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Barriers to Adoption of Building Information Modelling-Based E-Procurement of Public Building Projects in Abuja, Nigeria

Christy E. AMADUOBOGHA[1*], Abdulganiyu A. OKE[2]

[1,2]*Department of Quantity Surveying, School of Environmental Technology, Federal University of Technology, Minna, Nigeria*

[1,*]xtieamadu@gmail.com, [2]abdganioke@futminna.edu.ng

Abstract

The construction process has different characteristics, such as fragmentation, complicated stakeholder relationships, one-time production, and uniqueness. The aim of this study was to evaluate the barriers to the adoption of building information modelling-based (BIM-based) e-procurement of public building projects in Abuja, Nigeria. The objectives of the study included identifying the ways in which BIM-based e-procurement affects construction and examining the barriers of BIM-based e-procurement system implementation. The study employed a quantitative research design approach based on the use of questionnaires, and a total of 305 valid responses were collected for the data analysis, which utilised the descriptive statistical method of Mean Item Score. The findings revealed significant barriers to the adoption of BIM-based e-procurement such as limited admissibility of electronic evidence during procurement related litigation, lack of top management support, and insufficient legal frameworks supporting e- procurement. This has resulted in a BIM adoption rate of only 47% in the Nigerian construction industry. It was recommended that comprehensive legal and regulatory frameworks be set up to support the use of electronic documentation and transactions in procurement processes. Increased support from top management is also critical in building trust among procurement stakeholders.

Keywords: *Barriers, building information modelling, e-procurement, public building projects.*

1.0 Introduction

Construction is regarded as one of the most vital industries because it has a large output and shares a significant part of the world's economy. Construction is a project-based contract industry, and it integrates many participants with different interests in a complex process to build a facility (Umar *et al*., 2022; Oyegoke *et al*., 2009). The construction process has different characteristics such as fragmentation, complicated relationships among stakeholders, one-time production, and uniqueness (Xue *et al*., 2011). In a construction project, the supply side (e.g., architects, engineers, contractors, labourers, service providers, and suppliers) is linked with the demand side (e.g., project owner, investor, and client representative) through the procurement process (Hayden *et al*., 2023; Cox & Town-send, 1998).

Procurement can be defined as the process of acquisition of goods and services by a third party with the best price, proper quality, and the right time and place (Gurgun *et al*., 2024; Ruparathna & Hewage, 2015). The construction procurement process starts with establishing what needs to be procured and ends with contract administration to ensure that they match the requirements (Grilo & Jardim-Goncalves, 2011).

In general, procurement could be classified into two different types structured procurement and unstructured procurement (Grilo & Jardim-Goncalves, 2011). Structured procurement describes the procurement processes with a high level of automation regarding need identification, ordering, and fulfilment (Subramaniam & Shaw, 2004). Unstructured procurement describes the procurement processes that are not appropriate to any level of automation. The bidding process in the construction process is a critical decision. Also, it is an essential task for companies to position themselves in the construction market (Dikmen & Birgonul, 2004). BIM is a digital technique used to generate a computable representation of a facility's attributes, whether physical or functional. BIM models include essential information that may be used by the owner or operator of a facility throughout its life cycle. BIM was implemented in 2000 to meet the needs of the Architecture, Engineering, and Construction (AEC) business. BIM can provide the amounts of construction materials and components delineated throughout the design process (Sekgoele, 2023; Irizarry *et al*., 2013). BIM has the potential to enhance the coordination of the procurement process across the design and construction phases (Grilo & Jardim-Goncalves, 2011).

The bidding process needs a lot of time and effort. For a client, tender document preparation, bids evaluation, and contract awarding are the main tasks that have to be accomplished by the client's team or

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representative. Similarly, the general contractor also follows the same process when selecting subcontractors (Arslan *et al*., 2006). The aim of this research is to evaluate the barriers of building information modelling-based (BIM-based) e-procurement system used in the Nigerian construction industry. The aim of this study will be achieved through the following objectives, which are to: examine the barriers of BIM-based e-procurement system used in the Nigerian construction industry; and evaluate the level of adoption of BIM-based e-procurement for public building projects in Abuja, Nigeria. In order to gain more insights into the theme of the aim and objectives of the study, extant review of relevant literature was undertaken. This review of literature is highlighted in the following sub-sections.

