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Inhibitors to the Adoption of Building Information Modelling In Modular Construction: A Case Study of the Nigerian Construction Industry

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ABSTRACT

Building information modelling (BIM) adoption is transforming the way construction projects are delivered. Modular construction (MC) is one of the modern construction methods that drive continuous improvement and value addition globally. BIM and Modular construction offer enormous benefits and potential in enhancing project delivery and attaining sustainable construction. This is a major driving force causing the drift from traditional methods to a more digitized approach anchored on technology. Despite these benefits and the level of sophistication in project delivery, the application of these innovative methodologies is still low and housing construction projects are delivered with poor performance outcomes in a developing country like Nigeria. This study assessed the inhibitors to the use of BIM in driving modular construction project delivery in Nigeria. It also explored the measures for improving the adoption of BIM in modular construction. The well-structured quantitative questionnaire administered to construction experts using Snowball sampling techniques via electronic means was used to collect data. With a response rate of 70%, a reliability index of above 0.80, the gathered data were analysed using frequencies, percentages and Mean Item Scores. It was found that the level of BIM and MC is high, but BIM adoption in MC is low. The inhibitors to this low adoption level are; the high cost of investment in hardware and software, comfortable with the existing method and resistance to change, lack of management support, BIM software complexity, stakeholders' lack of interest to share information, collaboration problems, and legal issues with multiple designs and fabrication. It was recommended that collaboration between construction and technology firms should be encouraged to improve BIM application in MC for better productivity and project outcome. The government should support the use of Modern methodologies in the delivery of projects to help improve infrastructure provision, value addition, and citizens' well-being.

Keywords: BIM, Modular Construction, Technology, Nigeria

INTRODUCTION

Globally, the construction industry is recognised as an influential sector that stimulates growth and development in nations. The construction sector drives infrastructure provision and job creation (Onyeagam et al., 2019). Notwithstanding the vital role the construction sector plays in the economic development of nations, it is known for low-cost and time performances as well as poor productivity, and quality issues among others (Sekuo, 2012). This situation is worsened by the fragmented and conservative nature, and sluggishness toward the adoption of novel and innovative production methodologies, technologies and approaches (Ruparathna and Hewage, 2015). Major changes in production methodologies are the advent of Building Information Modelling (BIM) and Modular construction (MC) (Wuni & Shen, 2019; Wu et al. 2021; Abanda et al., 2017).

Modular construction (MC) is one of the modern construction methods that drive continuous improvement and value addition globally. It is a method that involves the production/fabrication of structural modules or units off-site, then transported and assembled where they are needed on a construction site (Bipat, 2019). MC advantages over the traditional, conventional approach include improvement in quality of product, better schedule performance, better health and safety performance, reduced number of workers on-site, reduced noise, air pollution and other environmental impacts. Similarly, MC is recognised as a 'cleaner' approach because of its capability to minimise waste, dust, noise, labour requirements, resource depletion, and improve safety performance (Lu et al., 2018; Jaillon et al., 2009). Lawson and Ogden (n.d.) posit that MC has gained a strong market in residential buildings, health and educational buildings where the importance of construction delivery speed is paramount. Thus, MC support and drives a sustainable built environment. BIM is one of the paradigm shifts in construction that is technology-based and enabled innovations that support virtual designing, constructing, and management of construction projects (Hardin, 2009; Eastman et al., 2011; Saka and Chan, 2019a). Thus, BIM facilitates virtual models and modules in construction. BIM adoption is transforming the way construction projects are delivered, and according to Tan et al. (2019), BIM plays a critical role in facilitating the fabrication and modularization of construction components and structures. In the same vein, Lu and Korman (2010) submit that BIM practice increases the potential of using modular coordination and pre-fabricated modules. BIM tools have improved the production of model-driven fabricated building components; it has also enhanced the dependability on prefabrication methods (Singh et al., 2015; McGraw Hill Construction, 2011). Activities such as planning, drawings development, analysis of designs, construction scheduling, and scheduling of fabrication, among others; as facilitated by BIM practices (Singh et al., 2015).

