Building Information Modeling: Case Study of a Duplex Building Project in Nigeria

Anthony Nkem Ede (PhD), Lecturer, Department of Civil Engineering, College of Science and Technology, Covenant University, Ogun State, Nigeria.

ABSTRACT

Activities involved in construction projects have always been complex and continue to be yet more complex for the high level of sophistication the world have attained today. As the desires of man continue to expand, so do the interests of the stake holders in the built environment industry. But the vast advances in the Information and Communication Technology (ICT) have brought about substantial amounts of research on approaches and applications to reduce the burdens of the built environment complexities. One of these new advances is the Building Information Modeling (BIM). BIM unites Design, Construction, Maintenance, Management and Documentation of building projects thereby enhancing better informed decisions by the project team players and improving the end product. This research engages Building Information Technology on a modest duplex building project. The results obtained demonstrates that Building Information Modeling breaks distance barriers between the team players working on a project, enhances safety, economy, beauty and eliminates waste.

Keywords:
Building Information Modeling, Built Environment, BIM’s Tools, BIM’s Benefits, Case Study

1. INTRODUCTION

Over the years, built environment projects have always been complex and are becoming too difficult to manage in the recent years because of the multifaceted tasks involved in the process and the chain of decision makings involved the process. The complexity starts from the difficulty of trying to force the cardinal points of construction projects: structural safety, constructability, economy, aesthetics and management to cohabit in harmony. Another complexity is the mutuality between different stakeholders, such as Financing Bodies, Authorities, Architects, Engineers, Lawyers, Contractors, Suppliers and Traders [1]. The conflicts of interest between the stake holders create great havocs that are detrimental to the success of construction projects and often limit the success that could hitherto been achieved in projects. As a succor to the intensifying complexity of Projects, Information and Communication Technology (ICT) has developed rapidly [2], and has brought about substantial amounts of research on approaches and applications to reduce the burdens of these complexities. One of these new advances is the Building Information Modeling (BIM). There has been rapid increase in the application of BIM in industrial and academic circles as the new Computer Aided Design (CAD) paradigm [3], which propels BIM as the best new way of approaching the Design, Construction, Maintenance, Management and Documentation of building projects. Building Information Modeling models and manages not just graphics, but also information that automates the basic and working drawings, design modeling and analysis, reports, schedule simulation, facilities management etc., thereby enhancing a better informed decisions by the project team players.

2. BUILDING INFORMATION MODELING (BIM)

[3] 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". Succar's definition of BIM highlights its holistic nature, which includes not only software that allows the geometrical modeling and the input of information but also project management (PM)-related tools and processes [4]. From this point, BIM can be seen as the center that unites all the actors and processes involved in a project, creating a fertile ground for a distributed team to coexist harmoniously allowing people and tools to perform their tasks effectively in the mist of free flow of information throughout the building lifecycle, thereby eliminating waste and reducing errors to the barest minimal.

BIM has a potential to be used at all stages of the project life-cycle from being used by the owner, by the design team, by the contractor and by the facility managers [5]. 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.

The future of BIM will lead to virtual project designs and construction approach, with a project being completely
Building information modeling is composed of many blocks on the way will be singled out. However, there is a view that the overall effectiveness of created in the USA towards promoting BIM's use [11].

Great awareness is being asset and project information, data and documentation "fully collaborative 3D" BIM [10]. 3DBIM means all onwards all contracts awarded will require the supply transaction costs and less opportunity for errors to be Foreseeing the benefits of using BIM in respect of reduced (Cosmix), Victoria Station Upgrade and several others.

Terminus, Colorado Springs Metro Interstate Expansion Motorway Upgrade, Express Rail Link West Kowloon Velodrome cycle track, Heathrow Terminal 2B, Ipswich Treatment Works, London 2012 Olympic 6,000 seating (Initial Upgraded Sections), Liverpool Wastewater Panama Canal, M2 5 London Orbital Motorway Widening mega construction projects, such as the 21st Century projects of our time. It has been adopted on high profile from the conventional structures to the most inspiring of all types of buildings and facilities around the world, the rule of the game. There is hope that the stumbling commitment of all the team players to effectively play to BIM utilization is still not completely justified [12]. The tasks far away from each other. The state of activities in each process can involve many operators performing their operators, processes, and communication flow, in which activities being facilitated by the rapid development of supporting technologies, it is very difficult to capture current status as new frontiers are emerging continuously. 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.

