

ADOPTION OF BUILDING INFORMATION MODELLING (BIM) FOCUSING
ON NIGERIAN CONSTRUCTION INDUSTRY

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DEDICATION

This project is dedicated to God Almighty for his gift of life, grace, mercy and enablement during the period of this program. To my Dear wife Mrs. Kangyang, who encourages me through prayers that even the largest task can be accomplished if it is done one step at a time. Indeed, to my loving children thank you for support.

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ABSTRACT

Many topical issues regarding the problems and challenges across construction are governance, method of construction, and regulatory framework. Building Information Modelling (BIM) is a current technology that enhances project performance and has been widely adopted in the building industry to produce better outcomes. BIM enables better coordination, synchronization, and sequencing of projects, which allows all project participants to access and retrieve project information. Hence, the study aims to develop a clear understanding of BIM implementation and to strategize an effective technique to be exploited for its adoption in the Nigerian construction industry. Data was collected through a survey questionnaire using a random sampling technique being administered on fifty-four (54) construction stakeholders in the Federal Capital Territory (FCT), Abuja, Nigeria and was analyzed using an excel spreadsheet and Statistical Package for Social Science (SPSS). This study pointed out some factors that impede BIM adoption in Nigeria construction industry which is people, policies, process, and technology. From the results, it shows that for first objective, adoption level of BIM has the highest mean score of 4.63 with perception on the process whereby there is lack of inclusion of BIM into the university curriculum is recommended. As for second objective which has 4.48 highest mean score, is associated with the Lack of inadequate funding. Additionally, the third objective placed elements of the strategies to be adopted to provide possible solutions to the challenges, such as; provide BIM awareness, provide a chance to observe efficiency of BIM tools, and Provide staff with BIM training opportunities mean value of 4.61. Hence by adopting this BIM in Nigeria it believes that the whole process and performance of construction industry might be improved.

ABSTRAK

Kebanyakan masalah didalam pembinaan adalah lebih kepada tadbir urus, kaedah dan kerangka peraturan pembinaan yang masih samar. Building Information Modeling (BIM) adalah satu teknologi terkini dimana ia boleh meningkatkan prestasi projek dan telah digunapakai secara meluas dalam industri pembangunan bagi menghasilkan keboleherjaan yang lebih bagus. Teknologi BIM berperanan didalam memudahkan penyelarasan, komunikasi, analisis, dan pengurusan projek yang lebih mudah dan dapat mengakses maklumat projek secara baik. Oleh itu, kajian ini bertujuan untuk memberikan pemahaman yang jelas mengenai pelaksanaan BIM dan strategi teknik yang efektif bagi dimanfaatkan dan diterapkan dalam industri pembinaan di Nigeria. Sebanyak lima puluh empat (54) responden terdiri daripada pihak berkepentingan pembinaan di Wilayah Ibu Kota Persekutuan (FCT), Abuja, Nigeria dan analisa menggunakan spreadsheet excel dan Pakej Statistik untuk Sains Sosial (SPSS) telah digunakan. Antara faktor yang menghalani penggunaan BIM dalam industri pembinaan Nigeria adalah manusia, polisi, proses dan teknologi. Dari hasil kajian menunjukkan bahawa untuk objektif pertama, tahap penggunaan BIM mempunyai skor min tertinggi 4.63 dengan persepsi di mana masih rendah tahap keberkesanan penggunaan BIM didalam kurikulum university. Selain daripada itu, bagi memenuhi objektif kedua yang mempunyai skor min tertinggi 4,48, dikaitkan dengan kekurangan sumber bekalan kuasa yang akan menyebabkan sambungan internet yang tidak efektif. Antara elemen strategi yang berkemungkinan didalam penyelesaian terhadap cabaran adalah seperti memberi kesedaran BIM, memberi peluang kepada kecekapan penggunaan BIM, dan memberi peluang latihan kepada BIM kepada staf nilai min prestasi 4.61. Oleh itu dengan menerapkan BIM teknologi di Nigeria, dapat membantu dan baik pulih didalam keseluruhan proses dan prestasi industri pembinaan.

