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The Utilization of Building Information Modeling In Nigerian Construction Industry: Challenges and Prospects

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Abstract

The aim of this research is to appraise the challenges and prospects in the use of Building Information Modeling (BIM) in the construction industry in Nigeria. It analyzed the uses of BIM in the construction industry, determined the stakeholders perception of the benefits, risk and benchmarks in the adoption of BIM in construction practice and process. It examined the extent of its interoperability in bringing together the different participants and processes of construction works for efficiency and effective construction management and timely project delivery. It compared the findings with the same studies carried out and/or currently being carried out in many parts of the world. Primary data were collected through structured questionnaires. The questionnaires were distributed and collected through personal contacts, letters, online groups and e-mails. Direct observation and interviews were made with professionals in the construction industry The secondary data were obtained from the exploration of various relevant literature and previous researches that have been done in relevant areas. A purposive and modified BIM measurement survey was used for this research work to gather the opinion and views of various construction professionals and clients A total of One Hundred and Fifty (150) questionnaires were distributed based on the sample population. One Hundred and Thirty-two (132) questionnaires were retrieved and used to obtain the required information for data. Tools used the purpose of this research include mean score, percentile and inferential method of statistical analysis. The statistical package for social science (SPSS) was basically used to create the frequency tables and the charts. The study showed that the application of BIM is economical and easy leading to improvement, enhanced technical and general management of construction projects which can lead to total control of cost estimates, prompt delivery of projects and quality are the most important key performance indicators in construction.

Keywords: Building Information Modelling, construction, industry, management, project.

Introduction

The construction industry is labour intensive and has remained relatively unchanged for many years. Traditionally, a construction project, consisting of drawings and specifications prepared by architects and engineers are delivered to the owners/clients of the proposed project, with a warranty that the design is complete and free of any defects. Owners then put the project up for bid among a selected list of contractors. Once the construction documents are in the possession of the contractor and construction begins, the relationship between the various building team also begins (Eastman, 1999). This relationship tends to be typically limited and distant. Any changes or discrepancies that occur in the drawings are corrected, typically, by a long trail of paperwork, for the contractual period of time for each request for information. This can stifle productivity on the job site because of tradesmen waiting for pertinent information which also decreases productivity (OCA, 2006).

Over the years, there have been many technological advances in the construction industry (Fisher and Kunz, 2004). Construction professionals have therefore relied on large construction equipment to perform tasks, and computer programs to help in the design, estimating and scheduling process for construction activities, both of which are integral in determining whether or not a construction project will be profitable and if the construction company will continue to stay in business (Edgar, 2006).

It is no longer news that relationships in the construction industry in Nigeria over the years have been poor, painting a bad picture of an institution that has had to struggle with the challenge of segmentation over the years. Not only has this segmentation resulted in haphazard implementation and uncontrolled quality of projects, the frequent break-downs in communication have also led to increased costs and prolonged project execution time. It is the heavy dependence of many construction firms on traditional ways of communication, such as exchange of drawings and associated paper documents that underscores the need for an adoption of the BIM system in modern-day projects. Without any doubt, the level of integration available in the adoption of the BIM technique has resulted in its being regarded as the next cutting edge in construction technology. According to NIBS (2006), the need to integrate the disparity in the various computer applications with its associated costs will no longer exist once an application is inter-operational. Furthermore, it suggests that the condensation, organisation as well as relaying of information at the detail level is key to achieving success with construction management via a BIM approach. This research is an exploration of the usage of Building Information Modeling (BIM) in Nigeria, the adoption of BIM, as well as its potentials to increase organizations' ability to deliver better and enhanced products to their clients.

