

Assessment of the Level of Awareness and Limitations on the Use of Building Information Modeling in Lagos State

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Abstract- Building Information Modeling represents the development and use of computer-generated n-dimensional (n-D) models to simulate the planning, design, construction and operation of a facility. It represents a new paradigm within the construction industry, one that encourages integration of the roles of all stakeholders on a project allowing the architects, engineers and constructors to visualize what is to be built in a simulated environment and to identify potential design, construction or operational issues.

This study assessed the level of awareness on the use of BIM by professionals in the Nigerian Building Construction Industry at the design, construction, and post construction phases of a project with a view of increasing the awareness level, and promoting its adoption in Nigeria. It also identified the factors that has militated against its adoption in Nigeria and further highlighted the factors that will encourage its adoption in the country. A total of fifty Questionnaires were distributed to professionals practicing in the Lagos State. However, forty seven were returned and these were analyzed using descriptive analysis and the relative importance index methods. It was revealed that there is a generally low level of awareness about the use of BIM among professionals in the Nigerian construction Industry. This, it was, however revealed can be resolved by increasing awareness on its use and benefits, and through increased government support for its use, professional bodies' involvement, training and retraining by both private and public organizations for project delivery in the country. This study concluded by recommending that appropriate means be adopted to increase the awareness level about BIM in Nigeria as this will encourage its adoption in project delivery.

Index Terms- Building Information Modeling (BIM), Information, Technology,

I. INTRODUCTION

Recent performance studies conducted on building projects by governmental bodies, corporate organizations and some professional individuals around the world have revealed an alarming rate of clients' dissatisfaction concerning time and cost overrun. This according to Mbachu and Nkado (2005) usually resulted from the use of inefficient procurement and project delivery, poor project management, incomplete documentation, discord between the design and construction teams, and frequent design change. Hence, leading to the development and subsequent adoption of Building Information Modeling by some countries around the world. However, according to Alufohai

(2012), the level of awareness and adoption of BIM in Nigeria's private, public sector and amongst different building professionals has been very slow considering the numerous benefits enjoyed by the various countries that have adopted it fully. He therefore suggested the promotion of BIM's adoption in Nigeria by increasing public awareness on the technique, the tools employed and the benefit associated with its use. To this end, this study is conducted to investigate the various means of promoting its adoption within Nigerian Building Construction Industry.

According to Eastman, Teicholz, Sacks, and Liston (2011), Building Information Modeling involves the creation of a digital parametric model which represents the physical and functional characteristics of a building in full detail and further shared knowledge pool which can be used to take reliable decisions during the design, construction and throughout the lifecycle of the building project. Gayathar and Himal (2013) also described BIM as an Information Technology solution for the integration of software application and Information Technology tools to design a building in a common platform which affords the diverse professionals involved in the construction of a building the opportunity to make decisions putting into consideration the constructability, buildability and maintainability of the building. Furthermore, Ibrahim and Bishir (2012) opined that the basic premise of BIM is collaboration by different stakeholders during different phases of project life cycle which makes it possible to insert, extract, update or modify information in the BIM process to support and reflect the roles of the stakeholders. Alufohai (2012) further highlighted increased speed of delivery, better coordination, decreased costs, greater productivity, reduction of errors, higher quality of work, and better facility operations as the key advantages and benefits of BIM.

This appraisal however become imperative following Ibrahim and Bishir (2012) and Alufohai (2012), suggestions that research studies be conducted to establish the extent to which BIM concept is known and applied in building construction projects within the Nigerian Construction Industry.

The Government and Construction Industry BIM programme existent in the United Kingdom came into being with the aim to promote the adoption of BIM technology by both public and private sector organizations involved in the procurement and delivery of buildings and infrastructure with the view to reduce asset costs and achieve greater operational efficiency, facilitate greater efficiency and effectiveness of construction supply chains, and to assist in the creation of a forward-thinking sector (Wix and Nicholas, 2008).

In Nigeria however, the reverse is the case as according to the findings of Ibrahim and Bishir (2012), there is no government

support on the adoption of BIM in the execution of construction projects, private clients are oblivious of it, and the professional bodies relevant in the construction industry have not taken steps for the training and retraining of its members on its use and application. This, Alufohai (2012) has attributed to the low level of knowledge and use of BIM as it is mainly used by architects in Nigeria for design presentations. Furthermore, Ibrahim and Bishir (2012) stated that there is the need for studies into the level of knowledge and use of BIM in Nigeria in order to promote its adoption through increased awareness on the technique, the tools employed and the benefits of its adoption. The aim of this study is to assess the level of awareness on the use of BIM amongst the professionals in the Nigerian Building Construction Industry with a view of increasing the level of knowledge of its uses, and to promote its adoption in Nigeria. To achieve the said aim, the following objectives are set:

1. To assess the level of awareness on the use of BIM by the professionals in the Nigerian Building Construction Industry.
2. To assess the perceived factors affecting the adoption of BIM in the Nigerian Building Construction Industry.
3. To identify the factors that will encourage the adoption of BIM in the Nigerian Building Construction Industry.

