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Application of Building Information Modelling (BIM) for Project Management by Building Construction Practitioners in Akwa Ibom State

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Abstract
This study investigated application of Building Information Modelling (BIM) for project management by building construction practitioners in Akwa Ibom State. In line with the specific purposes of the study, eight research questions and eight hypotheses guided the study. The study employed a descriptive survey research design. The population of the study was 401 building construction practitioners in Akwa Ibom State with a sample size of 114, drawn using cluster and simple random sampling techniques. The instrument for data collection was a structured questionnaire titled 'Application of Building Information Modelling for Project Management Questionnaire (ABIMPMQ)' which contained a total of 76 items built in eight clusters to address the research questions. The instrument was validated by three experts, two in the Department of Industrial Technology Education (Building technology option) and one in the Department of Measurement and Evaluation, all from the University of Uyo, Uyo. The reliability of the instrument was determined by trial testing the instrument on twenty (20) practitioners in the building industry in Akwa Ibom State who were not part of the Study. The Cronbach Alpha procedure was used to compute the estimate of internal consistency of the instrument and yielded the reliability coefficient of 0.85. Some questionnaires administered were retrieved on the spot while some were retrieved a day after with the help of three research assistants. The data collected were analysed using descriptive and inferential statistics. The Mean and Standard Deviation were used to answer the research questions, while one sample t – test was used in testing the hypotheses at 0.05 level of significance. Findings revealed that the extent of application of BIM in designing, scheduling, quantity take – off, visualisation, clash detection, and constructability analysis of building construction projects by building construction practitioners in Akwa Ibom State is low and not significant but only high and significant in risk control and facility management. Based on the findings, the study concludes that the extent of BIM application in building construction among practitioners in Akwa Ibom State is low. The researcher therefore recommends among others that the state government should formulate and enact acceptable policies that will encourage compulsory use of BIM among building professionals in construction industries in Akwa Ibom State so as to maintain global standard.

Key Words: Application, Building Construction, Building Information Modelling, Project Management

Introduction:

Building construction is an ancient human activity. It began with the need for a controlled environment to moderate the effects of climate. Constructed shelters were one means by which human beings were able to adapt themselves to a wide variety of climates. The history of building construction began from the period of primitive humans. As a way of protection against cold, rain, and heat, the primitive man-made caves as his shelter. A shift from caves ushered in the era of huts made from straws and leaves. In the search for better comfort, building construction got evolved and still evolving towards tackling the future upcoming challenges relating to security, business, industries, education and the economic sector among others. The need to tackle these challenges has led to the construction of various building structures in our societies among which are residential buildings, educational buildings, institutional buildings and industrial buildings. As opined by Zhao et al (2016), the functionality of these buildings to serve their intended purpose depends largely on management practice by building construction practitioners.

Building construction project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction. Construction project management as defined by Anastasios (2019) is the direction, regulation, and supervision of a project from early development to completion. It involves developing a project road-map, defining roles and responsibilities, setting scope and baselines, scheduling, developing the modification process, developing and implementing the quality plan, developing a communication plan and the construction process. Anastasios (2019) sees building construction project management as consisting of project initiation and conception, project planning and definition, project execution and launch; and project performance. Researchers including Kushwaha (2016), Nerija, and Audrius, (2012), and Sebastine (2011) agree that the ultimate goal of construction project management is the full satisfaction of the client's demand for a viable project both in terms of functionality and budget. To achieve efficiency and effectiveness of the construction project for the client's satisfaction, application of Building Information Modelling (BIM) in building construction management becomes essential.

Modelling is a simplified representation, structurally designed and used to explain the workings of a real world system. It is used to represent and show what an ideal system or project looks like. Building Information Modelling (BIM) is a digital representation of the physical and functional characteristics of a facility throughout its life cycle from inception to completion. BIM model gives the digital representation of the intended project in a virtual environment. The BIM software is a software designed to give a precise digital model of how

a facility is digitally constructed. According to Eastman *et al* (2011), the BIM model when generated gives an accurate dimension and a detailed data that will be required in the design, procurement, and material fabrication, and construction activities for the realization of the building into reality. At the post construction stage, the model can be utilised for operational management and maintenance of the facility.

