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# Effective Design and Construction of Building Projects in Anambra State Using Bim Tool: Practices, Problems and Prospects

**Professor K.C Okolie1 and Noel Ifeanyichukwukwu Okoye2**

1Department of Building, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
+2347036832715
Kc.okolie@unizik.edu.ng
2Department of Building, Nnamdi Azikiwe University, Awka. Anambra State, Nigeria.
noelokoye1992@gmail.com
+2348039556428

***Abstract:*** *Building Information Modelling being a design and construction tool is a three dimensional (3D) object-oriented model with embedded information. It is a three-dimensional module of a building representation in which all the elements that are comprised in the buildings are considered as "objects" connected to each other and represented in digitalized computer-aided design models. This study therefore attempts to discuss the practice, problems and prospects of Build. It also seeks to ascertain the extent BIM as a tool for design and construction, have been in use in Anambra state for the past decade. Secondary information used in the study were drawn from existing literature. Accordingly, the study achored on the Theory of Diffusion of Innovation which was propounded by E.M. Roger in 1962. The study reviewed that effective design and construction of building projects using BIM tool reduces error and saves time of operation; stores all related data of the building in united, consistent and quickly reachable record; aids accessibility of data; facilitates design and analysis. While highlighting plausible prospects, the researchers recommends that proper adoption of BIM tool for design and construction of building projects in Anambra State for effective change in the way building operations are conceived, designed, communicated and constructed.*

**Keywords:** Building, Building Projects, Construction, Design, BIM Tool.

## 1.0 INTRODUCTION

The performance of the Construction Industry globally and inclusive of Anambra State in areas such as building design, building construction, facility management, property (Real Estate) maintenance, green (House) building development to mention but a few, have been rated ineffective due to the poor application and use of Building Information Modelling tool. The use of Building Information Modelling, henceforth BIM as a tool for achieving effective design and construction of building projects have been on the rise despite the various challenges encountered. (Yan and Damian, 2010; Isikdag and Underwood, 2010; Nederveen *et al.,* 2010; Wong *et al.,* 2010; Sebastian and Berlo, 2011) in (Abubakar, Ibrahim & Bala, 2014).

The problem of poor application of requisite BIM tool in the analysis, design, construction, maintenance, materials re-use etc during project's life cycle has affected the effective design and construction of building projects in Anambra state. The BIM tool software (such as ArchiCAD, AutoCAD and other design tools) used by building professionals and engineers for building design and construction, which are often printed on a paper for the General contractors' use during building execution sometimes does not have available software for efficient Co-ordination, Scheduling and Project Planning. The use of paperwork as a method of communication between key players in the built industry without recourse to requisite BIM tool software is a major source of default in the efficient design and construction of building projects. These major problems have over the years adversely affected the cost effectiveness and timely delivery of building projects (Abubakar, Ibrahim & Bala, 2014).

To maximize the twenty first century digitalized problem-solving opportunities of combating these problems of inefficiencies and reducing errors, omissions and wastages caused by these challenges etc., the building industry must be involved in the digitalization crusade. As suggested by Kiprotich (2014), the contributions of wider use of technology, digital processes and automation to our economic, social and environmental future cannot be overemphasized. Effective application of BIM tool in building designs and construction will effectively change the way building operations are conceived, designed, communicated and constructed (Isikdag, 2015).

Against this backdrop, this study discusses the practice, problems and prospects of effective design and construction of building projects using BIM tool in Anambra State. It also seeks to ascertain the extent BIM as a tool for design and construction of building projects in Anambra State have been in use in the state for the past decade.

## 2.0 EVOLUTION AND DIFFUSION OF BIM TOOL INNOVATION

The evolution process of BIM tool innovation commenced (source of invention) from the early eighties (80s), during the cold war in Europe, when computer genius, "Gabor Bojar", smuggled Apple computers into Hungary to develop software applications. In order to enhance building operations, the quest to develop software ArchiCAD was conceptualized. Hence, ArchiCAD became the First BIM – enabled software tool available on a PC for building designs. In order to bring different models of a building together by various stakeholders to form a common building model, the concept of Building Information Modelling then came into place.