1.1 Electronic procurement

E-procurement uses transaction processes and electronic communication while acquiring services and supplies or carrying out tender works. The process could be separated into two stages, pre-award and post-award stage. The pre-award stage starts with e-notification followed by e-submission, then e-evaluation, and finally e-awarding. On the other hand, the post-award stage starts with e-ordering, then e-invoicing, and finally e-payment. There are different tools for e-procurement that could be used to accomplish any of the two phases (Hashim *et al*., 2013).

The use of e-procurement in different industries has been increased since the mid-1990s when the web and e-mail services become popular. The use of e-procurement could support procurement activities in different sectors (Ibem & Laryea, 2015). The construction industry is progressively recognizing the importance of information systems such as e-procurement in facilitating supply chain integration. Managers' views of procurement procedures and efficiency are positively affected by using e-procurement technologies (Naoum & Egbu, 2015).

1.2 Barriers of e-procurement in the construction industry

The construction industry is knowledge-based and extremely information-intensive. In addition, organisations in the construction industry still view information technology as a tool for facilitating design and site management (Isikdag, 2019). In order to improve performance, productivity, and revenues, the industry must move away from procurement through traditional sourcing approaches and embrace the global marketplace, using an internet-based system (McIntosh & Sloan, 2001; Hadikusumo *et al*., 2005).

Several challenges are associated with the implementation of e-procurement in any construction industry. Hassan (2021) used the example of the Finnish construction industry to identify these challenges, which include the resistance to change from traditional procurement methods, a lack of awareness of the benefits of e-procurement, the absence of guidelines for implementation, and limited examples of successful implementation in the industry. Additionally, the study found that the lack of a unified e-procurement system that would cater exclusively to the private sector is a significant challenge, along with the limited support from e-procurement service providers.

Although Umar *et al*. (2022) did not identify any specific challenges of e-procurement implementation in the construction industry, the study advocated for continuous improvements in project delivery systems due to challenges faced by the construction industry such as lack of efficiency and productivity, fragmented design process, unjust procurement processes, and flawed project delivery systems. Within the South African construction industry, Sekgoele (2023) listed a number of challenges and barriers to the implementation of e-procurement in the construction industry. These include (i) lack of technical expertise/skills, (ii) affordability/high cost of investment, (iii) electronic authentication and authorization issues, (iv) unreliable internet service and power supply, (v) security & privacy of data transactions, and (vi) lack of access to e-procurement technology. to effectively implement e-procurement in the construction industry's e-commerce model, especially in developing countries, it is imperative that stakeholder concerns regarding resistance to change, lack of management support, and low level of employee training must be addressed (Sekgoele, 2023).

According to Zulkarnain *et al*. (2023) there are several challenges in implementing e-procurement; these include (a) high cost of implementation, (b) lack of a widely accepted solution that hinders integration of different e-procurement software across the supply chain, (c) risks related to the security and control of the e-procurement process itself, (d) the need for clear and open standards to facilitate inter-organizational e-procurement of technology, (e) slow technology adoption without widely accepted coding standards, technical or process specifications, and (f) unauthorized actions that might disrupt production or other supply chain activities when committed to e-procurement technologies.

Within the Australian construction industry there is a clear lack of Australian-focused literature examining the potential benefits of e-procurement based on the local industry environment. Notwithstanding this, Hayden *et al*. (2023) found that there are 21 individual barriers to e-procurement adoption, which include technological usability and evolution-related barriers, security and unsupportive environment-related barriers, culture-related barriers, infrastructure-related barriers, unethical practices-related barriers, and

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financial and skill-related barriers. Tiruneh (2024) investigated the gaps in existing procurement processes, major barriers and challenges, and opportunities to implement technology as a requirement in the tender document during procurement of public building projects in Ethiopia. The study did not provide information about the specific challenges of e-procurement implementation in Ethiopia.

