

ASSESSMENT OF PRACTICABILITY AND BARRIERS OF USE OF BIM STRATEGIES FOR EFFICIENT MANAGEMENT OF PUBLIC BUILDINGS

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Abstract. The productivity of real property depends on the efficiency of the property management technique. Building Information Modelling (BIM) is an emerging technique examined. The aim of the research is to explore the practicability of BIM for the management of public buildings (PBs) and the hindrances subject to the effective operation. The tasks of the research were to investigate the awareness level of BIM for management of PBs; to investigate the acceptance level of BIM as a property management technique; to explore the hindrances of BIM use for the management of PBs; and, to assess the suitability of BIM for management of historic buildings. Survey and descriptive methods were used in the research. One hundred and nine questionnaires were distributed and a total of seventy-eight was returned. Purposive sampling technique was used for the selection of the respondents. Stratified random sampling was used to select the public buildings, while clustered sampling was used for locations. The findings of the research showed a low level of awareness from the respondents; BIM was not in use; the acceptance of BIM was high but the hindrances were numerous. The research concluded that the use of BIM was practicable given adequate awareness and training. The research recommended a paradigm shift from the traditional property management approach to BIM strategy for the effective performance of PBs.

Keywords: *BIM Awareness, BIM Acceptance, Building Information Modelling, Public Buildings, Property Management.*

INTRODUCTION

Many public institutions' buildings in Nigeria have been managed in such a manner that until there is a breakdown in the facilities, they may not receive the supposed attention that would keep them in a sustainable condition. It could be easy to form an opinion about the reasons why situations akin to that exists. It is only when an investigation embodied in research findings is undertaken that a conclusion can be drawn on the situation. However, such a scenario has been suspected to emanate from the property management strategies in use, which could not address the problem at hand on time, and the concerned management apathy in responding to the problems. In one of the research findings by Warren (2002), "many governments globally adopt a market-driven approach, subjecting non-core service delivery to competitive tendering and contracting with many services outsourced to the private sector. For instance, in Australia, the federal government undertook a

major property strategy review to implement a user-pay market system followed by comprehensive outsourcing of office property”.

The research assesses the practicability and barriers of the use of building information modelling (BIM) for efficient management of Public Buildings (PBs). Building Modelling BIM is one of the emerging techniques in building design, construction, and management. Goubau (2017) describes BIM as “a process improvement methodology that leverages data to analyse and predict outcomes throughout different phases of the building life cycle”. Since BIM cuts across building life cycle, this implicates that BIM is unavoidably required in real property management in the area of maintenance management. Sequel to this, the paper explores the practicability of BIM in PB management to identify the hindrances subject to the effective operation. The following tasks were set in the research: to investigate the level of awareness of BIM as a strategy for management of PBs; to investigate the level of acceptance of BIM as a property management technique; to explore the hindrances to the acceptance of BIM for the management of PBs; and, to assess the suitability of the extant building designs and components for the adoption of BIM strategy.

1. THE CONCEPT AND APPLICATION OF BUILDING INFORMATION MODELLING

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 Nigeria (Anih & Ajiero, 2018). A grasp of the concept of building information modelling explains its practicability for use by property managers. Shapiro (2014) observed that building information modelling is growing in concepts and tools which have been aligned with transitional potential within the Architecture, Engineering, Construction and Operations (AECO) industry”. BIM discussions have grown to accommodate increasing software capabilities, infinitely varied deliverables, and competing standards emanating from an abundance of overlapping definitions attempting to delineate the BIM term. Goubau (2017) compared BIM with the Internet in similarity as a transformative technology and stressed that much like the Internet adoption; it was initially used to automate known workflows and legacy information; as technology grows into clarity, it will soon be used to change and improve construction processes. Ilter and Ergen (2015) implied that “the owner community has not benefited from the information age, while the advent of technology has created a high level of transparency to the consumer. BIM is changing the owners’ processes and shaping the way they do business”. BIM is “a process involving generation and management of digital representations of physical and functional characteristics of a building or a facility through a holistic documentation process for operational visualization, design coordination, estimation and project scheduling” (Debasis & Raj, 2015; National Institute of Building Sciences, 2019).

Debasis and Raj (2015) emphasised BIM as the application to present objects parametrically in a virtual reality with the basic advantage of “visual coordination of the building structure and systems such as Mechanical, Electrical and Plumbing (MEP)”. The National Institute of Building Sciences (NIBS) reckons that BIM is “a digital representation of physical and functional characteristics of a facility” that serves as a “shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward”. Kreider and Messner (2013) highlighted the use of BIM as “a method of applying Building Information Modelling during a facility’s lifecycle to achieve one or more specific objectives”. The uses which they classified into five primary purposes: gathering; generating; analysing; communicating; and realising were further defragmented into eighteen (18) sub-uses to actualise BIM. Kreider and Messner (2013) argued that, „the overall classification of BIM uses allowed for better communication of the purposes and methods for implementing BIM throughout the lifecycle of a facility”. Fig. 1 shows the classification of uses and their characteristics.