BIM and Modular construction offer enormous benefits and potential in enhancing project delivery and attaining sustainable construction. This is a major driving force causing the drift from traditional methods to a more digitized approach anchored on technology. While BIM-driven modularisation and fabrication have increased in developed nations of Europe, the US, UK (Le´sniak et al., 2021), the same cannot be said of developing countries of Africa. Nigeria is one of the countries in Africa where there is slow uptake of innovative construction technologies (Akinradewo et al., 2021; Sholanke et al. 2019). This is attributed to awareness issues, lack of local experts, and the problem of poor financing (Aigbavboa et al. 2019; Oke et al., 2019). The slow BIM in modular construction has contributed to the housing and other construction projects being delivered behind schedule, over cost and with poor quality and other associated problems. Furthermore, while studies of BIM in MC are growing in the UK, US, and other advanced countries, Literature in this area is almost non-existence in Nigeria. This is despite the role it plays in overcoming the ills of building production and sustainability. It is based on the foregoing that this study assessed the inhibitors to the use of BIM in driving modular construction project delivery in Nigeria. It also explored the measures for improving the adoption of BIM in modular construction.

The outcome of this study will help construction companies come up with implementable policies that will entrench the adoption of modern and innovative methodologies in the production of structural components and buildings. This can only be attained where there is a comprehensive understanding of the key inhibitors to BIM adoption in MC. This study also supports sustainable infrastructure production, as BIM and MC drive and impact the economic, social and environmental dimensions of sustainability. The study will also add to the scanty studies on MC driven by BIM in developing nations of Africa and beyond.

LITERATURE REVIEW

Level of BIM Adoption in Construction

In the global construction industry, BIM is an innovative technology that has transformed the way construction projects are delivered, but their adoption is still below the expectations of stakeholders. This was confirmed by (Ayinla & Adamu, 2018) who posits that the rate of adoption and implementation among construction businesses is still slow and below what was envisaged. Although governments in developed nations have made an appreciable effort to make BIM an integral part of every construction operation and project, reports have shown that more still needs to be done (Okereke et al., 2021). For instance, It was projected that over 80% of construction organisations in Singapore would use BIM by 2015 (Build Smart Issue 09, 2011; Zahrizan et al., 2013). This is because, in Singapore, BIM adoption and implementation are made mandatory by the government for projects and construction firms (Liao et al., 2019; Liao and Teo, 2017;Liao et al., 2020). What this implies is that BIM adoption is high in Singapore, even though, there are still some hitches.

Similarly, in the UK, it was reported that BIM implementation improved from 13% in 2011 to 74% in 2018 (NBS, 2018). The same improvement in implementation was also reported in South Korea, Brazil, Japan, Denmark, Canada, Australia, US, among others (Saka et al., 2020). BIM usage in 2013 in South Korea was 24% and it grew to 73% in 2015 (Smart Market report, 2015). In 2015 in the US, BIM usage was reported to be 79% (Fitriani et al., 2019). Government supports and policies are behind the progress made in BIM implementation in these advanced nations.

In developing nations of the world, for example, in the Middle East and Africa, the level of adoption of BIM in general construction activities is low (Yang & Chou, 2018; Gerges et al., 2017; Othman et al., 2020; Al-Ashmori et al., 2020; Telaga, 2018; Okereke et al., 2021). The absence of government support, weak government, absence of guidelines and strategies for implementation, and high cost, were advanced as the reasons for the low and slower rate of BIM adoption and implementation in the developing counties of the world (Jayasena & Weddikkara, 2013; Lam et al., 2017; Saka & Chan, 2019b).

Level of BIM Adoption in Modular Construction

The advent of modern technologies and the urgency for the construction industry to upgrade its production system and solve the myriad of problems associated with its performance; provided a suitable opportunity for BIM implementation in modular and other prefabricated construction (Tan et al., 2019). Globally, BIM implementation in the Architecture, Engineering and Construction industries grew from 26% to 57% in 2007 and 2016 respectively (Bhatti et al., 2018). This achievement was because of policies that made BIM usage compulsory in some developed nations. In Malaysia and other developing countries, BIM implementation is low and this was attributed to a lack of national policies on BIM, issues related to software integration, Jealousy and reluctance of experts in sharing skills and knowledge (Zahrizan et al., 2013; Farooq et al., 2020; Okereke et al., 2021).

In China, BIM implementation in prefabricated construction is still in its infancy (Tan et al., 2019); this is despite the technological advancement it has achieved in recent years. In South Korea, BIM has been in use for over 10 years in both public and private projects. Modular construction has also been implemented since the year 2000 in projects such as schools, housing, and barracks. Research has shown the application of these technologies in middle – high rise buildings (Lee et al., 2020). While there has been a continuous shift from 2D CAD to BIM in Hong Kong, Chan (2014) reported that BIM implementation is limited among designers; this was attributed to clients' lack of interest in the use of BIM.

