Assessing Barriers to Implementing Information Technology for Quality Control in Nigerian Construction Organisations

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Received: 15/01/2025 **Revised: 20/02/2025** **Accepted: 24/03/2025**

The construction industry faces ongoing criticism for low productivity and quality, partly due to the limitations of traditional manual inspection methods. Integrating information technology (IT) offers a solution by enhancing project design, planning, and execution to improve overall efficiency and safety. Despite the evident benefits of IT in the literature, the Nigerian construction industry has yet to fully embrace its potential due to several obstacles, including a lack of technical expertise, cybersecurity concerns, poor internet connectivity, resistance to change, and high digital equipment costs. These challenges contribute to high project failure rates, low productivity, and inefficiency. However, the extent to which these barriers affect IT implementation for quality control in Nigerian construction organisations remains underexplored. This study identifies the barriers hindering the implementation of IT in Nigerian construction organisations. A quantitative research approach was adopted, and data were collected through a structured questionnaire survey from construction firms within Abuja (FCT) and Kaduna State, Nigeria. Out of 120 questionnaires administered, 65 were retrieved, which represents a response rate of 54%. Descriptive and inferential statistical analyses were conducted to examine the impact of identified barriers on IT implementation. The results indicate that all barriers identified from the literature significantly influence IT adoption in the Nigerian construction industry. Notably, the three most influential barriers are Limited Technical Expertise (mean score = 3.85), Lack of Reliable Internet Connectivity in some areas (mean score = 3.72), and Resistance to Change from Traditional/Manual Processes to IT-Based Systems (mean score = 3.58). Based on these findings, the study identifies key barriers to IT implementation in the Nigerian construction organisations, including limited technical expertise, poor internet connectivity, and resistance to change. Addressing these challenges is crucial for improving productivity and efficiency. Structured IT training programs and awareness campaigns are recommended for industry professionals and government stakeholders. These efforts will support a smoother transition to digital integration. Embracing IT solutions will ultimately enhance project outcomes and industry growth.

Keywords: Construction organisations, digital transformation, information technology, innovation, inspection methods, IT adoption, quality control, project failure

Introduction

The construction industry has been criticized because of its low productivity and quality in comparison with other industries. Due to its delayed adoption and implementation of Digital technologies, the construction sector has seen very modest productivity benefits (McKinsey & Company, 2017). Construction specifications, consisting of both project-specific requirements and standardised guidelines are commonly included in building projects. Furthermore, it is typical for some of these requirements to cross-reference one another, leading to intricate relationships between them. Because of all of these, utilising construction specifications is difficult and prone to mistakes (Boukamp, 2006). Studies have revealed that manual inspections, such as traditional techniques of quality assurance, are frequently insufficient to satisfy the industry's changing expectations (Okeke *et al.*, 2020).

Similar studies have identified comparable barriers to IT implementation in the construction industry. For instance, the adoption of Building Information Modelling (BIM) in Nigeria has been hindered by resistance to change and a lack of technical expertise (Bamgbose *et al.*, 2024). Kori (2013) found that medium and large firms led BIM adoption, while smaller firms lagged due to limited process and policy adherence. The industry's reliance on conventional 2D CAD systems and minimal use of 4D and 5D systems indicate a resistance to adopting new technologies.

Additionally, the construction industry's general reluctance to adopt new technologies has been noted. Field managers often rise through the ranks without exposure to higher education or new methods, leading to a preference for traditional practices (Moshood *et al.*, 2020). The demanding nature of fieldwork and the perception that new technologies disrupt established workflows contribute to this resistance. Unreliable internet connectivity is a significant barrier in Nigeria, affecting the efficiency of IT systems in construction. This issue is exacerbated in regions with underdeveloped infrastructure, limiting the effectiveness of IT-based quality control measures (Oke *et al.*, 2019).

However, studies have shown that information technology (IT) offers an opportunity to overcome

these challenges and increase the productivity, quality, and safety of the construction industry, improving project design, planning, and execution in the process (Moullier, 2015; Boateng, 2020; Okeke *et al*., 2020; Braithwaite, 2021). The Nigerian construction industry is characterised by a high percentage of project failure, low productivity, and inefficiency. These challenges are attributed to inadequate managerial capability, inefficient funding by the government and stakeholders, poor government policies, and the lack of appropriate technology for industrial projects (Anyanwu, 2013). These challenges are attributed to a number of issues, including outdated construction methods, inadequate education and training, and poor project management technologies (Fashola, 2016).