Gurgun *et al*. (2024) developed a framework for ranking the key barriers that supply chain administrators and project managers need to focus on. By prioritizing the reduction of these barriers in the implementation process, construction firms can promote better project performance and improve supply chain efficiency. The specific challenges and barriers to e-procurement adoption and implementation identified by the study include material cost fluctuations, a large number of change orders, a lack of trust between stakeholders, legal disputes, and difficulties in communication and in managing the supply chain using traditional procurement methods.

Popov *et al*. (2021) opined that while building information modelling (BIM) is a strategic enabler for cost, quality, and policy goals in public procurement, there are some challenges associated with its implementation. One significant barrier to the successful implementation of BIM is the lack of procurement guidelines and recommendations. Another challenge is the complexity of public procurement processes, which require different stakeholders to have a good understanding of BIM tools, methods, and processes. The lack of awareness and a clear understanding of the benefits and motivations for implementing BIM is also a challenge. Furthermore, the implementation of BIM requires an investment in training and skills development, which could pose budgetary and resource challenges for some organisations. Although the principles of public procurement are similar in different countries, public procurement is regulated differently in each country. Hence, it is necessary to develop national guidelines and recommendations for procurement procedures in BIM implementation, adapted to specific local conditions and legislation.

1.3 Level of adoption of BIM-based e-procurement in the construction industry

There have been quite a number of studies carried out on the adoption of BIM in various countries. Hassan (2021) found that the adoption rate of e-procurement in the Finnish construction industry is low, despite the potential advantages of e-procurement in managing the procurement process. This situation was attributed to a shortage of BIM-based e-procurement tools and integration between BIM and e-procurement. Umar *et al*. (2022) identified some of the benefits of the adopting BIM in the Nigerian Construction Industry. The study listed such benefits to include (i) increasing building performance, (ii) minimizing errors and omissions, (iii) enabling earlier collaboration of design disciplines, (iv) providing automatic corrections when changes are made, (v) automatic extraction of cost estimates during the design stage, and (vi) discovering design errors and omissions before the start of construction. Umar *et al*. (2022) did not however provide any information regarding the level of adoption of e-procurement in the Nigerian construction industry. Although limited examples of successful implementation of e-procurement in construction projects are available in the literature, the construction sector is lagging behind other industries in its adoption of this technology (Hassan, 2021).

Sekgoele (2023) presented data on the adoption of e-procurement in South African Construction Industry (SACI) and reported that the percentage adoption rate of e-procurement in SACI is as low as 11%. This low adoption rate, which is much lower than that of some other developing countries, has been attributed to reason such as unreliable IT infrastructure, high cost of investment, security concerns, lack of management support, and fear of job loss. The process of adopting e-procurement in developed countries has not yet fully evolved, mainly because some companies are taking a 'wait and see' approach to identifying the best e-procurement model (Zulkarnain *et al*., 2023). The study also found that the factors influencing the adoption of e-procurement consist of (i) organizational factors, (ii) readiness, (iii) supply, (iv) strategy, (v) policy, (vi) development strategy, (vii) supplier adoption, (viii) conformity to best practices for business cases, (ix) system integration, (x) procurement process rearrangement, (xi) implementation strategy, (xii) technology standards, and (xiii) legal compliance.

Hayden *et al*. (2023) did not provide a direct measurement of the level of adoption of BIM or e-procurement in the Australian construction industry. However, the study mentioned that there are various barriers to e-procurement adoption in the construction industry, as well as a significant volume of literature about the adoption of e-procurement across countries. Tiruneh (2024) opined that BIM adoption improves collaboration and communication, coordination of designs and identification of conflicts, identification, mitigation, and control of hazards in safety. The study reviewed the experience of BIM technology implementation in various nations, with the aim of optimizing procurement requirements for the implementation of technology in Ethiopian public client construction projects.