In the Australian construction industry, Schesinger (2014) reported that about 3% of construction projects are undertaken using prefabricated methods. Furthermore, in multi-trade modular construction projects, the use of prefabrication is anticipated to increase by over 10% and this can be achieved via BIM technology implementation. BIM in MC is however challenged by certain factors which vary from country to country. The factors are inhibiting the wide adoption of BIM in modular construction. Therefore major inhibitors to the use of BIM in MC require to be reviewed.

Inhibitors to BIM adoption In Modular Construction

A major hindrance to BIM implementation is modular and other prefabricated construction in China according to (Tan et al., 2019) are cost-related issues, absence of BIM research, lack of standards and domestic-oriented tools. These factors have kept BIM in prefabricated construction at the low level it is now. BIM implementation comes with unavoidable changes in the way projects are delivered, and it also impacts the organisational structure. Over-reliance on conventional paper-based methods and lack of inclination to adopt new technologies; are critical resistance to changing attitudes of stakeholders in the construction industry (Tan et al., 2019 Eastman et al., 2011; Arayici et al., 2011; Panuwatwanich and Peansupap, 2013). The ambiguous nature of the economic benefits of BIM implementation is a factor that has hindered the adoption of BIM (Papadonikolaki and Aibinu, 2017; Zhang et al., 2018). Negative attitudes towards data sharing and misunderstanding of BIM by stakeholders (Zhange et al., 2018), absence of professional interactivity (Jin et al., 2017), and the absence of insurance applicable to BIM implementation (Eadie et al., 2014); are barriers to BIM implementation in construction.

Piroozfar et al (2019) and Sarhan & Fox (2013) in the UK found that the absence of management commitment, awareness and knowledge issues, collaboration problems, cultural and human issues, and issues related to interoperability; are the barriers to the implementation of BIM in construction. In Germany, VonBoth (2012) and Johansen & Walter (2007) reported that the major barriers to BIM initiative implementation are BIM software complexity, functional limitations of Model-based BIM software, issues related to technology, management and organisational issues, and Problems of resource availability to invest in BIM. Peng & Pheng (2011) and Shen et al. (2016) in Singapore, found that lack of training as a result of top management unwillingness, organisational restructuring, unwillingness to adopt new methods, systems and innovative technologies, technical competence, investment-related concerns, among others are the barriers to BIM implementations.

The major barriers to prefabricated construction in the Australian construction sector are; Changes in business practices to back BIM adoption, replacing CAD technologies with BIM, the cost of investing in hardware, software and training, legal issues with fabrication and multiple designs, stakeholders' lack interest to collaborate and share information (Mostafa et al., 2020). The major barriers to BIM adoption in construction in Hong Kong according to (Chan, 2014) are the non-availability of qualified in-house staff, problems of training and education, absence of standards and demand from clients, and the government not providing a lead and/or direction. In a similar but different study by (Chan et al., 2019), resistance to change, organisational structure not supporting BIM, and inadequate interoperability of computer software were the top 3 barriers to BIM adoption in construction.

In Poland, Lesniak et al.(2021) found that people are the weakest links to BIM adoption as the emphasis was made on the low level of knowledge and reluctance to change. Wu et al. (2021) identified the major barriers under the project stakeholders and financial related barriers to include lack of support from senior management, Low level of cooperation between project participants, Lack of experience in using BIM, Unclear responsibilities for BIM, Lack of collaborative working processes, Reluctant to share information publicly for participants, Owner lacks demand for BIM, High cost of BIM software, High risk of ROI and Lack of benefits brought by BIM. In the South African Construction industry, it was reported that the biggest inhibitors to BIM adaptation and implementation are the absence of skills, lack of education and knowledge (Kekana et al., 2015; Kekana et al., 2014). Olanrewaju et al. (2020) reported that Lack of knowledge, inadequate government policies, and High cost of implementation are the major barriers to BIM application.

Measures for improving BIM adoption In Modular Construction

Chan (2014) emphasized the need for government to collaborate with built environment stakeholders such as educational institutions of learning, professional bodies; to establish proper standards and policies that will entrench the use of BIM in constriction. In addition, programmes that would be tailored towards the development of local experts and students were stressed. A proactive approach that involves training and education in all courses related to BIM technology were advocated as a suitable measure for improving the level of BIM usage (Le´sniak et al., 2021).