When compared to various other sectors of the economy, the Nigerian construction industry has not yet fully embraced information technologies (IT), despite the fact that their benefits are evident in the literature in the form of improved data and communication, reduced reliance on paper documents and drawings, improved record organisation and filing, and faster, less expensive, and more precise communication streams (Olalusi & Awosemo, 2020). The Nigerian construction industry currently has a low level of acceptance, implementation, and knowledge of the potential benefits of information technologies (IT) (Oyewo *et al.,* 2022).

Literature Review

Information technology (IT) according to the Information Technology Association of America (ITAA) is defined as "the study, design, development, implementation, support, or management of computer-based information systems, particularly software applications and computer hardware." IT is, in essence, the use of computer software and electronics to the safe conversion, storing, processing, transmission, and retrieval of data. According to this definition, "data" can typically be used in place of "information" without changing the meaning. (ITAA, 2010). "The use of electronic machines and programs for the processing, storage, transfer, and presentation of information" is another definition provided by (Bjork, 1999). Researchers studying IT in building have embraced this simple description.

Information Technology in construction, also known as Construction Information Technology (CIT), refers to the application of digital tools, systems, and methodologies to improve the planning, design, construction, and management of built assets (Bryde *et al.,* 2013; Cao *et al.,* 2018). CIT encompasses various technologies, including Building Information Modelling (BIM), Computer-Aided Design (CAD), Geographic Information Systems (GIS), project management software, mobile apps, and cloud-based collaboration platforms (Chang *et al.,* 2018; Keramati *et al*., 2018). The integration of IT in construction has revolutionized the industry's efficiency, productivity, and quality, enabling: Enhanced collaboration and communication among stakeholders, Improved data management and analytics, Increased accuracy and precision in design and construction, Reduced errors and conflicts, better decision-making and risk management, Improved project timelines and cost management etc.

The construction sector is increasingly expanding its usage of IT. However, due to its distinct characteristics that set it apart from other industries one-off projects, industry fragmentation, low levels of technology awareness and training, upfront investment requirements, ongoing maintenance costs, and resistance to change the construction industry appears to be moving slowly toward effective IT implementation (Betts, 1999; Feng, 2006). When it comes to project planning, organisation, operation, and control, IT may be a huge help. Studies have shown that the construction industry continues to lag in effective IT adoption compared to other sectors. For instance, a report by the London and District Construction Association (LDCA, 2023) highlights that construction remains among the least digitized industries, alongside agriculture. Similarly, LetsBuild, (2021) emphasised that while digital transformation is a priority for 71% of construction firms, adoption has been slow due to the complexity and fragmentation of the industry. These findings suggest that, despite some advancements, the construction sector still faces significant challenges in leveraging IT effectively. According to Dikbas *et al*. (1999), Sun *et al*. (2000), Peansupap (2004), Matheu (2005), Feng (2006), and ITAA (2010), IT applications in the construction industry focus on.

While regulatory or compliance issues and the limited availability of advanced IT tools are considered less critical barriers, they still pose challenges. The absence of mandated or national best practice BIM standards in South Africa, for example, leads organisations to implement company-specific standards, resulting in inconsistencies across the industry (Windapo & Moghayedi, 2022).

Computing (software and hardware)

In construction management, a variety of tool software kinds are employed. Software tools can be used for a variety of purposes (FENG, 2006). Including Computer Aided Design (CAD), Estimating Software, and Planning and Scheduling Software etc.

Communication technology

These days, communications technology plays a significant role in IT. In actuality, a large number of communication devices' features are becoming more integrated. Emailing is already available with laptop computers from the most recent generation. The fastest-growing field in communication is internet-based communication. Communication networks enable all parties engaged in a building project to exchange data and information. Cooperation and

coordination may increase when information flows more smoothly (Feng, 2006).

Benefits of IT in construction industry

The construction industry has witnessed significant transformations with the advent of Information Technology (IT). IT has become an indispensable tool in modern construction, revolutionizing the way projects are planned, designed, constructed, and managed (Bryde *et al*., 2013; Cao *et al.,* 2018). Effective adoption and implementation of IT improves efficiency, productivity, and quality, leading to better project outcomes. Bryde *et al*. (2013) demonstrated that Building Information Modelling (BIM) contributes to better project performance. Similarly, research by Kassem and Succar (2017) highlighted that strategic BIM adoption can lead to significant improvements in project delivery. Effective utilisation and implementation of information technologies offer significant advantages in the form of increased productivity, enhanced safety, improved quality control, efficient resource management, cost reduction, and supply-chain optimisation. Table 1 presents the barriers to IT adoption and implementation in Nigerian Construction organisations as identified in the literature by different scholars.