The aim of this research is to appraise the challenges and prospects in the use of Building Information Modeling in the construction industry in Nigeria. The objectives of this research are as follows:

- To analyze the uses of BIM in the construction industry
- To examine the prospect of the adoption of B.I.M in the Nigerian construction industry
- To examine the challenges in the adoption of BIM in the Nigerian construction industry
- To determine the stakeholders perception of the benefits, risk and benchmarks in the adoption of BIM in construction practice and process

This study researched into BIM, its prospects and possible challenges and how it can be used successfully by both designers and builders. The study examined how BIM is presently being used by architects, engineers, builders and other construction professionals and how BIM can help construction companies improve their methods of construction and increase productivity. The study of BIM software is significant to the various professionals, in the construction industry for some specific reasons. The builder can take the advantage of the BIM platform to monitor progress of work and make necessary correction if need be without having to exchange papers and document from other professionals. The architects can also complete drawings; make building models and simulation using the various BIM platforms while the engineers can also make designs with ease without any stress. Moreover, the various BIM platforms will serve as a meeting point for the various stakeholders in the construction industry to relate in terms of designs, construction process and method due to the presence of several interfaces that can foster good professional relationship among them. Another major significance of this research is that it will make all stake holders gain an understanding of BIM, to determine the shortcomings of the program and become aware of the barriers to implementation of this program.

Related Review on Building Information Modeling (BIM)

Succar (2008) defined BIM as a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle. It is a software that allows the geometrical modeling and the input of information but also Project Management (PM)-related tools and processes (Tarmizi, 2013).. BIM has a potential to be used at all stages of the project life-cycle by the owner, design team, contractor and facility manager thereby eliminating waste and reducing errors to the barest minimal (Ibrahim, 2010). In fact, BIM is very essential at all stages of the project life-cycle: from being used by the client to understand and express the project’s requirements, to the design team from the conceptual design to the full development of the project, to the contractor to manage the project from site clearing to the commissioning and by the facility manager from operation to decommissioning phases (Cruz, 2008). The future of BIM will lead to virtual project designs and construction approach, with a project being completely simulated before being undertaken for real (Foster, 2008).

Intrinsically, BIM will provide beneficial project outcomes by empowering rapid analysis of different scenarios related to the performance of a building through its life cycle. The utilization of BIM in construction projects is already leading to projects being built virtually 30 to 40 times. According to Aranda-mena (2008), Building Information Modeling (BIM) is revolutionizing the design and construction industry by transforming the way of designing cities, buildings and systems to perform throughout their entire life cycle. BIM has enhanced the design, construction, and operation of all types of buildings and facilities around the world, from the conventional structures to the most inspiring projects of our time (Seaman, 2006). It has been adopted on high profile mega construction projects, such as the 21st Century Panama Canal, M25 London Orbital Motorway Widening (Initial Upgraded Sections), Liverpool Wastewater Treatment Works, London 2012 Olympic 6,000 seating Velodrome cycle track, Heathrow Terminal 2B, Ipswich Motorway Upgrade, Express Rail Link West Kowloon Terminus, Colorado Springs Metro Interstate Expansion (Cosmix), Victoria Station Upgrade and several others (Suerman, 2009).

Foreseeing the benefits of using BIM in respect of reduced transaction costs and less opportunity for errors to be made, the UK Government has stated that 2014 onwards all contracts awarded will require the supply chain members to work collaboratively through the use of “ fully collaborative 3D” BIM (CRC, 2008). Great awareness is being created in the USA towards promoting BIM's use. The efficiency of BIM utilization will depend on the commitment of all the team players to effectively play to the rule of the game. There is hope that the stumbling blocks on the way will be singled out (AGC, 2006). Building information modeling is composed of many operators, processes, and communication flow, in which each process can involve many operators performing their tasks far away from each other. The state of activities in each building process such as architectural, structural construction can be so enormous that it will only take BIM to bring harmony in just a specialized sub sector. Activities in the specialized sectors or in the general context are made possible by the diffused presence of computer-based information technology (Holness, 2006).

The range of tools facilitating the diffusion of BIM is vast, from the evolved computational support to innovative soft wares that are pumped into the market on daily basis. In the field of built environment with diverse and dispersed activities being facilitated by the rapid development of supporting technologies, it is very difficult to capture current status as new frontiers are emerging continuously (Olatunji, Sher and Ogunseni, 2010). The pattern of operation is for each process exists as an island operating with the best localized BIM tools available. Global or more general BIM tools then creates integration of the specialized sectors across the entire facility development process (Edgar, 2006. It is hoped that this study will help to highlight the importance of BIM and go to some extent to improve the acceptability of this great innovation in the Nigerian Construction Industry.

