

# Perceived Benefit of Building Information Modelling to Construction Professional in Bauchi State Nigeria

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**Abstract**—Construction contractors have different projects in different locations in Nigeria, as such monitoring of the complete construction process is tasks that depend on different professionals. With the advent of current information and communication technology (ICT) in construction sector like Building Information Modelling (BIM), Radio frequency Identification Device (RFID), Geographic Information System (GIS), and Closed Circuit Television (CCTV) construction project budgets are becoming realistic, errors in design and construction times are drastically reducing, quality and performance are significantly improving. BIM is one of such innovative processes that promise to bring about the continuous improvement and desired change in the construction industry and revolutionize the processes of its operation to achieve better collaboration between project parties and ensure successful project delivery. Thus this study explored the perceived benefit of using BIM to construction professionals in construction projects in Bauchi state, Nigeria. Quantitative research method through descriptive survey was adopted. 50 structured questionnaires were administered to construction professionals in Abuja Nigeria. The data were tested for reliability and the questionnaire administration attained 76% success rate It was found that the Discovery of designs omissions & errors, Concepts, Feasibility & Designs benefits and Increased Building Performance & Quality are the most perceived benefit of BIM to professional in construction project. Therefore, this study recommends that the regulatory bodies and the relevant authorities should mandate the use of BIM in both public and private projects in the state

**Key words**— Building Information Modelling, Construction, contractors, Monitoring, perceived benefit, professionals, Relative importance index

## I. INTRODUCTION

Several public and private construction organizations are experiencing conflicts, complexities, uncertainties and ambiguities with traditional practices in implementing construction projects [1]. Construction contractors have different projects in different locations in Nigeria, as such monitoring of the complete construction process is tasks that depend on different professionals. According to [2], the advent of current information and communication technology (ICT) in construction sector like Building Information Modelling (BIM), Radio frequency Identification Device (RFID), Geographic Information System (GIS), and Closed

Circuit Television (CCTV) construction project budgets are becoming realistic, errors in design and construction times are drastically reducing, quality and performance are significantly improving. The use of ICT in construction projects helps to manage projects in productive and effective ways [3]. BIM is one of such innovative processes that promise to bring about the continuous improvement and desired change in the construction industry and revolutionize the processes of its operation to achieve better collaboration between project parties and ensure successful project delivery. [4] BIM emerged as innovative way to manage construction project planning. It is a new emerging approach to design and construction which facilitates with a digital representation of the building process [5]. [6] BIM technology, an accurate virtual model of a building known as Building Information Model is digitally constructed and used to support the design, procurement, fabrication and physical site construction activities required to realize the structure. The model is also used for the maintenance and facility management of the building after completion [7]. Over the years, much discussion has centered on the potential for building information modeling (BIM) to change industry work practices, especially the ways that architects, engineers, contractors, and owners share information, models, and data.

According to [8], almost 50% of the Construction industries North America are using Building Information Modeling (BIM) and those using it are planning to even increase their use significantly. The gain is a more integrated design, better quality buildings at lower cost and reduced projects duration [9], the implementation process is very important for realizing the advantages of BIM. The term building and information modeling (BIM) must be established prior to discussions about the perceived benefits of BIM.

The Nigerian construction industry has come under severe criticism over its poor performance and lacking the capacity to deliver due to inefficiency and poor service delivery among other problems [10]. [11] Stated that, there cannot be much progress in the Nigerian construction industry in national development without the provision of basic infrastructures, a network of good communications systems, collaboration and improved design techniques. However, several studies have

enunciated the need for the Nigerian construction industry to improve and change the way it performs its activities. The advent of BIM has shown a lot of potentials for the improvement of efficiency in design, construction and maintenance of building. BIM is a new digital construction technology but suffered set back in Nigerian construction industry, most of the construction professional are not aware of the full benefit and potentials of BIM adoption. Its adoption and implementation has been surrounded with several barriers that hindered its successful adoption. A lot of researchers in Nigeria highlighted the barriers to BIM adoption but none of them reported the full potentials and benefits of its adoption, hence, this forms the gap the research work seeks to fill. The introduction and adoption of any new technology such as the BIM usually requires that the factors that may positively or negatively affect the adoption by the relevant stakeholders be identified and addressed for the successful take up of the innovations and subsequent benefits to be derived thereof. There are numerous potential barriers of BIM adoption as defined by different experts in regard to the Nigerian construction industry, [12].

## II. REVIEW

BIM implementation serves as a useful alternative to addressing key construction sector issues, and offers solutions to these in order to increase productivity, efficiency, and quality, reduce costs, lead times and duplications, via effective communication with stakeholders in remote construction projects [13]. [14] outline the benefit of BIM in construction project to be Design conflicts are identified prior to construction, Productivity is significantly improved, Less rework, Increased opportunity for pre-fabrication, Fewer Requests for Information (RFIs), Fewer Change Orders, Design errors can be identified prior to construction, Ability to build the system with a less skilled labor force, Improved safety performance, and Better cost control,

The following are the benefits of BIM at the various stages of the lifecycle of a facility as stated by [15] and [16];

- Concept, feasibility, and design benefits
- Increased building performance and quality
- Improved collaboration using integrated project delivery
- Design Benefits
- Earlier and more accurate visualizations of a design
- Automatic low-level corrections when changes are made to designs
- Generation of Accurate and consistent 2D drawings at any stage of the design
- Earlier collaboration of multiple design discipline:
- Easy verification of consistency to the design intent:
- Extraction of cost estimates during the design stage:
- Improvement of Energy Efficiency and Sustainability:

