SCHOOL OF ENVIRONMENTAL TECHNOLOGY,
FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA, NIGER STATE, NIGERIA

4th INTERNATIONAL CONFERENCE (SETIC2022)

BOOK OF PROCEEDINGS

MAIN THEME:

SUSTAINABLE DEVELOPMENT AND RESILIENCE OF THE BUILT ENVIRONMENT IN THE ERA OF PANDEMIC

6th - 8th February, 2023

VENUE: NITDA Centre,
Federal University of Technology,
Minna, Niger State, Nigeria

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School of Environmental Technology International Conference (SETIC 2022)

6th – 8th February, 2023

Federal University of Technology Minna, Niger State, Nigeria

BOOK OF PROCEEDINGS

EDITOR IN CHIEF
B. J. Olawuyi

ISBN 978-978-54580-8-4

Proceedings of the 4th School of Environmental Technology International Conference (SETIC 2022)

Published by
School of Environmental Technology,
Federal University of Technology Minna.
PMB 65, Minna,
Niger State Nigeria.

ISBN 978-978-54580-8-4

PREFACE

The 4th edition of School of Environmental Technology International Conference (SETIC2022) is organised by School of Environmental Technology, Federal University of Technology Minna, Nigeria. In collaboration with Massey University New Zealand, University of Namibia, Namibia, Department of Architectural Technology, Najran University, Saudi Arabia, Deapartment of Civil Engineering, Stellenbosch University, Stellenbosch, South Africa and the Global Sustainable Futures, UK.

The main theme for this year conference is "**Sustainable Development and Resilience of the Built Environment in the Era of Pandemic**" and is of interest to everyone going by the fact that housing is a necessity following only after food and clothing while living in crowded places and poor sanitation is a concern and possible cause of spread of diseases and occurrence of epidemic/pandemic. This promotes and encourage innovative and novelty for emerging property management strategies in a pandemic era; modern geospatial tools for epidemiology; architecture, resilience and healthy buildings in pandemic era; planning for sustainable resilient neighbourhoods and cities in COVID-19 era; sustainable and resilient cities; sustainable cost management of built environment projects in the era of covid-19; wellbeing and resilience of the built environment.

The responses from participants for this conference are overwhelming, well attended, and successful. The operation mode was virtual for all participants with presentations in mode Our participants are from various Universities and other sector across the globe, from countries like United Kingdom, New Zealand, Saudi Arabia, South Africa, Namibia, Ethiopia and Nigeria just to mention a few. Hence, this conference provides a good platform for professionals, academicians and researchers to widen their knowledge and approach on latest advances in research and innovation. Papers presented in this conference cover a wide spectrum of science, engineering and social sciences.

Finally, a note of thanks must go to SETIC 2022 Local Organizing Committee (LOC) for their remarkable dedication in making this conference a success. We hope the event will prove to be an inspiring experience to all committee members and participants.

ACKNOWLEDGEMENTS

The effort put together in achieving the success of SETIC 2022 is predicated on the feat of the previous three edition of School of Environmental Technology International Conference held in 2016, 2018 and 2021, respectively. The support and goodwill from Vice-Chancellor of Federal University of Technology, Dean School of Environmental Technology, Dr. Renuka Thakore, Dr Dodo Y. A., Prof. James O.B. Rotimi and many other highly motivated people are highly appreciated.
It is also my privilege and honour to welcome you all, on behalf of the Local Organizing Committee (LOC) to the 4th edition of the Biennial School of Environmental International Conference (SETIC2022). This Conference which was earlier schedule for April, 2022 is holding now (6th to 8th th February, 2023) due to the prolonged ASUU-FGN crisis which made our public Universities in Nigeria to be closed for over Eight Months. Our experience in the 3rd edition held in 2021 after the COVID-19 Pandemic has thought us on new ways of doing things with the Virtual Conferencing offering us a wider coverage, it is our hope that SETIC2022 will be an improvement on the Participants experience of opportunity available for global networking and interaction at Conferences via the Virtual mode of presentation.

