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Challenges under Collapse of Building in Nigeria and Way to Improve It

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Abstract: Building collapse in Nigeria is alarming and indeed has become a subject of great concern. For the past 10 years an overwhelming number of buildings have collapsed in Nigerian rural and urban cities, with about 77% rise from the previous decade. The incidence of building failures and collapses has become major issues of concern in the development of Nigeria as the losses in terms of lives and properties are now becoming very alarming. This study provides critical reasoning and contributions regarding structural failures observed in Nigeria. To address this problem, The study aimed at exploring major causes of building collapse in Nigeria with a view of establishing effective way of solving the problem. The primary data that will be used if from the Questionnaires and field observations while secondary data will be obtained from textbooks, newspapers and Journal articles . This significant of this paper is to use building information modeling BIM to improve full project visualization, reduced construction collapse, cost, increased productivity, safer construction, better building and information analysis.
Keywords: Building Information Modelling, construction, industry, management project.

I. INTRODUCTION

Building collapse is a failure in a structure due to its inability to serve the purpose for which it was built for.The collapse of buildings and other structural failures has become major problems in Nigerian construction industry, over the past 50 years there have been a lots of building collapse disasters reported in different state[1]. The data shows that failures of low rise buildings constitute about 63% of all cases, followed by multistory buildings as a distant second In terms of their functions, However 199 people died in four Nigerian collapsed buildings between 2014 and 2016, according to the Nigerian Building and Road Research Institute[2]. 2012 over 33 building collapses in Lagos and 22 in Abuja, according to housing ministry figures 2013 17 building collapses in Lagos and 20 in Abuja 2014 13 building collapse in Lagos and two in Abuja More than 54 cases of collapsed buildings were recorded in 2017 across Nigeria[3]. Apartments are the most frequent to fail. External events and construction and maintenance deficiencies have been identified as the most frequent principal causes. External events include the rain, wind, snow, vehicular impact, and collision[4]. Construction deficiencies encompass improper renovation, unplanned demolition, poor workmanship, and unsafe excavation operations. Maintenance deficiencies are associated with building deterioration that was overlooked and improperly maintained[5]. If you can look at the situation you will observe the Building collapse may either be due to natural disasters resulting from earthquakes, hurricanes, floods or man made factors also known as human errors as a result of poor design or construction methods[6]. There are many problems that cause building collapse in Nigeria such as poor structural design, poorly skilled workmen, lack of quality material and lack of quality management.

Gambo, Adebowale, Danbirni, and Ankeli, (2016) carried out analysis and evaluation of the death rate which was involved in 47 reported cases of building collapses in between 2000 and 2010 which to that over 300 death rates were recorded for Lagos, Abuja and port Harcourt this area have the high rate of casualties[7][8]. Many of the documented cases of building collapse in Nigeria are due to the use of defective or substandard building materials, no requisite technical knowledge, non adherence to building codes and standards, the use of non professionals and the high level of corruption in construction industries[9][10]. It is no longer new that relationships in the construction industry in Nigeria over the years have been poor, portraying a bad institution that has to struggle with the challenge of segmentation over the years which resulted in a very bad implementation and uncontrolled quality of projects, lack of communication have also led to increased costs and prolonged project time[11]. Majority of the firms depends on traditional ways of communication, such as exchange of drawings and associated paper documents[12].

The adoption of the BIM system approach in modern day projects is one of the key to achieving success with construction management for solving the collapse of building[13]. 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[14]. The study of BIM software is important 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[15]. 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.

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II. COUSES OF BUILDING COLLAPSE IN NIGERIA

1) The strength of building is not tested: people are building it randomly without testing
2) The foundations of the building are too weak: Foundation should be considered when you are building. The solidity of the soil and the heaviness of the building and its contents should be major. In the commercial area like Lagos, the swampy ground requires strong foundations. Far stronger than solid ground. But developers save money that should be spent on foundations when building on the city's swampy ground and this result many buildings to collapsed Even on solid ground, foundations need to be strong enough for load otherwise building it self will surely collapse.
3) The building materials aren't strong enough : Materials are not strong enough to withhold the load cheap blocks are used which to that is not of the sufficient strength to hold the expected load
4) Workers make mistakes: Workers are given the right materials to make the concrete, they mix them incorrectly, You find bricklayers and even technicians calling themselves engineers without having the knowledge they keep on drawing houses, and mixing thing traditionally
5) The load is heavier than expected :Mr danbirni said a building collapses when the load is beyond the strength of the building. Even if the foundations and the materials are strong enough for what they were originally built for, that purpose may change if a building was designed to be a home and is then turned into a library where boxes and boxes of books are piled up, the building may strain under the weight. Because the load was often heavier than the original design because extra storey s are added.

