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Assessment of the Adoption of Building Information Modelling (BIM) In Construction Industries in Nigeria: A Case Study of Abuja Metropolis

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ABSTRACT

This paper examines the adoption of Building Information Modelling (BIM) in Nigeria's construction industries, specifically in the Abuja Metropolis. The study uses a quantitative approach and aims to assess the readiness of construction firms in Nigeria to adopt BIM. The target population includes Architects, Builders, Civil Engineers, and Quantity Surveyors working in the Federal Capital Development Authority (FCDA), Abuja. The population size is 127 professionals, with 127 registered under their respective professional bodies. Data was collected through a structured questionnaire, which was administered to 127 construction professionals in Abuja. The data was analyzed using descriptive statistical techniques, including frequency counts and percentages. The findings suggest that the readiness of construction firms in Nigeria for BIM adoption is crucial, and stakeholders' awareness of BIM adoption is high. The paper also identifies barriers to BIM adoption in the Nigerian construction industry and suggests strategies to enhance stakeholders' readiness. The study recommends enhancing BIM adoption by focusing on model-centric workflows, collaboration and data management, and integrated analysis as pre-requisites for setting up mechanisms for BIM adoption.

KEYWORDS

Building; building information modelling; construction; construction industries

INTRODUCTION

The need for increased productivity and higher return on investments in the construction industry has become a great concern for industry stakeholders. Such decline in productivity is bred by several factors resulting to increased wastages, rework, time overruns, cost overruns, and adversarial relationships between project stakeholders (Telaga, 2018; Iyorter, 2019). Furthermore, the Nigerian construction industry accounts for 70% of fixed capital formation, yet it contributes less to the economy when compared with other industries (Onungwa & Uduma-Olugu, 2017). The industry accounts for 4% contribution to Gross Domestic Product and it is a cross cutting or linkage industry which generates employment. The Nigerian construction industry faces problems such as construction delays, time and cost overruns, abandonment of projects, power shortage and corruption among others.

In addition, the Nigerian construction industry is stuck in traditional construction processes and fragmentation of work processes which leads to multiple exchanges of information between people, disciplines and project phases. Interestingly, studies such as Popoola, Aluko and Omoyajowo (2024) and Abubakar, Ibrahim, Kado and Bala (2014) have shown that Building Information Modelling (BIM) is capable of addressing these problems by promoting better integration of construction processes and enabling project teams to collaborate and exchange project information electronically.

BIM is therefore an innovative approach to building design, construction and management which is gradually being implemented by countries such as United Kingdom, United States, and New Zealand in order to address the challenges facing the industry (Iyorter, 2019).

BIM is described as a set of interacting policies and processes that are being enabled by technologies in generating a methodology to procure building works (Lucas, 2019), purely from inception through the construction process to completion and to the entire lifecycle of a building. It aids the visualization of what is to be built in a simulated environment in order to identify potential design, construction or operational problems of a facility.

Building Information Modeling is an IT-enabled procedure for the digital representation of the building and interaction with it by the many stakeholders throughout the project's lifecycle (Onyejeakor, Eze, Onyeagam & Adegboyega, 2020). The use of BIM at the project, organizational, and industry levels has been associated with several advantages. Studies that have already been conducted have proven benefits like improved design processes, cooperation, time and cost savings, and increased production. These advantages, along with several others, have motivated governments and other institutions to launch BIM campaigns in the building sector.

The information and data made available in the digital format by the BIM can be easily edited, copied, and shared with the project stakeholders, which has improved interoperability between different phases of projects compared to the 2D paper formats. Perceived benefits such as improved collaboration, improved profitability, reduced cost, saved time, improved communication, improved design, reduced errors have been reported on projects that implemented BIM (Olawumi & Chan, 2019). Similarly, some research studies (Hamma-Adama, Kouider & Salman, 2018; Popoola, et al., 2024) have reported on the significant benefits such as improved productivity and efficiency in construction organizations that have adopted BIM. This has led to an increase in the awareness, adoption, and implementation of BIM in the architecture, engineering, and construction (AEC) industry over the years.