The conference provides an international forum for researchers and professionals in the built environment and allied professions to address fundamental problems, challenges and prospects of **Sustainable Development and Resilience of the Built Environment in the Era of Pandemic**. The conference is a platform where recognized best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. This 2022 edition of SETIC has listed in the program a Round Table Talk on on Housing Affordability Beyond COVID-19 with selected Speakers from across the globe available to do justice on the topic of discussion. Distinguished Conference participants, permit me to warmly welcome our Keynote:

- Dr. Ibrahim Idris, *Director Public health, State Ministry of Health, Niger State, Nigeria;*
- Dr. A.A. Bilau, *Lecturer and expert in Disaster Risk Management, Department of Building, Federal University of Technology, Minna, Nigeria and;*
- Dr. Yakubu Aminu Dodo, *Ass. Prof. Architecture Engineering Department, Faculty of Engineering, Najran University, Najran, Saudi Arabia;*

And the lead Discussants for the Round Table Talk:

- Prof. James O.B. Rotimi, *Professor of Construction Economics & Management, School of Built Environment, College of Sciences, Massey University of New Zealand;*
- Prof. O.A. Kemiki, *Professor of Estate Management and Valuation, Federal University of Technology, Minna, Nigeria;*
- Dr. Renuka Thakore, *Founder, Institute for Global Sustainable Futures, Progress through Partnership, UK;*
- Dr. Guillermo Delgado, *Senior Lecturer, Architecture and Acting Director, Institute of Land, Livelihoods and Housing (ILlH), Namibia University of Science and Technology, Namibia;*
- Prof. Adewumi John Babafemi, *Associate Professor and Head of Construction Materials and Unit; Stellenbosch University, Stellenbosch, South Africa;*
- Dr. Yakubu Aminu Dodo, *Ass. Prof. Architecture Engineering Department, Faculty of Engineering, Najran University, Najran, Saudi Arabia.*

for accepting to share from their knowledge, wealth of experience and be available to interact with participants on varied issues on "**Sustainable Development and Resilience of the Built Environment in the Era of Pandemic**".
As reflected on the Conference program, the Conference activities will be Virtual for all presenters to run in four parallel sessions on the Zoon platform. With a total of Seventy (70) articles captured in the Conference Proceedings covering the six subthemes of the Conference, I have no doubt that we are all in for an impactful experience at SETIC2022 as we brainstorm, exchange ideas, share knowledge and participate in evolving more approach to sustainable housing and land management drives.

I implore us all to enjoy every moment of the deliberations and ensure we maximize the great opportunity offered by the Conference to network for better research and career development as we also make new friends.

I also on behalf of myself and the LOC express our appreciation to the Dean, School of Environmental Technology and the entire Staff of the School for giving us the opportunity to steer the ship for SETIC2022. To the Reviewers and various Committees that served with us, I say thank you for helping us through despite the pressure of work.

Thanks, and God bless you all.

Olawuyi, B.J. (PhD)
Chairman, LOC
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6th February, 2023

TO WHOM IT MAY CONCERN

I wish to state that all the papers published in SETIC2022 Conference Proceedings have passed through the peer review process which involved an initial review of abstracts, review of full papers by minimum of two referees, forwarding of reviewers' comments to authors, submission of revised papers by authors and subsequent evaluation of submitted papers by the Scientific Committee to determine content quality.

It is the policy of the School of Environmental Technology International Conference (SETIC) that for papers to be accepted for inclusion in the conference proceedings it must have undergone the review process and passed the academic integrity test. All papers are only published based on the recommendation of the Reviewers and the Scientific Committee of SETIC

Babatunde James OLAWUYI
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Investigating the Adoption Level of Building Information Modelling for Post-Construction Management in Nigeria