III. LITERATUREREVIEW

Buildings are structures that serve as human shelters and there properties which must be well conceptualized, designed and constructed to gain the desired comfort from the environment (Danbirni, 2016). however due to the issues of building collapsing we introduce BIM as a tool for construction management in Nigeria[16]. It thus makes literature on the subject limited. Given this, we focus on the BIM as a tool applied to the management of construction and a way to prevent the building collapse. The benefits that can be derived when it is applied[17]. It thus makes literature on the subject limited. Given this, this review will focus on the BIM as a tool applied to the management of construction. By showing the impact of BIM on construction management, the review will also emphasize the benefits that can be derived when it is applied. As it shows the advantages that can be derived from BIM, this review also gives attention to factors that impede its application in Nigeria. The innovations that have so far been introduced by the use of BIM are also highlighted.

A. BIM as a Construction Management Tool

The growth of BIM has brought about new methods of construction management and project delivery. However, “The continued growth of BIM has prompted new contractual arrangements of which the best known is Integrated project delivery ”. This enables the costs of subcontractors and fabricators to be established early in the design process. Construction is still based on the traditional design bid build process.

The inherent advantages that can be derived from using BIM as a construction management tool have not been utilized. “With the coordinating capability of Building Information Modeling (BIM) software, like Autodesk Revit, ArchiCAD and the use of IPD, companies have been seeing a reduction in costs and a more effective use of time’’. These are advantages relevant to construction management[18].

“The ability to utilize BIM to virtually construct a building prior to construction of the actual building provides an effective means to check its construct ability in the real world and to resolve any uncertainties during the process”. BIM is a valuable tool for construction management. In construction management, several key performance indicators have been identified as cost, time, and quality, team performance, communication, stake holder and human resource management.

B. Innovative Approaches in using BIM as a Construction Management Tool

Successful BIM requires new processes, new technologies and new behaviors. Of these three, new behavior is the most difficult to achieve. In other for BIM to be effectively utilized as construction management tool in Nigeria, there is a need for changes from existing mindset.

Innovative approaches to construction management must have to be developed[19]. BIM involves a collaborative approach to construction that combines various disciplines so as to build a structure in a virtual and visual environment. To do this it requires an efficient collaborative team.

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C. The Building Information Modelling and the Advantage of the Model

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[20][21]. The 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[22][23]. This mode of information sharing requires the team member to be working on the building information model instead of paper based documents. Therefore, The virtual building implies that it is possible to practice construction, to experiment and to make adjustments in the project before it is constructed[24]. 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.

IV. METHODOTHOLOGY

This paper focuses on the building collapsed crises in Nigeria and working of finding a solution throw implementation of Building Information Modeling in the Nigerian Construction Industry. It is divided into two part, the first part of this work comprised of literature survey which was carried out to find out the causes of building collapsing and to provide the background information on Building Information Modeling which serve as the solution for the building collapsing crises in Nigeria. Similar to other researches, BIM benefits and its implementation factors were identified through intensive literature review for the formulation of survey questionnaire. Information was obtained through literature search which included books and articles in libraries and some online materials[25]. A well prepared and structured questionnaire was designed, which was self administered. The questionnaire was designed to achieve the purpose of this research which include the awareness of the BIM implementation in Nigeria, The BIM benefits, and the last which is the BIM success factors implementation[26]. The got our data from the place in Lagos, Kano, Jigawa, and Abuja state in Nigeria. The participants for the survey were clients and developers, consultants, contractors, participants from Construction Industry Development Board,

The target population of this research was the Nigerian Building Design firms. The study identified Engineering, Architectural, Building and Quantity Surveying consultancy firms as those responsible for design of buildings in Nigeria. A sample size of 446 was obtained from a total respondent population of 4533 using Morgan's table for determining sample size from a given population. Out of 690 survey questionnaires we distributed, only 368 valid ones were returned. The percentage of the returned questionnaire is around 77% which is acceptable limits by Akadiri, 2011.The responses came out in details.we find out the despondence rate from Lagos and Abuja represented 39% and 32% respectively while only 18% and 15% responded from Kano and Jigawa respectively. When the questionnaires is returned, contractors responded at rate of 55% as the highest, followed by clients developers with 21%. Piping engineers Civil and structural engineer, Electrical, and architects and Mechanical scored 10%, 5%, and 3%. There also another other respondents from management, academic sectors and government representatives with 12%. All together the number of companies and organizations that participate in the research is satisfactory because a sample size of 220 respondents is adequate for a statistical power of covariance structure models such as Structural Equation Modelling.