The discussion on BIM adoption will not be complete without mention of the mandatory adoption of Building Information Modeling (BIM) in different countries. For example, BIM is mandatory for public building tenders in Spain. In Germany, BIM has become compulsory for all transportation projects since 2020.

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Lithuania is also planning to make the application of BIM methods mandatory in the design, construction, and installation of public sector buildings and facilities (Popov *et al*., 2021).

2.0 Materials and Methods

2.1 Research design

A research design reveals how a researcher conceptualizes the study and guides how data will be collected, measured and analysed. A quantitative research design approach was used in this study; this was based on the use of questionnaires.

2.2 Research population

The population sample of this study consisted of different stakeholders in the construction industry. The sample included construction professionals whose work designation bore titles such as procurement engineer, procurement manager, BIM specialist, BIM coordinator, and construction manager. The participants in this questionnaire survey had different years of experience, which was an essential factor in the accuracy of the results. The population sample was selected according to the area of expertise since construction procurement is a particular task that requires excellent technical knowledge, high coordination skills, and communication skills in order to deal perfectly between the project team and sub-contractors and suppliers.

In addition, the population was identified with specific focus on Nigeria only since the author wanted the study to be specific to the Nigerian construction industry. The topic of this study is highly related to the country level since the implementation factors of e-procurement and BIM are differ from one country to the other.

2.3 Sampling frame sampling technique and sample size

The purposive sampling technique was employed in this study. The research questionnaire was sent out to as many of the construction procurement professionals as could be identified by the author. It was expected that up to 300 potential respondents can be identified. Digital copies of the questionnaire were sent. At the end of the data collection/field survey period, a total of 305 valid responses were received and collated for the data analysis.

2.4 Method of data collection

The questionnaire employed for this study was designed in such a way as to best achieve the aim of the study. The questionnaire consisted of five different sections. The first, second and third sections measured the following points: (a) How using a digital tool such as BIM affects construction procurement; (b) The challenges that may be encountered when BIM is used for e-procurement in construction; (c) how BIM could support the procurement process and the issues of integrating BIM and e-procurement. (d) The fourth section of the questionnaire measured the level of adoption of BIM for e-procurement in construction; (e) The last section collected background information on the respondents such as company size, years of experience and company specialization. All of the questions were designed according to the Likert type in which the participants will be asked to show how much they agree or disagree on a five-item scale (Roberts *et al*., 1999).

2.5 Method of data analysis

The data for objectives were analyzed using descriptive statistical method (Method and Mean Item Score) which are found in Microsoft Excel and the Statistical Package for Social Science (SPSS) Version 26. The analyzed data will be presented using tables and charts. The level of adoption of BIM for e-procurement could thus be computed as follows:

$$\text{Level of BIM adoption} = \frac{\text{(number of tasks identified through consensus opinion)}}{\text{(total number of tasks)}} \quad (4.1)$$

3.0 Results and Discussion

3.1 Analysis of respondents' profile

From the results presented in Table 1, the respondents were from different professional backgrounds; engineers (who made up 18.3%) and quantity surveyors (18.0%) were the most numerous in the sample, while other professionals such as project managers and surveyors were fewest, making up only 6.2% of the sample. Other professionals in the sample were architects, who comprised 12.7%, builders who made up 14.1%, estate surveyors (17.0%) and town planners (1.4%). Only 50 out of 305 respondents had worked for more than 15 years; 116 respondents had put in at least 10 years in the construction industry, while new entrants, who had worked less than five years, made up 17.3% of the sample. These results show that the respondents were spread across most of the categorizations available within the construction industry, in terms of professional

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specialization and experience.