The Building Information Modelling Model

According to Smith &Tardif (2009) the concept of Building Information Modelling is to build a building virtually, prior to building it physically, in order to work out problems and simulate and analyse potential impacts. The heart of Building Information Modelling lies in an authoritative building information model. At its core, according to AGC (2006), BIM software is a database where its application to a process requires that the database be initially populated and then maintained as the project progresses. The information contribution from each team member which consists of architect, civil and structural engineer, mechanical and electrical consultant, builder and subcontractor, becomes crucial. This mode of information sharing requires the team member to be working on the building information model instead of paper based documents. Therefore, instead of providing information in 2D drawings to represent 3D reality, each team develops their own model to represent their information. According to Kymmel (2008) virtual building implies that it is possible to practice construction, to experiment and to make adjustments in the project before it is constructed. Virtual mistakes generally do not have serious consequences provided that they are identified and addressed early enough so that they can be avoided in the actual construction of the project.

In terms of the types of information or data that can be derived within a Building Information Model, generally, Elvin (2007) and Hardin (2008) explained that a Building Information Model could provide 2-D and 3D drawing with non-graphical information including specifications, cost data, scope data, and schedules. Kymmel (2008) on the other hand, categorised several types of information within Building Information Model based on the nature of the link between information and the model. This pertains to all information that is part of, or connected to, the components as well as the physical information inherent in the model itself such as size, location, etc. It is important that all information required in making an actual analysis be available from the BIM. The various categories of information can be summarised from Kymmel (2008) (Tarandi 2003). Elvin (2007) as Component Information, Parametric Information, Linked Information, External Information.

To extend the application of Building Information Modelling to integrated practice in construction, according to Eastman et al. (2008), the building information model should be used as a building model repository. Building model repositories are object based, allowing query, transfer, updating and management of individual project objects from a potentially heterogeneous set of applications. In this context, the integration occurs at the level of data and could also integrate with other dimensions such as the time dimension (schedule) and cost dimension, which are known as 4D and 5D modelling respectively (Zhou et al., 2009; Koo & Fischer, 2000, Dawood & Sikka, 2007; Fischer & Kam, 2001). This application would allow construction phases to be analysed early in the design phase which as a result could support early involvement of the contractors in design development.

The Advantages of BIM

Many organisations encountered problems inherited with CAD design complexity and drafting errors as identified by Kaner et al. (2007), which led to low productivity and low cycle times for design review. By understanding the BIM benefits, the organisations could possibly strategize their action plan for BIM implementation to suit their needs. According to Kiviniemi et al. (2008), the use of BIM depends on the roles of the company and for the design consultant, the purpose normally concentrates on consistent drawings production, reuse of data for visualisation and improving communication which resulting in the reduction of design error

BIM has reduced the number of requests for information and change order on a project and thus improves the productivity as the problems which are rooted at the change order, inadequate drawings and specifications and late issuance of construction drawings are minimised. In addition, labour productivity increased, according to (Eastman et al. 2008), the total cost in terms of labour hours and salaries to realise the task, are often under-applied considerations for design firms. Also (Kaner et al. 2007), research in the productivity gain for producing structural engineering drawings with rebar detailing has yielded gains of between 21% and 59%, depending on the size, complexity, and repetitiveness of the structures. Both of the organisations involved in the case study cited that the productivity and improved quality of design and documentation as primary advantages drives the implementation of BIM, besides being aware of the time consuming element, to achieve productivity enhancement. The use of 3D parametric modelling tools in BIM also improves the clarity of representation of the design intent and consistent drawings production.