V. RESULTS AND DISCUSSION

A. The Awareness of Building Information Model

The BIM awareness level is still low in Nigeria. One of the level which is moderately aware was considered as the acceptable level of awareness. The highest moderately awareness level was found to be in Lagos with 39% then Abuja and Jigawa with 21% and Kano 28%.

The respondents in total were above the level moderately 45% are aware of the BIM technology in all the states. However, the highest percentage indicated a low awareness level slightly aware and not at all aware, If we look at the whole States the total was around 56%.

All together, the result showed that awareness level in Nigeria is very low. Nevertheless, there is a great opportunity for the Nigerians construction industry to increase the level of awareness through the yearly organized construction program such as seminars, exhibitions and workshops. This strategy has proven its excellence to promote the BIM application by motivating the local organizations to shift from the conventional construction practices which is the local practice to the BIM based technology. For a successful transition, this research brings about the most important benefits that influence the stakeholders' decision to initiate the BIM implementation.

B. Benefits of Building Information Model

Descriptive analysis was carried out to rank the significant level of the identified BIM advantage based on their mean values. According to some researchers they used the mean value of 4 as a cut off to identify the benefit factors. The results we gotten showed that only 8 out of the 19 has a mean value greater than 4 were ranked due to the identification of the benefits. The benefits showed a standard deviation which is below 1 which represent a good accuracy of the collected data. In this study, the null hypothesis which is (benefits were neutral, and very insignificant) is accepted if the t-value is smaller than 2.10 the critical t-value. This research adopted the 7 benefits that are significant according to the mean of 4.00. The Test revealed that no difference between the stakeholders' perception on the 7 essential benefits. The null hypothesis was rejected. The difference was found to be in clients developers group.

The outcomes demonstrated that all the 7 advantages can be factually considered as the most critical and significant to influence the decision on the BIM implementation. Since the respondents have different backgrounds and experiences, in different organizations, their views and opinions are very significant to stimulate their focus when promoting the BIM projects. Therefore, the 7 significant benefits selected and ranked as important will provide a sound basis upon which decision making guidelines for the BIM implementation.

Table 1 : Awareness of the BIM

		Kano	Lagos	Jigawa	Abuja	Total
		%	%	%	%	%
Awareness	Not Aware	5	29	26	23	23
	Slightly Aware	42	27	32	43	35
	Moderately Aware	40	22	29	20	26
	Some are Aware	14	18	19	13	16
	Extremely aware	3	9	0	6	6

Table 2: BIM implementation advantage on Nigerian Companies

No.	Significant benefits	Mean	Sd	t-value
1	Increment of productivity and efficiency	4.09	0.79	2.73
2	Assess time and cost associated with design change.	4.08	0.85	2.27
3	Visualize and Eliminate clashes in design.	4.08	0.78	2.38
4	Improve multiparty communication and maintain synchronize communication.	4.03	0.78	1.58
5	Integrate construction scheduling & planning.	4.02	0.76	1.44
6	Identify indicating time based clashes.	4.02	0.79	1.37
7	Monitor using bim and track progress during construction.	4.01	0.82	1.17

The observation during the data collection found that the construction industry face a serious problem in term of construction conflicts. As a result, project delay, cost over run, and low quality is experienced. Practitioners acknowledge the benefits of BIM to the construction projects, but they are reluctant to adopt it. Some construction players believe that the construction industry should enforce the application of BIM, while others comment that the industry should provide evidence on how construction players could implement BIM to achieve the desired benefits. The governmental policy is viewed to be in line with the stakeholders' perception of the value gained from BIM implementation. Therefore, this research recommends that the BIM implementation should focus on how organizations can achieve their concerned goals with minimal losses and/or in a short period.