Table 1: Demographics of respondents

Demography aspect	Frequency (n)	Percentage (%)
Profession of respondent		
Architect	39	12.7
Builder	43	14.1
Engineer	56	18.3
Estate Surveyor	52	17.0
Quantity Surveyor	55	18.0
Town Planner	41	13.4
Other (Project Managers, Surveyors)	19	6.2
Work experience		
Less than 5 yrs	53	17.3
5 yrs – 10 yrs	86	28.1
10 yrs – 15 yrs	116	37.9
More than 15 yrs	50	16.3

Source: Author's fieldwork (2024)

The result of organisational demographics for the study sample was presented in Table 2. The organizations that the respondents worked for ranged in size from small firms to medium sized ones. Firms having less than 10 employees made up 15.4%; those firms that had between 10 and 49 employees were the most numerous in the sample (46.4%). the least numerous categories of organizations were firms that employed more than 250 employees; these made up only 10.1% of the sample. These results of the demographics of the respondents are presented in Table 2.

Only 61 out of 305 respondents worked for clients (19.9%); 80 respondents worked for consultants in the construction industry (26.1%), while respondents who worked for general/main contractors made up 22.9% of the sample. Respondents who worked for subcontractors and material suppliers accounted for 14.4% and 14.7% respectively. As previously stated, these results show that the respondents were spread across most of the categorizations available within the construction industry, in terms of company size and specialization.

Table 2: Demographics of respondents' organizations

Demography aspect	Frequency (n)	Percentage (%)
Current company size		
0 – 09 employees	47	15.4
10 – 49 employees	142	46.4
50 – 249 employees	85	27.8
More than 250 employees	31	10.1
Employer / Company specialization		
Client	61	19.9
Consultant	80	26.1
General / Main Contractor	70	22.9
Sub-contractor	44	14.4
Materials supplier	45	14.7
Others (please specify)	5	1.6

Source: Author's fieldwork (2024)

3.2 Barriers of the use of BIM-based e-procurement systems in construction

A total of 20 barriers had been distilled from the literature and were put to the test during the fieldwork stage of the study. Using a 5-item Likert scale instrument, the 20 barriers were ranked based on the responses received from participating construction professionals. Mean item score was employed as the tool for descriptive analysis. The results were presented in Table 3. The section also identified specific barriers that were the subject of consensus opinions of respondents. To this end, a radar chart was created with the questionnaire survey data. Wherever the radar line is above the 70% mark in the chart, the barrier concerned is the subject of a consensus agreement. Consensus agreements help to identify barriers that may be useful in the formulation of strategies for enhancing the uptake of BIM-based e-procurement in the construction

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industry.

Respondents agreed with 8 of the 20 barriers of e-Procurement systems implementation as presented in Table 3; respondents were neutral about a further 10 barriers and disagreed outrightly with the last 2 barriers as presented in Table 3. The first three of the 8 barriers that respondents agreed with were (i) Limited admissibility of electronic evidence during procurement-related litigation (MIS = 4.29, ranked 1st), (ii) Lack of top management support (MIS = 4.12, ranked 2nd) and (iii) High cost of internet service provider (ISP) services (MIS = 4.10, ranked 3rd). Other barriers that respondents agreed with included 'Immaturity of the technology for BIM and e-procurement', 'Cultural preference for paper-based procurement systems' and 'Lack of trust in electronic documents.

The ten barriers that respondents were neutral about included challenges such as 'Fear of price transparency', 'Difficulties in remodelling the procurement process to accommodate BIM', 'Undiminished widespread acceptability of traditional procurement' and 'Low reliability of wireless communication networks. The large number of barriers about which significance respondents could not make up their minds is an indication of the fact that BIM and e-procurement are still very much emerging areas of technology application in the construction industry.