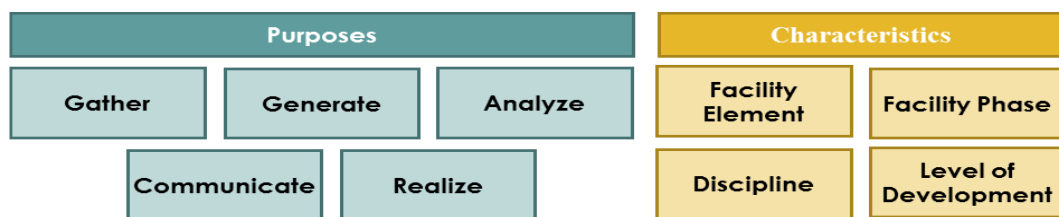


Fig. 1. The components of BIM use and characteristics (Kreider & Messner, 2013, p. 6).

BIM uses as shown in Fig. 1 are classified primarily based on the purpose of implementing BIM throughout the life of a facility. According to Kreider and Messner, (2013), several other characteristics were defined to identify and communicate BIM uses. Kreider and Messner (2013) restated that the purposes and characteristics were defined at varying levels depending upon the level of specificity required for different uses.

Fig. 2 below shows the breakdown of the BIM uses categorized into primary and secondary ones.

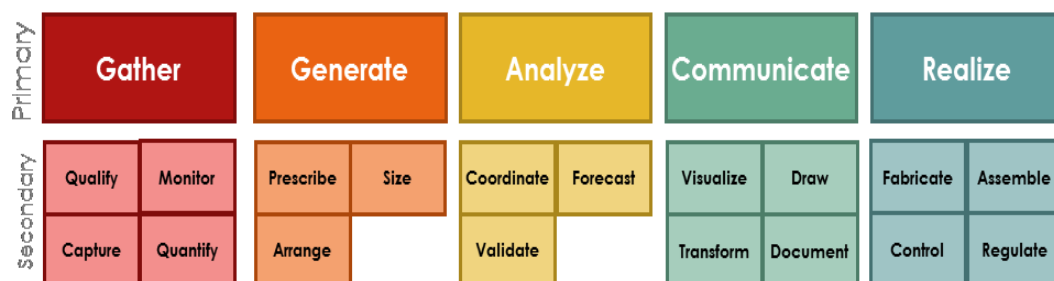


Fig. 2. The BIM uses and purposes: the primary and secondary uses of BIM (Kreider & Messner, 2013, p. 6).

The primary uses include gathering, generating, analysing, communicating and realising. The secondary uses have several items organised under specific heading under the primary uses. Kreider and Messner (2013) stated that the BIM uses and purposes communicate the primary objective of implementing the BIM. The BIM uses and purposes, shown in Fig. 2, fall into five primary categories: gathering, generating, analysing, communicating, and realising. Of these primary categories, numerous subcategories further specify the purpose of the BIM use.

1.1. Awareness of BIM for Management of Public Institution Building

The consciousness of the use of building information modelling is at the sitting stage in Nigeria's architectural, engineering and construction (AEC) industry. This statement is better interpreted to mean that the use of building information modelling is born, lives and ready to stand and walk. Anih and Ajiero (2018) observed that Nigeria is one of the nations where the concept of BIM is pictured despite the lethargy in implementing the idea. Utiome et al. (2014) observed that adopting building information modelling in the architectural, engineering and construction sector in Nigeria would set a benchmark for homogeneous practice throughout building industries. The AEC sector is encompassing in responsibility and is not limited to architecture, engineering and construction. BIM ideology is more popular within the podium of architecture, engineering and construction industry than any other profession and it is gradually creeping into other disciplines, which have realised the benefits of its application (Sarkar & Modi, 2015). Hall (2018) explains that "while BIM is mostly concerned with design and preconstruction, it is useful in every phase of the project life-cycle, even after the completion of the building construction". Hall further states that building information modelling helps the operation of the building after handing over the building which enables return on investment (ROI) during the use of the building. He notes that the use of construction software would result in an accurate and digital account of building information, which could assist in renovation and facility management throughout the lifecycle of the building. Hall highlights some of the benefits of BIM to include:

1. Better collaboration and communication;
2. Model-based cost estimation;
3. Preconstruction project visualisation;
4. Improved coordination and clash detection;
5. Reduced cost and mitigated risk;
6. Improved scheduling/sequencing;
7. Increased productivity and prefabrication;
8. Safer construction sites;
9. Better builds;
10. Stronger facility management and building handover.

Information regarding BIM awareness and usage, data representation of BIM awareness in the UK is shown in Fig. 3.