As noted by Bazjanac (2016), the BIM illustrates the geometrical details, geographic data, spatial correlations, cost schedules, material estimates, quantities and details of building components together project schedule. The BIM model can be employed to display the complete details of building from inception to completion. Consequently, quantities and related material properties can be easily obtained. The scope of work can be simply separated and outlined. The sequence, assemblies and systems can be illustrated in a virtual scale in the entire facility. Contract documents which contains the drawings, procurement and tender documents, and other construction details can be clearly connected using BIM (Khemlani *et al*, 2016).

BIM can be seen as a simulated process that incorporates all areas, specialties, and approach to a single facility within a digital model, by giving access to all professionals to work together professionally and correctly than using traditional methods. Carmona and Irwin (2007) opined that when the model is generated, the model is subjected to constant review and adjustment to suite the drawing specification and model modifications to ensure accuracy as imaginable as possible before the implementation of the project. It is worthy to note that BIM is not just an ordinary software, it is a method and software. The BIM is not just using 3D model tools but also a means for making considerable modifications in the project delivery processes. BIM represents a new concept in Architectural, Engineering and Construction (AEC) industry that promotes collaboration of relevant stakeholders on a project. As opined by Bynum et al (2013), BIM has the ability to encourage better efficiency and coordination among the project team members who see themselves as adversaries in the past. BIM is a novel project delivery process that integrates systems, people and business practices in a collaborative manner to minimize waste and maximize efficiency throughout the project lifecycle. A project lifecycle can be defined as the process that involves different phases of work from inception to completion. The processes involve the extraction of raw materials, manufacture building materials, assembling of materials on-site, usage of facility, facility management, maintenance and repair, demolition and disposal and recycling of the materials.

BIM is considered as a multidimensional interrelatedness of social and technical aspect which merges artificial technology and social aspect and establish the significance of its implementation in the organisation. The most essential technical aspect of the BIM software is that it enables data management and 3D modelling (McGraw, 2013). The BIM software is specifically manufactured and designed by vendors to work within the BIM framework, and

gives room for modification for long term purposes and for maintenance purposes into the model. Among the commercially available BIM software in the market is the Autodesk Revit which allows the operator to design a facility, structure together with its other components in 3D or 4D model form. The BIM software uses the latest digital technology in creating a model. A model in BIM according to Buyle (2013), is a digital illustration of an object or a concept ordinarily with a precise degree of abstraction.

BIM serves as a shared knowledge resource for information about a facility and provides a reliable basis for decisions during the entire life cycle of the project. According to Xiao and Noble (2014), BIM is an innovative design tool which has changed a lot in the construction industry. As reported by Bryde, *et al* (2013), BIM is a suitable tool for management of various phases of the construction projects such as project procurement, execution, and facility management. There is a need to manage the asset from inception through to operation and end of life. Construction managers need to understand, interrogate, contribute and validate BIM data, to maximise its benefits. They need to harness the value of data by using model information and new ways of working to better support new construction techniques, scheduling, cost, quality, coordination, fabrication, sequencing and facilities management to name but a few. To be able to tackle this expanded role of the construction manager he needs to consider new tools, processes, and skillsets offered by BIM.

As opined by Nasila and Cloete (2018), BIM is used in pre-construction, construction, and post construction stages of building projects. In pre – construction stage, BIM is used for designing, scheduling, quantity take – off, and visualization of building construction projects. At the construction stage, they assert that BIM is useful in clash detection, constructability analysis, and risk control, while being used at post construction stage in facility management of building construction projects. Sarkar and Modi (2015) conclude that BIM can be applied in the pre-construction phase for conceptual design, sketching, space planning, site inventory, and guaranteeing programme consistency with respect to site-related variables. At the construction stage, Yamazaki et al (2014) note that basic investigation in the construction procedure, mechanized crash checking innovation, continuous construction simulation, and 3D estimation innovation are keys to productively utilizing BIM during construction. In the post-construction stage, BIM keeps track of built asset, manages facilities proactively, enables scheduled maintenance, and provides a review of maintenance history (Latiffi *et al*, 2013). Sarkar and Modi (2015) further emphasize that, in this stage, BIM allows facility management to be implemented in relation to renovations, maintenance, operation, cost estimation by investigating the quantities of materials, and construction sequencing to make scheduling more consistent.