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LIST OF ABBREVIATIONS

AEC	-	Architecture, Engineers and Construction
AIA	-	American Institute of Architects
BEP	-	BIM Execution Plan
BIM	-	Building Information Modelling
BSI	-	Building Smart International
CA	-	Computer Aided Design
CDE	-	Common Data Environment
CM	-	Construction Manager
GDP	-	Gross Domestic Product
GC	-	General Contractor
ISO	-	International Standardization Organization
IT	-	Information Technology
LOI	-	Level of Information
MVD	-	Model View Definition
NBIMS	-	National Building Information Modelling Standard
ND	-	Number of Dimension (in BIM)
R&D	-	Research and Development
SME	-	Small and Medium Sized Enterprises
VDC	-	Virtual Design and Construction

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upgrades and uses the design and continually improves as the facility is constructed. BIM is described as an imaginable tool that has the potential to overcome some of the construction industry's challenges (Ghaffarianhoseini et al., 2017). However, Damian (2008) stated that BIM is a potential management tool in designs, construction, and facility to ensure collaboration amongst project participants. Consequently, productivity and efficient communication within the participants can be achieved through BIM according to Rice & Student, (2010) cited in Min, Abdul-Rahman, Takim, & Min, (2009) is accepted generally, achievable, and cost-effective tool in the construction industry. It is broadly accepted as an integrated system that makes buildings performance in areal-world giving accurate information on building elements, quantities, and design information in an organized database.

In Nigeria, the current system of building procedures regulates information only on one side. Therefore, this research work tries to provide solutions to the issues of information sharing, communication and collaboration among stakeholders/professionals across different levels of building infrastructure design, construction, maintenance and management in Nigeria. Additionally, this research is expected to offer effective ideas for the Nigerian construction sector to operate effectively in the current competitive economy. The findings will improve cooperation and shared knowledge among participants, ensure transparency, consistency, estimating, visualizing alternative solutions and options, reducing production cost, and errors (Ullah et al., 2019). This will also help in decision-making processes by providing a virtual environment where project stakeholders can test and analyze multiple sequencing and scheduling method for building construction costs and feasibility. Thus, the research focuses on developing a clear understanding of BIM implementation and to strategize an effective technique to be exploited for its adoption in the Nigerian construction industry.

1.3 Problem Statement

Despite the implementation of Building Information Modelling (BIM) in Building construction, it has been expanded worldwide with various obstacles caused

by the high rate of implementation of BIM tools, the acquisition of new computer hardware, the training of new BIM operators, the high cost of these tools. This may be a hurdle for small and medium-sized construction firms to take BIM into their ventures (Ferron & Turkan, 2019). Equally, the inability of a successful strategy to incorporate BIM in an organization may also be due to the slow adoption of BIM by construction stakeholders (Farzad Khosrowshahi, 2012). For instance, the dearth of a complete BIM policy framework and the acceptance of the BIM implementation model (Fadason et al., 2018). No reasonable consensus is reached on how to incorporate BIM in construction projects (Ghaffarianhoseini et al., 2017).

(Gao & Chen, 2017) carried an assessment of “Mechanical, Electrical, and Plumbing (MEP) Implementation Review of BIM on construction firms in Nigeria”. The report described the lack of professional expertise on the use of BIM technology, high cost of training personnel involved, system reform, software/hardware update as the major challenges and obstacles in BIM adoption. Hence, the factors affecting BIM adoption in Nigerians construction industries need to be examined. Also, Ugochukwu et al., (2015) conducted a study on the status of “Building Information Modelling (BIM) framework for better execution of building projects in Nigeria”. The findings from the study revealed that BIM application knowledge within professionals is very poor and there is no involvement in the use of BIM on construction projects, lack of awareness among other professionals remains the major barrier to BIM application. Hamada et al, (2016) emphasized that understanding the challenges and barriers to BIM’s adoption could improve its acceptance in construction. (Ahuja, Arif, & Rittu A et al, (2018);, E.O.E. Nnadi, (2014); and Amade (2017) classified the barriers in terms of technology impediments. Akbar Marefat, Hossein Toosi, (2018), asserted that the main barriers for BIM adoption as may be noticed in some developing countries is lack of awareness and inaccessibility of training skilled personnel. To ensure effective adoption of BIM, drivers like BIM software accessibility and obtainability, support through government/legislation, technology awareness, interest by clients, commitment and cooperation, procurement collaboration, and evidence of cost-saving form its adoption.

Overwhelmed with the ability of BIM to reduce rework and increase project value, governments around the world are taking steps on the usage of BIM. In the US nearly half of the building industry is using BIM, while the United Kingdom (UK) has prepared a strategy for BIM usage on projects (Farzad Khosrowshahi, 2012). According to (Jensen & Jóhannesson, 2013), the government of Singapore brought a policy on implementing a BIM roadmap via the Building Construction Authority (BCA) with the objective that by the year 2010 at least 80% of the construction sector will adopt the use of BIM and by 2015 as government plan 4 to advance the productivity of the construction sector by 25% over the next current 10 years. Also, in an attempt to enhance the adoption of BIM in some nation countries, BIM curriculum must be implemented in the institution of higher learning to acquire BIM skills and develop programs that will overcome the challenges of BIM implementation. Therefore, the study suggested the strategies to be adopted for BIM implementation and proposed the best BIM integration method to be utilized in Nigerian construction sector as the effective technique to be exploited if delay, rework and cost overrun must be reduced in project construction.