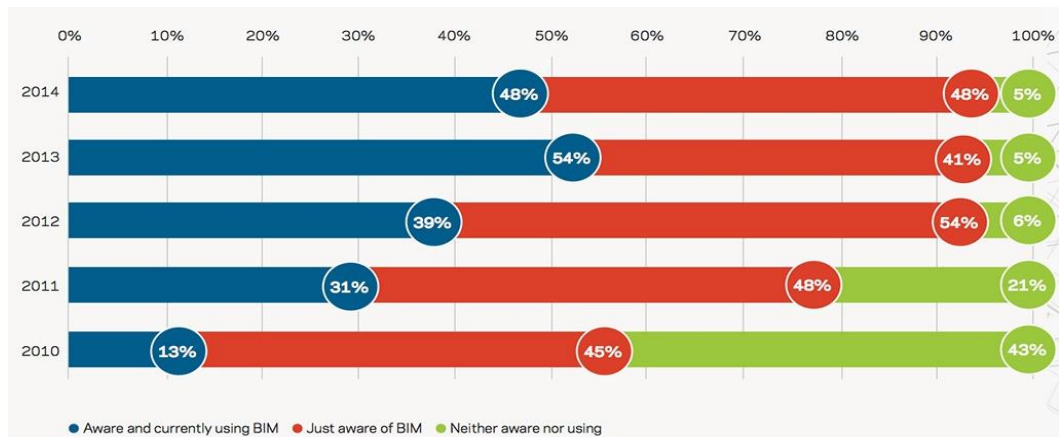


Fig. 3. BIM awareness and usage, data representation of BIM awareness in the UK (National BIM Report, 2019).

Fig. 3 demonstrates the fourth annual BIM survey in the United Kingdom. It shows a drop in the number of organisations, which claimed that they used BIM. The red colour represents the group of respondents who were just aware of BIM; the blue colour represents the group of respondents who were both aware and currently using the BIM and the green colour represents the number of respondents who were neither aware nor using it. National BIM Report (2019) expressed shock at the drop in the number of people who claimed that they used BIM. They stressed that it was the first time that the surveys they conducted for four years had dropped after the government participation in the use of BIM on all public sector contracts in 2016. A survey of over 900 respondents from across the construction industry was conducted by RIBA Enterprises. The data from RIBA, which is an offshoot of National BIM Report, show that the proportion of the firms that claimed they used BIM dropped from 54 % in the previous year to 48 % in the succeeding year. This report concluded that “there remained a significant number of practices who could not comprehend the advantages of BIM, and so chose not to adopt it, or they are currently unable to adopt BIM, because of time, cost, or expertise.”

1.2. Level of Acceptance of BIM for Property Management

Awareness of an idea is different from the acceptance of an idea, which interprets that people could be aware of ideology but may not accept it. An ideology is proved to be accepted when there is evidence of use. Acceptance is only proved by implementations and subsequent substantiation of the practicability. National BIM Report (2013) displays some countries and their status of BIM adoption in Fig. 4.

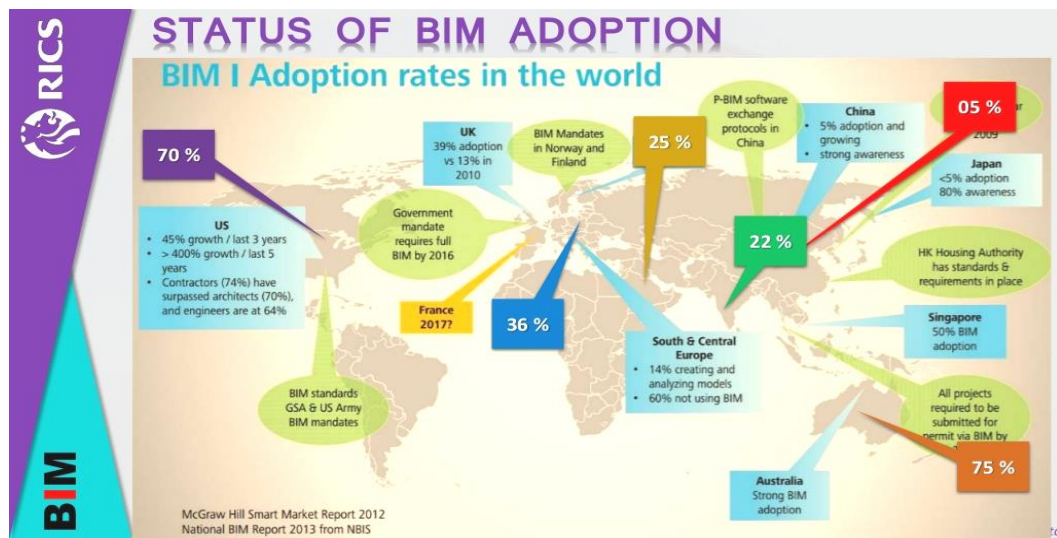


Fig. 4. Status of BIM-1 Study on BIM adoption rate in the world (Royal Institute of Chartered Surveyors (RICS), in the United Kingdom (McGraw Hill Smart Market Report, 2012, as cited in National BIM Report, 2013, p. 9).