Many developed economies of the world have recorded impressive outcomes by implementing BIM in their construction practices (Wong, Wong & Nadeem, 2020). In the opinion of Kong et al. (2020) reported that many surveys and researches show the effort of using BIM worldwide.

The United Kingdom (UK) mandated the use of BIM towards the bid of reducing the industry cost by 20% with 2016 deadline and the level of implementation has since increased from 13% in 2011 to 74% in 2018 (NBS, 2018). General Services Administration (GSA) started the BIM implementation on projects in the United States in 2003 and this influenced industry-wide awareness and adoption. McGraw Hill (2014) reported an increase from 28% (2007) adoption level to 71% (2012) in North America. The Building and Construction Authority (BCA) led the BIM adoption in Singapore and BIM has since become a mandatory part in the procurement of public sector projects from 2012 (Edirisinghe & London, 2015). The Hong Kong Housing Authority (HKHA) has been piloting the use of BIM since 2006 and the adoption has increased in the industry. Similarly, Senate Properties started piloting of BIM project in the public sector of Finland while Skanska Oy started the implementation in the private sector (Wong, Wong & Nadeem, 2020). BIM was mandated on public projects over S$50 million in South Korea. Countries as such Norway, Denmark, Malaysia, Australia, Canada among others have also recorded an increase in the level of BIM adoption.

However, the challenges still exist since industrial players have certain reasons for not adopting BIM in their projects. For developed countries, it was reported that the lack of adequate training is the greatest challenge while cost of software and required hardware upgrades were reported to be the second greatest challenge (Bui, Merschbrock & Munkvold, 2016). Also, Ruyam Chitumu and Kaduma (2018) showed that for the years of 2009, 2012 and 2014, the lack of demand is the top reason for not adopting BIM among non-users in Australia, New Zealand and North America.

Nigeria, a developing country, is likewise noting these developments in BIM usage. Similar to other developing countries, Nigeria experiences several challenges with its building projects, including delays, cost overruns, project delays, project abandonments, corruption, disputes, and the production of waste (Bello & Saka, 2017).

According to Awodele, Adegboyega, Sofolahan, Adamu and Saidu (2020) and Ryal-Net and Kaduma (2015), the adoption of BIM in the Nigerian construction industry has been relatively slow, which is believed to be associated to low level of awareness and utilization amongst stakeholders.

The few extant studies on BIM in construction industries are from developed countries with a high level of awareness, adoption and implementation of BIM and coupled with government support. Little is known about BIM in construction industries in developing countries such as Nigeria, where the level of awareness is low, no government mandate and low technology adoption (Onungwa & Uduma-Olugu, 2017). According to Pandya (2012) reported that construction industries in developing countries are more vital and important to the economy. Thus, the construction industries in developing countries are more vital to the growth of the industry and have cogent roles to play in improving productivity as they represent a large percentage of the industry. However, the construction industries in developing countries are performing below expectancy, less competitive and are often fighting for survival. Also, despite the importance of construction industries in developing countries, there has been an underrepresentation of the construction industries narratives in BIM research (Saka, Chan & Siu, 2019). This could be partly explained by the low level of awareness in the industry and low level of implementation in the construction industries in Nigeria using a case study of Abuja metropolis.

STATEMENT OF THE PROBLEM

The Nigerian construction industry has faced so many criticisms across the globe for its inefficiency and lack of productivity, which have been attributed to its fragmented nature (Abubakar *et al*., 2014). BIM is one of such innovative processes that promises to bring about the continuous improvement and desired change in the construction industry and revolutionize the processes of its operation to achieve better collaboration between project parties and ensure successful project delivery (Telaga, 2018; Iyorter, 2019).

Hamma-Adama and Kouider (2018), Architecture Engineering and Construction business is developing as a result of digital transition. This development became obvious since development of BIM concept. However, this is yet to be achieved globally due to conventional nature of the industry. BIM is the most recent development of the construction industry's process and a promising concept determined to shape the industry's fragmented culture (Zhao, Hwang & Lee, 2016).