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Abstract

The construction industry is often criticized for its reluctance to change and low productivity. However, Building Information Modelling (BIM) has been proposed as a solution to mitigate these challenges. While BIM has been widely adopted during the planning, design, and construction phases of projects, its adoption in the post-construction phase remains limited. This is a critical phase where up to 80% of the total life cycle cost of a facility is expended. This study aimed to investigate the adoption level of BIM for Post-Construction Management (PCM) in Nigeria, using a quantitative research method with 132 International Facility Management Association (IFMA) professionals as respondents. The study found that there is a high level of awareness of BIM for PCM among respondents, with 84% indicating a high and higher level of awareness. However, the usage of BIM-compliant software was very low, with limited proficiency in its use. This high level of awareness is a positive factor that could facilitate rapid adoption of BIM for PCM. Conversely, low awareness could result in slower adoption. Despite the high level of awareness, the adoption level of BIM for PCM remain very low. The study suggests that further efforts are needed to bridge the gap between awareness and adoption, including improving proficiency in BIM-compliant software and creating incentives for its use. Overall, the study highlights the importance of BIM for PCM and the need to increase its adoption in the construction industry.

Keywords: Keywords: Adoption, Awareness, BIM, Level, Post-Construction Management.

Introduction

According to World Economic Forum (2018) the construction industry contributes about 6% to the world Gross Domestic Product (GDP), similar the construction industry is expected to contribute about 15% to the world GDP by the year 2030 (Olanrewaju *et al*., 2021). In the first quarter of 2021, the National Bureau of Statistics report, the industry accounts for 10.17% of the nominal GDP. Consequently, the construction industry is paramount to the development of nations globally. The construction industry is slow in adoption and transitioning from the conventional to a digitalized method of operation by application of technological tools which their application can increase productivity in the construction industry. According to Olorunfemi *et al*. (2021), an increase in new technological tools and applications has led to a paradigm shift in the method of operation from traditional to digitalized around the world.

Although the construction industry is regarded as a major contributor globally, the industry is faced with challenges relating to productivity due to the slow adoption and application of technologies such as BIM (Acre and Wyckmans, 2015), IoT (Ghosh *et al*., 2021), Industry 4.0 (Newman *et al*., 2020) and Blockchain (Parn and Edwards, 2019). Adoption of BIM software can ensure improvement in the facility life cycle and adequate data management (Olanrewaju *et al*., 2021; Chioma *et al*., 2020; Aka *et al*., 2020). Despite BIM technology has been adequately adopted during the planning, design and construction phase of the project, it is still considered to be at the early stage of adoption for managing post-construction activities to ensure the facility performs optimally all through its life cycle after completion (Olanrewaju *et al*., 2021).

According to Mohandes *et al*. (2014), PCM is the management of facility assets and maintenance after the design and construction phases have been completed. The American Institute of Architects considers the benefits of BIM lie in the post-construction phase of the project life cycle (AIA, 2015). Even though the major benefits of BIM lie more in the post-construction phase of the project, the level of awareness and adoption is still very low as indicated by various studies (Bello *et al*., 2022; Durdyev *et al*., 2021).

The post-construction activities have usually been managed manually which brings about a waste of time and resources. According to Anton and Diaz (2014) data are erroneously entered repeatedly up to seven times when entered manually, also resulting in poor quality documentation (Jylha and Suvanto, 2015) resulting in handing over delay (Wu and Issa, 2012). Real life can be traced to the United States, where almost $11 billion is lost annually due to inefficient operation of facilities which is worth giving urgent attention to (Arayici *et al*. 2012). In a related study by Hu *et al*. (2018) annual costs through waste caused by operating issues from inaccurate information and interoperability were reported as $10.6 billion in the United States. These cases among others bring about the need to carry out studies in the context of developing countries.

The awareness and level of adoption of BIM for PCM are reasonably high in the developed nations, however, in developing countries, the case is not the same as only south Africa is the only country that has fairly and leading in the adoption of BIM for PCM (Chioma *et al*., 2020). Olanrewaju *et al*. (2021) indicated that sub-Saharan countries like Nigeria are lacking behind in the adoption of BIM for PCM, this basis was further supported by (Olapade and Ekemode, 2018)

This study investigates the adoption level of BIM for PCM in Nigeria using Abuja as the study area which is considered as one of the cities experiencing high rate of modern construction in Nigeria. The study set four distinct objectives to; determine the level of awareness of BIM for post-construction management; determine the usage level of BIM-compliant software among the professionals, determine the level of BIM-compliant software's proficiency among the respondents and established the level of adoption of BIM for post construction management in Nigeria. The outcome of the study will adequately provide insight into the BIM-post-construction management adoption in Nigeria's construction industry and provides the stakeholders with the requisite information about BIM-post-construction management to make informed decisions towards the adoption of BIM for post-construction management.