Application refers to the use or act of directing or referring something to a particular case. Application of BIM in this study refers to the use of BIM for project management by building construction practitioners. Cao *et al* (2014) listed the applications of BIM in construction projects to include design coordination, energy performance simulation, scheduling and quantity take-off, clash detection and 3D visualization. The forgoing implies that BIM finds applications in designing, scheduling, quantity take – off, visualization, clash detection, constructability analysis, risk control, and facility management of building construction projects. Each of these shall be discussed beginning with applications of BIM in designing of building construction projects.

Applications of BIM in designing of building construction projects involves the use of BIM authoring tools by architects to create a digital 3D model of the building which allows them to see a representation of what it will look like and how it will operate. According to Tahir et al (2017), it is the process of taking a client's requirements for a new building or changes to an existing building and translating them into an agreed design using BIM. It involves the use of BIM by construction workers to translate the ideas and rough sketches of engineers, architects and scientists into detailed drawings. The drawings provide visual guidelines, showing the technical details of the structures, specifying dimensions, materials to be used, and procedures and processes to be followed. A building design is a detailed blueprint of the construction work from inception to completion. It specifies the space available for the construction work, what needs to be done, and how it should be done. This is chiefly the business of architects. In designing building construction projects, BIM finds application in site planning and analyses, hosting of 3D modelling, generation of accurate and consistent 2D drawings, scheduling, and collaboration among others Kjartansdóttir, and Snæbjörnsson (2015). As noted earlier, BIM can also be used in scheduling of building construction projects.

Scheduling is described as the process of a 4D model used to plan the phased occupancy in renovation, addition, retrofit, or to show the construction sequence, and space requirements on a building site. A 4D modelling is a very powerful visualization and communication tool that can give project stakeholders a much better understanding of the project. According to Dim et al (2015), application of BIM in Scheduling involves the use of BIM to communicate how the job would-be run-in terms of time and sequence. It involves the linking of objects from the 3D model to a task in the construction schedule, using a 4D scheduling tool like Vico Office, Synchro, or Navisworks. This approach as affirmed by Azhar *et al* (2012) is changing how complex projects are planned, making it possible to visualize the whole construction project or just some phases of it, and see how timing of tasks affect the workflow. This includes comparison of planned versus actual schedules; time-based clashes, such as verifying the planned sequence towards constrained activities (i.e. demolition, permanent construction and temporary construction), site utilization planning and more. A 4D model can be used at all

stages of the project. During the conceptual design, it can be used to discuss site logistics. During the construction phase it can be used to validate costs of completed work, demonstrate work to owners, provide health and safety instructions and justify subcontractor billings to the owner for completed work. As applicable in scheduling, BIM is also used in quantity take – off and estimation of building construction projects.

Application of BIM in quantity take – off and estimation of building construction projects involves the use of Information models to generate accurate cost estimates at a faster rate of modelled materials. Here the model is linked to a cost database, which then computes a cost estimate. Kjartansdóttir, and Snæbjörnsson (2015) avers that BIM can be used to provide more accurate cost information to the owner during the early decision-making phase of building design and throughout the lifecycle of the building, including changes during construction. It allows estimators to focus on more value adding activities in estimating such as: identifying construction assemblies, generating pricing and factoring risks, which are essential for high quality estimates. According to Kjartansdóttir and Snæbjörnsson (2015), added to a construction schedule (such as a 4D Model), a BIM developed cost estimate can help track budgets throughout construction and help reduce time on quantity take-offs and cost estimations.

There is a very limited awareness and knowledge of BIM technology in Nigeria (Onungwa *et al*., 2017); and this is generally associated with lack of awareness of the concept, or lack of trained staff on the BIM tools or both (Abubakar et al., 2013; Onungwa *et al.*, 2017). Kori and Kiviniem (2015) reveals that large and medium firms were found to be leading the BIM application in the Nigerian Architectural Engineering and Construction (AEC) industry while the small firms are less advanced regarding policy and process adherence therefore has less adoption. Primarily, the Nigerian construction industry is fragmented as all the professionals are generating information and managing them separately (Onungwa *et al*., 2017). Structural and services designs are still on conventional CAD (2D) system with few (mostly Architects) utilising 3D CAD system for visualisation purpose (mostly) or as a presentation drawing (Hamma-adama *et al* 2017; Kori, 2015).