Table 3: Barriers of BIM-based e-procurement use

ID	Barriers of the implementation of e-procurement systems in construction	Mean Score	SD	Rank	Level of Agreement
QC15	Limited admissibility of electronic evidence during procurement-related litigation	4.29	1.22	1st	Agree
QC5	Lack of top management support	4.12	1.36	2nd	Agree
QC20	High cost of internet service provider (ISP) services	4.10	1.35	3rd	Agree
QC2	Immaturity of the technology for BIM + e-procurement	4.07	1.43	4th	Agree
QC14	Lack of laws and regulations underpinning use of e-procurement	4.07	1.38	5th	Agree
QC17	Cultural preference for paper-based procurement systems	4.05	1.40	6th	Agree
QC1	Unavailability of e-procurement platforms	3.82	1.55	7th	Agree
QC7	Lack of trust in electronic documents	3.69	1.65	8th	Agree
QC9	Fear of price transparency	3.49	1.69	9th	Neutral
QC11	Lack of trust between parties in the electronic system	3.48	1.67	10th	Neutral
QC10	Difficulties in remodeling the procurement process to accommodate BIM	3.46	1.69	11th	Neutral
QC18	High cost of obtaining access to use of BIM and e-procurement software	3.03	1.74	12th	Neutral
QC16	Undiminished widespread acceptability of traditional procurement	3.02	1.78	13th	Neutral
QC6	Not perceived as an advantage at all	2.91	1.75	14th	Neutral
QC13	Doubts in the reliability of digital signatures	2.89	1.78	15th	Neutral
QC19	Low reliability of wireless communication networks	2.80	1.77	16th	Neutral
QC4	Lack of skill and knowledge	2.78	1.77	17th	Neutral
QC3	Incompatibility with existing ERP (enterprise resource planning) systems	2.75	1.77	18th	Neutral
QC12	Lack of IT skills and opportunities for IT training	2.41	1.67	19th	Disagree
QC8	Fear of change (from paper to electronic)	2.39	1.64	20th	Disagree

Source: Author's fieldwork (2024)

The two barriers that respondents felt did not hold any notable significance for e-procurement in the construction industry were 'Lack of IT skills and opportunities for IT training' and 'Fear of change (from paper to electronic)'. This meant that respondents hold with the view that it is neither a lack of information technology (IT) training opportunities that is holding back the implementation of e-procurement, nor a fear of change. It is possible that respondents felt that there are opportunities for IT training, but these might be available at costs that are not affordable. Respondents also felt that stakeholders in the construction industry were not afraid of change, with respect to implementation of e-procurement.

The radar chart of the level of agreement observed amongst the sample with respect to the barriers of e-

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procurement implementation was presented in Figure 1. The chart revealed that only seven barriers were the subject of consensus agreement within the respondents. All of the 8 barriers that respondents agreed with obtained consensus agreement with the exception of one (Lack of trust in electronic documents). This was because these seven barriers were agreed to by at least 70% of all respondents. These findings are very similar to what other studies have found out. Umar *et al.* (2022) opined that flawed project delivery systems were a major barrier to digitization in the Nigerian construction industry. Sekgoele (2023) listed a number of challenges of the implementation of e-procurement in South Africa, which included (i) lack of technical expertise/skills, (ii) affordability/high cost of investment, and (iii) electronic authentication and authorization issues.