2.0 BIM Adoption in the Construction Industry

Although BIM adoption is expanding in most developed countries, it is stagnating in most developing countries, such as Nigeria (Chioma *et al*., 2020). BIM is a cutting-edge technology that enables the parameterised expression and integrated management of various data kinds throughout a facility's lifecycle (Eastman *et al*., 2011). During the information management process in the facility lifecycle, BIM technology has transformed the conventional construction industry's development mode, assisting in resolving difficulties such as work coordination and information integration (Hamma-Adama, 2020). As a result, BIM is regarded mainly as a transformative tool for the construction industry and enhancing project management efficiency (Cao, 2016: Ayegba and Root, 2018).

Using BIM technology in construction projects can save up to 40% on unnecessary budgetary modifications, reduce construction time by 7%, save 10% to 17% on operating costs, and reduce greenhouse gas emissions by 50%. (Boston Consulting Group, 2016; World Economic Forum, 2016). BIM can be adopted in the post-construction phase for restorations, space planning, and maintenance functions (Azhar, 2011). A study was conducted by Ikediashi and Uyanga (2016) to better understand the current state of BIM adoption for facilities management roles in Nigeria, with the goal of better understanding the current level of use and efficacy in facilities management service delivery established low usage level and lifecycle cost reduction and on-time service delivery were significantly impacted by the implementation of BIM for facilities management applications.

In a related study by Olapade and Ekemode (2018), just two (2) of the thirty-seven (37) facility management firms examined on their awareness and use of BIM for facility management practices are currently implementing BIM for their operations, indicating a low level of BIM for facility management adoption in Lagos. The findings of this study offered information on the level of understanding and use of BIM for facility management practice in Nigeria, allowing industry stakeholders to gain insight into the possible full integration with facility management practices in developing countries. The research

is a ground-breaking investigation of the use of BIM for facilities management awareness and implementation in a rapidly growing property market like Nigeria.

Traditional PCM is inefficient because of the wide time range, extended durations, multiple items, and sophisticated employees involved. In PCM, BIM technology can not only meet user's basic activity needs and increase investment income, but it can also enable information sharing between design, construction, and operations and maintenance, improve information accuracy, and provide a convenient management platform for all participants to enhance the efficiency of building facility management (Wang, 2015). In terms of BIM's application in PCM, Akcamete *et al*. (2010) discovered that maintenance costs account for more than 60% of total project costs. BIM can practically visualise many aspects of facility management in real time. Data can be stored in the BIM model indefinitely and studied from various angles to enhance PCM tasks.

Several researchers have demonstrated the potential of BIM in PCM, and they agree that the early application of BIM in the operation and maintenance phase included seven aspects of BIM: maintenance and repair, change management, space management, emergency management, security management, energy management, and asset management (Gao and Pishdad-Bozorgi, 2019). The literature reviewed argues for the embrace of innovation, particularly BIM innovation, for the sector to survive. In the construction industry, BIM has been innovative, and its adoption needs a streamlined approach. As this is a novel paradigm, investigation methods are continually emerging. There is limited study on BIM in the researched country significantly, outside of a single field and possibly cities (Hamma-Adama, 2020). More than three-quarters of the published literature on BIM studies in Nigeria such as (Abubakar *et al*., 2014; Ugochukwu *et al*., 2015) identified a fundamental barrier to BIM adoption as a lack of knowledgeable personnel in the technology. And more than half of them is due to a lack of knowledge and understanding of the technology's potential.