Recommendations herein will encourage the Government through the legislative arm to enact laws, making the application of BIM in construction projects a necessity in order for quality, reduced cost, elimination of corruption and compliance with due process. Furthermore, it will encourage the relevant regulatory bodies vested with overseeing the activities of engineers and construction workers in Nigeria to ensure the training and re-training of stakeholders in construction industry on the use of BIM.

II. REVIEW OF LITERATURE

The need for coherent information flow among the building construction team to address problems associated with late delivery of projects, cost overruns, quality and general management of the facility throughout its lifecycle has led to the development of Building Information Modeling, which according to Ibrahim & Bishir (2012), offers the building construction management team, the best ways to communicate all information required by all the different stakeholders in discharging their professional duties with much ease and high accuracy. Therefore the desired goal of the construction industry, which is to be able to successfully deliver projects to clients within agreed time frame, estimated cost and according to the designed quality becomes realistic, which makes it imperative to improve awareness on the subject-BIM- in Nigeria. According to American Institute of Architects (2007), Building Information Modeling (BIM) is defined as a digital, three-dimensional model linked to a database of project information. It is identified as one of the most powerful tools to support Integrated Project Delivery (IPD). Because BIM can combine, among other things, the design, fabrication information, erection instructions, and project management logistics in one database, it provides a platform for collaboration throughout the project's design and construction. As a tool, it is a modeling technology and associated set of processes to produce, communicate, and analyze building models

(Eastman et al. 2011). According to Harding (2008) Building Information Modeling is not just a tool but it is a process. It is not only using three-dimensional modeling software but also implementing a new way of thinking as certain processes that have made perfect sense for CAD-type technology now do not seem to be as efficient. Smith (2007) also opined that the concept of Building Information Modeling is to build a building virtually, prior to building it physically, in order to work out problems, simulate and analyze potential impacts. In addition to this, Kymmel (2008) opined that virtual building implies that it is possible to practice construction, to experiment, and to make adjustments in the project before it is actualized. He also, described the Building Information Model as a virtual representation of a building, potentially containing all the information required to construct the building, using computers and software. The term generally refers to both the model(s) representing the physical characteristics of the project and to all the information contained in and attached to the component of these models. A Building Information Model therefore may include any of or all the Two Dimensional, Three Dimensional, Four Dimensional (time element-scheduling), Five Dimensional (cost information), or *n*Dimensional (energy, sustainability, facilities management, etc., information) represents of a project created using suitable Building Information Modeling tools. Elvin (2007) further explained that the Building Information Model provide Two Dimensional and Three Dimensional drawing with non graphical information including specifications, cost data, scope data, and schedules. Most importantly, it creates an object-oriented database, meaning that it is made up of intelligent objects, for example representation of doors, windows, and walls which are capable of storing both quantitative and qualitative information about the project.

Application of BIM as an information system in the construction industry is really a re-engineering factor to the sector. Improved profitability in the construction business and more successful delivery of projects to clients are benefits of applying BIM in construction industry. The factors responsible for late delivery of projects, overruns of cost estimate, risk management, safety and even compromise in quality are grossly taken care of by the application of BIM. Considering this benefits, the fact that BIM is not being used in the Nigerian Construction Industry is of a great cause for concern (Alufohai, 2012). Chewlos, Benbasat, and Albert (2001) identified; private clients not mandating the use of BIM due the generally low level of awareness on its application and lack of knowledge on use, the general conception that the current technology in use is enough and the lack of inter-agency collaboration for the adoption and use of BIM as the factors militating against the use of BIM.

Other identified factors include: lack of Government support for the adoption of BIM; high cost of implementation; concerns about its complexity; lack of educational facilities to support its use and lack of laws and policies mandating the application of BIM. Andy, Francis and Abid (2011) concluded that Government's support is a major driving force towards higher utilization of BIM in developing countries as supported by the findings of Alufohai, 2012. However, according to Ibrahim and Bishir (2012) this is the bane of BIM's adoption in Nigeria as there is no government support for the adoption of BIM in Nigeria. The establishment of laws and policies making the use

of BIM a necessity according to Ibrahim and Bishir (2012) is one of the factors that will drive the adoption of BIM in any country. In Nigeria however, this is not in existence as there is no law or policy regarding the application of BIM in the execution of projects. Alufohai (2012) corroborated this as He cited the Construction Real Estate Network (CORENET) e-PLAN check system launched in Singapore which provided automated compliance checking against building codes.