To improve the implementation of BIM and other innovative methodologies, Sriyolja et al.(2021) recommended for government to make regulations that will guide consultants and contractors and other stakeholders, Government should lead the way and show High-level commitment, and development of training and educational programmes. Kekana et al. (2015) identified fifteen ways of improving BIM adaptability and implementation and reported that BIM adoption and implementation in construction can be improved primarily through education in BIM-related skill development and increasing the availability of BIM tools and technologies. Some of the ways they use Modular construction and other innovative technologies can be improved in the construction industry as submitted by (Wuni & Shen, 2019) include; the development of loan schemes for financing innovative methodologies, public-private partnerships, and improvement in collaboration among project stakeholders.

Liao et al. (2020) confirmed that in Singapore, the use of innovative technologies and management initiatives such as BIM has been normalised as a result of strong government policies and backing. While further wider adoption is still designed amongst the key players in the Singaporean construction industry, the level of implementation achieved so far can be improved through a sound BIM vision and leadership from the management of construction businesses, increase appetite of owners to lead in the adoption of BIM, better design coordination among various discipline through cash detection and resolution, BIM certification course to gain new skillset and better ways of working with BIM projects, and strengthening of the government system of BIM-related policies, standards and guides from the government. In Liao's earlier study, similar suggestions on how to overcome hindrances to BIM implementation were made (Liao and Teo, 2017; Liao et al., 2019). Liao et al. (2021) confirmed that BIM use is mandatory by the Government of Singapore. This, however, was not able to eliminate the prevalence of non-value-adding practices. The study of Liao et al. (2021) aided the diffusion of BIM and reduction in Non-value adding BIM implementation activities to improve the production of the construction sector.

RESEARCH METHODOLOGY

The questionnaire was developed after a detailed literature review was adopted for the survey to meet the aim of this study. Data were collected from construction professionals who have at least 5 years of work experience, and have knowledge of BIM and MC, and are actively involved in a construction project within the 5 states of the South-East geopolitical zone of Nigeria. The South-east zone has 5 states. The questionnaire is simple and easy to use and can cover wider audiences at an economical cost (Tan and Yeoh, 2011; Eze et al., 2021). The questionnaire adopted was designed on a 5-point Likert scale.

150 questionnaires were distributed electronically using Snowball sampling techniques via the email addresses, WhatsApp, and LinkedIn handles of the professional across the study area. The details were obtained

through a preliminary survey of the study area. The Snowball technique is dependent on referral and it can significantly increase the sample size (Heckathorn, 2011; Atkinson and Flint, 2001). Electronic means helps to reduce paper questionnaires and it is eco-friendly means of survey (Nwaki and Eze, 2020). After a sample survey period of 13 weeks, a total of 105 useable responses were received, and this represents an effective response rate of 70.0%, and this is well above the acceptable rate of 20-30% suggested by Pallant (2011) for an online-based survey. The gathered data were analysed using frequencies, percentages and Mean Item Scores (MIS). Frequency and percentage were used for analysing the respondent's background information, and Mean Item Scores (MIS) was used to analyse the data on inhibitors to BIM in MC and the measures for improving the usage of BIM in MC. The reliability evaluation using Cronbach's alpha showed high reliability of research instrument and data internal consistency. This is evident in the alpha values of 0.903 and 0.838 obtained for data on inhibitors to use of BIM in MC and Measures for improving the adoption of BIM in MC respectively