Ultimately, the culture of the industry is very conventional, hence require behavioural change which is the most difficult move amongst the successful BIM adoption and application (Hardin and McCool, 2015). Change is possible only when people are aware of BIM application in Nigeria. In view of the varied benefits and usefulness of BIM to the construction industry and the challenges to its adoption and application in Nigeria, it becomes imperative to determine the extent of application of BIM in building construction project management by building construction practitioners in Akwa Ibom State.

Statement of the Problem

The need for the application of the Building Information Modelling (BIM) technology in the construction industry especially in developing countries like Nigeria has become very pertinent. Building Information Model (BIM) in construction design is regarded as an alternative approach for design which makes it easy to present digital designs which contains all the necessary information about the proposed project before it is constructed. BIM is an innovative design tool which has changed a lot in the construction industry such as project procurement, execution, and facility management. Without any doubt, the level of integration available in the application of the BIM technique has resulted in it being regarded as the next cutting edge in construction technology.

Developed countries have adopted the use of Building Information Modelling (BIM) technologies in both small- and large-scale capacities. BIM is an intelligent 3D model-based process that equips architecture, engineering and construction professionals with the insight and tools to more efficiently plan, design, manage and construct buildings and infrastructure. Using a BIM methodology improves collaboration and ensures a new level of control over projects of all sizes. Better project outcomes are achieved through a complete flow of information among applications and across distributed project teams for greater accuracy. The adoption and application of BIM does not only enhance profit and productivity in the built industry but also increase efficiency and effectiveness.

It is no longer news that relationships in the construction industry in Nigeria over the years have been poor. Not only has this situation resulted in haphazard implementation and uncontrolled quality of projects, the frequent break-downs in communication have also led to increased costs, prolonged project execution time and most times, abandoned projects. The alarming cases of collapsed buildings in Nigeria only point to the sub-optimal constructions which fall short of global standards. In the past few years, there has been several cases of collapsed buildings in Nigeria resulting in the loss of lives and properties. A case in point is the recent collapse of storey buildings in Akwa Ibom State and in Lagos State which claimed many lives. Building collapse in Nigeria has been attributed to a number of factors including sub – standard or poor-quality building materials, design issues, construction issues, weak foundation, structural overloads, and incompetence of construction workers. BIM addresses these issues and its application for building construction project management by building contractors in Nigeria is expected to reduce the menace of building collapse and its associated problems. The heavy dependence of many construction firms on traditional ways of communication, such as exchange of drawings and associated paper documents underscores the need for an adoption of the BIM system in modern-day projects.

In a bid to embrace the global construction trend, the Nigeria Institute of Quality Surveyors (NIQS) has called upon the government to support the development of BIM technologies through funding and implementation of laws for the construction industry. The institute urged all the stakeholders and professional bodies of the construction industry to create awareness on the application of BIM for projects, to assume the new roles defined by BIM in their service delivery, and the Bureau of Public Procurement to encourage and subsequently make the use of BIM mandatory on projects of certain magnitude as a starting point.

Literature has also revealed that the BIM concept seems relatively new in Akwa Ibom State. This suggests that the construction industry in Akwa Ibom State may still be struggling to adopt and fully maximize the potentials and gains of BIM to develop the sector. This study therefore seeks to determine the application of BIM for building construction project management by building construction practitioners in Akwa Ibom State.

Purpose of the Study

The general purpose of this study was to determine the extent of application of Building Information Modelling (BIM) for project management by building construction practitioners in Akwa Ibom State. Specifically, the study sought to:

1. determine the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State.
2. determine the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State.
3. determine the extent of application of BIM for quantity take – off of building construction projects by building construction practitioners in Akwa Ibom State.

Research Questions

The following research questions guided the study

1. What is the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State?
2. What is the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State?
3. What is the extent of application of BIM for quantity take – off of building construction projects by building construction practitioners in Akwa Ibom State.