- Construction and Fabrication Benefits:
- Use of design model as basis for fabricated components
- Quick reaction to design changes
- Discovery of design errors and omissions before construction
- Synchronization of design and construction planning
- Better implementation of lean construction techniques
- Synchronization of procurement with design and construction
- Improved commissioning and handover of facility information
- Better management and operation of facilities
- Integration with Facility Operation and Management

## III. METHOD

The identified benefit to BIM reviewed from the previous work were translated into structured questionnaires and administered quantitatively to construction professional in Bauchi state Nigeria. A total of 50 structured questionnaires were administered through purposive non-probability sampling. Thirty seven (37) questionnaires were retrieved and properly filled. The questions asked for this study were relevant and straight forward and the alpha test was run to determine the reliability of the scales and the value obtained was  $> 0.75$ . The data generated for this study were subjected to analyses using mean score and standard deviation, SPSS version 21 was used as tool for the analysis. The data were further subjected to ranking analysis to determine the firm's perception of the most perceived benefit of BIM in the construction industry. Relative Importance Index Method (RII) was used in this research and the formula was computed as

$$\text{Relative importance index (RII)} = \frac{\sum w}{(A \times N)} \dots, (0 \leq \text{index} \leq 1)$$

Where:  $w$  = weighting given to each factor by the respondents,

$A$  = highest weight (i.e. 5 in this case), and

$N$  = total number of respondents (i.e. in this case 37).

The rating of all the factors for degree of significance will be based on the value of their respective relative importance index (RII). The item with the highest RII is ranked first followed by the next and so on. Therefore, this research adopted the method of RII ranking used by [17] where he rank RII above 0.85 to be very significant and RII of 0.54 to be not significant at all

## IV. RESULTS

Table 1: below represents respondent's perceptions on the

most perceived benefits of BIM at various building construction phase. From the table, it is deduced that the most perceived benefits with the highest Relative Importance Index (RII), is Discovery of designs omissions and errors before construction begins with (RII=0.96), followed by Concepts, Feasibility and Designs benefits (RII=0.94), Increased Building Performance and Quality (RII=0.92), Synchronization of Designs and Construction Planning (RII=0.86), Improved Collaboration using Integrated Projects Delivery (RII=0.83), Earlier Collaboration of multiple design Discipline (RII=0.82), Extraction of cost estimates during the design stage (RII=0.77), Earlier and more accurate visualization of designs together with Generation accurate and consistent 2D drawings at any design stage has (RII=0.66) respectively, Quick reactions to design changes (RII=0.63) which is the least most perceived benefits.

However, from the results, BIM virtual 3D models is the source for all 2D and 3D drawings which eliminates designs errors caused by inconsistent 2D drawings. And because models from all disciplines can be brought together and compared, multisystem interfaces are easily checked both systematically (for clash detections) and visually (for other kinds of errors). The second is concepts, feasibility and design benefits which aids clients/owners with accurate and reliable information that guides decisions on whether to proceed with a project or not when the BIM model is built into and linked to a cost database

TABLE 1: THE PERCEIVED BENEFITS OF BIM

S/N	Benefits	Mean	RII	Rank
1.	Concepts, feasibility and design benefits	4.7027	0.94	2 <sup>nd</sup>
2.	Increased building performance and quality	4.6216	0.92	3 <sup>rd</sup>
3.	Improved collaboration using integrated project delivery	4.1622	0.83	5 <sup>th</sup>
4.	Earlier and more accurate visualization of a design	3.2973	0.66	8 <sup>th</sup>
5.	Generation of accurate and consistent 2D drawings at any stage of the design	3.1351	0.66	8 <sup>th</sup>
6.	Earlier collaboration of multiple design discipline	4.1081	0.82	6 <sup>th</sup>
7.	Extraction of cost estimates during the design stage	3.8649	0.77	7 <sup>th</sup>
8.	Quick reaction to design changes	3.1622	0.63	9 <sup>th</sup>
9.	Discovery of design errors and omissions before construction begins	4.8108	0.96	1 <sup>st</sup>
10.	The synchronization of design and construction planning	4.3243	0.86	4 <sup>th</sup>

Source: Survey (2018)

Therefore, the most perceived benefits of BIM to construction professionals is that BIM is capable of reducing request for information and change orders, eliminates the use of paper work, avoiding clashes, better understanding and control of cost schedules.

## V. CONCLUSION

The construction industry is constantly on demand to produce work faster, at less cost and higher quality. Construction professionals are problem solvers and are constantly looking for new ways on how to apply technology to produce work. One of the new technologies that help today is building information modelling (BIM). The benefits of using building information modelling are evident, especially when analyzing the way that this technology enhances the structural design workflow.

The study explored the perceived benefit of BIM to construction professionals in Bauchi state, Nigeria. This information is very vital to construction professionals under the intricacies of understanding BIM. The discovery of design errors and omissions before construction work started, is the most significant benefit that BIM provides in construction projects. Construction documents are generated completely when using BIM model, significantly reducing the time required for detailing. It also reduces the need to make extensive checks, helping prevent errors in the documentation that can affect the construction.

Using the building information model does not only enables the production of construction documents, but it also serves as a base to present the results from the structural analysis and design in an easy sharable way, keeping all the information regarding the analysis, design and documentation of a structural project in one place.

This study has the limitation of a relatively small number of responses; this might not be the whole construction practitioners in Bauchi state. There is therefore, the need for further studies of similar nature to cover the whole construction professionals in the state

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