Hindrances to acceptance and use of BIM for management of public buildings are described further.

1.3. Hindrances to Acceptance and Use of BIM for Management of Public Buildings

Kori (2013) assessed the current level of adoption of BIM in Nigeria and observed that the firms that indicated interest in accepting the use of BIM ideology were mostly large established industries. The small and medium operating industries were lethargic in adopting the use of BIM for the running of their establishments. The apathy to the use of BIM was blamed on incomprehension of the processes coupled with policy issues. In summary, even though, the large firms showed interest, they were yet to adopt the use of BIM in both construction and maintenance of their real properties. Hence, until now, the Nigerian construction industries are currently addicted to 2D traditional computer-aided design (CAD) approach even though the production could be in the 3D system. The National BIM Report (2014) identified the fourteen reasons that could be a barrier to the implementation of BIM. These barriers are presented in Fig. 5 below and are rated percent wise from the data obtained from the respondents.



Fig. 5. Hindrances or barriers to the adoption of BIM in the UK (National BIM Report, 2019, p. 22).

Fourteen (14) items have been identified as the major barriers to the implementation of BIM in the United Kingdom. The horizontal axis shows the percentage of the respective items investigated. The vertical axis shows the description of the items, which were measured. The survey portrays that “no client demand of BIM” was rated 65 %; lack of in-house expertise in the use of BIM was 63 %; the least score was obtained by “other related issues”, which was 9 %. The item “we are unsure of the government’s commitment to BIM” was 12 %. Representation of the benefits of the use of BIM is provided in Table 1, and benefits of adopting BIM in the UK are shown in Fig. 6.

Table 1. Representation of the Benefits of the Use of BIM (National BIM Report, 2019)

S/No	Items	Response %
1.	BIM is in high demand	91
2.	Coordination of construction documents	81
3.	Increased speed of delivery	55
4.	Clients need BIM	61
5.	BIM brings cost-efficiency	60

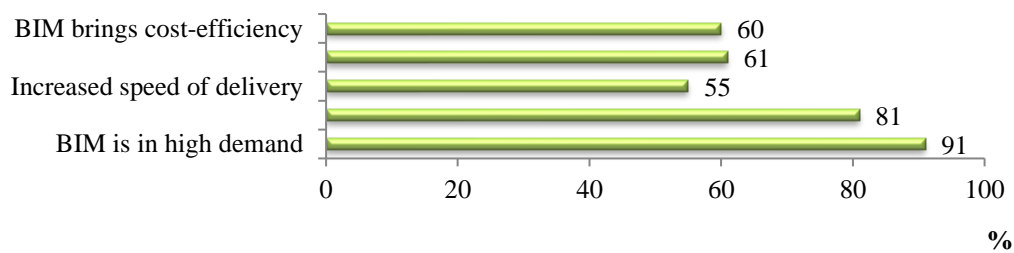


Fig. 6. Benefits of adopting BIM in the UK (National BIM Report, 2019, p. 20).

Figure 6 shows the benefits of adopting BIM despite the barriers expressed from the survey report of 2019 conducted by National BIM Report. In Fig. 6, the vertical axis displays items measured and the horizontal axis shows the percentage of responses that agreed that there are benefits in using BIM. According to the National BIM Report (2019) report, 91 % of the organisations observed agreed that BIM was in high demand. The percentage was high. 81 % of the users of BIM discovered that coordination of construction documents was improved. 55 % observed that BIM was speed-efficient in service delivery and 61 % agreed that clients need BIM.

1.4. Suitability of BIM for Management of Traditional/Historic Buildings

Traditional facilities are the real properties that provide services, which were designed without having BIM in mind. Such properties could include historic buildings and any other type of properties before building information modelling technology. Regardless of the design and production workflow established in the past, moving to BIM is going to be a change that may have to adopt a BIM kind of strategy, which is known as historic BIM. Historic BIM is, by definition, “a multi-disciplinary process that requires the input and collaboration of professionals with very different skill-sets” (Sofia, 2017). Charles (2019) argues that industrial maintenance and facility management require visibility implying that the older facilities, particularly, require centralising information. 3D models and laser scans are a simple way of capturing, storing and visualising detailed information about physical space. They are now being used proactively in construction projects, renovations and high-end manufacturing. Recently, this technology has been employed to great effect for facility management and ongoing maintenance of existing spaces. 3D models are a powerful tool for delivering and storing information. This is exactly what facility managers need to maintain operations and create a safe working environment. This information can be paired with predictive maintenance techniques to further improve facility quality control and enhance productivity. Succar (2010) and Sofia (2017) agreed that “BIM is capable of incorporating both qualitative and quantitative information about a built asset to represent physical and functional characteristics that can provide simulations of the appearance, development and performance of an asset”. Sofia (2017) further buttressed that intangible attributes, as “heritage values, could be integrated into the 3D model in a structured and consistent way, which would allow for easy information extraction and the production of deliverables”. Kumar et al. (2019) opined that “systematic approach could be needed when deciding what elements are essential to avoid an excessively complex situation”, and, introducing high-quality digital survey datasets, BIM, “would allow for the exploration and complex analysis of proposed interventions in various scenarios”.