Mismatch or internal contradictions in the content of any individual document or related sets of documents are eliminated and the increase in clarity and consistency leads to a much more efficient design production process within the organisations and improves the interaction and communication between parties in the construction projects (Kaner et al., 2007; Khanzode et al., 2008; Staub-French & Fischer, 2001). In the three case studies conducted by Bouchlaghem et al. (2005), they found that the visualisation could be benefited across entire project life. In the design stage, visualisation helped the designers to work collaboratively and communicate design ideas more efficiently as each project participants shared the same 3D design view. In addition, for housing development stage, site layout models can be used as a marketing tool with clients or for planning consultations with planners and improved design types that were developed by the design team. While during construction stage, the visualisation could bridge the gap between team designer and site to workout constructability issues. Meanwhile, the use of BIM as the repository has identified potential to achieve the collaboration required for integrated practice, vital for resolving the fragmentation problems, which have been discussed previously in the challenges of the Malaysian construction industry. Meanwhile, the potential use of BIM as a tool has also been explored further to integrate the dimension beyond 3D geometry to nDModelling Project. The work that has been carried out by the University of Salford, In the project, the additional dimensions that have been incorporated into the model were whole-lifecycle costing, acoustic, environmental impact data, crime analysis, and accessibility. The work enabled the what-if analysis to be carried out before the real construction takes place; for instance what are the knock-on effects for time, cost, maintainability, etc. of widening a door to allow for wheelchair access (Marshall-Ponting & Aouad, 2005).

At the downstream level, the other BIM benefits, as can be simplified from Eastman et al. (2008), are as follows: Easy Verification of Consistency to the Design Intent, Extraction of Cost Estimates during the Design Stage, Automatic Low-Level Corrections when Changes are made to Design, Generation of Accurate and Consistent 2D Drawings at any Stage of the Design, Early Collaboration of Multiple Design Discipline, Communicate the Design Intent Better by (tarmizi 2013), Reducing the Knowledge Gap between Junior and Senior Staff, Reducing Risk of Losing Project's Information, (Froese 2010), Process

Streamlined and Time Saving (NBS 2013). Better Visualization and Documentation (Lewis 2013), Single and Integrated Information Resource (Tarmizi 2013), Time Saving Utility Design (Lane 2013).

Research Methods

This research work is aimed at appraising the prospect and challenges in the use of BIM in construction industry in Nigeria. A purposive and modified BIM measurement survey was used for this research work to gather the opinion and views of various construction professionals such as builders, engineers, architects and quantity surveyors on the subject matter. It examined the extent of its interoperability in bringing together the different participants and processes of construction works for efficiency and effective construction management and timely project delivery. It compared the findings with the same studies carried out and/or currently being carried out in many parts of the world. Data collection was done by two methods. Primary data was collected through structured questionnaires. The questionnaires were distributed and collected through personal contacts, letters, online groups and e-mails. Direct observation and interviews made with professionals in the construction industry (Fellows and Liu, 2008). The secondary data were obtained from the exploration of various relevant literature and previous researches that has been done in the area in which this research is focused. Such data were obtained from textbooks, journals, articles, research papers, academic articles, newspapers, conference papers, technical papers and electronic source.

The study areas for this research include Lagos, Ibadan, Abuja, Benin and some parts of Kaduna. These areas were chosen solely because they are the commercial centres in their various Geo Political zones. They are the cradle of development and the hub of construction activities in such zones. Furthermore these areas are also the commercial nerve centres where all major developmental activities and policies are concentrated thereby giving rise to the formation and establishment of various firms that has to do with construction activities in those places.

The questionnaires were distributed according to the areas of specialization of the targeted population which has been identified as Academics, Consultancy and Construction. These include the Engineers, Builders, Architects, Quantity Surveyors and other allied professionals such as land surveyors and estate managers. Also, questionnaires and interviews were conducted on the clients that finance the projects.