Methodology

This study adopts a quantitative method to carry out the research by collecting data from IFMA professionals in Abuja. A questionnaire was adopted as the method of data collection which was based on the five Likert scales. The research population are registered IFMA members in Abuja, and at the time of data collection for this study, the total number of registered IFMA members stands at 207. Since the total population is known, the study adopts a probability sampling technique using a simple random technique. The sample size is calculated below using the using Yamani's (2013) formula below and adopts a 95% level of confidence at 0.05.

$$n = \frac{N}{1+N(e)^2} \qquad (1)$$

Where n = sample size
N = population size (207)
e = acceptable sampling error (0.05)

Adopting this formula, the sample size outcome is 135 which indicates the number is sufficient enough for this study.

A total number of 164 questionnaires were distributed among the 207 professionals, and 148 were retrieved during data collection. Two distinct criteria were set to select valid responses; any unanswered question and if more than one answer is provided for one question. Based on these criteria 16 responses were considered unfit for the study, hence the study considers 132 valid responses. The data were presented in table and charts for easy understanding.

Result And Discussion

Characteristics of the Respondents

A five-sectioned questionnaire was presented to the respondents based on five Likert scales. Among the 207 IFMA registered professionals in Abuja, the questionnaire was administered to 164, and 148 questionnaires were retrieved during collection. 132 questionnaire was properly filled and considered

for the study. The number of respondents considered in this study is found adequate compared to previous related studies (Olanrewaju *et al.*,2020; Chioma *et al.*, 2020). Table 1 presents the characteristics of respondents according to their academic qualification, profession, age group, gender, registration with IFMA, years of experience, client type and size of the firm. Academic qualification: The academic qualification of the respondents shows that 6.82% hold a Higher National Diploma, 4.55% hold a Post Graduate Diploma, 46.97% hold a bachelor's degree, 36.36% hold a master's degree and 5.30% hold a doctor of philosophy. Professional Background: Among the respondents, 6.06% were Architect, 25% were Builder, 12.88% were Engineer, 44.70% were Estate Surveyor, 0.76% were Project Managers and 10.61% were Quantity Surveyor.

The years of respondents have been a registered member of IFMA shows that 4.55% have been a registered member for less than 5 years, 43.18% have been a registered member for 5-10 years, 37.12% have been a registered member for 10-15 years, 9.85% have been registered for 15-20 years and 5.30% have been registered for 20 years above.

Table 1: Characteristics of the Respondents

Variable		Frequency	Percentage (%)
Academic Qualification	Bachelor Degree	62	46.97
	Doctorate Degree	7	5.30
	Higher National Diploma	9	6.82
	Master Degree	48	36.36
	Post Graduate Diploma	6	4.55
	Total	**132**	**100.00**
Profession	Architect	8	6.06
	Builder	33	25.00
	Engineer	17	12.88
	Estate Surveyor	59	44.70
	Project Manager	1	0.76
	Quantity Surveyor	14	10.61
	Total	**132**	**100.00**
Registration with IFMA	Less than 5 years	6	4.55
	5-10 years	57	43.18
	10-15 years	49	37.12
	15-10 years	1	0.76
	15-20 years	12	9.09
	20 years Above	7	5.30
	Total	**132**	**100**
Years of Experience	Less than 5 years	4	3.03
	5-10 years	49	37.12
	10-15 years	56	42.42
	15-10 years	1	0.76
	15-20 years	12	9.09
	20 years Above	10	7.58
	Total	**132**	**100.00**
Client Type	Government	39	29.55
	Private	93	70.45
	Total	**132**	**100.00**
Size of Firm	Large (250 Above)	6	4.55
	Medium (50-249)	59	44.70
	Small (10-49)	67	50.76
	Total	**132**	**100.00**

The respondent working experience shows that 3.03% of the respondent has been working for less than 5 years, 37.12% have been working for 5-10 years, 42.42% has between 10-15 years of working experience, 9.85% has between 15-20 years working experience and 7.85% has 20 years above working experience. The result shows 29.55% of the respondents work in a government establishment while

70.45% work in a private establishment. The result shows that 4.55% of the respondent works in a large firm (250 above), 44.70% works in a medium firm (50-249) and 50.76% works in a small firm.

