

Research Article

Construction Professionals and BIM: An Assessment of Awareness Level in Transmission Company of Nigeria (TCN) in Lagos State

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Abstract

This study assess construction professionals level of awareness of BIM, especially among those working in TCN projects in Lagos state. This is necessitated by the low awareness levels of BIM in Lagos state which undermines client demand for BIM deliverables, restricts its uptake among SMEs, and perpetuates the use of traditional fragmented methods that are prone to error and inefficiency. The method used to acquire data included the use of convenience sampling technique where information was obtained from construction professionals operating TCN projects in Lagos State. A structured questionnaire was sent to the 355 respondents and 253 questionnaires were returned with a return rate of 71.27%. Descriptive statistical measures such as mean, Chi Square and Post Hoc test was used. Mean and Chi Square results suggest that most of the respondents (small, medium, and large firms) are highly aware about BIM. This means that there is a significant difference among the opinions held by the respondent firm sizes ($p < 0.05$). This was proven by post hoc results since there was a significant difference between the two groups including Small Size Construction Firm and Medium Size Construction Firm (p -value (0.000*)) and Medium Size Construction Firms – Large Size Construction Firm (p -value (0.014*)). It is therefore recommended that professional and regulatory bodies as well as higher institutions should sensitize public and private clients on the long-term lifecycle value of BIM.

Keywords

Awareness, BIM, Construction, Professionals, TCN

1. Introduction

The construction sector is well-known as one of the most important contributors to global economic growth, offering significant employment and helping deliver necessary infrastructure globally. Current estimations suggest that the sector is responsible for about 13% of economic activity on a global scale, employs a sizeable percentage of the labor force, despite some difficulties associated with carbon emissions and other

factors [13]. The same applies to Nigeria, where the industry is considered vital in relation to the development of the nation, having a direct impact of 4% of the GDP and being helpful for job creation and infrastructure development [2]. Moreover, [9] suggest that the contribution of the construction sector in Nigeria stands at about 5–7% of the country's GDP and more

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than 40% of domestic fixed capital formation. These economic achievements are facilitated by the use of digital technologies in construction management, including Building Information Modelling (BIM).

Building Information Modeling (BIM) has been shown to be an effective tool to solve these problems. All parts of a construction project are integrated into one single virtual model that includes the architecture, structure, and MEP (mechanical, electrical, and plumbing) systems, in addition to being a means of collaborating between all parties involved in the project throughout its lifespan [6]. Through the use of technologies such as 3D modeling, proper data management, and live communications, BIM can play a major role in optimizing projects' execution, reducing their costs, and enhancing cooperation among the stakeholders [11]. However, BIM adoption in Nigeria is currently in its nascent stages; nevertheless, its ability to enhance the outcome of construction projects has been increasingly recognized [12].

Nonetheless, there is still a lack of awareness in Lagos regarding the use of BIM. Studies carried out on construction firms in Lagos reveal that while some people understand the concept of BIM to some extent, most people are not aware of its existence, perceiving it as merely 3D design software as opposed to an all-encompassing platform for the whole life cycle of a building project [3]. This limited awareness undermines client demand for BIM deliverables, restricts its uptake among SMEs, and perpetuates the use of traditional fragmented methods that are prone to error and inefficiency [5]. The lack of structured campaigns, education, and government-led sensitization initiatives further entrenches this gap, leaving Lagos behind global and regional peers in digital construction transformation. This study, therefore, found it necessary to assess construction professionals level of awareness of BIM, especially among those working in TCN projects in Lagos state.

The awareness of BIM cannot be gauged without first understanding the principles and components of BIM in construction. It is the awareness of these principles and components that showcases how well construction professionals are aware of BIM. Stakeholder collaboration during the construction process is one of the basic concepts of BIM because it improves the coordination between all parties involved in the project. Simulation of the performance of the building at various situations to create realistic animations and visuals is another basic concept of BIM. BIM can also be used to develop highly sophisticated 3D digital models of a facility based on its physical and functional features. Ultimately, the concept of standardization is facilitated through BIM by promoting good industrial practice [6].

Furthermore, these key principles are very vital to the integration of BIM in construction. Using BIM to design and construct buildings that are energy-efficient and environmentally friendly is another component of BIM [7]. It is greatly linked to another component of interoperability which ensures that BIM tools and data can work together seamlessly. It leads to

prompt clash detection aimed at identifying and resolving conflicts between different building systems before construction begins. BIM also has a principle of lifecycle management, which aids the management of a building's information throughout its entire lifecycle, from planning to demolition [1]. With this principle, there is a level of compliance, ensuring that the project complies with all relevant laws and regulations.