A total of One Hundred and Fifty (150) questionnaires were distributed based on the sample population. One Hundred and Thirty-two (132) questionnaires that were retrieved were used to obtain the required information for data analysis. In addition, Sixty (60) clients that finance the projects were sampled .In order to correctly assess and present the results obtain from scoring the questionnaires for the aim and objective of the study, tools used the purpose of this research include mean score, percentile and inferential method of statistical analysis. The statistical package for social science (SPSS) was basically used to create the frequency tables and the charts

Data Analysis and Presentation

The descriptive representation of data collected and the allocation of mean score, standard deviation and ranking of the individual variables as appropriate according to their mean score and standard deviation. These values were obtained systematically by relating each of the variables involved in the questionnaire against their frequency ratios.

Respondent Biodata

Table 1: **Personal characteristics of respondents**

Characteristics of respondents	Frequency (N)	Percent %)
Year of Establishment		
1- 5 years	17	12.87
6-10 years	33	25
11-15 years	40	30.3
16-20 years	30	22.7
Above 20 years	12	9.09
Total	132	100
Type of Firm		
Consultancy	39	29.5
Construction	59	44.7
Academic	34	25.8
Total	132	100
Profession of Respondent		
Architect	41	31.1
Builder	35	26.5
Engineer	17	12.9
Quantity surveyor	23	17.4
Others	16	12.1
Total	132	100
Academic qualification		

PhD	44	33.3
MSc	40	30.3
BSc	20	15.2
HND	18	13.6
OND	10	7.6
Total	132	100
Professional qualification		
NIOB	55	41.7
NSE	27	20.5
NIA	31	23.5
NIQS	10	7.6
Others	9	6.8
Total	132	100
Years of industrial Experience		
1 – 5 years	27	20.45
6 -10 years	35	26.52
11 – 20 years	39	29.55
20 yrs and above	31	23.48
Total	132	100

Table 1 shows that 39(29.50%) of the respondents are into consultancy, 59 (44.70%) are into construction while 34 (25.8%) in the academic community. This indicates that the information obtained for the analysis cuts across board.

It also shows that majority (41) of the respondents were Architect 31.10%, followed by Builder (35), Quantity Surveyor (23), and Engineer(17) with 26.50%, 17.40% and 12.90% respectively. Other professionals (16) constitute 12.10%. This implies that the respondents were all professionals within the construction industry.

It shows that 60 (45.45%) of the respondents were degree certificated, while 28 (21.2%) had diploma degrees basically (higher national diploma and ordinary national diploma) while 44 (33.30)% had doctorate degrees in different fields. This means that 100% of the respondents possessed high education and were therefore competent to answer the questionnaire.

It also shows that the years of experience of the respondents are adequate since it ranges from 6yrs to 20years. In addition, 20yrs and above constitute (23.4%) of respondents.

Prospect of Adopting BIM

Professionals` awareness to BIM software were sampled and a large majority 118 (89.39%) of the professionals admitted to awareness of BIM software while 14 (10.6%) were not aware of any software. Most of them admitted that they have not used BIM software for their projects. The prospect of adopting BIM by firms and also ranking the various prospects according to their mean score are as follows:

BIM is a Good Development

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Disagree	29	22.0	22.0	22.0
Disagree	28	21.2	21.2	43.2
Neutral	5	3.8	3.8	47.0
Agree	33	25.0	25.0	72.0
Strongly Agree	37	28.0	28.0	100.0
Total	1324	100	100	

Table 4.2.1 shows the level of agreement with the BIM development. 57 (43.2%) of the respondents cumulatively disagreed that the BIM is a good development in the construction industry while 5 (3.8%) were indifferent about and 70 (53%) of the respondents agreed with the fact that BIM is a good development

Contribution of BIM to Construction Industry

	N	Minimum	Maximum	Mean	Std. Deviation	Ranks
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Valid N (listwise)	132					
Improved productivity.	132	1	5	3.16	1.567	1
Effective construction coordination.	132	1	5	2.73	1.393	2
Effective construction planning.	132	1	5	2.67	1.322	3
Effective Data Storage (Construction document).	132	1	5	2.64	1.437	4
Operation efficiency.	132	1	5	2.53	1.400	5
Improved the quality of work.	132	1	5	2.52	1.444	6
Adequate health and safety plan.	132	1	3	1.96	.746	7

Table 4.2.2 shows that improved productivity, is ranked the highest while adequate health and safety plan is ranked the lowest as the contribution of BIM to the construction industry. This implies that BIM has major effect on productivity.