Improvement of project cost control and conflict reduction are among the numerous benefits associated with BIM (Telaga, 2018). Therefore, BIM has been widely adopted in many countries to increase the productivity of construction projects. However, level of BIM utilization in construction industry varies among countries. While developed countries are among the early implementer of BIM, its implementation in developing countries still poses many challenges.

Nigerian construction industry is besieged with problems such as increased wastages, rework, time overruns, cost overruns, and adversarial relationships between project stakeholders and these problems can be attributed to the low level of BIM adoption (Iyorter, 2019). In order to address these problems, it is necessary to assess the level of adoption of BIM in the Nigerian construction industry using Abuja as the study area.

RESEARCH QUESTIONS

(1) What are the barriers to the readiness of BIM adoption in the Nigerian construction industry?
(2) What is the current level of awareness of stakeholders on the adoption of BIM in the execution of construction projects in Abuja, Nigeria?
(3) What are the pre-requisites for the readiness of the adoption of BIM in the execution of construction works at different stages of a project?
(4) What is the level of readiness for adoption of BIM in the execution of construction projects in Abuja?

LITERATURE REVIEW

The Concept of Building Information Modelling (BIM)

The building construction industry has undergone significant transformations in its manufacturing processes and operational protocols over the years (Kori & Kiviniemi, 2015). From the time of conception until the processes of delivery and completion, the building—the principal product of the industry; is always being innovated, modified, and changed. One of these more recent breakthroughs is building information modelling or BIM. Claims that Building Information Modeling (BIM) is a new and innovative approach to building design, construction, and management that has changed the way experts in the industry consider how technology may be applied nationally and internationally (De-Matos & Miranda, 2018). According to one of the most interesting advancements in building design, management, maintenance, and operations is the recent introduction of BIM (Hamma-Adama, Kouider & Salman, 2018). These developments have provided project teams with the potential for novel communication formats as well as multisensory collaborative tools. These days, there are sophisticated analytical and multidisciplinary decision-making instruments intended to model and replicate real or imagined structures and environments. Thus, BIM has significant effects on the purchase of buildings.

Describes BIM as a process that begins with the creation of an intelligent 3D model and enables document management, coordination and simulation during the entire lifecycle of a project plan, including design, build, operation and maintenance (Autodesk, 2019). BIM has been defined as a highly collaborative process that allows multiple stakeholders and construction professionals to collaborate on the planning, design, and construction of a building within 3D models. Data created, modified and added to by the several professionals involved is used in the operation and management of buildings. These data allow owners and stakeholders to make decisions based on pertinent information derived from the model, even after the building is constructed. According to BIM is the process of developing an intelligent building model which can be more easily modified, and which can accurately represent the final building product (Olugboyega & Aina, 2018). It can be used to illustrate the entire building lifecycle, from cradle to inception, design and demolition and material reuse; quantities and properties of materials, which can be easily extracted from the model; and the scope of work, including the management of project targets and facilities throughout the building's life.

Building Information Modelling (BIM) in the Nigerian Construction Industry

The Nigerian Construction Industry (NCI) is the largest in West Africa and plays a key role in the development of the country (Olugboyega, & Aina, 2018). It employs approximately 25% of Nigeria's workforce and contributed 3.72% to the real GDP in 2017 (Danwata, 2017). However, this sector is not performing up to expectation and it is being marred by many challenges such as low productivity, waste, low quality, cost overrun, rework, delay, project abandonment and conflicts (Ayodele & Alabi, 2011). This is a result of the fragmented nature of the industry coupled with ineffective communication/information management (Olugboyega, 2018). Kori and Kiviniemi (2015) opined that the NCI stands to benefit from the implementation of BIM. However, the discussion on BIM in the Nigerian context is less than a decade, as the discussion just started in 2012. Review studies on the potential of adopting BIM in the NCI were carried out by Alufohai (2012), Ibrahim and Birshir (2012) and Munir and Jeffrey (2013). These early studies stressed the need for adopting and implementing BIM in the NCI and the associated benefits during the design stage, construction, and operation phases of construction projects. Extant studies revealed that the level of awareness and adoption of BIM in the industry is still low and facing many challenges such as lack of knowledge, lack of government support, and lack of implementation guidelines/strategies.