Null Hypotheses

The following null hypotheses were posed for the study

1. The extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State is not significant.
2. The extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State is not significant.
3. The extent of application of BIM for quantity take – off of building construction projects by building construction practitioners in Akwa Ibom State is not significant.

Methodology

This study employed a descriptive survey design. The use of this design is considered appropriate because it will establish the opinions of building construction practitioners on the extent of application of BIM for building construction project management in Akwa Ibom State. The study was conducted in Akwa Ibom State. Akwa Ibom is one of the 36 states in Nigeria, located in the coastal southern part of the country. It lies between latitudes $4^{0}32^{'}$N and $5^{0}33$'N, and longitudes $7^{0}25^{'}$E and $8^{0}25^{'}$E. The state is located in the South – South geopolitical zone, and is bordered on the east by Cross River State. The population of this study was 401 building construction practitioners. This consisted of registered professionals in the building construction industry in Akwa Ibom State, obtained from the directories of professional bodies in Nigeria. (https://www.vconnect.com › Akwa Ibom).

The sample size for this study was One Hundred and fourteen (114). A cluster and simple random sampling techniques was adopted in selecting the sample. The population was grouped into three clusters to represent three senatorial districts of Akwa Ibom State namely: Uyo, Ikot Ekpene, and Eket. A Simple random sampling technique was adopted to select the sample size of 38 from each cluster. (See Appendix II for sample distribution by cluster). This was to ensure that each member of the population has equal chances of being selected for the study. Questionnaire titled Extent of Application of Building Information Modelling for Project Management Questionnaire (EABIMPMQ) was used for data collection. The questionnaire was developed by the researcher and structured based on the research questions. The questionnaire contained a total of 30 items built in three clusters: A, B and C with 10 questions in each cluster to address the research questions. The three clusters therefore consisted of items structured to address the three research questions that guided the study. A five-point rating scale was provided in each of the clusters for the respondents to make their responses as follows: Very High extent (VHE), High Extent (HE), Moderate (M), Low Extent (LE), and Very Low Extent (VLE). The scale was weighed 5, 4, 3, 2, and 1 respectively.

The face validation of the instrument was done by three experts, two in the Department of Industrial Technology Education (Building technology option) and one in the Department of Measurement and Evaluation, all from the University of Uyo, Uyo. The experts were asked to assess the suitability of the language, adequacy and relevance of the items in addressing the

research questions, bearing in mind the purpose of the study. Their corrections and comments were used to modify the questionnaire before producing the final copy. The reliability of the instrument was determined by trial testing the instrument on twenty (20) practitioners in the building industry in Akwa Ibom State who were not part of the sample of the Study. The Cronbach Alpha procedure was used to compute the estimate of internal consistency of the instrument so as to determine the reliability coefficient. The instrument yielded the reliability coefficient of 0.85. This showed that the instrument was reliable to be used for the study.

The researcher with three research assistants administered and collected the questionnaire. The research assistants were instructed on how to administer the questionnaire to ensure high return rate. Some questionnaires administered were retrieved on the spot while some were retrieved a day after.

The data collected were analysed using descriptive and inferential statistics. The Mean and Standard Deviation were used to answer the research questions, while one sample t – test was used in testing the hypotheses at 0.05 level of significance. The mean value of 3.0 was used as a decision rule in answering the research questions. Any item with the mean value below 3.0 was considered as low, while the mean value of 3.0 and above was considered as high. As for the hypotheses, in a situation where calculated p value is greater than the critical value of 0.05, the null hypothesis was retained. If the calculated p value is less than or equal to the critical value of 0.05, the null hypothesis was rejected for the alternative.

Results

Research Question 1: What is the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State?

Table 1: Extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State

Variables	n	$\bar{X}$	SD	Weighted mean	Remark
Building construction practitioners	114	22.27	2.20	2.22	Low extent

In Table 1, the result revealed that the mean rating of building construction practitioners on application of BIM for designing of building construction projects is 22.27 and the weighted mean of items is 2.22. Since the weighted mean of items is less than the benchmark of 3.0, it

is regarded as low extent. This implies that the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State is low.

Research Question 2: What is the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State?