The term BIM was first used by Nederveen G.A and Tolman F (1980) in their article titled "Automation in Construction". Over the years, many programs were developed and spread through the process of diffusion, and this revolutionized the BIM concept such as the Revit program in 2000 which gave rise to a gradual diffusion of the innovation. Through the theory of Diffusion of innovation, BIM achieved a somewhat wide-spread popularity in the last decade. The spread in the use of BIM tool have moved from countries to countries especially in the European legislated countries such as Norway, Finland, Denmark and Sweden. These were the pioneer countries that first enforced the use of the BIM method (innovation) in public projects. They have joined forces to form the non-profit organization "Building SMART Novdic" to promote the building of a sustainable environment.

BIM tool being a new innovation in the building industry is undergoing the process of diffusion. Communication on the application of BIM as an innovative tool in the construction industry is still at the uncertainty stage, whereby, building professionals in the industry are yet to be clarified on the acceptability of the new innovation. However, BIM tool being technologically based innovation, has a need based developmental idea which embodies information that reduces uncertainty about cause–effect relationship in solving the developmental problems.

Diffusion of innovation refers to the spread of developmental ideas/innovations through a population, and is simply the result of a host of individual adoption decisions. The individual adoption decisions are to an extent predictable, hence, a predictable larger diffusion process envisaged. According to Rogers (1995), Diffusion process is the spread of new idea from its source of invention or creation to its ultimate use of adopters. The diffusion of innovations is essentially a social process in which subjectively perceived information about a new idea is being communicated.

According to Roger (2003), the Diffusion process of BIM innovation, have created a focus on the careful exchange and transfer of information, to various countries of the world, with the consideration of international standard in the building industry especially, the Public and Private Sectors. This theory has transmitted to various sectors; some far reaching benefits in the use of BIM which include, shorter construction times and costs on any construction projects. The result of a building project is generally predictable and risk of bad designs minimized, courtesy of BIM Diffusion Innovation. In the course of applying BIM innovation in building operations, new buildings, are built to be of high performance and energy efficient, protecting the environment and costing less to operate. With the assistance of the Diffusion theory in the BIM initiative, it has become mandatory for most organizations and countries to apply the BIM tool to new projects, the benefits do not only apply to individual projects but to public buildings especially office projects. The development and spread of BIM innovation was influenced by many factors that made it difficult to define the exact date of its birth. It is therefore the Diffusion process that makes the story of BIM more popular. The diffusion of innovations is essentially a social process in which subjectively perceived information about the new idea, is communicated.

Rogers, (1962) stipulates four main elements that influence the spread of the (BIM) new idea/ innovation. These include; (i) Innovation (ii) Communication Channels (iii) Time and (iv) Social System. Rogers (1962), went further to define the following mentioned elements.

i. Innovation**:** As an idea, practice or object that is perceived as new by an individual of other unit of adoption. This idea or practice may have a slight modification or a significant departure from the existing idea or practice – Innovation Contingencies
ii. Communication Channel: As a channel that serves as a means by which messages of information are relayed from one individual to another. These may include, Mass Media Channels, Interpersonal Channels, Conferences/Conventions Channel etc.
iii. Time**:** This refers to the innovation- decision period, that is, the length of time required to pass through the innovation – decision process.

According to Ryan and Gross (1943), various sequence of stages in the process of its adoption exist. These stages of adoption include:

1. Awareness of the existence of the innovations.
2. Acceptance and the Willingness to try the use of BIM as an innovation.
3. Complete adoption of the BIM as an innovation

The new idea constitutes the central element of an innovation which often manifests itself in a material or behavioral form, using BIM practice as an example of the behavioral form. BIM practice does not diffuse at the same rate. An innovation which represents only a slight modification of an existing idea or practice will obviously diffuse at a faster rate than the one which represents a significant departure from it.

BIM practice therefore, being a new innovation and representing significant departure (modification) from the traditional 2D/3D CAD Concept, is observed to diffuse but at a slow pace especially in developing countries and states like Nigeria and Anambra State.

Therefore, the rate of adoption of decision is directly proportional to the time required to pass through the innovation (decision period).