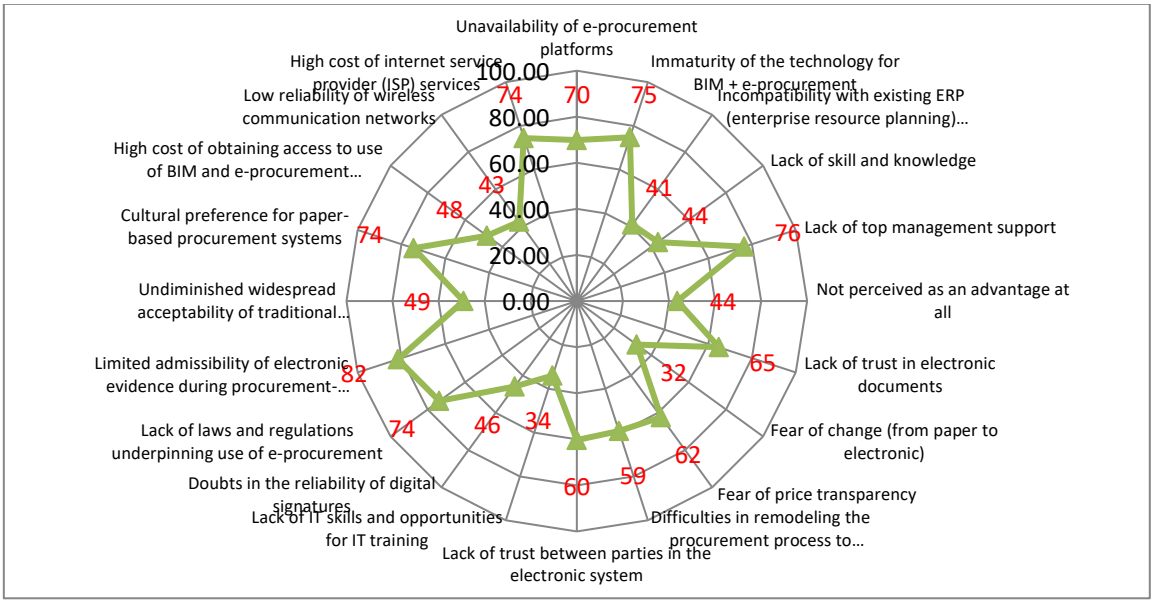

Figure 1: Radar chart of e-procurement challenges

3.3 Level of adoption of BIM-based e-procurement for public building projects

A total of 17 tasks that BIM could be employed for had been distilled from the literature and were put to the test during the fieldwork stage of the study. Using a 5-item Likert scale instrument, the 17 tasks were ranked based on the responses received from participating construction professionals. Mean item score was employed as the tool for descriptive analysis. The results were presented in Table 4.

Respondents agreed with 8 of the 17 tasks that BIM could be employed for and were neutral about the remaining 9 of the tasks. The three highest ranked tasks that respondents agreed were most frequently carried out through BIM-based e-procurement were (i) Interaction with other professionals (MIS = 3.71, ranked 1st), (ii) Preparing project materials schedule (MIS = 3.70, ranked 2nd) and (iii) Making payments (MIS = 3.69, ranked 3rd). The other five tasks handled through BIM were Distribution of contract drawings, Receipt of payments, Production of contract drawings, Project management and Preparation of tenders.

Respondents were neutral about the use of BIM being involved in the following nine tasks: Consultation with client, contract formulation, receipt of tender notification, generating tender documents automatically, tracking payments to suppliers, submission of tenders, tender analysis, tendering and obtaining design brief. It was noteworthy that respondents did not disagree outrightly about BIM being used for these nine tasks.

Table 4: Level of adoption of BIM-based e-procurement

S/N	ID	Level of adoption of BIM base e-procurement of public building projects	Mean Score	SD	Rank	Level of Agreement
1	QB8	Interaction with other professionals	3.71	1.07	1st	Agree
2	QB17	Preparing project materials schedule	3.70	1.35	2nd	Agree
3	QB14	Making payments	3.69	1.10	3rd	Agree
4	QB6	Distribution of contract drawings	3.67	1.14	4th	Agree
5	QB13	Receipt of payments	3.65	1.10	5th	Agree
6	QB2	Production of contract drawings	3.65	1.07	6th	Agree
7	QB7	Project management	3.64	1.15	7th	Agree
8	QB1	Preparation of tenders	3.58	1.23	8th	Agree
9	QB10	Consultation with client	3.13	1.19	9th	Neutral

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S/N	ID	Level of adoption of BIM base e-procurement of public building projects	Mean Score	SD	Rank	Level of Agreement
10	QB4	Contract formulation	3.10	1.15	10th	Neutral
11	QB12	Receipt of tender notification	2.67	1.60	11th	Neutral
12	QB16	Generating tender documents automatically	2.63	1.61	12th	Neutral
13	QB15	Tracking payments to suppliers	2.62	1.60	13th	Neutral
14	QB11	Submission of tenders	2.60	1.58	14th	Neutral
15	QB3	Tender analysis	2.58	1.55	15th	Neutral
16	QB5	Tendering	2.57	1.59	16th	Neutral
17	QB9	Obtaining design brief	2.55	1.58	17th	Neutral

Source: Author's fieldwork (2024)

The section also attempted to identify specific tasks for which BIM could be employed and which were the subject of consensus opinions of respondents. To this end, the results in Table 4.7 were computed from the questionnaire survey data. A cut-off value of 70% was employed as the minimum for a consensus opinion. A consensus agreement was used to describe the total number of respondents who strongly agree or agree with an opinion (Udoekanem, 2013).