C. BIM Implementation

Similarly, to the BIM benefits, the BIM implementation success factors were ranked according to their mean values. A total of 24 factors were ranked as significant and very significant. The standard deviation was below 1 and this represent a good data accuracy. A t-test was used to indicate the most significant factors among the 24 benefits. The null hypothesis factors were neutral, insignificant, and very insignificant which is accepted if the t-value is smaller than 2.01. The very significant factors were ''mutual trust, respect, and personal commitments to cooperation", ''early involvement and participation of project teams", and ''early selection and capability to use appropriate BIM software tool to perform the task". However, the results indicate that 3 factors can be statistically considered as the most significant and relevant for the initial success of the BIM implementation. According to The Wallis test, the results gotten revealed that the null hypothesis that the distribution of the factors are the same across different stakeholders is rejected for mutual trust, respect, and personal commitments to cooperation with significant difference between clients/developers and other respondents, and retained in the other two factors knows as ''early involvement and participation of project teams" and ''early selection of the appropriate BIM tools to perform the task".

This factors it self above are essential for initiating the BIM implementation. It was observed that the big organizations have a great chance to maintain those factors and successfully implement BIM faster than the Small and Medium Enterprises. This is because the big organizations have their own different departments such as architecture, engineering, and construction departments' making it easier to work in the same environment, trust each other, cooperate, and collaborate. Therefore, those organizations value the benefits of BIM. However, small and medium have different interest, and each party focuses on its own benefits rather than the project success, so they usually face difficulties to meet the requirements for the BIM implementation. Even though they acknowledge the BIM benefits but they believe that the interests will not be equal.

D. Structural and Measurement model

A measurement model demonstrates the existing relationships between items and their underlying latent construct. The statistical analysis numbers show that the measurement model had a Root Mean Square Error of Approximation value of 0.017 acceptable, Chai square (CMIN) of 66.832, and degree of freedom (df) of 33. The Comparative Fit Index (CFI) of 0.989, CMIN/df of 2.058, Standardized Root Mean Squared Residual of 0.017, and Close Fit of 0.078 were within the excellent interpretation of the threshold value. Therefore, the fit statistics are adequate within the acceptable thresholds and factor loading to establish convergence validity of the BIM implementation. The correlation occurred between the BIM benefit and its influence on the BIM implementation was 0.24. However, the structural equation model in Fig. 3 and the resulting path test of two-tailed significance in Table 6 revealed that the BIM benefits had a significant impact of 0.49 on the BIM implementation.

VI. CONLUSION

This research investigated the influence of Building Information Model implementation benefits with the Nigeria stakeholders' decision in the construction implementation using the Building Information Model.The data from the analysis of the survey carried out show the need for government agencies responsible for construction in Nigeria to enforce quality assurance on every project. Because The study carried out through the identification of the important benefits and factors affecting the initiation of Building Information Model implementation. But thorough examinations and checks must be carried out during designs and construction by duly certified professionals. Awareness should be promoted to educate investors and owners of buildings about possible collapse from over interference in the construction process. This research showed that the application of BIM is economical easy leading to improvement, It will 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 when it comes to cost and time of projects, productivity and efficiency decrease of building collapse. Improved profitability in the construction business and more successful delivery of projects are further benefits of applying BIM in construction industry.

A questionnaire survey was one of the basis of this research. A sample size of 347 was obtained from respondent population of 3534. Around 591 survey questionnaires were distributed which to that only 269 returned as the valid ones. The results show that the diffusion of Nigerian construction companies to BIM implementation is very low. So, it is important for the construction industry to promote BIM based on the practitioners' interest. According to descriptive analysis obtained, 7 important benefits identified as significant to stakeholders' decision which were; increase efficiency and productivity, assess time and cost associated with design change, eliminate clashes in design, improve multiparty communication and maintain synchronize communication, integrate construction scheduling & planning, identify time-based clashes, and monitor and track progress during construction. These benefits significantly influenced the practitioners' decision to enhance mutual trust, respect, and personal commitments to cooperation.A successful case study show the possibility to achieve practitioners' benefits through the BIM implementation could motivate and increase the BIM adoption. Benefits presented in this research could be used as a good reference to reflect the practitioners' thoughts and how they will influence the essential factors for a successful BIM implementation.