1.4 **Research Questions**

- 1 What is the level of adoption of Building Information Modelling (BIM) in Nigerian construction industry?
- 2 What are the factors affecting Building Information Modelling (BIM) in Nigerian construction industry?
- 3 What are the strategies for effective adoption of Building information modelling (BIM) in Nigerian construction industry?

1.5 Aim and Objectives

This study aims to provide a develop and clear understanding of BIM implementation and to strategize an effective technique to be exploited for its adoption in the Nigerian construction industry. The objectives of this study are:

- 1 To identify the level of adoption of Building Information Modelling (BIM) in Nigerian construction industry.
- 2 To determine the factors affecting Building Information Modelling (BIM) adoption in Nigeria construction industry.
- 3 To recommend strategies for effective adoption of Building Information Modelling (BIM) in Nigeria construction industry.

1.6 Scope of Study

To achieve the research objectives the study was limited to a specific area of study focusing on the current state of BIM adoption in Nigeria construction industry through the public and private sectors that have previously or currently involved in building construction. Besides, the study also aimed to identify the level of BIM adoption and its implementation through integrating best methods of application like teamwork amongst construction participants, legal changes to documentation, Changes in practice and use of information. Stakeholders' awareness through workshops and seminars, standard guide to implementation, proper IT Information Technology infrastructure, need for government, and private direction towards the adoption of BIM technologies.

However, the need for an in-depth understanding of the strategies of BIM implementation in building construction to increase the rate of BIM adoption in Nigeria is the major focus in this study to improve the efficiency of building construction in Nigeria to prepare the industry for the future development. The research methodology will include; Input-Process-Output (IPO) Model structure (Yu, 2005)

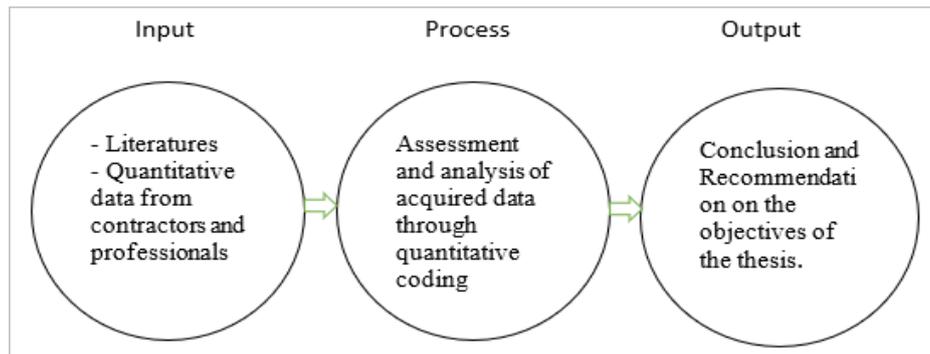


Figure 1.1 I-P-O Model (Yu, 2005)

1.7 Significance of Study

The focus on determining the level of adoption of BIM is viewed as the potential and a major to be considered in the construction sector problems. BIM is an appropriate and most capable current development in the construction sector and is an important tool for the development of the construction industry. However, Chileshe et al, (2015) confirmed that BIM is essential to the effectiveness and competitiveness of the Construction sector. Besides, BIM Guide, (2013) emphasized that BIM will change the traditional system of operating in the construction sector over a broad range of its features, including that of people, processes, information, and work habits.

Ritu, (2018) identifies the use of BIM which must be analysed to give the construction sector a clear awareness of BIM adoption status in assessing with global developments. Smith, (2014) opined that BIM can be utilized to change the construction sector into an efficient and value-oriented organization that can successfully execute the clients' expectation and that its adoption to transform the construction sector to a data-rich environment and knowledge-intensive industry that can aid virtual and computerized design, analysis, construction, and information. According to Yusuf et al., (2018) reveals that information on the factors motivating the adoption of BIM can speed up its adoption in the construction industry.

Consequently, the research is therefore considered critical to the development of the Nigerian Construction sector to identify the level of BIM implementation and to integrate on possible methods for achieving a successful project delivery in Nigeria.

1.8 Research organization

The research consisted of five (5) major chapters as:

Chapter 1: Introduction

This chapter comprises the introduction, background of study, problem statement, research questions, Aim and objectives, scope of study, significance of study, research organization and chapter summary.

Chapter 2: Literature review

This chapter discusses several kinds of literature on BIM adoption and its implementation with a focus on the factors contributing to the construction industry GDB in the country, the BIM concept, discusses BIM scenario globally, the chapter also discussed on BIM adoption in developed countries around the world and Nigeria in particular. This chapter also reviews some literature on the methods of integrating BIM to be adapted in Nigerian construction industry by focusing on the factors affecting benefits of BIM adoption, factors affecting the use of BIM in construction, and the strategies for the implementation of BIM in building projects by construction players. The chapter ends with explanations on conceptional workflow, summary.