## 3.0 OVERVIEW OF EXISTING BIM TOOL DESIGN AND CONSTRUCTION SOFTWARE

Building Information Modeling (BIM) tool for design and construction has been defined by various scholars. Abubakar, Ibrahim & Bala, 2014 citing Building Smart, 2010 see Building Information Modeling (BIM) as a tool for the digital representation of the physical and functional characteristics of a facility, which serves as a shared knowledge, resource for information about a facility, thus forming a reliable basis for decision making during its life-cycle from inception to completion etc. The authors also expressively state that BIM refers to the means by which aspects of the building can be displayed or deduced through the use of digital model. In their own postulation, BIM has the ability to interact digitally with all aspects of the building to optimize actions and achieve greater whole life value for the asset; to create value through the combined efforts of people, process and technology; to gather information about every component of a building at a glance; to give easy accessibility to information regarding the building and helps integration on different aspects of the design and construction more effectively.

Abubakar, Ibrahim & Bala, 2014, citing Becerik – Gerber and Rice (2010), states that BIM is an enabler that can assist the building industry to improve its productivity and enhance efficiency in project delivery by ensuring effective communication and collaboration between all project stakeholders from inception to completion.

Succar (2009) holds in affirmation that BIM is a set of interacting polices, processes and technologies which produce the digital format employment in managing building designs and project data processing. Succar notes that due to the proliferation of BIM, there was the need to develop metrics that will measure the performance of BIM. Hence, his affirmation points more on the aspect of managing building design without emphases on other stages of its application.

Agele (2012) views BIM as an approach to construction which supports the continuous and immediate availability of a high quality reliable and integrated project design. The author's view dwells mostly on high quality, reliable and integrated project designs without addressing specific aspects of building operation such as building analysis, engineering (structural) analysis, conflict analysis, code criteria checking, engineering cost analysis, building management and maintenance analysis, during the life span of the building. Also, no reference is being made to the use of computer aided tools and digital-model-based information process in its operation.

Boukara and Naamane (2015), in their analytical expressions, view BIM as an intelligent model-based process that provides insight to help in planning, designing, construction and management of buildings and infrastructure. According to the authors, BIM provides intelligence to individuals on building components (windows, walls or chillers, etc) as well as providing system and building wide information and awareness in addition to simple spatial relationships.

## 4.0 BIM TOOL (SOFTWARE) AND ITS EFFECTIVENESS IN BUILDING DESIGNS AND CONSTRUCTIONS

Messner et al., (2011), opine that BIM being a digital representation of the physical and functional characteristics of a facility, becomes effectively implemented in building projects design and construction, only if the project team performs a detailed and comprehensive planning.

Ibrahim and Abdullahi (2016) observe that a BIM begins with a parametrically enriched 3D containing both geometric and non-geometric information which are embedded into various components. Aouad *et al.* (2006), cited in Ibrahim and Abdullahi (2016), classifying BIM as 3D, 4D, 5D, 6D, 7D and nth D computer aided design models. Of all these classes, the nth D model incorporates all design information required at each stage of the building facility lifecycle. They went further to aver that Building Information Model as a project simulator consists of the 3D models of the project components with links to all the required information connected with the projects planning, construction or operation, and decommissioning.

BIM being a design and construction tool is therefore a three dimensional (3D) object-oriented model with embedded information. It is a three-dimensional module of a building representation in which all the elements that are comprised in the buildings are considered as "objects" connected to each other and represented in digitalized computer-aided design models. Each object has a unique identifier and relates information about its geometry and its properties. This object-oriented approach allows the user to organize the virtual model and develop different behavior's or interactions according to the type of objects (for instance, windows have special relationships with walls, objects can be attached to floors, walls, ceilings or other objects). The goal is not simply having a BIM, but the project understanding generated through the creation of the BIM tool, and the benefits of the use of the information that is available through the BIM tool.

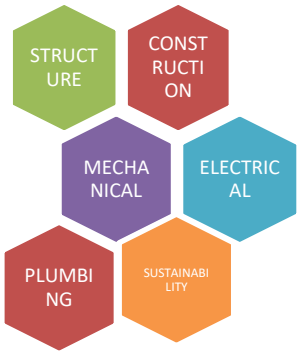
According to Alufohai (2012), various basic BIM tool software are used to achieve effectiveness in design and construction of building facilities. The basic BIM tool software includes: Autodesk Architectural Desktop (ADT), Autodesk REVIT (ADR), Bentley System, Graphisoft ArchiCAD and Nemetschek:

i. Autodesk Architectural Desktop (ADT) is a BIM tool that creates its building model as a loosely-coupled collection of drawings, each representing a portion of the complete BIM. They are aggregated through various mechanisms to generate additional views of the building, reports, and schedules as though there was a single BIM at the center. Errors occur when the user manipulates the individual files outside the drawing management capabilities provided in ADT.