Abubakar, Ibrahim,Kado and Bala (2014) assessed the readiness of design firms in Nigeria to adopt BIM using the four readiness categories of management, people, process, and technology. It was revealed that the firms are ready to adopt BIM but are facing challenges such as lack of awareness among professionals and clients. Abubakar et al., (2014) surveyed BIM barriers and drivers in the NCI. Availability of trained BIM professionals, affordability of BIM tools, and enabling environments are the most significant drivers while resistance to change, high cost of BIM and lack of enabling environment are hindering BIM in NCI. Dare-Abel, Igwe and Ayo (2014) assessed the level of awareness of the architecture firms and concluded that there is an increase in the level of awareness of the firms.

Awareness of NCI professionals have also been carried out in many studies (Akereke & Etiene, 2016; Ogunde, Babalola, Akinola, Ogundipe, Ademola, Akuete & Olaniran, 2017) and the level of awareness has been increasing over the years. However, the level of awareness does not translate to increase in the level of implementation. The level of adoption and implementation of BIM by the professionals is still low and this is also reflected by studies (Olapade & Ekemode, 2018; Onungwa, Uduma-Olugu & Igwe, 2017) at the organization level.

METHODOLOGY

This study was carried out using the quantitative research approach. The target population in the study composed of Architects, Builders, Civil Engineers and Quantity Surveyors working in FCDA, Abuja. This is because these professionals are the primary participants who have substantial involvement and responsibilities in the execution of construction projects. There is a total of 286 professionals in FCDA and 127 of them are registered under their respective professional bodies. The population size is therefore 127. The researcher considered the population size to be manageable therefore the sample size remained 127. Data was obtained with the use of structured questionnaire of the close ended response format. The questionnaire was designed on a five-point Likert Scale format. The questionnaire was made up of six sections. The first section addressed issues concerning the general profile of respondents. The other sections addressed issues concerning the research objectives respectively. The questionnaires were administered to 127 construction professionals in Federal Capital Development Authority (FCDA) in Abuja. All the questionnaires administered were returned and used for data analysis.

The Data collected for this study were analyzed with the use of descriptive statistical techniques. The use of frequency counts and percentage was employed to analyze the profile of respondents. Mean Item Score (MIS) was employed in order to analyze the data collected on the research objectives. The use of SPSS was employed to aid the analysis of data in this study.

TABLE 1: Decision rule for MIS.

Scale	Cut-off point MIS	Importance	Awareness	Effectiveness
5	4.50 – 5.00	Very important	Very high	Very effective
4	3.50 – 4.49	Important	High	Effective
3	2.50 – 3.49	Fairly important	Average	Fairly effective
2	1.50 – 2.49	Less important	Low	Less effective
1	1.00 – 1.49	Least important	Very low	Least effective

Source: Adapted and modified from Morenikeji (2006) and Agumba and Haupt (2014)

RESULTS AND DISCUSSIONS

TABLE 2: Demographic Profile of the Respondents.

Respondents' Profile	No	Proportion (%)
Respondents' Profession		
Architect	35	28
Builder	12	9
Civil/structural engineer	18	14
Quantity Surveyor	19	15
Building/service engineer	37	29
Others	6	5
Total	**127**	**100**

Respondents' Profile	No	Proportion (%)
Respondents' highest educational qualification		
HND	12	9
BSc/BTech	84	66
MSc/Mtech	31	24
PhD	0	0
Others	0	0
Total	**127**	**100**
Respondents' Years of Experience		
1 – 10 years	58	46
11 – 20 years	67	53
21 – 30 years	2	1
Above 30 years	0	0
Total	**127**	**100**
Respondents' involvement in project where BIM was used		
1 – 5 years	30	100
6 – 10 years	0	0
Never been involved	0	0
Total	**30**	**100**
Respondents' membership professional body		
NIA	15	18
NIOB	0	0
NSE	50	60
NIQS	12	14
Others	6	7
Total	**83**	**100**