A summary of the methodological flow is shown in *figure 1 below;*

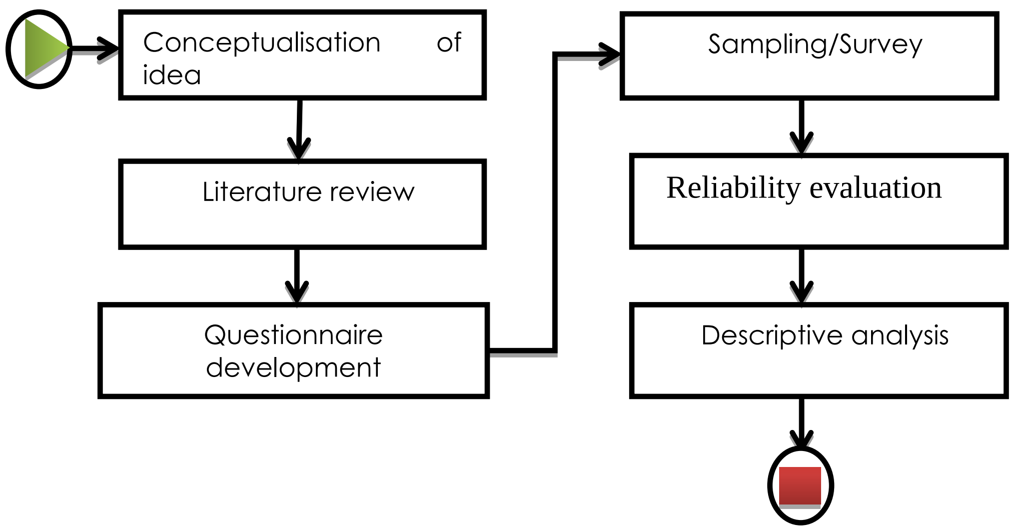

Figure 1: Research methodological flow chart

FINDINGS AND DISCUSSIONS

Respondents' background information

The analysis of the respondent background information showed that 14.29% are from Abia state, 18.10% (Anambra state), 16.19% (Ebonyi state), 20.95% (Enugu states), and 30.48% are from Imo state. It was further revealed that 36.19% work with public organisations, and 63.81% work with private organisations. In terms of their professional composition, 28.5% are Architects, Builders are 8.57%, Engineers (Civil/structural & Services) are 36.19% and Quantity Surveyors are 26.67%.

Regarding their years of work experience, 27.62% have 5-10 years experience, 37.14% 11-15 years, this is followed by 5-10yearhave 11-15 years, 16-20years (20.0%) and 15.24% have spent over 21 years in the industry. The highest academic qualification of the participants shows that, those with BSc/B.Tech is more with (52.38%), MSc/M.Tech (20.0%), PGD (9.52%), HND (16.19%) and lastly PhD (1.90%). Finally, 80% of the participants are chartered members of their various professional bodies, While 20% are probationer members.

Level of awareness and adoption of BIM and MC

The participants were asked to rate the level of awareness and adoption of BIM in MC in the delivery of construction projects in Nigeria. The result in figure 2 shows the level of awareness of BIM and MC. It can be seen that 59% of the respondents have a very high awareness level, 30% high awareness level, 8% have a moderate awareness level, 3% and 1% have low and very low awareness levels respectively. It can be concluded that the Awareness level of BIM and MC is high. Figure 3 shows the level of adoption of BIM in MC. It can be concluded that the adoption of BIM in MC is low, and this is premised on the distribution of the responses, which shows that 56% of the respondents indicated a low level of adoption of BIM in MC. The result obtained here is in support of the findings of previous studies such as (Sholanke et al. 2019; Akinradewo et al., 2021). *See* ***Figures 2 and 3 below.***