Chapter 3 Research Methodology

The chapter discussed the research procedures, method of data collection. Next is the methodology for the conduct of the research and thereby discussed each adapted approach, employed for data collection and finally the data analysis.

Chapter 4: Analysis and Discussion of Results

The chapter comprises of results and findings obtained from questionnaires that were distributed to the respondent on the adoption of BIM in the construction

industry. Furthermore, this chapter also focused on presentation of results obtained from the data., analysis and discussion of results.

Chapter 5: Conclusion

The chapter explains the overall overview of the research study and summarized the findings in line with the aim and objectives which provided the conclusion and explanation of each objective that was carried out in this study. Also, the researcher outlines the findings and suggested recommendations for further research.

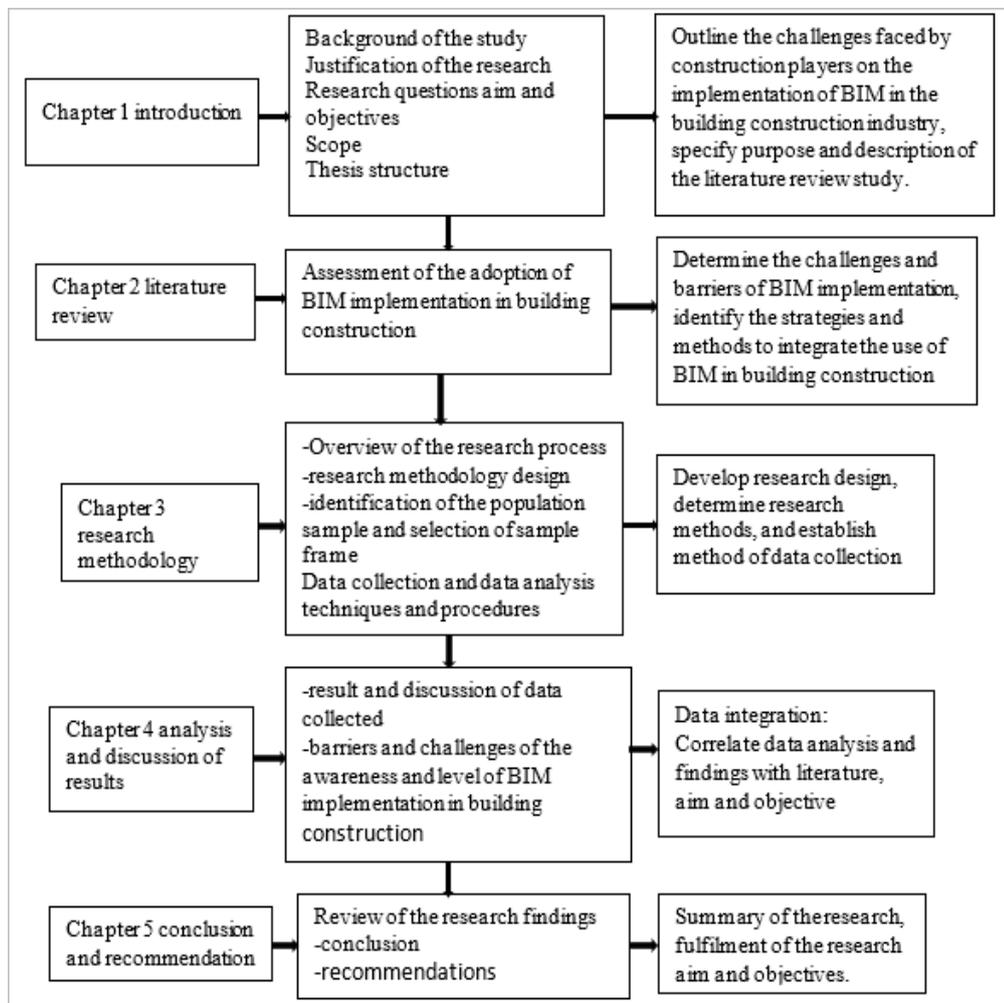


Figure 1.2 Structure of thesis

1.9 Summary

The chapter has presented major outline for the research work from the Introduction, background of study that outlines the detail of the research and statement of problem which necessitated the need for the study. From the critical study of statement of problem, some research questions were formulated thus the aim and objectives were also established for this study. The chapter also outlined the research plan and methodology adapted for the study. The structure of this study is presented at the end of the chapter. The next chapter focused on literature related to the adoption of BIM in the building construction industry.

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