r = 0.676$), BIM implementation driving forces and concerns ($r = -0.156$) and BIM implementation driving forces and intentions ($r = 0.038$)]. In this way, this study acknowledges alternative model 4 as the finalized model, as portrayed in Figure 3. Based on the modifications in alternative model 4 and the parameter estimates, hypotheses 1 and 3 were completely upheld. Hypothesis 2 was not upheld by alternative model 4 on account of the modifications that it contained.

The inverse link between BIM implementation driving forces and concerns partially supports Hypothesis 4. The negative relationship between BIM implementation driving forces and concerns suggests that concerns that would have a significant impact on BIM implementation cannot be predicted by BIM implementation driving forces. According to the theory that developed from the revisions in alternative model 4 and the validated hypotheses, the forces that drive BIM implementation intentions are derivative and relative in intensity to BIM implementation techniques. On the other hand, these forces are conversely related to BIM implementation concerns. Figure 3 depicts these discoveries.

As found in this study, CPs are genuinely worried about what BIM implementation will mean for their time and service quality. Their main goal was to take trips to delve deeper into BIM in order to explore their interests. By focusing on CPs' worries and goals, the most successful BIM implementation strategies have changed the way CPs' worries and goals about BIM implementation interact with each other. The interconnections in the model showed that the BIM implementation strategies empowered the driving forces to increase in accordance with their intentions. This gives consolation to the CPs as they continue looking for BIM implementation. The interplay in the model shows that the BIM implementation strategies are set to meet each known BIM implementation concern and support the distinguished BIM implementation intentions.

Based on what this study found, the most effective ways to drive BIM implementation are to use the latest digital technology, give staff BIM roles and job titles, start self-initiated BIM training, adjust the cost and benefits of BIM reception, re-plan work processes with the help of staff and figure out the right level of development for BIM-based projects. These exceptionally successful BIM implementation strategies were not consistent with mandatory BIM adoption on public projects and BIM workshops as recommended in previous studies (Siebelink *et al.*, 2021; Malik *et al.*, 2021). According to the results of this study, the most effective BIM implementation strategy puts the CPs at the center of BIM implementation and connects their responsibilities and skills to the use of proven technologies and self-driven self-awareness.

The findings of this study also uncovered that as BIM implementation strategies heightened, driving forces would increase, but concerns that would deter BIM implementation would likewise increase. This implies that the CPs would keep on having concerns about BIM implementation at each phase of the implementation process. This could

Table 2.
Comparison of the strength and fit index for the proposed and alternative models

Model types	Proposed model	Alternative model 1	Alternative model 2	Alternative model 3	Alternative model 4
Comparison of the fit index for the proposed and alternative models					
Chi-square	638.598	638.598	638.598	638.598	638.598
RMSEA	0.116	0.116	0.116	0.162	0.113
SRMR	0.068	0.068	0.068	0.21	0.068
CFI	0.931	0.931	0.931	0.862	0.932
TLI	0.911	0.911	0.911	0.827	0.915
Chi-square differences		0	0	0	0
RMSEA differences		0	0	0.142	0
SRMR differences		0	0	0.046	0.003
CFI differences		0	0	0.069	0.001
TLI differences		0	0	0.084	0.004
Comparison of the strength of hypothesised relationships for the models					
Hypothesized relationships					
COV_BIMips_BIMdrf	0.5241237379162876	–	0.5241237379375935	–	0.5242075247793176
COV_BIMcon_BIMint	0.036895952161118774	0.036895952159788956	–	0.036419053991476005	–
BIMips → BIMcon	0.4400513347184923	0.44005133475554514	0.414903308542248264	0.3253892834946819	0.44787600725403276
BIMips → BIMint	0.6662413445153959	0.6662413444908333	0.666241344655145	0.6462578674683186	0.6761196046975729
BIMdrf → BIMcon	−0.14786748999078436	−0.14786749003974142	−0.14974793870534409	0.030997289916253928	−0.15618309377033765
BIMdrf → BIMint	0.04981833934416631	0.04981833937623939	0.04981833914966087	0.12943747088821322	0.03897045836914026
BIMips → BIMdrf	–	0.7189421591348508	–	–	–
BIMint → BIMcon	–	–	0.0377461203364422	–	–

Source(s): Table by authors

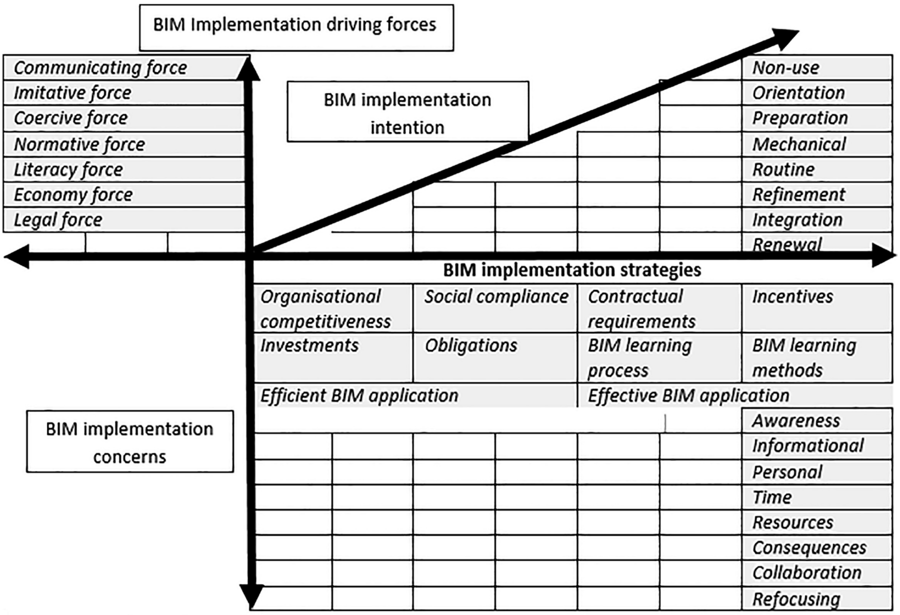

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Figure 3. Modified prescriptive BIM implementation model