Table 1: Barriers to IT adoption and implementation in Construction Organisations

S/n	Barriers	Sources
1	Lack of control over automated IT systems	Adeyemi *et al.* (2018)
2	Limited Access to Technology	Oyedele *et al*. (2019)
3	Digital Skills Gap	Afolabi and Oluwatayo (2019)
4	Cybersecurity Concerns	Oyegoke and Ahmed (2016)
5	High Initial Costs	Akintoye *et al.* (2020)
6	Lack of Skilled Workforce	Teo *et al.* (2019)
7	Resistance to Change	Pitteway *et al.* (2021)
8	Complexity of Integration	Ma *et al.* (2017).
9	Data Privacy Concerns	Zhang *et al.* (2019)
10	Regulatory and Compliance Issues	Scheifele *et al.* (2021)
11	Lack of Industry Standards	Volk *et al*. (2014)
12	Concerns about cybersecurity and privacy	Rahman *et al.* (2021)
13	Cultural Resistance	Smith *et al.* (2022)
14	Inadequate Infrastructure	(Ugwu & Haupt, 2014)
15	Lack of reliable internet connectivity	Oliveira *et al*. (2020)
16	Supply Chain Disruptions	Cheng *et al.* (2020)
17	Lack of Education and Awareness	Cheah *et al.* (2019)
18	Legal and Liability Issues	Li *et al*. (2021).

Research Methodology

Research design involves the intersection of philosophical assumptions, strategies of inquiry, and specific methods, serving as a framework for collecting, measuring, and analysing data (Creswell, 2014). It is the blueprint for data collection, measurement, and analysis. This study adopted a questionnaire survey that involved various construction organisations within Nigeria. The research approach/method considered for this study was the quantitative approach. Kothari (2004) describes a research population as the totality of items or units under consideration, which can be finite or infinite. The main objective of a study population is to define the scope of the proposed study, usually, a typical population is taken to be very large, but where the population is sufficiently small, the entire study population is considered and such research type where data is gathered on every member of the population is called a census study (Kothari, 2004).

The target population for this study was construction firms within Abuja and Kaduna state, Nigeria. Since not all the construction firms in Nigeria could be examined, a sample of the population was focused on. According to the Federation of Construction Industry (FOCI, 2018), there are 1,407 registered construction firms across Nigeria. However, considering Abuja (211) and Kaduna state with (71) numbers of registered construction firms, where construction activities are more predominant and where most of the firms are located or have branch offices, the research arrived at a sample frame of 282 firms. This data was

used because there was no latest data that could be obtained from the FOCI database.

Given that the total population number was known, using the following formula (n= $\frac{N}{1+N(E)^2}$) (Nasir, *et al.*, 2021). A sample size of 86 was established, with an additional 40% added to account for the non-response rate, resulting in a total of 120 firms. To maximize the study's response rate, as typically recorded in construction industry studies (Crafford, 2007; Ibrahim, 2011), and based on the recommendations of Salkind (1997), Sambo (2008), and Guthrie (2010), the sample size should be increased by 40%–50% to compensate for lost responses. Additionally, a larger sample size enhances the study's ability to accurately represent the population. Therefore, structured questionnaires were administered to the 120 firms selected within FCT Abuja and Kaduna State. A total number of 65 questionnaires were retrieved from the survey that was carried out which represents 54% out of the number of the respondents in the sample size, while 55 were not retrieved which resulted in 46%. This response rate is not unusual for this type of survey. For example, Nasir et *al*. (2021) received a response rate of 41.5% while Nasir *et al*. (2024) received a response rate of 40%. Mbugua *et al.* (2000) further argued that a minimum of 30 responses is adequate for research-based in the construction industry.

Data was collected using a structured questionnaire. The questionnaire had two sections (i.e., A and B). section A of the questionnaire gathered general information (background disciplines of the respondents, years of working experience, type of organisation, role/position in the organisation, awareness of IT tools used for quality control within construction organisations, and usage of IT tools in delivering projects within their organisations) about the respondents. Section B of the questionnaire had eighteen (18) barriers hindering the implementation of IT within Nigerian construction organisations which were identified from the literature. Respondents were asked to indicate the extent to which each of these variables influence the implementation of information technology (IT) for quality control in Nigerian construction organisations.

Using five-point Likert scale (1-5) based on the level of impact. Where 1 = NO Influence, 2 = LOW Influence, 3 = MODERATE Influence, 4 = HIGH Influence, and 5 = EXTREME Influence. Frequencies, percentages, mean scores, standard deviation and ANOVA were the tools utilised for this study using SPSS version 23.