Awareness Level of BIM for Post-Construction Management

Figure 1 show the awareness level of respondents of BIM for PCM ranging from very high to very low. Respondents were asked to select based on their level of awareness on a scale of (*5 = Very High, 4 = High, 3 = Moderate, 2=Low, 1 = Very Low).* The result shows that the majority of the respondents are aware of the usage of BIM for PCM and none of them is unaware of BIM usage for PCM with 53.03% awareness level being very high, 31.06% high, 12.88% moderate and 3.03% low. According to Nicał and Wodyński (2016), the basis of appreciating a BIM-enabled process in the application of BIM for post-construction is to create awareness among the stakeholders. Studies in the context of developing nations like Nigeria (Babatunde *et al*., 2020; Gamil and Rahman, 2019) and other developing nations Khoshfetrat *et al*. (2020) have all established lack of awareness of BIM as a major challenge.

A related study by Olapade and Ekemode (2018) using Lagos as a case study, established that awareness of BIM among facility management professionals is low. Also, (Bello *et al*., 2022; Olanrewaju *et al*., 2020) reported a low level of awareness of BIM at the operation stage in the Nigerian construction industry.

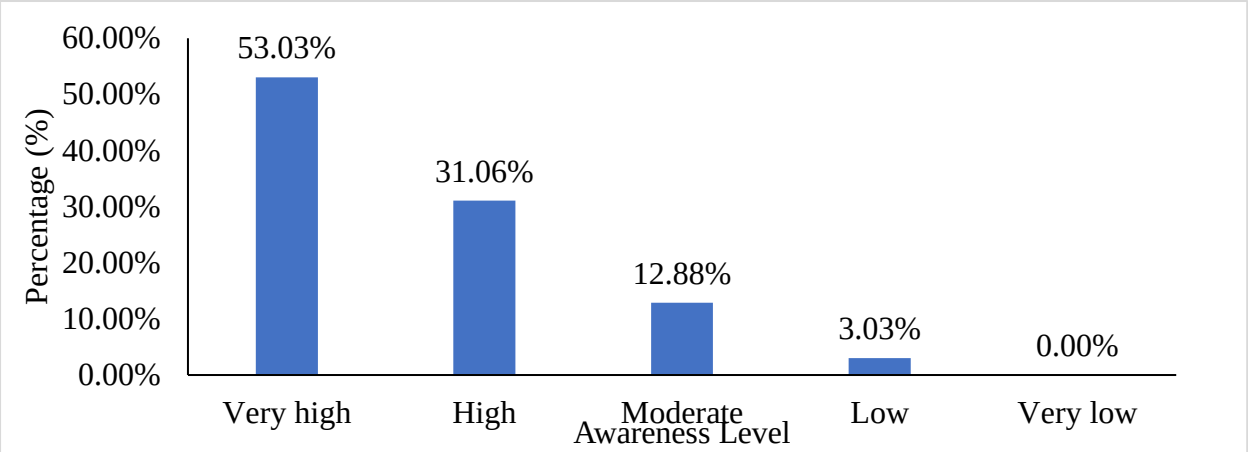

Figure 1 Awareness Level of BIM for Post-Construction Management

A similar study by Ogunmakinde and Umeh (2018) established that awareness of BIM has been rapidly growing in the Nigerian built environment industry but the understanding of the full concept is still found to be lacking among Nigerian built environment professionals. Hence, this study establishes there is now a high level of awareness of BIM for the PCM of the facility, which negates previous literature establishing a lack of awareness. However, despite the promising results on awareness of BIM for PCM in the Nigerian construction industry, there is a paramount need to transform the awareness into usage and implementation of BIM for PCM which is the most essential stage of the project lifecycle.