Impact of BIM on Construction Professionals

	N	Minimum	Maximum	Mean	Std. Deviation	Ranks
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Timely service delivery.	132	1	5	3.58	1.400	1
Stress free and easy work output.	132	1	5	3.55	1.382	2
Quality work output.	132	1	5	3.22	1.354	3
Improved quality service.	132	1	5	3.17	1.327	4
Improved communication system.	132	1	5	2.64	1.237	5
Quality management of construction work.	132	1	5	2.53	1.168	6
Proper storage of organizational data.	132	1	5	2.33	1.016	7
Proper assessment of health and safety procedure.	132	1	5	2.19	.872	8

Table 4.2.3, the impact of BIM on the construction professional was analysed and timely service delivery (3.56) has the highest ranking while proper assessment of health and safety plan (2.19) has the lowest ranking. This implies that BIM has major effect on time delivery of projects.

Factors Influencing BIM Adoption

	N	Minimum	Maximum	Mean	Std. Deviation	Ranks
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
SPEEDY DELIVERY	132	1	5	3.39	1.344	1
WORK ACCURACY	132	1	5	3.30	1.326	2
COST OF SOFTWARE	132	1	5	2.73	1.169	3
SAVES TIME	132	1	5	2.66	1.074	4
AVAILABILITY OF SOFTWARE	132	1	5	2.57	.853	5
SIMPLICITY	132	1	5	2.14	.635	6
Valid N (listwise)	132					

Table 4.2.4 shows speedy delivery (3.39) is ranked the highest while simplicity (2.14) has the lowest rank as the factors influencing the adoption of BIM in Nigerian construction industry; This implies that BIM will enhance speedy delivery of projects.

Assessment of Factors Militating Against the Adoption of BIM

The factors militating against the adoption of BIM in the Nigerian construction industry were examined and were ranked as follows:

Factors Militating against the Adoption of BIM

	N	Minimum	Maximum	Mean	Std. Deviation	Ranks
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Lack of constant Power Supply.	132	1	5	3.52	1.544	1
Lack of Trainning Facilities.	132	1	5	3.34	1.437	2

Adaptation to Traditional Method of Work.	132	1	5	3.09	1.400	3
Cost of Investment.	132	1	5	3.16	1.367	4
Interoperability Problems.	132	1	5	2.63	1.249	5
Connectivity Problem	132	1	5	2.47	1.011	6
Keeping Abreast of New Innovations.	132	1	5	2.23	.922	7
Inadequate Supply of Manpower.	132	1	5	2.11	.593	8

Table 4.3.1 shows lack of constant power supply (3.52) has the highest rank while inadequate supply of man power (2.11) has the lowest ranking. This implies that the use of BIM is impaired by lack of constant power supply.

Assesement of Clients` Perception

This section aims to sample the opinions of clients on software application in the construction industry

Nature of Client

	frequency	Percent	valid percent	cumulative percent
Government	22	36.67	36.67	36.67
Private	38	63.33	63.33	100
Total	**60**	**100**	**100**	

Table 4.4.1 shows the nature of client with the private clients scoring 63.3% while the government clientele scored 36.67% which indicates that this sample opinion is more of the private clients that the public clients.

Software Application in Construction Industry (Clients View)

	Frequency	Percent	Valid Percent	Cumulative Percent
Good	22	36.67	36.67	36.67
Fair	23	38.33	38.33	75
Poor	15	25	25	100.0
Total	**60**	**100.0**	**100.0**	

Table 4.4.2 shows the opinions of the clients on their perceptions in terms of software application in the construction industry, 36.67% admits to good use of software, 38.33 admits to fair usage while 25% admits to poor usage. This implies that the clients agree to the use of BIM software application in the construction industry.

Table 4.4.3 Clients awareness and familiarity to software

Clients awareness to software were sampled and a large majority 53 (88.33%) of the clients admitted to awareness of software while 7 (11.67%) were not aware of any software.