Source: Field Survey, 2024

This section presents the profile of the respondents considered for data collection. The respondents' profile is presented in Table 2, out of the 127 respondents considered for the study, 35 were Architects, 12 were Builders, 18 were Civil/Structural Engineers, 19 were Quantity Surveyors, 37 were Builders/Services Engineers, and 6 were from other related construction professions. This shows that 37% of the respondents, representing the majority, are Builders/Services Engineers. It was also shown from Table 4.1 that 66% of the respondents, representing the majority, are holders of Bachelor's Degree (BTech/BSc). This is followed by Master's Degree holders which represent 25% of the respondents. Holders of Higher National Diploma (HND), representing the minority of the respondents, constitute 9% of the population of respondents. This shows that the respondents have the requisite educational qualification to give reliable response required for the study.

Table 2 also indicates that 46% of the respondents have between 1 and 10 years of experience; 53% of the respondents, representing the majority, have between 11 and 20 years of experience; and 1% of the respondents, representing the minority, have between 21 and 30 years of experience. This shows that the respondents are experienced enough to give reliable information needed for the study. It was also revealed that 30 of the respondents have been involved in projects where BIM was used for up to five (5) years, indicating that some of the respondents have actually experienced the usage of BIM to some extent.

It was revealed from Table 2 that 83 of the respondents, representing 65% are registered members of the professional Associations of their respective professions. Of the 83 professionally registered respondents, 18% are members of the Nigerian Institute of Architects; 60% are members of the Nigerian Society of Engineers; 14% are members of the Nigerian Institute of Quantity Surveyors; while 7% belong to other related professional associations. This indicates that the respondents have the required professional experience to give useful information needed for the study.

Research Question 1

TABLE 3: Respondents' mean ratings on the pre-requisites for the readiness of the adoption of BIM in the execution of construction works at different stages of a project.

S/N	Items on the pre-requisites for the readiness of the adoption of BIM in the execution of construction works at different stages of a project	MIS	Rank	Decision
1	Model-centric workflows: Identifying deliverable standards that specify the asset models and its downstream use in other lifecycle phases	4.55	1st	Very Important
2	Collaboration & data management: Accompanying data management framework solution to control the sharing of relevant and accurate information to all project stakeholders	4.55	2nd	Very Important
3	Integrated analysis: Analyses of integrated asset models with the application of 2D,3D, 4D (cost) and even to greater complexity	4.52	3rd	Very Important
4	Governance: Organization and management of the BIM deployment upkeep, compliance and performance	4.48	4th	Important
5	Evaluation: Project review, dissemination and integration into strategy plan	4.42	5th	Important
6	Action planning: Design of new business processes and technology adoption path	4.31	6th	Important
7	Diagnosis: Review and analysis of current practice	4.28	7th	Important
8	Action taking: Consideration of possible implementation	4.23	8th	Important
	Average MIS	**4.42**		**Important**

Table 3 shows that the very important pre-requisites for the readiness of BIM adoption by construction firms in Nigeria are: Model-centric workflows (MIS = 4.55); Collaboration and data management (MIS = 4.55); and Integrated analysis (MIS = 4.52). Other pre-requisites for the readiness of BIM adoption by construction firms in Nigeria are also important. These range from Governance (MIS = 4.48) to Action Taken (4.23). Averagely, all the pre-requisites for the readiness of BIM adoption by construction firms in Nigeria are important.

In support of this finding, Bernstein and Pittman (2004) referred to these pre-requisites as BIM implementation precedence. In addition, the study of Arayici, Egbu and Coates (2012) and Doumbouya, Gao and Guan (2016) corroborate the finding of this study by stating that the readiness for the adoption of BIM by any firm in the construction industry is basically determined by some basic pre-requisites which are: Diagnosis Stage, Action Planning Stage, Action Taking Stage; and Evaluation Stage (Arayici *et al*., 2012) and Governance; Model-centric workflows; Collaboration & data management; and Integrated analysis (Doumbouya *et al*., 2016).