Furthermore, Andy et al. (2011) in His comparison of the implementation of BIM in some countries including; Finland, Denmark, Norway, Singapore etc. observed that the support of the central government towards BIM implementation can be regarded as the driving force towards higher utilization of BIM in those countries. He noted that if the support is strong it would create a uniform environment for nation- wide acceptance of BIM and its requirement. Also, He suggested that a strong government support would also create an active environment for research and development in BIM. Situations to this scenario, He noted, can be observed from the implementation of BIM in Finland, Denmark, and Norway and to certain extent in Singapore where the support of public sector is significant. He further argued that if the government support for BIM implementation in a country is not strong then market forces could be dominant in BIM implementation. However, this scenario could result in uncertain outcomes. Even if the market conditions depict a booming economy especially in the building sector, there would be non-uniformities in the nationwide implementation of BIM as each market stakeholder would implement its own BIM system. Also, Ibrahim and Bishir (2012) suggests; that the Federal Government through the legislative arm should enact a law, making the application of BIM in construction projects a necessity, construction companies should embark on training and retraining of their staff and engineers abroad so that skills and construction methods like BIM and virtual reality can be acquired , construction companies and relevant government agencies and parastatals in Nigeria should procure all necessary software for BIM and there should be increased research and development in evolving construction methods like BIM in order to promote the adoption of BIM in Nigeria

III. RESEACH METHODOLOGY

The research work is aimed at assessing the awareness level on the use of Building Information Modeling in the Nigerian Building Construction Industry. Well structured questionnaires evaluating the perceived factors affecting its adoption of BIM in Nigeria, and identifying the factors that will encourage the adoption of BIM in the Nigerian Building Construction Industry were administered to the Construction industry professionals practicing in Lagos State viz Architects, Builders, Civil/Structural Engineers, Mechanical Engineers, Electrical Engineers, Estate Surveyors and Valuers, Quantity Surveyors, and Estimators practicing in Lagos State through the use of simple random sampling technique. 85% of the questionnaires distributed to professionals practicing in the Lagos State were retrieved and analyzed using descriptive analysis i.e. frequency, percent and cumulative percent and the relative importance index methods to determine the relative importance of the perceived

barriers and factors that will encourage the adoption of BIM in Nigeria. The RII for each factor was computed from the analysis of the rating indicated by the respondents with the use of five point likert scale.

IV. RESEARCH FINDINGS

The data collected for this study were analyzed statistically and is as presented below:

Characteristics of Respondents: The characteristics of the respondents were measured in terms of six basic facts: profession, professional body, grade of membership, highest level of education, area of professional practice, and number of years of experience of respondents. The information collected revealed that all respondents are members of their respective professional bodies, majorities (31.9 %) of the respondents are Architects with 19.2% in the fellow cadre and 21.3% are PhD holders, 14.9% are Builders, 6.4 % are Mechanical Engineers , 10.6% are Estate Surveyors and Valuers, 8.5% are Quantity Surveyors, 19.1 % are Structural /Civil Engineers, 4.3% are Estimators, and 4.3 % are Electrical Engineers. 38.3 % of the respondents are into contracting, 42.6% into consulting and 17% are employer's representatives. It was also revealed that 19.1% of the respondents have 0-5 years experience, 31.9 % have 5-10 years experience, 21.3% have 10-15 years experience while 12.8% have 15-20 years experience and only 14.9 % have above 20 years experience.

Assessment of the Level of Awareness on the Use of BIM in the Nigerian Building Construction Industry: The mean score, ranking method was used to assess the level of awareness on the uses of BIM by professionals at the different stages of the project lifecycle. Table 1 shows the mean scores and ranking of the identified uses of BIM at the design, construction and post construction phases of a project. From the table, it can be inferred from the low mean scores that there is a generally low level of awareness about the use of BIM in the Nigerian Building Construction Industry. At the Design Stage, Construction planning ranked first with a mean score of 2.55 from the analysis of the data followed by Visualization, 3D Coordination and Cost Estimation which ranked 2nd and 3rd respectively with mean scores of 2.53 and 2.43. Prefabrication and Constructability Analysis both ranked 4th with a mean score of 2.34 while sequencing ranked 6th with a mean score of 2.17. This reveals that the respondents are most aware of the use of BIM in Construction planning and are least aware of its use in Sequencing at the Design stage. At the Construction Stage, Construction Monitoring ranked 1st with a mean score of 2.28 while Construction Modeling and Fabrication ranked 2nd with a mean score of 2.23. From this, it can be inferred that the respondents are mostly aware of the use of BIM in Construction Monitoring at the Construction stage. The results show that the respondents are most aware of the use of BIM in Construction Monitoring at the Construction stage. At the Post Construction stage, Maintenance Scheduling ranked 1st with a mean score of 2.21 while Building System Analysis and Asset Management ranked 2nd with a mean score of 2.02 while Record Modeling ranked 3rd with a mean score of 1.83. This reveals that the respondents most aware of the use of BIM in Maintenance

Scheduling and least aware of its use in Record modeling at the Post construction stage.