Based on the great qualities already identified with this innovative method of operation for the built environment industry, this research tries to establish the utility of BIM on a modest duplex building project yet saddled with many intricacies. It is hoped that this work will help to highlight the importance of BIM and go to some extent to improve the acceptability of this great innovation in the construction industry.

3. CASE STUDY OF BIM APPLICATION ON A DUPLEX BUILDING PROJECT

For this case study, a client that resides in Maryland USA gives a brief to an engineer resident in Ota Nigeria indicating that he desires to build a duplex in Enugu Nigeria. The engineer takes the brief to an architect in Ota Nigeria and the architect goes into operation in collaboration with the engineer. Based on the technical and economic data furnished by the client, conceptual designs were produced, detailed and redesigned. After series of trials and corrections that met the client’s need, the architectural design was optimized, making room for the other specialized sectors to perform effectively and then the working drawings were produced. The basic tools adopted in this sub-sector include laptop computer, design soft wares (Autodesk Revit 2014 and Navisworks Manage 2013) and communication mediums between the client, architect and engineer such as phone, internet, text messages, papers, etc. The problems encountered and resolved during this stage include the first model being rejected by the client, next model modified severally to increase the number of rooms on the two floors, increasing the size of the garage for two cars, making part of the sitting room slab to be open to the roof, reconciling the first floor with ground floor. Each modification brought about much other consequence. Figures 1 and 2 show the final architectural model produced by the architect.
After the architectural model was ready, the structural designers took over. First an engineer in Ota started the structural analysis, but was substituted with another one in Abuja because his pace of work was slow. The second engineer was ultimately substituted because he failed to deliver on schedule. The working structural engineering was finally produced through collaborative efforts between other engineers based in Enugu and in Ota.

The softwares engaged for structural analysis were Orion, Robot, Civil Soft, Sta-so. Among the problems encountered include modeling of the curved slab over the sitting room, reconciling the ground floor columns with the first floor columns. Through the different BIM tools, it was found a column from the ground floor pieced thru a room on the first floor and appropriate solutions were provided. Figures 3 and 4 show the elements that were eliminated (in red) and the new ones that were introduced (in green). Figure 5 shows the curved slab opening over the sitting room. This particular slab created a lot of modeling difficulties for one of the softwares. After the architectural and structural working drawings were ready, the client then arrived Nigeria to initiate the project. Different contractors in Enugu were considered and one was chosen. The contractor commenced work at the site in December 2013 and every of the processes are proceeding smoothly as the manager of the project in Ota Nigeria and the client in Maryland USA remain fully connected to the contractor and the project in Enugu Nigeria through ICT facilitated BIM tools. Through these BIM tools, the progress of work at the site is often evaluated from time to time.

4. FINDINGS AND CONCLUSION

From this modest project, it can be said that BIM is a great approach for simplifying complex built environment projects. From the architectural stage to the structural stage, a lot of problems were identified and promptly
resolved making room for enhanced quality of the end product. The architectural model produced goes forth to show you what the final project must look like. Any deviation along the line can be easily identified and resolved on time. Another very important fact that emerged from the project is the nullification of distance barriers among the key players in the project. The client stays thousands of kilometres away from the other operators, yet all are proceeding well and at minimal cost. The project manager is hundreds of kilometres away from the site, yet all are under his control. This project demonstrates that Building Information Modeling breaks barriers of distance between team players working on a project as they don’t really need to be present in the project’s environment for a task to fully run its course. BIM turns out to be a full demonstration of what globalization is all about. As this project has been virtually tested and proved, safety is enhanced, economy and beauty are guaranteed and waste is eliminated.

5. REFERENCE


ABOUT THE AUTHOR

Dr Anthony Nkem Ede obtained PhD in Composite Materials for Civil Applications, Universita’ di Sorrento, Lecce Italy (2008) and MSc Civil Structural Engineering, Alma Mater Studiorum, Universita’ di Bologna Italy (2001). He was a Visiting Research Scholar, George Washington University, Washington DC USA. Currently lectures Structural Engineering Courses at Covenant University Ota Nigeria and is a Structural Consultant in Nigeria.