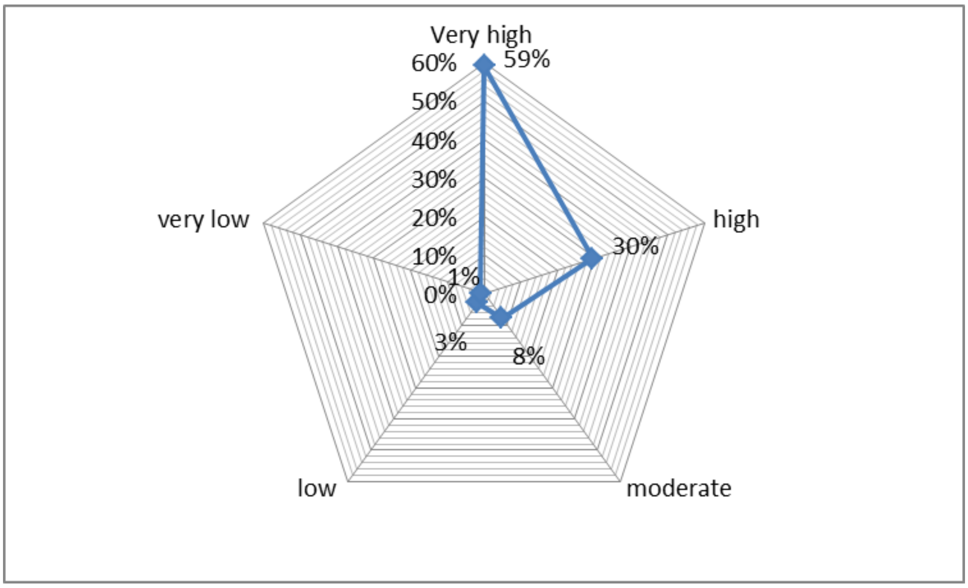

Figure 2: Level of awareness of BIM and MC

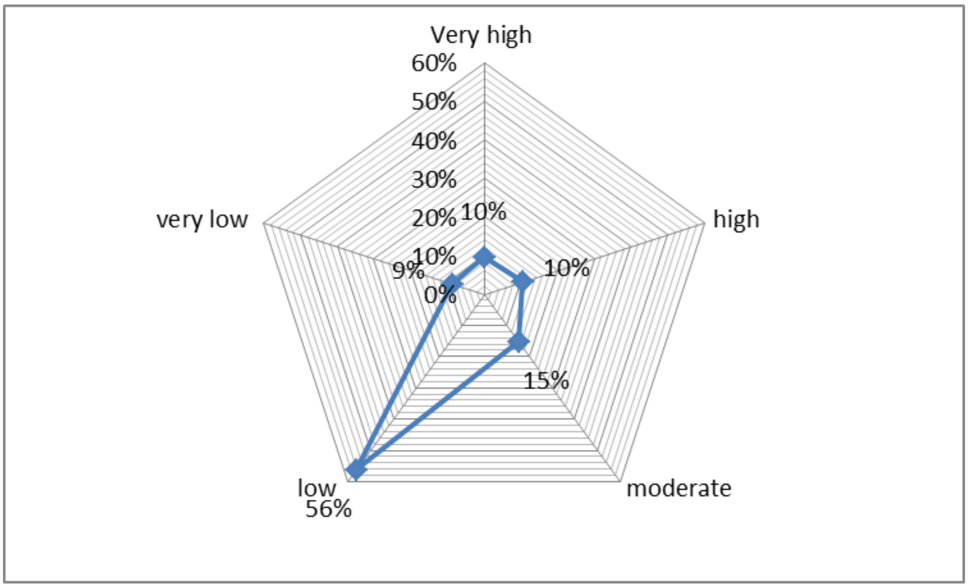

Figure 3: Level of adoption of BIM in MC

Inhibitors to use of BIM in modular construction

Table 1 shows the results of the analysis of the data collected on the major Inhibitors to the use of BIM in modular construction. The top ten (10) major inhibitors to BIM adoption in MC are; High cost of investment in hardware and software (MIS=4.52; S.D=0.9104), comfortable with the existing method and resistance to change (MIS=4.50; S.D=0.8893), lack of management support (MIS=4.46; S.D=0.7848), BIM software complexity (MIS=4.43; S.D=0.8419), Stakeholders lack the interest to share information (MIS=4.43; S.D=1.0271), collaboration problems (MIS=4.41; S.D.=1.1240), legal issues with multiple designs and fabrication (MIS=4.4; S.D=1.0706), problems of training and education (MIS=4.34; S.D=0.9591), unwillingness to adopt new methods, systems and innovative technologies (MIS=4.32; S.D=1.3045), and High cost of training in BIM and MC (MIS=4.30; S.D=0.9896). While the least five (5) inhibitors to BIM in MC are; absence of BIM research (MIS=4.15; S.D=1.1332), the absence of insurance applicable to BIM implementation (MIS=4.04; S.D=1.3077), non-availability of qualified in-house staff (MIS=3.98; S.D=1.0918); issues related to technical competence (MIS=3.97; S.D=1.2126), and lack of demand from clients (MIS=3.90; S.D=1.3440).

Overall, the average MIS is 4.26 (85.20% of 5) and the maximum and minimum MIS for the variables are 4.52 (90.48%) and 3.90 (77.90%) respectively. Furthermore, notwithstanding the relative ranking of the assessed inhibitors, they have an impact on the level of adoption of BIM in MC in Nigeria and other countries with similar construction markets. The result obtained in this section supports the findings of previous studies such as (Le´sniak et al., 2021; Wu et al., 2021; Mostafa et al., 2020; Chan et al., 2019; Piroozfar et al., 2019; Peng & Pheng, 2011; Tan et al., 2019; Eastman et al., 2011; Arayici et al., 2011; Panuwatwanich and Peansupap, 2013). A critical inhibitor to the adoption and implementation of BIM in construction and particularly in MC is the high cost involved in securing both the hardware and software needed to set up BIM. Olanrewaju et al. (2020) and Wu et al. (2021) reported that the high cost of implementation of BIM, especially investment in the critical hardware and software, is a major factor that inhibits the adoption and implementation of this innovative technology in modular construction. Another major barrier to the adoption of BIM is the lack of support from top management, who have the responsibility of resources and powers to make decisions that affect the implementation of novel ideas and methodologies. This was reported in the study of (Wu et al., 2021) that one of the major barriers of the stakeholder-related inhibitors to BIM adoption is the lack of support from senior management. The absence of commitment and unwillingness by the management of construction businesses was among the barriers to BIM adoption in MC in studies from the UK and Singapore (Piroozfar et al., 2019; Sarhan & Fox, 2013; Peng & Pheng, 2011; Shen et al., 2016). Management and leadership go together, without committed management, the leadership will not be effective, especially when it comes to new techniques and methods.