2. METHODOLOGY AND RESULTS

The research examined two public buildings (Federal and State Secretariat) clustered in two states (Akwa Ibom and Enugu States) in Nigeria. The sample of

the research was selected from the population of the employees of federal and state ministries whose offices were located in federal and state secretariats. The sampling technique used was purposive sampling for the selection of the respondents. Stratified sampling was used to select the type of public properties, while the clustered sampling was adopted for state ones. The sample size used for the research was one hundred and nine (109) workers drawn from the Directorates of Housing in the four secretariats of both federal (Federal secretariats: Enugu, 22; Uyo, 17) and state (State secretariats: Enugu, 32; Uyo, 38). One hundred and nine questionnaires were distributed and a total of seventy-eight questionnaires were returned. The questionnaires administered contain items in structured questions in line with the objectives of the research. Table 2 contains both the number of staff from respective federal and state secretariats in Enugu and Uyo, which are the state capitals of the respective states.

Table 2. Administered Questionnaires to the Respondents
(developed by the authors)

Location	Federal Secretariat staff		State Secretariat staff		Total	
Enugu	22	41 %	32	59 %	54	50 %
Uyo	17	31 %	38	69 %	55	50 %
Total	39	36 %	70	64 %	109	100 %

Source: Authors' Field Survey, 2019

Table 2 presents the number of respondents that was also expressed in percentage. The respective percentage for each column was obtained by dividing each figure in the column by the column total and multiplied by 100. This gave the percentage of respondents from federal secretariats of Enugu and Uyo, respectively. The same method was used to obtain the percentage for state secretariats of Enugu and Uyo, respectively. Table 3 shows the returned questionnaires by the respondents observed.

Table 3. Returned Questionnaires by the Respondents (developed by the authors)

Location	Federal Secretariat staff		State Secretariat staff		Total	
Enugu	15	39 %	23	61 %	38	49 %
Uyo	13	33 %	27	67 %	40	51 %
Total	28	36 %	50	64 %	78	100 %

Source: Authors' Field Survey, 2019

The total number of questionnaires returned was seventy-eight (78) out of one hundred and nine (109) instruments distributed. This number of questionnaires returned represents about 72 % of the total instruments administered and this was used to address the objectives of the research. The percentage of the group of respondents was obtained by dividing each group by the column total and multiplied by 100. Table 4 displays the respondents' characteristics.

Table 4. Respondents' Characteristics (developed by the authors)

Characteristics	Categorisation	Federal	State	Total
Gender	Male	17	33	50
	Female	11	17	28
	Total	28	50	78
Age	Below 30	12	18	30
	Between 30–50	10	23	33
	Above 50	6	9	15
	Total	28	50	78
Educational qualification	FSLC	2	5	7
	WAEC/SSCE/GCE	8	15	23
	Diplomas (ND, HND & others)	5	12	17
	First Degrees	12	13	25
	Second Degrees (M.Sc., PGD,)	1	5	6
	Third Degrees	0	0	0
	Total	28	50	78

Source: Authors' Field Survey, 2019

The characteristic that was relevant to the research was classified into three categories: gender; age and educational qualifications. The gender shows that there was no bias in selection as male-female sex groups were included in the observation. The total number of males observed was fifty in number and the females observed were twenty-eight (28) in number, which represented 36 % of the returned instrument for the female gender and 64 % for the male gender. The age of the respondents was categorised as follows: < 30 years; between 30 and 50 years, and >50 years. The educational qualifications of the respondents were from "first school leaving certificate" (FSLC) to Doctorate Degree (PhD). Table 5 and Fig. 7 show the level of awareness of BIM as a strategy for PB management. The level of awareness of BIM as a strategy for PB management is provided in Table 5 and its visual representation – in Fig. 7.

Table 5. The Level of Awareness of BIM as a Strategy for PB Management (developed by the authors)

Items	Respondents	Percentage (%)
BIM unawareness	41	53
BIM awareness	37	47
BIM uses	0	0
Awareness through journal article	29	37
Awareness through academics	33	42
Awareness through conference	34	43
Awareness through workshop/seminar	45	58
Awareness through interpersonal discussion	13	17

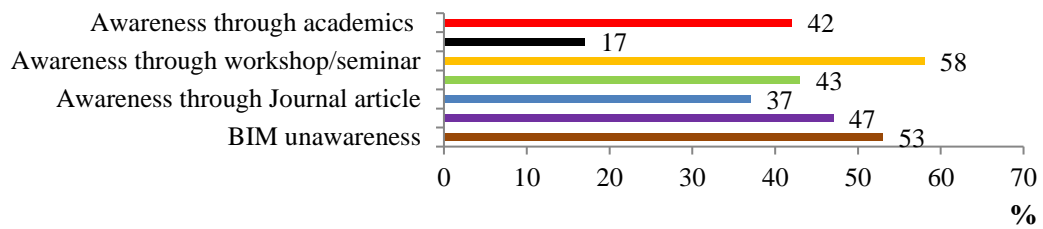


Fig. 7. The level of awareness of BIM for PB management (developed by the authors).