Additionally, data integration, which is the combination of data from various sources to provide a comprehensive view of the project is a major component of BIM that needs to be understood comprehensively by construction professionals. It ensures that the building meets all quality standards and specifications [3]. Using BIM to generate accurate cost estimates and manage budgets and creating detailed project schedules to ensure timely completion are other principles of BIM that makes it sustainable and widely used. The principle of training and education is key to understanding BIM, as it entails providing education and training to stakeholders to ensure effective use of BIM. It also aids risk management which is the identification and mitigating potential risks during the project [6]. Hence, the government initiatives and policies that promote BIM adoption and implementation is a good principle while the influence of client requirements and expectations on BIM adoption is a major component of BIM in determining its adoption level in the construction industry.

2. Materials and Methods

The research methodology used was the quantitative approach where the main method of data gathering was through questionnaires. The questionnaires were already prepared and structured in order to get information about the difficulties and consequences that result from the use of BIM in the delivery of construction projects in Lagos State. They were given to construction practitioners such as architects, builders, quantity surveyors, engineers, and project managers who are currently working in TCN construction projects within the sub-regions of Egbin, Ikeja-West, Akangba, Aja, and Papalanto, as well as their substations in Lagos.

Due to the huge cost implication of accessing all the construction professionals in the sample frame, the convenience sampling procedure was used. Given that it is a non-probabilistic sampling technique, it limits generalization and introduces some level of bias. However, its use is justified as it is easier to navigate the entire sample frame and elicit information from the respondents. Questionnaires were administered and collected by the joint efforts of the lead researcher and co-researchers after ensuring that the respondents were well acquainted with the nature of the instrument used. A total of 355 construction experts in the sample population were chosen for the survey sample, out of which 253 were able to give valid responses, resulting in a 71.27% response rate. Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 23.0, using methods like mean analysis and chi-square test among others.

Table 1. Sample frame/sample size for the construction professionals.

Sub-regions of Lagos region	Number of professionals/Sample size
Egbin	64
Ikeja-West	109
Akangba	82
Aja	55
Papalanto	45
Total	355

Source: Transmission Company of Nigeria (2021) (www.tcn.org.ng)

3. Results and Discussion

3.1. Demographic Information of the Respondents

When it comes to profession designation, 28.5% of the respondents are architects, 16.2% are quantity surveyors, 22.5% are builders, 24.9% are engineers, while 7.9% are project managers. These percentages suggest that all important professions in the construction industry are fairly represented in the sample used for data collection. Speaking about professional affiliation, 27.3% of the respondents are members of the NIA, 18.2% – members of the NIQS, 20.5% belong to the NIOB, 23.7% – NSE. Furthermore, 10.3% are members of the

PMP. All mentioned affiliations indicate that all the respondents are registered professionals in their organizations, thus ensuring credibility of collected data. Finally, speaking about organization type, 54.8% of respondents are working in large organizations, 12.9% in small ones and 9.7% – in medium-sized organizations. Furthermore, 18.3% of them are members of private organizations and only 4.3% of respondents work in the public sector. Such percentages suggest that all the respondents have significant experience and knowledge in the field of construction management.

Likewise, regarding the organization size where the respondents are practicing, 19.4% have an organization size of 0-20 persons, 30.5% are with 21-50 persons, 37.9% have an organization size of 51-100 persons while 5.9% have 101-150 persons working with them. While 5.1% have an organization size above 200 persons, 1.2% have 151-200 persons working with them. Moreover, concerning years of professional experience, 26.9% of the respondents have below 5 years of experience, 34.4% have experience ranging from 6–10 years, and 11.0% have experience between 11–15 years. Further, 17.4% have experience ranging from 16–20 years, while 10.3% have above 20 years of experience. Therefore, it is evident that the respondents have vast experience in the construction sector.

Finally, on the number of BIM-compliant projects undertaken by the respondents, About 15.0% of the respondents have undertaken in 11-15 projects, 7.5% in 16-20 projects and 2.0% have participated in more than 20 BIM-compliant projects. 44.3% have participated in 6-10 of such projects while 31.2% have undertaken 1-5 projects. This reveals the fact that the professionals are well experienced in BIM-compliant construction projects in the construction industry.

3.2. Level of Awareness of BIM Among Construction Professionals on Construction Sites

Table 2. Level of Awareness for BIM in the construction industry among small, medium and large construction firms.