Reluctance to make changes usually evolves from people being too conformable with the old ways of doing things. This is one of the major drawbacks to the full uptake of BIM in construction, and this has been reported in construction management literature. For example, Le´sniak et al. (2021) found that reluctance to change is one of the main factors that impact the adoption of BIM in constriction. Chan et al. (2019) equally observed that resistance to change was a major factor that inhibits BIM adoption in the Hong Kong construction industry. In addition, the reluctance of the stakeholders to share project information is another barrier to BIM implementation. This is part of what Mostafa et al. (2020) found in Australia, it was found that stakeholders' lack the interest to share information is a critical barrier to BIM adoption in prefabricated construction.

Table 1: Inhibitors to use of BIM in MC

S/N	Variables	MIS	S.D	Rank
1	High cost of investment in hardware and software	4.52	0.9104	1st
2	Comfortable with the existing method and resistant to change	4.50	0.8893	2nd
3	Lack of management support	4.46	0.7848	3rd
4	BIM software complexity	4.43	0.8419	4th
5	stakeholders lack the interest to share information	4.43	1.0271	4th
6	Collaboration problems	4.41	1.1240	6th
7	Legal issues with multiple designs and fabrication	4.40	1.0706	7th
8	Problems of training and education	4.34	0.9591	8th
9	Unwillingness to adopt new methods, systems and innovative technologies	4.32	1.3045	9th

10	High cost of training in BIM and MC	4.30	0.9896	10th
11	Issues related to interoperability	4.29	1.0894	11th
12	Lack of domestic-oriented tools	4.28	1.2897	12th
13	Misunderstanding of BIM by stakeholders	4.28	1.0237	12th
14	Lack of standards	4.26	1.1769	14th
15	Absence of professional interactivity	4.25	1.2918	15th
16	Awareness and knowledge issues	4.22	1.0189	16th
17	Inadequate government policies	4.22	1.0829	16th
18	Organisational restructuring	4.20	0.9747	18th
19	The ambiguous nature of the economic benefits of BIM implementation	4.19	1.1359	19th
20	Functional limitations of Model-based BIM software	4.18	1.1584	20th
21	Absence of BIM research	4.15	1.1332	21st
22	The absence of insurance applicable to BIM implementation	4.04	1.3077	22nd
23	Non-availability of qualified in-house staff	3.98	1.0918	23rd
24	Issues related to technical competence	3.97	1.2126	24th
25	Lack of demand from clients	3.90	1.3440	25th

Measures for improving the adoption of BIM in MC
Table 2 shows the results of the analysis of the data collected on the Measures for improving the adoption of BIM in MC. The top five (5) measures for improving the adoption of BIM in MC are; Incorporating BIM-related courses into the curriculum of higher education in all built environment disciplines (MIS=4.29; S.D=1.3135), programmes targeted toward the development of skills in the use of BIM, MC and prefabricated construction methods (MIS=4.18; S.D=1.3358), government enforcing the use of BIM as a primary requirement in the built environment sector (MIS=4.17; S.D=1.1220), increasing the availability of BIM technology (MIS=4.16; S.D=1.3525), management and organisational supports (MIS=4.16; S.D=1.2099). While, the least measures for improving the adoption of BIM in MC are; devising means of moving from conventional practice towards adoption of Innovation tools and techniques (MIS=3.97; S.D=1.5408), improving interoperability of the BIM software with existing applications (MIS=3.97; S.D=1.3690), develop forms of contracts for the insurance of BIM (MIS=3.93; S.D=1.4496), and Public-private partnership (MIS=3.92; S.D=1.3423).