Table 2: Extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State

Variables	n	$\bar{X}$	SD	Weighted mean	Remark
Building construction practitioners	114	24.64	3.28	2.46	Low extent

In Table 2, the result revealed that the mean rating of building construction practitioners on application of BIM for scheduling of building construction projects is 24.64 and the weighted mean of items is 2.46. Since the weighted mean of items is less than the benchmark of 3.0, it is regarded as low extent. This implies that the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State is low.

Research Question 3: What is the extent of application of BIM for quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State.?

Table 3: Extent of application of BIM for quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State

Variables	n	$\bar{X}$	SD	Weighted mean	Remark
Building construction practitioners	114	25.362	2.89	2.53	Low extent

In Table 3, the result revealed that the mean rating of building construction practitioners on application of BIM for quantity take–off of building construction projects is 25.36 and the weighted mean of items is 2.53. Since the weighted mean of items is less than the benchmark of 3.0, it is regarded as low extent. This implies that the extent of application of BIM for

quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State is low.

Null Hypothesis 1: Extent to which building construction practitioners do apply BIM for designing of building construction projects in Akwa Ibom State is not significant.

Table 4: Summary of one sampled t-test on extent to which building construction practitioners do apply BIM for designing of building construction projects in Akwa Ibom State

Variable	$\bar{X}$	SD	df	t	P=0.05	Decision
designing	22.27	2.20	113	108.045	.671	**

*note ** = p is not significant*

The result in Table 4 revealed that the calculated t = 108. 045, and p = .671 at 113 degree of freedom. Since the p value is greater than 0.05 level of significance the null hypothesis which stated that the extent to which building construction practitioners do apply BIM for designing of building construction projects in Akwa Ibom State is not significant is retained. This implies that the extent to which building construction practitioners do apply BIM for designing of building construction projects in Akwa Ibom State is not significant.

Null Hypothesis 2: Extent to which building construction practitioners do apply BIM for scheduling of building construction projects in Akwa Ibom State is not significant.

Table 5: Summary of one sampled t-test on extent to which building construction practitioners do apply BIM for scheduling of building construction projects in Akwa Ibom State

Variable	$\bar{X}$	SD	df	t	P=0.05	Decision
scheduling	24.64	3.28	113	79.97	.439	**

*note ** = p is not significant*

The result in Table 5 revealed that the calculated t = 79.97 and p = .439 at 113 degree of freedom. Since the p value is greater than 0.05 level of significance the null hypothesis which stated that the extent to which building construction practitioners do apply BIM for scheduling of building construction projects in Akwa Ibom State is not significant is retained. This implies that the extent to which building construction practitioners do apply BIM for scheduling of building construction projects in Akwa Ibom State is not significant

Null Hypothesis 3: Extent to which building construction practitioners do apply BIM for quantity take–off of building construction projects in Akwa Ibom State is not significant.

Table 6: Summary of one sampled t-test on Extent to which building construction practitioners do apply BIM for quantity take–off of building construction projects in Akwa Ibom State

Variable	$\bar{X}$	SD	df	t	P=0.05	Decision
quantity take–off	25.36	2.89	113	93.58	.560	**

*note ** = p is not significant*

The result in Table 6 revealed that the calculated t = 93.58 and p =. 560 at 113 degree of freedom. Since the p value is greater than 0.05 level of significance the null hypothesis which stated that the extent to which building construction practitioners do apply BIM for quantity take–off of building construction projects in Akwa Ibom State is not significant is retained. This implies that the extent to which building construction practitioners do apply BIM for quantity take–off of building construction projects in Akwa Ibom State is not significant.

Discussion of Findings

Application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State

The result as indicated in Table 1 showed the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State. The result revealed that the extent of application of BIM for designing of building construction projects by building construction practitioners in Akwa Ibom State is low. The corresponding hypothesis as shown in Table 4 also revealed that, the extent to which building construction practitioners do apply BIM for designing of building construction projects in Akwa Ibom State is not significant. The result could be explained based on the fact that construction practitioners are often prone to making mistakes while at site and as such fail to reduce the number of errors and clashes substantially in buildings. When all the components of the building are constructed on a computer, the construction expert can detect the clashes and also resolve them. In the final design, everything will be sorted out to create a flawless construction outlay. Thus, the finding agrees with that of Tahir et al (2017) who conducted a study on the Applications of BIM in Malayan Construction Industry. The result of the analysis showed that "quantity take-off and estimation", "clash detection and coordination", "integration and collaboration of stakeholders", and "design and visualisation" were the main applications of BIM in Malaysia.