Awareness of BIM by Organizational Size	Small Size Construction Firms			Medium Size construction firms			Large Size construction firms			Overall Level of Awareness for BIM by Organizational size			Chi-Square	Asymp. Sig
	Mean	S. D	Rank	Mean	S. D	Rank	Mean	S. D	Rank	Mean	S. D	Rank		
Sustainability	3.630	0.711	9	4.460	0.795	3	4.540	0.868	1	4.21	.556	1	6.674	0.036*
Cost Estimation	3.971	0.938	1	4.553	0.782	1	3.955	0.837	4	4.16	1.077	2	3.806	0.149
Collaboration	3.875	0.978	3	4.478	0.864	2	3.738	0.855	7	4.03	1.009	3	5.904	0.052
Risk Management	3.856	0.903	4	3.971	0.806	4	3.993	0.810	3	3.94	1.082	4	6.146	0.046*
3D Modelling	3.746	0.646	5	3.884	0.625	5	4.040	0.718	2	3.89	.876	5	5.790	0.055
Data Integration	3.902	0.907	2	3.872	0.774	6	3.566	0.871	10	3.78	.674	6	1.456	0.483
Simulation	3.702	0.955	6	3.741	0.740	8	3.778	0.818	6	3.74	1.218	7	0.294	0.863
Technological Infrastructure	3.653	0.940	8	3.792	0.969	7	3.685	0.587	8	3.71	1.004	8	1.734	0.420

Awareness of BIM by Organizational Size	Small Size Construction Firms			Medium Size construction firms			Large Size construction firms			Overall Level of Awareness for BIM by Organizational size			Chi-Square	Asymp. Sig
Factors	Mean	S. D	Rank	Mean	S. D	Rank	Mean	S. D	Rank	Mean	S. D	Rank		
Clash Detection	3.560	0.549	12	3.660	0.659	9	3.820	0.602	5	3.68	1.117	9	8.475	0.014*
Visualization	3.670	0.848	7	3.640	0.845	10	3.640	0.923	9	3.65	.564	10	0.216	0.898
Asset Management	3.590	0.797	10	3.560	0.911	11	3.561	0.991	11	3.57	.442	11	18.483	0.000**
Government Policy	3.473	0.756	13	3.477	0.928	12	3.400	0.767	13	3.45	.997	12	1.767	0.413
Quality Control	3.348	0.889	14	3.229	0.871	16	3.413	0.960	12	3.33	1.213	13	0.189	0.910
Lifecycle Management	3.275	0.788	15	3.252	0.956	15	3.102	0.889	14	3.21	1.405	14	0.466	0.792
Standardization	3.133	0.742	16	3.417	0.803	13	2.749	0.665	15	3.10	.509	15	0.246	0.884
Scheduling	3.582	0.849	11	2.455	0.947	19	2.572	0.694	17	2.87	1.018	16	2.191	0.334
Training and Education	2.303	1.179	19	3.339	0.971	14	2.337	1.074	19	2.66	.221	17	8.068	0.018*
Legal Compliance	2.670	1.116	17	2.630	0.755	17	2.381	1.026	18	2.56	.609	18	2.542	0.281
Client Demand	2.472	1.074	18	2.464	0.987	18	2.595	0.942	16	2.51	1.496	19	5.353	0.069

(S. D) = Std. Deviation, M = Mean; R K= Rank

Test Statistics: a) Mean Item Score, b) Kruskal Wallis Test (Grouping Variance – Awareness of BIM by Organizational Size I. ** Significant at the 0.01 level, *Significant at the 0.05 level.

Table 2 shows the degree of awareness and BIM use in the construction industry among small, medium, and large construction firms. Cost estimation among the respondents representing small size firms was also found to be the most familiar and used feature of BIM, with an average score of 3.971. Data integration (3.902) and collaboration (3.875) came afterwards and the use of BIM to train and educate least with a mean score of 2.303. In the case of medium-sized firms, cost estimation was also the highest with a mean score of 4.553. The second and third mean scores were 2.455 and 2.455 respectively and 2.455 was the lowest mean score, however, the lowest mean score of 2.455 was third in ranking after collaboration (4.478) and sustainability (4.460). The sustainability was discussed as the most salient area of BIM awareness and use with a mean score of 4.540. This was followed by 3D modelling (4.040) and risk management (3.993) and training and education once again ranked lowest with the mean score of 2.337.

Based on the general scoring of all the firm sizes, sustainability was the most identified aspect of BIM with a mean score of 4.540. Cost estimation (3.955) was ranked second followed by collaboration (3.738), and the lowest mean score was client demand which was 2.51. Based on the firm size as a point of comparison, Kruskal-Wallis test showed that the respondents had similar views on fourteen out of the nineteen identified

sources of BIM awareness. These are cost estimation, collaboration, 3D modelling, data integration, simulation, technology infrastructure, visualization, government policy, quality control, lifecycle management, standardization, scheduling, legal compliance and client demand.

Nevertheless, it was found that there are differences in opinions concerning five factors: sustainability, risk management, clash detection, asset management, and training and education. The p-values of these factors were below 0.05, which depict statistically significant difference in perceptions among respondents in small, medium, and large firms. On the whole, the mean score of all nineteen BIM awareness factors was moderate with the lowest being 2.51 and an average of 3.413. This implies that any factor is pertinent in the evaluation of the awareness of the BIM of the respondents in the study area.