be because of the way the project is delivered, the use of BIM on the project or the people involved. Construction projects are unique and dynamic. It is absolutely impossible that BIM could be conceptualized to catch every one of the issues that could arise in project delivery. In the course of delivering BIM-based projects, the project managers or CPs forming the project team would almost certainly confront challenges that could disappoint the BIM process. This issue was perceived as a sustained barrier to BIM adoption by Olugboyega and Windapo (2021). Olugboyega and Windapo (2021) saw that the obstructions to be settled through BIM implementation strategies would only create a preliminary BIM adoption.

The authors (Olugboyega and Windapo, 2021) noticed that as BIM was adopted, real problems (sustained barriers) would come up that had not been thought of when BIM implementation strategies were being made and barriers to initial BIM adoption were being broken down. The results of this study agree with Olugboyega *et al.*'s (2023) idea that BIM implementation could be triggered by BIM implementation strategies and the created impetuses. However, the battle is not over yet because BIM implementation would raise some concerns. Defeating these concerns gives the surest approach to implementing BIM for all time. The model in Figure 3 integrates the findings pertaining to alternative model 4. The figure illustrates the validated hypotheses (hypotheses 1, 3 and 4). The approved hypotheses establish the connections between BIM implementation strategies, driving forces, concerns and intentions. The validated hypotheses also firmly established the moderating role of BIM implementation strategies. Contrary to the postulations in Hypothesis 4, the outcomes showed that the connection between BIM implementation driving forces and concerns is negative. This was likewise integrated into Figure 3.

Based on the findings, the established theory says that BIM implementation driving forces, strategies, concerns and intentions are proportional in terms of intensity. However, in terms of direction, BIM implementation driving forces and concerns are oppositely relative, BIM implementation driving forces and intentions are directly proportional and BIM implementation strategies and intentions are directly proportional. These results show how important it is for BIM implementation strategies to drive BIM implementation intentions and create driving forces for BIM implementation. These agree with what Aka *et al.* (2021) found, which was that strategies are expected to drive the implementation of BIM. The mediating role of BIM implementation strategies is upheld by the findings of this study. In hypothesis 1, BIM implementation strategies were found to significantly affect the main impetuses. In hypothesis 3, BIM implementation strategies were found to assume a colossal part in guaranteeing that the BIM implementation intentions and concerns of the CPs are reconciled. These discoveries infer that forces that would inspire the CPs as well as the clients to acquire BIM capacity, interest in BIM, procure BIM infrastructure and acquire BIM data could be helpfully formulated utilizing BIM implementation strategies.

5. Conclusions

The study concludes that the CPs are concerned about what BIM implementation will mean for their time and service quality. This study's model, which was built, modified and accepted, depicts a transaction between BIM implementation strategies, driving factors, concerns and intentions. As BIM implementation strategies heightened, driving forces would increase, but concerns that would deter BIM implementation would likewise increase. According to the model, several unclear BIM implementation difficulties are likely to occur as BIM implementation efforts are made. This would create concerns for the CPs at each phase of the implementation process. It means that there are issues that may develop while applying BIM to a project or an organization. These issues may cause the BIM implementation process to be delayed or even terminated. In any event, how these issues are dealt with and resolved will determine whether BIM adoption is continued or terminated. BIM users could figure out the gaps and inadequacies in their systems using the findings of this study in order to make a crucial correction and recognize the next step in the BIM implementation process. The study's findings are also effective for differentiating between BIM implementation concerns and intentions in order to support appropriate BIM implementation driving factors and tactics for satisfying concerns.

This study contributes to the body of knowledge by providing a decision-support system for construction organizations to develop appropriate strategies for effective BIM deployment management. This study gives some helpful insights using CBAT that the construction industry and organizations may utilize to remove or influence BIM implementation barriers and achieve a smooth BIM implementation. The study also contributes to the CPs' professional development by providing a resource system for assessing the CPs' needs and concerns, individualizing BIM implementation strategies based on the CPs' concerns, identifying the stages of the CPs' BIM implementation intentions, elevating the level of BIM expertise and development and developing BIM implementation theories. The study also contributes to improving understanding of the process of implementing BIM change by CPs as well as CPs' organizational-level responses to BIM implementation requirements. This study was unable to account for the dynamics that motivate construction professionals' concerns about BIM deployment. Similarly, the study failed to recognize the potential issues that would impede BIM use in projects. These principles should influence future examinations. This paper proposes that client sourcing, client satisfaction, skills and competence, project features and rivalry be explored as potential causes of BIM implementation challenges.

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Supplementary material

The supplementary material for this article can be found online.

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