ii. Autodesk REVIT (ADR): ADR provides the enabling environment to coordinate every building element in one database, so users can immediately see the results of any design revisions made in the model, and reflect them in the associated views (drawings), as well as detect any coordination issues.
iii. Bentley System: This system enables the creation of more explicit origins in Computer Aided Design. Bentley users can migrate work methods with origins in CAD easily. This is one of the software packages that supports Industry Foundation Class file formats from early development. But optimal levels of interoperability can be attained only when other Bentley products are being used on a project.
iv. Graphisoft ArchiCAD: This application creates a virtual building model as one of the many applications in a building's model rather than being the central clearing point that contains a single model.
v. Nemetschek: All plan conceived from this design software allows third party design and analysis applications to interface with the building objects in the model. Its main market is German-speaking countries in Europe.

Kalfa (2018), avers that various BIM compliant software exists for building design and construction. The most common and useful ones being the REVIT, ARCHICAD, and BENTLEY software, which run with smart objects creating building components. The study expresses that this BIM software are classified into six sub-groups, namely, Structure, Construction, Mechanical, Electrical, Plumbing, Sustainability and Facility Management groups. See figure 1.0 below.

**Figure 1: BIM Software Classification Groups**




**Source: Kalfa (2018)**

According to Kalfa (2018), BIM design software are listed as Autodesk BIM 360, Revit, Navisworks and Archicad. These BIM software enables project design, delivery and construction management. They also unify the processes of project design and construction and can be viewed as the best building information modelling software, owing to its capability to connect project data and teams in real-time from design to construction. They are cloud-based web service that provides team's access to data to improve decision-making and avoid expensive delays. Designed for the construction industry, these BIM tools can automate tasks, manage quality, and reduce risk to ensure project delivery within budget and schedule. The Electrical, Plumbing, Sustainability and Facility Management groups make use of these software. It also streamlines designing complex and conventional structures with efficiency, versatility, and convenience. It has an intuitive modelling feature that uses similar CAD functions for drawing and creating nodes and elements. In addition to its user-friendly property, it also has a robust post-processor, auto-design features, and full analysis and design options.

Langer (2008), further argues that the life cycle of the database includes all steps (and environments) necessary to assist in the database's design and final implementation and its integration with application programs. He went further to state that irrespective of which design methodology that is applied, effective application of BIM analyses/design of a system development projects will usually include the following generic steps:

i. Determining the need for a system to assist a business (building) process.
ii. Defining that system's goal.
iii. Gathering building's requirements.
iv. Converting building's requirements to system requirements.
v. Designing the database and accompanying applications.
vi. Building, testing, and implementing the database and applications

According to various authors, the effectiveness of BIM design tools has been found to depend on the assistance architects, engineers and other building professionals offer in the use of digital design information to analyze and understand projects performance before they are built. The evaluation of multiple alternatives at the same time enhance easy comparison and ensure better sustainable design decisions. To design and deliver more sustainable projects require a close coordination across different project stages. A computable Autodesk Revit Architecture design model is devised for sustainability analysis during the project life-cycle, even during early

conceptual design stage. The establishment of the layout of a building's walls, windows, roofs, floors and interior partitions, offers the architect easy access to create a Revit Model which can be used to perform the analysis. The use of Auto CAD work flow in performing design analysis and construction have been found to pose a little challenge as the CAD model has to be exported first and carefully managed to work with the analysis program.

Khan et al., (2018) specify that BIM helps Architects, Engineers and Construction professionals to envision whatever is to be built in computer-generated setting and to recognize probable design, structure or operative problems. They also affirm that using Building Information Modelling (BIM) helps to characterize the method of improvement and use of a simulated model to put on the planning, design, construction and set-up of a capability. They further assert that BIM illustrates the geometry, 3-D associations, geographical data, magnitudes and possessions of building basics, rate estimations, solid records and project agenda. From the result of this review, magnitudes and mutual assets of materials can be freely pulled out from a concept using the BIM Tools for analysis and design of buildings. This design and construction BIM model can be effectively used to establish the whole building life cycle (Bazjanac, 2006).