TABLE 4: Respondents' mean ratings on the current level of awareness of stakeholders on the adoption of BIM in the execution of construction projects.

S/N	Items on the current level of awareness of stakeholders on the adoption of BIM in the execution of construction projects	MIS	Rank	Decision
9	Construction stage	3.76	1st	High
10	Decision stage	3.73	2nd	High
11	Procurement stage	3.50	3rd	High
12	Predesign stage	3.39	4th	Average
	Average MIS	**3.60**		**High**

The results of MIS employed to rate the current level of awareness of stakeholders on the adoption of BIM in the execution of construction projects, based on the different stages of construction projects, are summarized.

Table 4 indicates that the Construction phase/stage and Design phase/stage are the stages of construction projects where the level of stakeholders is most high (MIS = 3.76 and 3.73 respectively). This is followed by the Preconstruction (tendering and award)/ phase/Procurement Stage which also has a high level of awareness by the stakeholders (MIS = 3.50). The least ranked stage is the Predesign (planning) phase/ Preliminary Stage which has the least level of awareness by the stakeholders (MIS = 3.39). On the average, the stakeholders' level of awareness on the adoption of BIM in the execution of construction projects in Nigeria appears to be high (Average MIS = 3.60).

The current level of BIM awareness as revealed in this study disagrees with the study of Anih and Ajiero (2018) where it was found that in Nigeria, the application of BIM in property management, especially in the areas of building maintenance, letting, occupation, inspection and repairs of the properties, is rarely embraced among property managers. In addition, the studies of Akerele and Etiene (2016) and Olanrewaju, Babarinde and Salihu (2020) also revealed low awareness on the usage of BIM in Nigeria in contrast with the finding of this study.

TABLE 5: Respondents' mean ratings on the barriers to the readiness of BIM adoption in the Nigerian construction industry.

S/N	Items on the barriers to the readiness of BIM adoption in the Nigerian construction industry	MIS	Rank	Decision
13	Lack of adequate BIM training and inadequate exposure to BIM concept	4.19	1st	Important
14	Low level of BIM technical know-how	4.10	2nd	Important
15	Inaccessibility to suitable technology and framework	4.09	3rd	Important
16	Industry/working environment	4.05	4th	Important
17	Initial BIM hug capital outlays	4.03	5th	Important
18	Lack of policy and standardization	4.03	5th	Important
19	Clients' shortage of BIM skills	3.98	7th	Important
20	Absence of understanding by finance management professionals	3.87	8th	Important
	Average MIS	**4.04**		**Important**

Table 5 reveals the MIS for the 8 identified barriers to the readiness of BIM adoption in the Nigerian construction industry. It was shown that the most important barriers to the readiness of BIM adoption in the Nigerian construction industry are: Lack of adequate BIM training and inadequate exposure to BIM concept; Low level of BIM technical know-how; Inaccessibility to suitable technology and framework; Industry/working environment; Initial BIM huge capital outlays; and Lack of policy and standardization with MIS values of 4.19, 4.10, 4.09, 4.05, 4.03 and 4.03 respectively. On the average, all the identified barriers to the readiness of BIM adoption in the Nigerian construction industry are important (average MIS = 4.04).

Findings from the study of Kassem, Graham, Nashwan, Michael and Steve (2015) is in support of the finding of this study by establishing the existence of two factors serving as barriers to the readiness for BIM adoption in the construction industry. These are that the various stakeholders of the project do not intend to collaborate during modelling or in optimum utilization of the BIM model, and lack of awareness by clients which is aggravated by the shortage of BIM skills and absence of understanding by finance management professionals. Also, in line with this finding, Onungwa and Uduma-Olugu (2017) discovered that there is low level of awareness and technical know-how of BIM in Nigeria.

TABLE 6: Respondents' mean ratings on the strategies for enhancing the level of readiness of construction professionals in the adoption of BIM for the execution of construction projects.