Results and Discussion

This section presented the results based on the objectives set out for the study. Table 2 shows the general background information about the respondents\. It highlights information regarding respondents' professions, years of working experience, role/position in the organisation, awareness of IT tools used for quality control within construction organisations, and usage of IT tools in delivering projects within their organisations, and frequency of usage.

Table 2: Demographic information of respondents

Variables	Frequency	Percentage (%)
Respondent's Profession		
Quantity surveyor	32	49.2
Architect	13	20
Project manager	8	12.3
Construction manager	5	7.7
Engineer	5	7.7
Quality control officer	2	3.1
IT manager	0	0
Total	65	100
Range of Working Experience		
1-5 years	3	4.6
6-10 years	27	41.5
11-15 years	18	27.7
16-20 years	15	23.1
20 years and above	2	3.1
Total	65	100
Role/Position in The Organisation		
Top-level management	39	60
Lower-level management	26	40
Total	65	100
Awareness of IT tools used for quality control in construction projects		
YES	61	93.8
NO	4	6.2
Total	65	100
Usage of IT tools for quality control in delivering construction projects		
YES	57	87.7

NO	8	12.3
Total	65	100
Frequency of usage		
Never	3	4.6
Rarely	14	21.5
Occasionally	33	50.8
Frequently	12	18.5
Always	3	4.6
Total	65	100

From the result in Table 3, most of the barriers are shown to significantly influence the implementation of IT for quality control within Nigerian construction organisations with all mean scores above 3.00 except for one with a mean score of 2.89. Also, about four of the assessed variables have a mean score of above 3.50 which can be approximated to scale 4.00 which means that these barriers HIGHLY influence the implementation of IT for quality control. While the remaining fourteen can be approximated to scale 3.00 which means that these barriers MODERATELY influence the implementation of IT for quality control. On a general note, this means that none of the factors presented on the above table are said to have insignificant influence on the implementation of IT for quality control within Nigerian construction organisations. However, Limited technical expertise, reliable internet connectivity, and resistance to change from the traditional method to IT based systems were found to be the most influential barriers to the implementation of IT within the Nigerian construction organisations with mean scores and standard deviation of 3.85, 0.870; 3.72, 1.083; and 3.58, 0.827 respectively.

The result further revealed that Regulatory or compliance issues related to IT Implementation, Limited availability of advanced IT tools, and lack of control over automated systems were found to be the least crucial barriers influencing the implementation of IT within the Nigerian construction organisations with mean scores and standard deviation of 3.09, 0.805; 3.02, 0.820; and 2.89, 0.793 respectively.

The study identifies resistance to change (M = 3.58) and limited technical expertise (M = 3.85) as major barriers to IT implementation for quality control. This aligns with findings from Bamgbose *et al*. (2024) and Moshood *et al.* (2020), who highlight that many construction professionals in Nigeria lack sufficient IT training and prefer traditional methods. Oke *et al.* (2019) similarly noted that older construction managers often resist IT adoption due to a lack of familiarity. Furthermore, study ranked unreliable internet connectivity as a key barrier (M = 3.72), which is consistent with previous studies (Yap *et al*., 2022; Moshood *et al*., 2020). Poor internet infrastructure in developing regions has been cited as a major limitation to digital transformation, particularly in Nigeria and other Sub-Saharan African countries.

While financial constraints were not explicitly ranked as a top barrier to implementing IT for quality control in this study, several prior studies (Bamgbose *et al*., 2024; Ozorhon *et al*., 2010) emphasise that the *high cost of IT infrastructure* is a primary obstacle to adoption. The difference may stem from the nature of the surveyed organisations if larger firms were included, financial constraints might not be perceived as strongly as in studies focusing on SMEs. The study also finds that regulatory or compliance issues have the least influence (M = 3.09), whereas prior research (Oke *et al.*, 2019; Yap *et al*, 2022) suggests that unclear IT regulations and the absence of industry-wide BIM standards significantly hinder IT adoption. The difference could be due to variations in research scope this study focuses on IT for quality control, while previous studies examined BIM implementation as a whole, which may have wider regulatory considerations.

In addition, the study reports limited availability of advanced *IT tools* as a minor barrier (M = 3.02), but existing literature suggests otherwise. Moshood *et al*. (2020) argue that inadequate access to modern IT tools (e.g., BIM software, automated quality control systems) is a major limiting factor in construction IT adoption. The discrepancy may be because larger construction firms, which have better access to technology, were more represented in your study. The study finds lack of control over automated systems as the least influential barrier (M = 2.89), which aligns with previous findings (Bamgbose *et al*., 2024). Unlike financial and expertise-related barriers, concerns over automation tend to be secondary in IT adoption discussion.