## 5.0 BIM PRACTICE BY BUILDING PROFESSIONALS: THEIR ROLES IN EFFECTIVE DESIGN AND CONSTRUCTION OF BUILDING PROJECTS USING BIM TOOL IN ANAMBRA STATE.

Kubba, (2012) avers that building professionals actively participate in the effective design and construction of building projects using BIM tool. These group of professionals include but not limited to Architects, Builders, Estate Surveyors and Valuers, Land Surveyors, Quantity surveyors, Town Planners, Engineers (Civil, Mechanical, Electrical), Construction professionals etc. The overall priorities of these professionals in the use of BIM tool for design and construction of building projects in the State are to ensure that the projects are economically viable, structurally sound, physically attractive, safe for habitation, sustainable and completed on time and within budget. Their roles in achieving effective design and construction of building projects using BIM tool in Anambra Sta**te** can be itemized and described as follows:

The ***Architect*** is responsible for creating a design concept that meets the requirements of the client and provides a facility suitable for the required use. Duties and responsibilities of the Architect include:

1. Contribution for initial discussions and consultations which relevant to design and plans with a person or a business organization in satisfactory level.
2. Should be understood clearly about clients' intended objectives and explaining them.
3. Getting clear idea of Clients' budget which is expected to invest for projects and consulting with suggestions for any alternatives may be required.
4. Preparing initial proposals subsequent to discussions with client.
5. Studying environmental impact and the effect having with proposed structure.
6. Follow-up feasibility studies and how it affected for constructions in specific locations.
7. Attending site selections and produce a cost analysis as a part of the initial proposals.
8. Explain all aspects of initial proposals to client very briefly.
9. To be worked altogether with client to get a final product as plans and important designs.
10. All design and plans with respect to the rule and regulation of government and relevant organizations and institutions respectively.

An *Architect* is the principal designer in most of building projects. The architect has overall responsibility for the design and construction of the project in accordance with the client's specification. Architect is responsible to translate and develop the design concept based on the client's requirement. The roles of architect in the project using BIM are to develop conceptual design, detailed design and design analysis as well as to develop construction-level information (Reddy, 2012; Becerik-Gerber and Kensek, 2009).

Murphy (2011) viewed a ***Quantity Surveyor (QS)*** as one of the professionals involved in the construction process with specific responsibility for project cost control not only through the construction phase but for the whole life of the building. Quantity Surveyors are experts that are concerned with financial probity in the conceptual, planning and execution of building, civil and heavy engineering projects. They are financial managers that bring the concept of the clients to cost reality. In the pre-contract stage, quantity surveyors prepare bill of quantities, tender document preparation, analyzing, estimating and tendering, tender evaluation, tender clarification meetings, negotiation meetings, elemental cost estimate, measurements etc. In the Post Contract stage, it includes variation order calculations, variation order negotiation, kick of meeting, progress on site, payment certifications, financial statements, final accounts. Quantity Surveyors (QS) use BIM to produce accurate project cost estimation.

The ***Civil/Structural Engineer*** provide design drawings which show the locations, sizes, reinforcement and details of structural elements at their appropriate scales, to enable the fabrication, installation, and connection of the elements in a reasonable sequence by a reasonably competent general or subcontractor who is familiar with the techniques of construction for the specified materials. They coordinate the general supervision of the structural elements of the building project. The Civil/Structural Engineers utilize BIM tools to ensure the buildings they are working on are as sturdy as possible. BIM software enable these users streamline workflows.

The ***Mechanical Engineer*** prepare complete, contract drawings using the same scale as that of the building layout drawings showing the mechanical services needed and their locations. The mechanical services provided by Mechanical Engineers include: plumbing, drainage, heating, ventilating and air conditioning, fire protection, process piping and equipment and other special systems necessary (Association of Professional Engineers and Geoscientists of British Columbia, 2013). connect design to detailing and improve the quality of their design.

The ***Electrical Engineer*** prepares, completes, contract drawings using the same scale as that of the building layout drawings showing the electrical services needed and their location. The electrical services provided by electrical engineers include: lighting and power, HVAC electrical services, communication and alarm system requirements, one-line diagram and risers and other special systems necessary.