Usage Level of BIM-Compliant Software for Post-Construction Management

Table 2 shows the result on the usage level of some selected BIM-compliant software's for PCM. The respondents were asked to select as appropriate on a scale of (5 = *Almost Always, 4 = Sometimes, 3 = Not sure, 2 = Rarely and 1 = Not at all*) based on their level of usage. Table 2 show the result for data reliability test, reliability test is necessary to determine if the collected data is reliable and suitable for analysis. According to rule of thumb of Maree and Pietersen (2016) on interpreting Cronbach's alpha coefficient, value of 0.90 is considered strongly reliable, 0.80 is considered moderately reliable and 0.70 is considered low reliable. Based on the reliability value (0.806) show in Table 2 indicates the data for this study is reliable and suitable for analysis.

The result shows that the software's are practically not in use in Abuja by the IFMA professionals. The mean score ranges between 1.136 to 1.000 as shown in Table 3. Similarly, Table 4 shows the scale measurement for the mean as relate to table 4.3. Only seven software's have mean value higher than 1.000 which ranges from "BIM 360" (mean = 1.136; SD = 0.442; Var = 0.195) to "usBIM.facility"(mean = 1.008; SD = 0.087; Var = 0.008). Considering the scale measurement all the mean value in Table 3 fall under the scale of 0.00-1.49 which represent "not at all" level of usage. It can then be established that BIM compliant software's are not in use by the professionals.

This study established that the conventional methods are practically still in use by the professionals in Abuja to provide guidance and operate the buildings during the post-construction stage of the facilities leaving numerous benefits of BIM untapped at the post-construction stage. It is advantageous to adopt tools such as BIM to foster the performance of facilities in the post-construction phase. As stated by Faltejsek and Chudikova (2019) lifecycle of facilities requires to be maintained to foster operation at the maximum level for end users throughout the lifecycle of the building.

Table 2: Test for Data Reliability

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.806	0.858	7

Table3: Mean ranking of the identified BIM-software's for PCM

BIM-Compliant Software	**Mean**	**N**	**SD**	**Min**	**Max**	**Var**
BIM 360	1.136	132	0.442	1.000	4.000	0.195
BIMCOLLAB	1.030	132	0.245	1.000	3.000	0.060
BIMOBJECTS	1.030	132	0.348	1.000	5.000	0.121
BIM TRACK	1.030	132	0.275	1.000	4.000	0.075
LOAD PLANNER	1.023	132	0.261	1.000	4.000	0.068
REVIZTO	1.015	132	0.123	1.000	2.000	0.015
usBIM.facility	1.008	132	0.087	1.000	2.000	0.008
ECODOMUS	1.000	132	0.000	1.000	1.000	0.000
ONUMA	1.000	132	0.000	1.000	1.000	0.000
ARCHIBUS	1.000	132	0.000	1.000	1.000	0.000
YOUBIM	1.000	132	0.000	1.000	1.000	0.000
VUEOPS	1.000	132	0.000	1.000	1.000	0.000
AVAIL	1.000	132	0.000	1.000	1.000	0.000
BIMandCO	1.000	132	0.000	1.000	1.000	0.000
SEFAIRA	1.000	132	0.000	1.000	1.000	0.000
GREEN BUILDING STUDIO	1.000	132	0.000	1.000	1.000	0.000
LADYBUG	1.000	132	0.000	1.000	1.000	0.000
TRIMBLE CONNECT	1.000	132	0.000	1.000	1.000	0.000
ALLPLAN BIMPLUS	1.000	132	0.000	1.000	1.000	0.000
DROFUS	1.000	132	0.000	1.000	1.000	0.000

Note: SD = Standard Deviation: Var = Variance

Table 4: Scale Measurement for Mean

Scale	**Mean**	**Decision**
5	4.50 to 5.00	Almost Always
4	3.50 to 4.49	Sometimes
3	2.50 to 3.49	Not sure
2	1.50 to 2.49	Rarely
1	0.00 to 1.49	Not at all

This study further establishes a low level of BIM adoption for post-construction management concerning previous studies (Durdyev *et al*., 2021; Chioma *et al*., 2020; Olanrewaju *et al*., 2020; Ademci and Gundes, 2018; Olapade and Ekemode, 2018; Ikediashi and Uyanga, 2016; Akcamete *et al*., 2010).