	N	Minimum	Maximum	Mean	Std. Deviation	Ranks
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
AUTOCAD	60	1	2	2.64	1.371	1
REVIT	60	1	2	2.33	1.093	2
Microsoft Project	60	1	2	1.92	.944	3
ORION	60	1	2	1.67	.671	4
PROJECT DOCUMENT MANAGEMENT	60	1	2	1.50	.522	5
Building Information Modelling	60	1	2	1.48	.467	6
Valid N (listwise)	60					

Table 4.4.3 samples the opinions of clients so as to know which of the softwares they are familiar with and rank them accordingly. The AutoCAD software has the highest ranking in the case while BIM has the

lowest ranking. This implies that most clients are only familiar with AutoCAD and not BIM software application in the construction industry

Conclusion

This research explored the prospect and challenges in the adoption of Building Information Modelling (BIM) on the delivery of construction projects in Nigeria in terms of the key criteria for project success; cost, quality and time. It aimed at exploring the extent of the success and challenges in organizations or projects in which the BIM platform has been applied. It reviewed how the construction industry in Nigeria has evolved to embrace its use. The findings of the research indicate a strong convergence of perceptions that Building Information Modelling is a process for enhancing productivity rather than just a mere tool. Moreover, this research investigated construction projects to which the BIM technique had been applied within the Nigerian context. Most respondents were using not BIM platform in their firms presently, they were confident that their firms would be up to date about BIM and looked forward to implementing future projects with BIM as an aid. Therefore this research could not lay claim to any physical investigations of projects purported to have been executed using BIM. This was not possible because the BIM platform within the professional practice in Nigeria is still regarded as relatively new and a development for the future.

This research showed that the application of BIM is economical and easy leading to improvement, enhanced technical and general management of construction projects. The use of BIM in the construction industry can result in clients' satisfaction, zero defects in projects, predictability in terms of cost and time of projects, productivity and efficiency. Improved profitability in the construction business and more successful delivery of projects to clients are further benefits of applying BIM in construction industry. The factors responsible for late delivery of projects, overruns cost estimate, risk management, safety and even compromise in quality can be grossly taken care of by the application of BIM. The management of construction industry is in better position with BIM to manage construction projects. The BIM approach to project design and construction will simplify the work of the various professionals on the project.

While the literature did portray a positive outlook and future for BIM, the analysis of the research data shows otherwise which is a pointer to the fact that the benefits BIM as it were cannot be adequately measured. Therefore, BIM has not definitely been proven to have too many effects due to its low level of application within the Nigerian construction industry. The BIM application according to the result of the analysis has shown that BIM has gained more than enough popularity within the academic environment and has refused to filter or diffuse in like manner to the professional caucus of the Nigerian construction industry. The BIM tends to be gaining more popularity within the academic environment than in the professional circus.

Recommendations

It is hereby recommended that the Federal Government of Nigeria through the legislative arm should enact a law, making the application of BIM in construction projects a necessity. There should be prove of a company's competency in using the BIM during bidding process for government projects in order to qualify for tendering and award for any construction projects. The various professional bodies in Nigeria that are vested with the responsibilities of overseeing the activities of construction works in Nigeria all have major roles to play. They should make BIM a priority for all their members to learn and put to use in construction projects in Nigeria.

The construction companies in Nigeria should embark on training and re-training of their staff internationally so that new skills and construction methods like BIM and virtual reality can be acquired to impact positively on the construction industry at large. Construction companies and relevant government agencies and parastatals in Nigeria should procure all necessary softwares for BIM and virtual reality to facilitate the learning and use of BIM for application in construction projects in the country.

There should be more synergy between the academia and the professional circus of the construction industry in the area of research base knowledge in the aspect of latest innovational development in terms of software packages which can further improve the quality of work done and also improve the construction industry professionally. This will give the Nigerian professionals the edge and the ability to compete with their counterpart all over world and also expose them to the global best practices in construction projects.

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