The ***Builder*** manages the production process of building projects. They are liable to the clients directly in all the stages of building contracts, ranging from contract award, material procurement, site operations and project delivery (Funmilola *et al*., 2013). The Nigerian Institute of Building (2014) describes a registered builder as a professional who has received an approved standard of professional training and practice in building and found competent after due examination. A Builder is the professional at the Centre of the physical construction of buildings. Their role in building development process in general, is to construct the building (Anyanwu, 2013). He does this by taking charge of the activities on a building construction site in translating designs, working drawings, schedules and specifications into a physical structure. He uses his production management expertise, coupled with the necessary resources such as money, manpower, materials, and machinery, in the site execution of building projects. His expertise in Building production management is the main professional input that he renders on building projects. In constructing building projects, a builder performs the following roles:

i. Carry out Buildability and Maintainability analysis.
ii. Prepare Production Management Document.
iii. Manage the execution process on site.

The Builder's responsibility of using BIM in managing the operation and maintenance of the facility is closely related to the project conception and planning for future facility's need.

**The B*uilding Contractor*** draws up a plan to carry out the construction project using a BIM application tool. This extends anywhere from hiring workers to developing a step-by-step timeline that the project will follow from start to finish. The BC is responsible for hiring, supervising, firing and payment of workers alongside obtaining materials for the project to precise specifications, mostly using the services of suppliers. The general responsibilities of a B***uilding Contractor*** entail the individual planning and carrying through any and all pertinent activities relating to the construction of a dwelling, building or other structure. In projects using BIM, the building contractor develops digital model using BIM tool such as Navisworks for identifying any design issues before the construction take place (Azhar, 2011; Azhar et al., 2012). With the digital model, the contractor could simulate the process; identify construction outcomes, any problems that affect cost, schedule and quality of projects

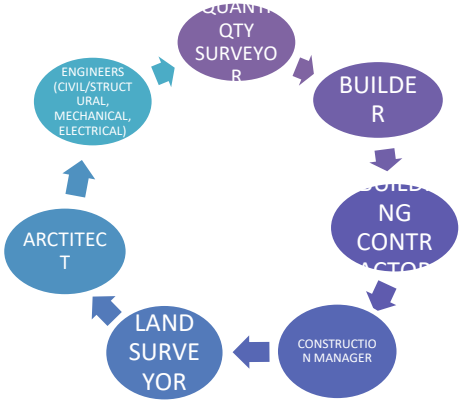
***Land Surveyors*** have been working with the elements of *geometry, trigonometry, regression analysis, physics, engineering, metrology, programming languages*, and the law. These works require software that offers unique strengths that will make data collection on land survey jobs easier and more efficient for land surveyors and other professionals.

Land surveyors measures and maps out the shape of land. They gather data for civil engineering and construction projects so that accurate site plans can be drawn. A surveyor is always part of a fast-moving, technologically advanced industry. Much of the surveyor's time will be spent on-site; using technical instruments to record the environment. A land surveyor is responsible for carrying out the review of land using technical equipment to ensure it is suitable for a construction project to take place. The land surveyor helps in the following duties:

i. Analyze data using geographic information systems (GIS) and drawing charts using computer-aided design (CAD).
ii. Assess land due for redevelopment.
iii. Carry out surveys of the environment with construction projects in mind.
iv. Manage and monitor projects from start to finish.
v. Monitor changes in the land during the construction process.
vi. Produce maps using GPS, surveying instruments, digital images and satellite photographs.
vii. Survey airports, landfill sites, mines, quarries, pipeline systems and more.
viii. Works in an office, with regular site visits.
ix. Works in diverse sectors, such as construction, property, cartography (maps), offshore engineering and exploration.
x. Write reports and share crucial information with colleagues and clients

Dim *et al*., (2015) concluded that professionals in the Nigerian building industry cannot be effective in the use of BIM tool (software) by working with only 2D and 3D BIM software technologies and yet hope to catch on with the full value that BIM brings to projects.

**Figure 2: Various Professionals in a Project Team**




**Source:** ADVENSER Engineering Services Private Limited. (Kubba, 2012)

## 6.0 PROBLEMS ASSOCIATED WITH EFFECTIVE USE OF BIM TOOL IN DESIGN AND CONSTRUCTION OF BUILDING PROJECTS IN ANAMBRA STATE

The problems inherent in the use of BIM tool in design and construction of building projects in Anambra State is enormous, although BIM practice is considered a new innovation and a paradigm shift from the traditional 2D/3D CAD Concept. BIM practice is observed to diffuse but at a slow pace especially in developing countries and states like Nigeria and Anambra State.The problem of poor application of requisite BIM tool in the analysis, design, construction, maintenance, materials re-use etc during project's life cycle has affected the effective design and construction of building projects in Anambra state.