Table 3 shows the post hoc test carried out to establish the exact sources of differences among respondents using construction company sizes (small, medium, and large) towards BIM awareness in the construction industry. As shown in the table below, the LSD post hoc test reveals that there are differences in the level of BIM awareness among Small and Medium companies ($p = 0.000, \leq 0.01$) and Medium and Large construction companies ($p = 0.014, \leq 0.05$).

Table 3. LSD Post hoc test on the Level of Awareness for BIM in the construction industry.

Stakeholders	Test statistic	Std. error	Std. test statistic	Sig.	Adj. Sig.
Small Size Construction Firms- Medium Size Construction Firms	48.107	12.625	3.810	0.000	0.000*
Small Size Construction Firms- Large Size Construction Firms	35.730	12.772	2.796	0.005	0.826
Medium Size Construction Firms - Large Size Construction Firms	75.107	13.488	5.810	0.004	0.014*

*. The mean different is significant at the 0.05 level.

3.3. Discussion

The knowledge of the BIM principles and components among construction firms is not evenly distributed because many of the firms might be knowledgeable about such elements of BIM as 3D estimation, sustainability, and cost estimation but may not always implement them in practice. Higher levels of adoption are usually exhibited by larger contractors, especially those with previous exposure to construction technologies. [10] supported this opinion, as they discovered that medium- and large-scale construction companies are more likely to implement formal BIM champions or specific implementation workflows. In the same vein, the relative widespread awareness of BIM among the construction professionals in the study area implies that construction professionals are familiar with the concept, although actual adoption remains low. This is in line with [12] who revealed that firms located in Lagos, Abuja, and Port Harcourt have a higher level of awareness since they are closer to a major client, as well as infrastructure and infrastructure project. By contrast, [8] have observed that BIM awareness when conducted in larger firms can be as high as about 75%.

Moreover, the results indicate that companies within the study area have a poor knowledge of the training and education principles related to BIM. This can be explained by the lack of exposure, the lack of access to training opportunities and the lack of institutional requirements. This is in contrast to [8], who realized that some companies acquired the awareness of BIM and its adoption through international conference participation or by working with foreign consultants.

Moreover, the comparatively high level of the awareness of the lifecycle management among the respondents points to the relative BIM principles sensitization level. This is however, contrary to the [4] who reported that most of contractors in Nigeria had little or no knowledge of BIM as a lifecycle management tool with most associating it to design stages. This indicates that full lifecycle BIM (6D/7D applications) is still more of a theory in the Nigerian construction environment. In general, there is a threat of superficial knowledge and uptake in the industry as many respondents might think that they know BIM and might not have deep or practical knowledge of BIM. In research, scholars warn that this superficial knowledge may result in overconfidence with no attendant

technical skills or successful application.

4. Conclusion

The findings show that while awareness of BIM has increased considerably in the past five years, this awareness is uneven. Large consultancy firms, multinational contractors in TCN construction projects and academic institutions in Lagos State exhibit relatively higher levels of knowledge and practical application. By contrast, small and medium-sized firms, who collectively deliver a large proportion of Nigerias construction output, tend to operate at very low levels of BIM maturity. For many medium construction firms, BIM is conflated with 3D visualization or seen merely as a software tool rather than an integrated process. This duality creates a two-tier construction industry where a few actors demonstrate global best practices while the majority lag behind. Nonetheless, there is an observable growth in BIM awareness in Nigeria, particularly among large firms, urban-based consultants which is largely at the conceptual and visualization stage with relatively limited understanding of advanced dimensions.

It is therefore recommended that universities and polytechnics should fully integrate BIM modules into architectural, engineering and construction curricula, ensuring graduates enter the workforce BIM-ready. Also, professional and regulatory bodies should sensitize public and private clients on the long-term lifecycle value of BIM. Likewise, professional institutes should expand CPD programmes to include intensive BIM training workshops at subsidized rates. Cross-disciplinary training initiatives should be promoted to encourage architects, engineers, and quantity surveyors to understand each others BIM workflows.

Abbreviations

BIM	Building Information Modelling
CPD	Continuous Professional Development
NIA	Nigeria Institute of Architects
NIOB	Nigeria Institute of Building
NIQS	Nigeria Institute of Quantity Surveyors
SMEs	Small and Medium Enterprises
TCN	Transmission Company of Nigeria

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Author Contributions

Saka Afis Abiodun: Conceptualisation, Data Curation, Formal Analysis, Investigation, Methodology

Akinola Victoria Olufunke: Methodology, Funding Acquisition, Project Administration

Conflicts of Interest

The authors hereby declare that there are no conflict of interest.

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