As discussed in the study, building information model can be used for planning, design, construction, and operation of the facility. Its application helps constructors visualize what is to be built in a simulated environment to identify any potential design, construction, or operational issues so as to avoid clashing of buildings. This finding is consistent with the

findings of Salman (2021) who stated that building performance and operation is greatly improved by adopting BIM as the use of BIM accelerates collaboration within project teams and leads to improved profitability, reduced costs, better time management, and improved economic benefits of constructors. Hence, the present study concludes that the application of BIM predictably account for building performance and as such building constructors should adopt the use of BIM in constructions.

Application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State

The result found in Table 2 showed the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State. As revealed, the extent of application of BIM for scheduling of building construction projects by building construction practitioners in Akwa Ibom State is low. The corresponding hypothesis as shown in Table 5 also revealed that the extent to which building construction practitioners do apply BIM for scheduling of building construction projects in Akwa Ibom State is not significant. The result is attributed to the fact that construction practitioners in Akwa Ibom State do not always apply BIM in Construction Scheduling. This is evident in their frequent adjusting of the building design. It is obvious that most time constructors do pull down structures and rebuild before completion, which often leads to wastage of time and money. However, the application of BIM in scheduling of building construction will contribute to the monitoring of construction project development and preparing the coming steps to avoid mistakes by the constructors. This finding is in line with the findings of Latiffi et al (2015) who revealed that BIM applied at various stages of the project in scheduling, 3D visualization, quantity take – off, determines clash detection, and risk control. This implies that the use of BIM in scheduling building construction enable building constructors to get an accurate schedule & sequence of project activities and allow efficient execution of project. Thus, the present study project that construction practitioners in Akwa Ibom State should adopt the application of BIM in scheduling construction project as this will reduce efficient clash & risk management**.**

Application of BIM for quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State

Table 3 presents the result for the extent of application of BIM for quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State. As indicated, the extent of application of BIM for quantity take–off of building construction projects by building construction practitioners in Akwa Ibom State is low. The corresponding hypothesis as presented in Table 6 further revealed that the extent to which building construction practitioners do apply BIM for quantity take – off of building construction projects

in Akwa Ibom State is not significant. This is as a result of the fact that constructors often lack consistent quality model that would allow them to extract data that would facilitate an appropriate quantity take-off and estimate. This could be reason for having uncompleted buildings that looks abandoned by the owners. As discussed in the study, the application of BIM determines the cost and workload of building construction from start to the finish. This blueprint is believed to determine accurate measurements of materials to be used in construction and also productivity of the constructors. BIM model serves to reduce time as estimators are able to extract measurements and material quantities straight from models. The finding is in collaboration with the findings of Latiffi et al (2015) who stated that BIM was applied at various stages of building project in scheduling, 3D visualization, quantity take – off. However, this serves to be cost effective and efficient when constructors of building adopt the use of BIM as shown in the study. Thus, conclusion is made that the application of BIM in building helps the constructors in understanding the project needs and thereby execute the job on time without running cost.

Conclusion

Based on the results of the study, it is concluded that the extent of BIM application in project management among building construction practitioners in Akwa Ibom State is low. Also, most constructors are not familiar with the use of BIM in designing, scheduling and quantity take – off of building construction projects which often causes delay in completing a building project.

Recommendations

The following recommendations are made based on the findings of the study;

1. The curriculum planners should include BIM-enabled education into the school curriculum such that the teachers would embrace it and explore in courses to improve teaching and learning of construction management concepts.

2. The Akwa Ibom State government should be poised to train and retrain building constructors to acquire professional knowledge on constructability through the use of BIM for productivity.

3. To encourage the use of BIM, training should be undertaken by construction firms to ensure that constructors have first-hand knowledge of the importance and application of BIM.

4. The state government should also formulate and enact acceptable policies that will encourage compulsory use of BIM among building professionals in construction industries in order to maintain global standard.

5. There is need for construction industries to standardize the BIM process and to define guidelines for its implementation.

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