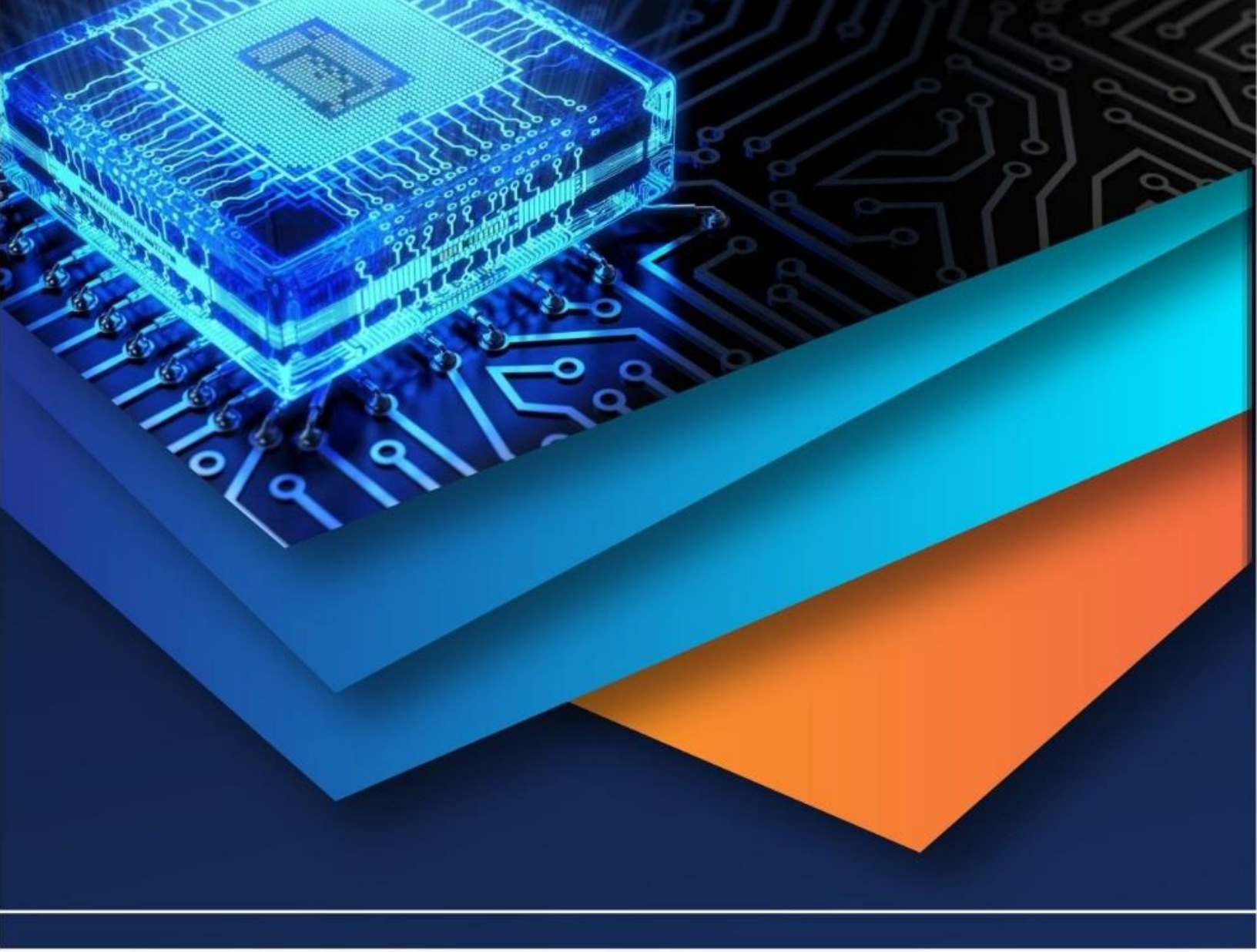
VII. RECOMMENDATION

It is hereby recommended that the Federal Government of Nigeria through the legislative arm should amend 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. This will enable the building in Nigeria to reduce, The construction companies in Nigeria should embark on training and retraining 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. There should be innovation development in terms of software packages which can further improve the quality of work done and also improve the construction industry professionally. This will motivate and give hope to Nigerian professionals and the ability to even compete with their counterpart all over world and also expose them to the global best practices in construction projects so that building will be calculated before it was build and the rate of building collapsing will reduce due to the implementation of BIM. The BIM approach to project design and construction will simplify the work of the various professionals on the construction project.

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