Fig. 7 is a bar chart representation of Table 5 above. From Table 5, it could be seen that the respondents were aware of the existence of BIM (47 %). However, there are greater number of respondents who were not aware of BIM existence (53 %). The respondents who were aware of the existence of BIM got their knowledge of BIM through various media and programmes: journals; discussion; education; conferences; workshops and seminars. The use of BIM was scored zero, i.e., the establishments did not use BIM. There are seven items at the y-axis of the bar chart which were measured by the scale at the x-axis. The scale measured the level of awareness by the respondents.

Table 6 shows that the level of acceptance of the use of BIM as a property management technique by the respondents. Eight items were listed in the table for the four secretariats. Seventy-eight (78) respondents were observed which were made up of 15 respondents from Enugu Federal Secretariat, 23 respondents from Enugu State Secretariats, 13 respondents from Uyo Federal Secretariat and 27 respondents from Uyo State Secretariat. The level of acceptance for use of BIM among the four classes of respondents was high: Enugu 87 % each for Federal and State secretariats respectively. The Uyo Federal and State secretariats were 85 % and 89 % respectively. Fig. 8 is the graph of Table 6 showing the scale on the y-axis of the measurements of the items on the x-axis.

Table 6. The Level of Acceptance of the Use of BIM Property Management (developed by the authors)

	Level of perceived acceptance of the use of BIM for management of building			
	Enugu State, Enugu		Akwa Ibom State, Uyo	
	Federal Secretariat (15)	State Secretariat (23)	Federal Secretariat (13)	State Secretariat (27)
Operations	13	20	11	24
Inspections	14	21	11	25
Repairs	12	18	12	27
Inventories	09	18	10	22
Reporting	07	21	12	18
Material costing	13	17	11	21
Performance monitoring	14	21	13	26
Safety and security	12	19	12	23

Source: Authors' Field Survey, 2019

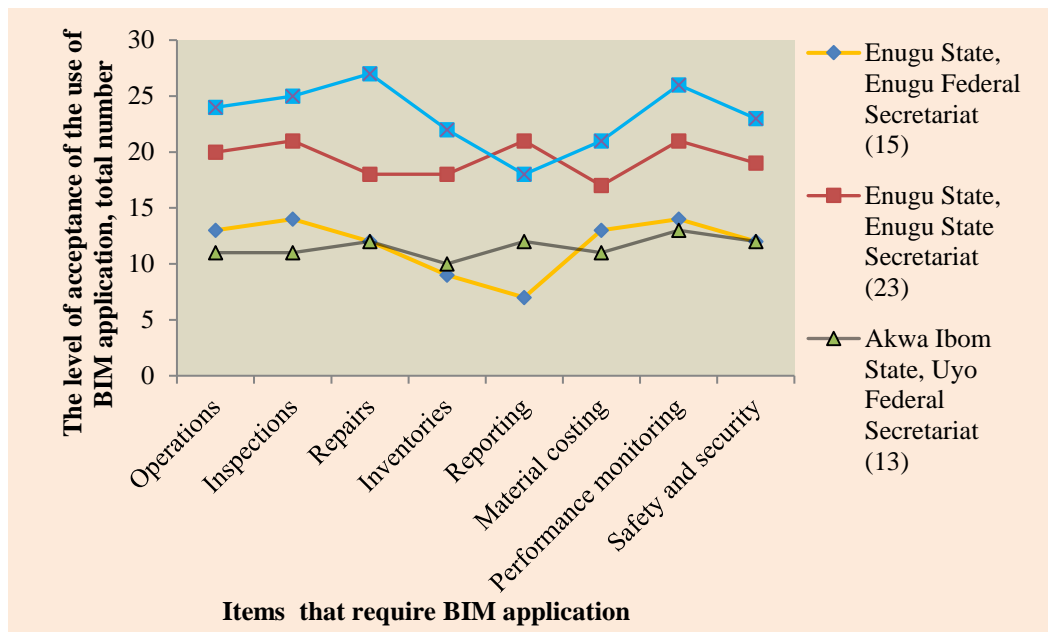


Fig. 8. Acceptance of the use of BIM for property management (developed by the authors).

There are eight items listed in Table 7, which were perceived to be hindrances to BIM implementation. Table 7 has two major sections. The sections are made up of the two states for both federal and state secretariats (Enugu and Uyo). Fig. 9 shows a graphic representation of the responses from the four secretariats observed.