Overall, the average MIS is 4.09 (81.82% of 5) and the maximum and minimum MIS for the variables are 4.29 (85.71%) and 3.92 (78.48%) respectively. In addition, regardless of the relative ranking of the variables, they have a high impact on improving the adoption of BIM in MC in Nigeria, and by extension other nations with similar construction market structures. The result in this section is in support of the findings and recommendations from previous studies of (Chan, 2014; Le´sniak et al., 2021; Liao et al. 2020; Kekana et al., 2015; Wuni & Shen, 2019). BIM education is one of the ways the awareness and implementation levels of BIM can be enhanced. The courses of the curriculum of the built environmental programme as currently adopted is grossly lacking in BIM-based contents. This has been identified in BIM-related studies among construction management researchers. Liao et al. (2020) highlighted that BIM certification courses to gain a new skill set and better ways of working with BIM projects is one of the ways to cover some of the hitches experienced in the widespread use of BIM. Incorporation of BIM in the courses of the higher institution is a sure way to get the numbers of locals and local BIM users enhanced. Le´sniak et al. (2021) advised that training and education on Courses related to BIM technology is the sure way to improve not only the awareness of BIM technologies but also their usage. Collaboration of Government in BIM-related matters is key as the policies, standards and guidelines developed by the government are like laws that must be followed and obeyed. Chan (2014); Kekana et al. (2015) stressed the need for government to step in not only for the education and training of built environment professionals but also in the establishment of standards and policies for entrenching BIM in construction. This will go a long way in developing students and local manpower on BIM. Government and top Management supports as well as cooperation from organisations, team members are central to improving BIM adoption. Government must ensure that the regulations and standards are made compulsory for construction payers. These regulations and standards would government clients, consultants, contractors and other stakeholders in the sector (Sriyolja et al., 2021). This would improve the adoption level of BIM like what is obtained in advanced nations of the world.

Table 2: Measures for improving the adoption of BIM in MC

S/No	Variables	MIS	S.D	Rank
1	Incorporating BIM-related courses into the curriculum of higher education in all built environment disciplines	4.29	1.3135	1st
2	Programmes targeted toward the development of skills in the use of BIM, MC and prefabricated construction methods	4.18	1.3358	2nd
3	Government enforcing the use of BIM as a primary requirement in the built environment sector	4.17	1.1220	3rd
4	Increasing the availability of BIM technology	4.16	1.3525	4th
5	Management and organisational supports	4.16	1.2099	4th
6	Improve on BIM software standardization	4.14	1.2281	6th
7	Developed policies and regulations to guise BIM usages	4.13	1.2486	7th
8	improvement in collaboration among project stakeholders	4.11	1.4299	8th
9	Workshops and seminars to further increase BIM benefits awareness among stakeholders of the construction industry	4.1	1.2929	9th
10	Develop forms of contracts for stakeholders for the use of BIM technology	4.08	1.1742	10th
11	Development of loan scheme for financing	4.03	1.3262	11th

	innovative methodologies,			
12	Devising means of moving from conventional practice towards adoption of Innovation tools and techniques	3.97	1.5408	12th
3	Improve the interoperability of the BIM software with existing applications	3.97	1.3690	12th
14	Develop forms of contracts for the insurance of BIM	3.93	1.4496	14th
15	Public-private partnership,	3.92	1.3423	15th

CONCLUSION

This study assessed the inhibitors to the use of BIM in driving modular construction project delivery in Nigeria. It also explored the measures for improving the adoption of BIM in modular construction. A well-structured questionnaire was administered to construction professionals via electronic means and snowballing sampling techniques were used to gather data from the 5 states of the southeast geopolitical zones of the country. Mean Item Score was used to analyse the collected data and the key findings were reported. The study also found that whiles the awareness level of BIM and MC is high, it's the adoption of BIM in MC is low. The major factors that inhibit the use of BIM in MC are; the high cost of investment in hardware and software, comfortable with the existing method and resistance to change, lack of management support, BIM software complexity, stakeholders' lack of interest to share information, collaboration problems, and legal issues with multiple designs and fabrication. The measures for improving the adoption of BIM in MC are; incorporating BIM-related courses into the curriculum of higher education in all built environment disciplines, programmes targeted toward the development of skills in the use of BIM, MC and prefabricated construction methods, government enforcing the use of BIM as a primary requirement in the built environment sector, increasing the availability of BIM technology, management and organisational supports. Management Commitment is key to encouraging collaboration between construction and technology firms to improve BIM application in MC for better productivity and project outcome. The government should support the use of Modern methodologies in the delivery of projects to help improve infrastructure provision, value addition, and citizens' well-being. The key players in the construction industry should take advantage of this study to come up with implementable policies that will get BIM and prefabricated methodologies entrenched in the production processes of the construction organisations. This study adds to the few existing studies on BIM and modular construction adoption in developing nations.

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