The BIM tool software (such as ArchiCAD, AutoCAD and other design tools) used by building professionals and engineers for building design and construction in Anambra State, which are often printed on a paper for the general contractors' use during building execution, sometimes, does not have available software for efficient co-ordination, scheduling and project planning. The use of paperwork as a method of communication between key players in the built industry without recourse to requisite BIM tool software is a major source of default in the efficient design and construction of building projects. These major problems have over the years adversely affected the cost effectiveness and timely delivery of building projects (Abubakar, Ibrahim & Bala, 2014)

Timely delivery of design and construction of building projects in the State which is very essential to effective BIM design and construction, cannot be achieved only with the traditional architect building design of 2D and 3D CAD concept. The traditional architect design practice produces drawings that do not capture detailed analysis and or design of the facility in a whole concept, but deficient oriented.

There also exists poor collaboration and integration of the building professionals and stakeholders in the building industry at the early planning and design stage of most projects, thus resulting to great impediment in the effective use of BIM tool in design and construction of building projects in Anambra state. This has led to ineffective information sharing and poor project delivery in the State.

Lack of highly skilled and trained personnel both in the private and public sector that possesses the requisite information technological skills and knowledge in the use of BIM tool for analysis, design and actual construction of office projects is observed as a recurring problem (Fox and Hietanen, 2006). This problem is inherent in Anambra State.

## 7.0 PROSPECTS, CONCLUSION AND RECOMMENDATIONS

### 7.1 PROSPECTS

BIM tool being an intelligent Model-based process provides insight and helps in the effective planning, designing, construction, and management of buildings and infrastructure (Boukara & Naamare, 2015). BIM tool for design and construction of building projects in Anambra State has so much to offer. These include:

1. It provides intelligence to individual building components (example: windows, walls or chillers, roofs etc.) as well as providing system and building wide information and awareness (system flows or building loads) in addition to simple spatial relationships.
2. Information relating to a building projects can now be contained in, or linked to the BIM tool. BIM tool can significantly improve the flow of information in every stage of the design analysis, construction and the project life cycle
3. Effective design and construction of building projects using BIM tool reduces error and saves time of operation in the ongoing projects in Anambra State.
4. It stores all related data of the building in united, consistent and quickly reachable record.
5. It helps building professionals in Anambra State in quick accessibility of data and facilitates analysis, design and construction of building projects.
6. It also reduces the chances of user mistakes caused by multiple data entries during project design and construction in the state.
7. Improve Cost Estimating – BIM tool can simplify and help provide better cost estimates because of the depth and precision of the information it provides. The ease with material and assembly quantities can be extracted from the model can increase the speed and accuracy of estimates providing a better gauge of the impact of design changes so that budget concerns can be dealt with proactively.
8. A valuable tool in facilitating successful collaboration and coordination during Pre-design, design, construction, and operation and maintenance of both new and existing building.
9. BIM has the capability of capturing, organizing, integrating, maintaining and growing the vast amount of knowledge, data and information required to conceive plan, design, construct, operate, maintain, adapt, renovate and deconstruct a building at the end of its life cycle.

### 7.2 CONCLUSION

Essentially, the prospects for adoption of BIM tool for building designs and construction is to ensure that appropriate information are created in a suitable format at the right time so that better decisions can be made throughout the design, construction and operation of the built assets. It is not about creating a 3D model for its own sake, and it is not an add-on process.

BIM is fundamental to the way a building project is set up and run. Achieving effectiveness in design and construction using BIM tool in Anambra State is therefore vital to the overall performance of the construction industry.

### 7.3 RECOMMENDATIONS

To combat the challenges associated with design and construction using BIM tool, the following are hereby recommended:

1. The building industry must be engaged in the digitalization crusade. The contributions of wider use of technology, digital processes and automation to our economic, social and environmental sectors must be essentially considered.

2. The study suggests proper adoption of BIM tool for design and construction of building projects in Anambra State for effective change in the way building operations are conceived, designed, communicated and constructed.