Table 7. Hindrances to the Use of BIM for the Management of PBs (developed by the authors)

Perceived hindrances to the use of BIM for the management of PBs could come from	Secretariats in Enugu		Secretariats in Uyo	
	Federal (15)	State (23)	Federal (13)	State (27)
Government perception	9	21	8	15
Perceived costs	15	23	12	21
Novice	12	18	10	16
Poor staffing	11	17	9	23
Equipment	10	21	12	22
Material costing	13	17	12	25
Liability concern	12	21	8	17
Lack of standard tools	14	19	11	25

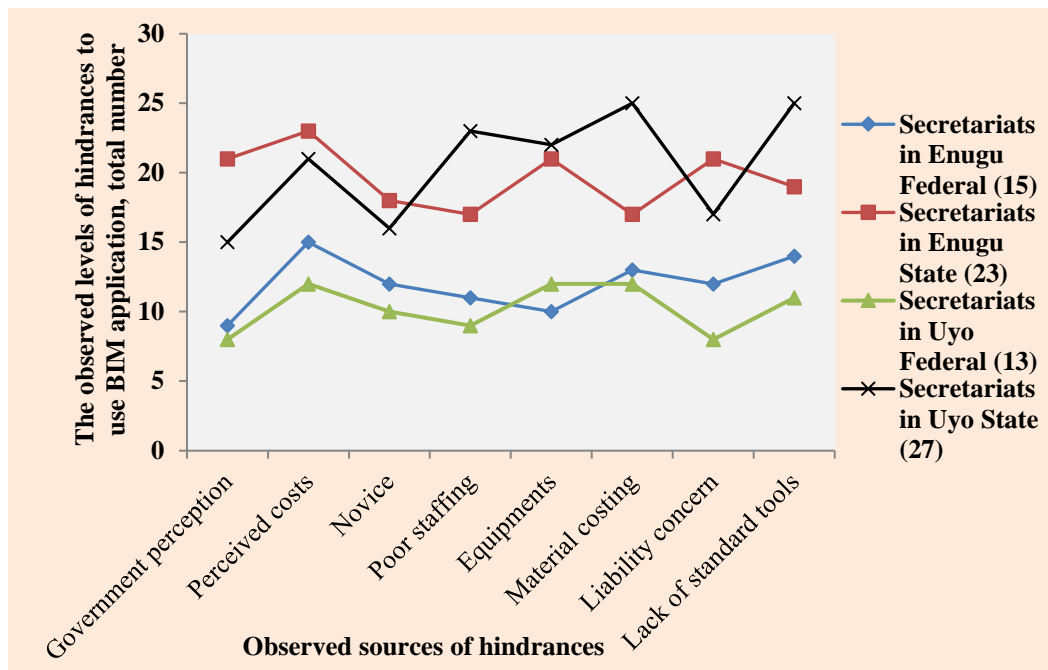


Fig. 9. Hindrances to the use of BIM for the management of PBs (developed by the authors).

In Enugu, the cost of implementing the BIM received the highest response rate, while in Uyo, cost, equipment and materials (12) were considered to be the perceived major hindrances. The respondents at the State Secretariat in Uyo indicated that a lack of standard tools and material costing were to be perceived hindrances to BIM implementation in the state. The suitability of the use of BIM for the management of the existing building designs and components is demonstrated in Table 8 and 5-point Likert scale of the suitability of the use of BIM for the management of the existing building is shown in Fig. 10.

Table 8. The Suitability of the Use of BIM for the Management of the Existing Building Designs and Components (developed by the authors)

S/No.	The suitability of the use of BIM for the management of historic building designs and components	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	Information	24	34	10	10	0
2.	Condition monitoring	18	23	21	8	11
3.	Conservation planning	17	34	18	6	3
4.	maintenance	12	17	19	23	7
5.	Asset management	17	18	11	22	10
6.	Heritage management	11	14	32	9	12
7.	Visitor management	19	26	13	12	8

8.	Intervention appraisal	22	33	13	6	4
9.	Work programming	38	20	13	7	0
10.	Renovation simulation	27	33	18	0	0
11.	Repair management	18	21	17	19	3
12.	HSSE planning	12	23	33	10	0
13.	Disaster preparedness	23	27	23	5	0