Level of BIM Adoption for Post-Construction Management

Figure 2 shows the result when the respondent was asked to indicate the adoption level of BIM for PCM. Respondents were asked to select based on their level of agreement on a scale of (*5 = Very High, 4 = High, 3 = Moderate, 2=Low, 1 = Very Low).* The majority of the respondents are of opinion that the adoption level of BIM for post-construction management in Abuja is on the low side, as none of the respondents considered the adoption to be very high or high, 2.27% considered it as moderately adopted, 72.73% considered the adoption is low and 25.00% considered the adoption level to be very low.

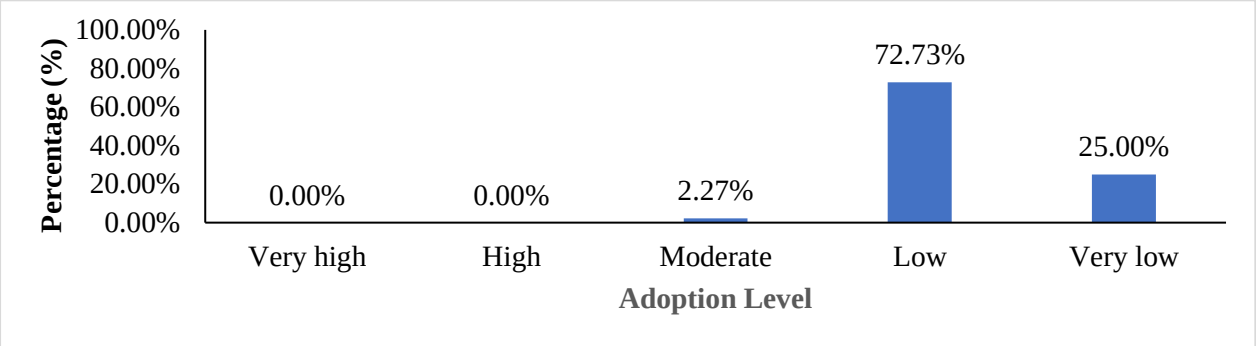

Figure 2: Level of BIM Adoption for PCM

This result further corresponds with table 4.3 investigating the usage level of BIM-compliant software's for PCM. This study establishes that there is low adoption of BIM for PCM in Abuja which is in line with and backed by the previous related studies (Bello *et* al., 2022; Durdyev *et al*., 2021; Chioma *et al*., 2020; Olanrewaju *et al*., 2020; Ademci and Gundes, 2018; Olapade and Ekemode, 2018; Ikediashi and Uyanga, 2016; Akcamete *et al*., 2010). Further, since BIM compliant software's are not in use, it explains the reason why the proficiency level is lacking among the professionals.

Conclusion And Recommendation

Conclusion

Generally, the adoption of BIM is low in developing countries, especially African nations which are considered the only continent that has not maximized the benefits of BIM. However, its adoption at PCM of the facility is lacking and almost not appearing. In the context of Nigeria where previous studies have established a low level of awareness for PCM in the construction industry, this study established that currently there is a high awareness level of BIM for PCM among professionals. Despite the high level of awareness of BIM for PCM, its adoption and implementation are low among the industry professionals as they are all still operating traditionally (manually). As indicated in the findings of the study, usage of BIM-compliant software's is insignificant which then interprets low adoption and implementation. Consequently, this study contributes to the literature indicating a low awareness level of BIM for PCM. This study set out four objectives which were adequately discussed based on the valid responses considered for the study which contribute to the body of literature and will be of benefit to both industry and academia.

Recommendation

This study recommends the construction industry stakeholders should encourage flexibility towards the adoption of new technologies to ease operations which will in turn bring about mitigating productivity challenges which have been ravaging the industry. Various organizations should encourage and provide training on BIM for PCM for their employees to increase the adoption, usage and proficiency of the BIM software's. Higher institutions offering construction-related courses should include BIM courses in their respective curriculum, this will create more awareness from the grassroots and rapid rate of experts in the handling of BIM software's. Governments have been a major driving force towards

ensuring BIM is adequately adopted and implemented in developed countries, this approach is recommended to be emulated in developing countries to foster the adoption of BIM software's.

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