S/N	Items on the strategies for enhancing the level of readiness of construction professionals in the adoption of BIM for the execution of construction projects	MIS	Rank	Decision
21	Incorporation of BIM to academic curriculum	4.59	1st	Very effective
22	Provision of appropriate technology and infrastructure	4.52	2nd	Very effective
23	BIM should be made compulsory for all procurement processes and contracts	4.45	3rd	Effective
24	Setting up BIM council	4.44	4th	Effective
25	Software vendors and relevant training institutes should embark on intensive awareness of BIM	4.39	5th	Effective
26	Mandate BIM on public projects	4.39	5th	Effective
27	Education and training	4.33	7th	Effective
28	Improved data exchange standards	4.33	7th	Effective
29	Customize the local building components for objects libraries	4.25	9th	Effective
30	Consider other countries' guide as a starting point	4.22	10th	Effective
	Average MIS	**4.39**		**Effective**

The result of the MIS obtained on the identified strategies for enhancing the level of readiness of construction stakeholders in the adoption of BIM for the execution of construction projects in Nigeria is summarized in Table 6 It shows that 10 strategies for enhancing the level of readiness of construction stakeholders in the adoption of BIM for the execution of construction projects in Nigeria, Incorporation of BIM to academic curriculum (MIS = 4.59) and Provision of appropriate technology and infrastructure (MIS = 4.52) are the most effective strategies. On the average, all the identified strategies for enhancing the level of readiness of construction stakeholders in the adoption of BIM for the execution of construction projects in Nigeria are effective (average MIS = 4.39).

In line with this finding, Poole (2014) identified collaboration, training and promotion as effective strategies for enhancing the readiness for BIM adoption in Hong Kong. Also, in support of the finding of this study and in the Nigerian context, Ezeokoli, Okoye and Nkeleme (2016) identified education and training program, and the incorporation of BIM to academic curriculum as the most effective strategies for improving BIM usage.

CONCLUSION

The Nigerian construction industry is undergoing a significant transformation, with the Design phase and Construction phase being the most critical stages for the adoption of Building Information Modeling (BIM). Key prerequisites for BIM adoption include model-centric workflows, collaboration and data management, and integrated analysis. The Construction phase and Design phase are the most aware stages of BIM adoption in Nigeria. However, barriers to BIM adoption include lack of adequate training, low BIM technical know-how, inaccessibility to suitable technology and framework, industry/working environment, initial BIM capital outlays, and lack of policy and standardization. To improve BIM readiness, the most effective strategies include incorporating BIM into the academic curriculum and providing appropriate technology and infrastructure. Despite the average level of readiness, the industry needs to address barriers such as inadequate BIM training and exposure to the concept.

RECOMMENDATIONS

Based on the findings and conclusion of the study, the following recommendations were made:

(1) Mechanism should be put in place to encourage and prepare for the adoption of BIM right from the Preconstruction (tendering and award)/ phase/Procurement Stage in order to allow the adoption of BIM throughout the project

life cycle covering the Predesign (planning) phase/ Preliminary Stage; Design phase/stage; Preconstruction (tendering and award)/phase/Procurement Stage and Construction phase/stage.

(2) The readiness of BIM adoption should be enhanced by construction firms in Nigeria by focusing more on Model-centric workflows; Collaboration & data management; and integrated analysis as pre-requisite for setting up mechanism for BIM adoption.

(3) Project stakeholders should create more awareness through training and sensitization program on BIM adoption during the Predesign (planning) phase/ Preliminary Stage so as to enhance effective implementation of BIM throughout the project life cycle. This will also assist in addressing the barriers to the readiness for BIM adoption.

(4) In order to set up a mechanism for effective readiness for the adoption of BIM for sustained implementation of BIM in the Nigerian construction industry, the Government and all construction stakeholders should incorporate BIM to the academic curriculum and also provide appropriate technology and infrastructure ready for BIM adoption right from the procurement processes and contracts in Nigeria.

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