Source: Authors' Field Survey, 2019

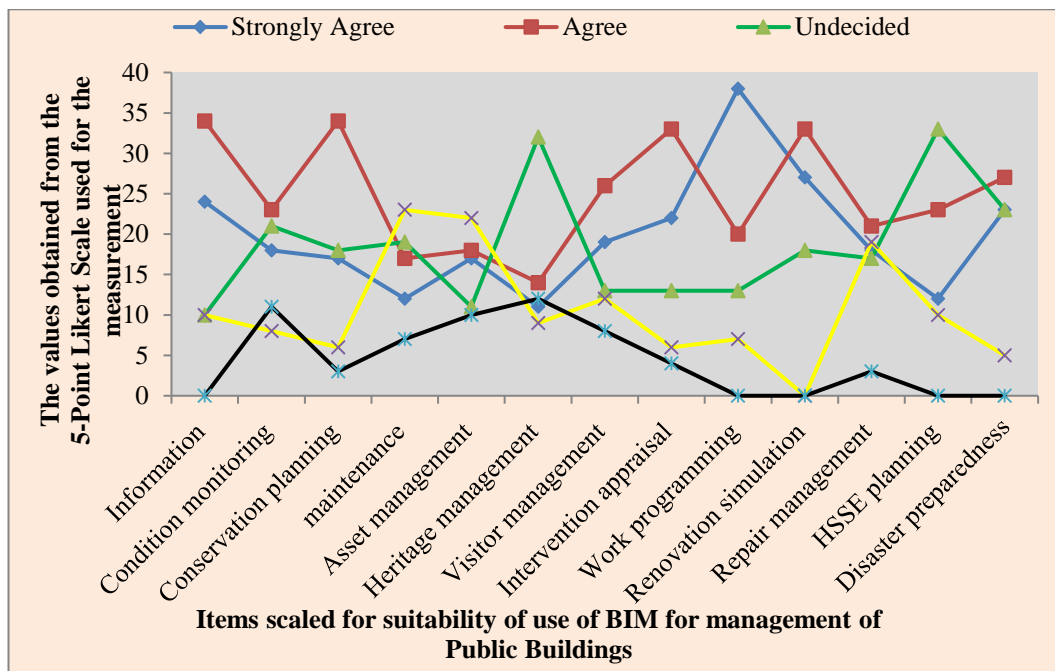


Fig. 10. 5-point Likert scale for the suitability of the use of BIM for the management of the existing building (developed by the authors).

In Table 8, the 5-point Likert scale was used to measure the responses from the respondents in both Enugu and Uyo. The respondents from various secretariats were merged to obtain a total of seventy-eight (78) persons. The items of the scale are: Strongly agree; agree; undecided; disagree and strongly disagree. The items of the building measured were nine (9) in number. The number of respondents, who agreed that BIM strategy, could be suitable for the management of existing or pre-BIM buildings was highest according to the 5-point Likert scale compared to those who strongly agreed, undecided, disagreed and strongly disagreed. The implication is that the property management team observed, agreed that BIM strategy was suitable for management of properties/buildings which were built before BIM emergence for information repository, condition monitoring, asset management, renovation simulation, etc.

Fig. 10 above shows the graphical depiction of the items of the 5-point Likert scale. The responses can be seen from the legend, where various colours represent

different items according to the 5-point Likert scale. The graph of agreeing which is in red has its point almost high above many of the other graphs.

Discussion of the Findings

The finding from Table 5 shows that the level of awareness (47 %) of the existence of BIM is lower than the level of unawareness (53 %) and that the use of BIM is zero percentage. The finding reveals that the awareness of BIM came through academic involvement, journal articles, conferences, workshops and seminar programmes. These findings agree with some of the literature reviewed, for instance, Anih and Ajiero (2018) observed that the use of BIM in Nigeria was pictured but not implemented.

The findings from Table 6 and Fig. 8 reveal that the level of acceptance of BIM was investigated. At the four workplaces (two federal and two state secretariats) in Enugu and Uyo, there were acceptance (> 50 %) for all the items observed. Table 7 and Fig. 9 displayed the likely hindrances to the implementation of BIM. The finding shows that the policy, education, personnel and finances could likely be barriers to the implementation of BIM. The perception was based on the four Secretariats observed. This agreed with the experiences of some organisations using BIM (National BIM Report, 2019).

Despite the hindrances observed in the implementation of BIM, the need to verify the suitability of use of BIM for the management of pre-BIM properties was investigated. 5-point Likert scale was used to measure the responses (see Table 8). Majority of the respondents agreed that BIM could be suitable for management of pre-BIM properties. Charles (2019) restated that industrial maintenance and facility management require visibility which interprets that the older facilities could benefit from BIM strategy.

CONCLUSION

The research concludes that it is practicable to adopt Modelling BIM for use as a strategy for efficient management of public buildings. The barriers to adoption of BIM for use in the management of public buildings were inevitable but could be untied by involving the government, educational institutions, and researchers. A greater numbers of respondents were not aware of BIM due to limited information and exposure. The level of acceptance was encouraging and this could be a sign of readiness for the use of BIM. The use of BIM is comprehensive and can be adopted for both construction and operation of buildings.

Recommendations

The following recommendations will help in actualising the use of BIM for management of public buildings:

1. Adequate awareness strategy should be carried out through educational institutions, conferences, workshops and seminars;
2. The government should create and develop a functional environment through efficient and realisable policy;

3. Barriers to the implementation of BIM should be identified and adequate measures should be taken to control and eliminate them;

4. BIM is an information and communication technology friendly tool; this implies that human and material resources should be effectively planned to make the strategy suitable for the intended use.

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