Table 5: Consensus agreement on adoption of BIM-based e-procurement

S/N	ID	Level of adoption of BIM base e-procurement of public building projects	Agree (No. of responses; n=305)	% Agreement
1	QB8	Interaction with other professionals	239	78.36
2	QB14	Making payments	238	78.03
3	QB7	Project management	232	76.07
4	QB2	Production of contract drawings	231	75.74
5	QB13	Receipt of payments	231	75.74
6	QB1	Preparation of tenders	229	75.08
7	QB6	Distribution of contract drawings	229	75.08
8	QB17	Preparing project materials schedule	220	72.13
9	QB12	Receipt of tender notification	137	44.92
10	QB15	Tracking payments to suppliers	134	43.93
11	QB16	Generating tender documents automatically	132	43.28
12	QB5	Tendering	126	41.31
13	QB10	Consultation with client	124	40.66
14	QB11	Submission of tenders	123	40.33
15	QB4	Contract formulation	121	39.67
16	QB9	Obtaining design brief	120	39.34
17	QB3	Tender analysis	119	39.02

Source: Author's fieldwork (2024)

It was observed that all of the 8 tasks that respondents agreed were carried out through the use of BIM were the subject of consensus opinions. This meant that the tasks could be accepted as representative of the opinions of all of the respondents

Level of BIM adoption would thus be 47.06%. The explanation of this value is that the study respondents agreed that 47% of the procurement tasks identified by the study are being carried out through the use of BIM in the Nigeria construction industry. The value obtained (47%) did not refer to the proportion of professionals in the industry that are using BIM for procurement. The study has also identified 8 tasks that BIM could be adopted for; these include Interaction with other professionals, Preparing project materials schedule,

Project management and Preparation of tenders. The findings of this study thus agree wholly with the work of Umar *et al.* (2022), which identified some of the tasks that BIM could be adopted for, in the Nigerian Construction Industry; the list included 'enabling earlier collaboration of design disciplines. Whereas this study has discovered that BIM was adopted for 47.06% of procurement tasks, Sekgoele (2023) reported that the percentage adoption rate of e-procurement in the South African construction industry is as low as 11%.

4.0 Conclusion

This study aimed to evaluate the barriers to the adoption of Building Information Modelling (BIM)-based e-procurement in public building projects in Abuja, Nigeria. Through a quantitative research approach, using a survey distributed to various stakeholders in the construction industry, key barriers were identified and

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analyzed. The findings revealed several significant barriers to the adoption of BIM-based e-procurement. These included limited admissibility of electronic evidence during procurement-related litigation, lack of top management support, high costs associated with internet service providers, immaturity of the technology for BIM and e-procurement, and cultural preferences for traditional paper-based procurement systems. The study also highlighted a general lack of trust in electronic documents and insufficient legal frameworks supporting e-procurement.

These barriers demonstrate that while there is potential for BIM-based e-procurement to enhance efficiency and integration in the construction industry, substantial challenges need to be addressed to facilitate its wider adoption. The results underscore the need for strategic interventions to overcome these obstacles and promote a more conducive environment for BIM-based e-procurement implementation.

In the light of the findings of this study, the following recommendations have been made:

- It is essential to establish comprehensive legal and regulatory frameworks that support the use of electronic documentation and transactions in procurement processes. This will enhance the admissibility of electronic evidence in legal settings and build trust among stakeholders.
- Increasing awareness and support from top management is critical. Organizations should invest in training programs that enhance the skills and knowledge of construction professionals regarding BIM and e-procurement systems.

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