Table 1: Level on the awareness of the use of BIM

S/NO	IDENTIFIED USES	MEAN SCORE	RANK
1.	DESIGN STAGE		
	Construction Planning	2.55	1
	Visualisation	2.53	2
	Cost Estimation	2.43	3
	3D Coordination	2.43	3
	Constructability Analysis	2.34	4
	Prefabrication	2.34	4
	Sequencing	2.17	6
2.	CONSTRUCTION STAGE		
	Construction Monitoring	2.28	1
	Construction Modeling	2.23	2
	Fabrication	2.23	2
3.	POST CONSTRUCTION		
	Maintenance Scheduling	2.21	1
	Building System Analysis	2.02	2
	Asset Management	2.02	2
	Record modelling	1.83	3

Source: Field survey

Assessment of the Perceived Barriers to the Adoption of BIM in the Nigerian Building Construction Industry: Table 2 shows the relative importance index of barriers to the adoption of BIM in the Nigerian Building Construction Industry.

Table 2: RII of barriers to the adoption of BIM

S/NO	Perceived Barriers	RII	Ranking
I.	Lack of awareness on the use of BIM	2.70	1
II.	Lack of Government support for the adoption of BIM	2.68	2
III.	Lack of educational facilities to support its use.	2.66	3
IV.	High cost of implementation	2.61	4
V.	Lack of laws and policies mandating the application of BIM	2.60	5
VI.	Inadequate research and development	2.60	5
VII.	Lack of professional bodies support for the adoption of BIM	2.56	7
VIII.	Private clients not mandating the use of BIM	2.55	8
IX.	Available technology is adequate	2.30	9
X.	Concerns about limitations or complexity of BIM technology	2.24	10

Source: Field survey

It shows that lack of awareness on the use of BIM, lack of government support for the adoption, lack of educational facilities to support its use and high cost of implementation respectively are the most important barriers to the adoption of the use of BIM followed by inadequate research and development,

lack of laws and policies mandating its use all rank are amongst the least important.

Encouragements on the adoption of BIM: Increased awareness on the use and benefit of BIM through increased research and development, increased government support and relevant professional bodies ensuring the training of its members

with indigenous companies ensuring the training and retraining of their staff will encourage the adoption of BIM in the country. These are as evident in Table 3. The Nigerian Construction Industry stakeholders have a fair knowledge of the use of BIM being mostly aware of its use in Construction planning and

Visualization. The general low level of its awareness can be increased through increased awareness on its uses and benefits and also through government supporting the use of BIM in project delivery in the country.

Table 3: Identifying the factors that will encourage the adoption of BIM in the Nigerian Building Industry.

S/NO	Identified Factors	RII	Ranking
I.	Increased awareness of the benefits of using BIM	4.33	1
II.	Increased research and development in the area of BIM	4.14	2
III.	Increased Government support for the adoption of BIM	4.10	3
IV.	Relevant professional bodies ensuring the training of its members on the use of BIM	4.02	4
V.	Indigenous companies ensuring the training and retraining of their staff	4.00	5
VI.	Professional bodies supporting the adoption of BIM	4.00	5
VII.	The provision of educational facilities to support its use.	3.98	7
VIII.	Government mandating BIM for all project delivery	3.90	8
IX.	The enactment of laws and policies making the application of BIM compulsory	3.64	9
X.	Private clients mandating BIM for project delivery	3.60	10

V. CONCLUSION AND RECOMMENDATION

Based on the result of this study, it can be concluded that: there is a generally low level of awareness on the use of BIM among professionals in the Nigerian Building Construction Industry; major factor contributing to the low level of awareness on the use of BIM is the lack of awareness on the its use of and the lack of governmental support for its adoption in Nigeria. In driving for the adoption of BIM in the Nigerian Building Construction Industry, increasing awareness on its use and benefits is the first and most important step through government intervention, training and re-training of construction industry professionals and involvement of the various professional bodies in the field of construction.

Increased awareness of the use of BIM should be made using means suitable and putting into consideration the peculiarities of the Nigerian Construction Industry; relevant bodies, agencies, organizations should inform the government on the benefits of the use of BIM and together as a team support the adoption of BIM in Nigeria.

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