3. The study recommends that the contribution of various building professionals through team work, information sharing and Anambra State Government support will contribute greatly to achieving near effective design and construction of building facilities using BIM tool.

4. The researcher propagates proper application of relevant BIM software in design and construction operations for paramount achievement of effective design and construction of building facilities in the State.

5. The prospect of BIM tool for achievement of effective design and construction of building projects in Anambra State is also dependent on the activation of BIM Drivers and enablers

## REFERENCES

Alufohai A. (2012). Adoption of Building Information Modelling and Nigeria Quest for Project Cost Management FIG…...

Anumba *et al.,* (2009). BIM project Execution Planning Guide. 1st ed. Computer Integrated Construction Research Program Pennsylvania University, October, web. Jan. 2017 <engr.psu.edu/ae/cic/bimex>.

Austin*et al.,* (2001). Mapping the conceptual Design activity of Interdisciplinary teams, Design studies. Vol. 22(3), Pg. 211-232.

Ayarici, *et al.,* (2009). Towards Implementation of Building Information Modeling (BIM) in the construction industry. Proc. Fifth International Conference on Construction in the 21st Century (CITC-V)-Collaboration and Integration in Engineering, Management and Technology. May 20-22, Istanbul,

Becerik-Gerber*et al*., (2011). The Pace of Technological Innovation in Architecture, Engineering and Construction Education: Integrating Recent Trends into the Curricula. Journal of Information Technology in Construction, 16, 411-432

Becerik-Gerber*et al.,* (2010). "The Perceived Value of Building Information Modeling in the U.S. Building Industry". Journal of information Technology in Construction. Web. Jan. 2017. <itcon.org>

Eastman *et al.,* (2008). Managing BIM Technology in the Building Industry AECbytes, Feb.12, 2008.

Eastman *et al.,* (2011). BIM Hand book: A Guide to Building Information Modelling for Owners, Managers, Designers, Engineers and Contractors, 2nd Edition, John Wiley & Sons Inc., New Jersey.

Eastman *et al.,* (2011). BIM Handbook: A Guide to Building Information Modelling for Owners, Managers, Designers, Engineers and Contractors.2nd Edition, John Wiley &Sons. Inc. New Jersey

IAI, Building Smart 2005: Project Collaboration through Virtual Design and Construction, Last accessed 12 June, 2006, from http://buildingsmart.org.au/.

Jung, Y and Joo, M (2011). Building Information Modelling (BIM) Framework for practical implementation, Automation in construction, 20(2), 126-133

Kassen *et al.,* (2011). A practice-oriented BIM Framework and Workflows, ASCE. International workshop on computing in civil Engineering, 524-532

Kassen *et al.,* (2013). A proposed approach to comparing the BIM maturity of countries CIBW782013-3012. International Conference on the application of IT in the AEC industry, Beijing, China.

Kassen *et al.,* (2014). Building Information Modelling: Analyzing noteworthy publications of eight countries using a knowledge content taxonomy in R. issa & S Oibina (Eds) Building Information Modelling: Applications and Practices in the AECindustry, ASCE Technical

Succar, B (2009). Building Information framework: A research and delivery foundation for industry stakeholders, Automation in construction, 18(3) pp. 357-375

Succar, B. & Poirier, E. (2020). Lifecycle information transformation and exchange for delivering and managing digital and physical assets. *Automation in Construction*, 112, 103090. http://bit.ly/PaperA11

Suermann and Issa (2009). Evaluating Industry perceptions of Building Information Modelling (BIM) impact on construction, Journal of Information Tech. in Construction: 14, 574-594.

Lichtig and William (2008), "The Integrated Agreement for Lean Project Delivery," *Construction Lawyer*, vol. 26, no. 3, summer 2006, published by the American Bar Association.

Lichtig et al., (2008). Managing BIM Technology in the Building Industry AECbytes, Feb.12, 2008.Selecting Project Delivery Systems: Comparing Design-Build, Design-Bid-Build and Construction Management at Risk, State College, Project Delivery Institute (1999) p. 3.

Underwood and Isikdag, 2010. Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies: ISBN 978-1 60566-928-1 (hardcover) -- ISBN 978-1-60566-929-8 (e-book) 1. Building information modeling. 2. Buildings--Computer-aided design. I. 1969- II. 1976-TH437.H26 2010690.068'4--dc2220