Table 3: Barriers to Implementing IT for Quality Control

Barriers	Level of influence			
	Mean	Std. Deviation	Rank	Remark
Limited technical expertise or skills among staffs for utilising IT solutions	3.85	0.87	1	High Influence
Lack of reliable internet connectivity or infrastructure in some areas	3.72	1.083	2	High Influence
Resistance to change from traditional/manual process to IT-based systems	3.58	0.827	3	High Influence
Concerns about cybersecurity and privacy when adopting IT solutions	3.57	1.045	4	High Influence
Lack of government support, policies and initiatives	3.45	0.936	5	Moderate Influence
Initial high cost of IT solutions	3.45	0.902	6	Moderate Influence
Disruption of existing workflow and process	3.37	0.762	7	Moderate Influence
Limited awareness of IT benefits for quality control	3.32	1.077	8	Moderate Influence
Higher digital equipment requirements	3.28	0.893	9	Moderate Influence
Lack of awareness about available IT solutions for quality control	3.28	0.801	10	Moderate Influence
Insufficient financial resources to invest in IT infrastructures and software	3.25	0.902	11	Moderate Influence
Organisation and process changes"	3.25	0.884	12	Moderate Influence
Uncertainty on cost and return on investment concerns	3.25	0.708	13	Moderate Influence
Limited access to IT tools used for quality control	3.20	0.851	14	Moderate Influence
Lack of standards in software	3.09	0.879	15	Moderate Influence
Regulatory or compliance issues related to IT Implementation	3.09	0.805	16	Moderate Influence
Limited availability of advanced IT tools"	3.02	0.82	17	Moderate Influence
Lack of control over automated IT systems"	2.89	0.793	18	Moderate Influence

The ANOVA (Analysis of Variance) test was conducted to determine whether there are significant differences in the mean scores of the barriers affecting IT implementation for quality control among different groups.

Table 4 shows between-groups sum of squares (3.831) indicates the variation in mean scores across different groups. The F-value of 2.842 suggests that there are some differences between the groups, and the p-value (Sig. = 0.019) is less than 0.05, meaning the difference is statistically significant. This implies that at least one of the groups has a significantly different mean compared to the others. The linear term tests whether there is a significant linear trend in the data. The F-value of 9.648 and the very low p-value (0.002) indicate a strong linear relationship, meaning that as one factor increases (e.g., barrier severity), there is a consistent trend in the response.

The deviation from linearity tests whether the relationship follows a perfectly linear trend or if there are significant deviations. Since the p-value (0.342) is greater than 0.05, we fail to reject the null hypothesis, meaning there is no significant deviation from a linear trend. This suggests that the trend is mostly linear. The within-groups sum of squares (27.501) represents the variation within each group. The mean square of 0.270 is relatively small, suggesting low within-group variability compared to between-group variability.

Table 4: Analysis of Variance (ANOVA) for Respondents' Profession

			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		3.831	5	0.766	2.842	0.019
	Linear Term	Contrast	2.601	1	2.601	9.648	0.002
		Deviation	1.23	4	0.307	1.4	0.342
Within Groups			27.501	102	0.27		
Total			31.332	107			

The Post-Hoc Test (Least Significant Difference, LSD) examines pairwise comparisons to determine which specific groups have significant differences in their mean responses regarding the barriers to IT implementation for quality control.

Table 5 presented the post hoc analysis using the Least Significant Difference (LSD) test. The largest mean difference (-0.62056, p = 0.001) occurs between Architects and Quality Control Officers, indicating that Architects perceive fewer IT barriers. This could be because Architects may have more exposure to IT tools (e.g., BIM software) in design phases compared to those overseeing quality control in construction projects. Both Quantity Surveyors (p = 0.010) and Engineers (p = 0.014) reported significantly lower barrier perceptions than Quality Control Officers. This may indicate that their IT adoption challenges are less severe, possibly because their tasks involve fewer real-time quality control requirements. The p-value (0.049) for Project Managers vs. Quality Control Officers suggests that while Project Managers also perceive fewer barriers, the difference is only marginally significant. This implies that Project Managers may still encounter considerable IT implementation challenges, likely due to their role in overseeing the entire project lifecycle.

Table 5: Post Hoc Tests

Respondents			Mean Difference	Std. Error	Sig.
LSD	Architects	Quality control officers	-0.62056	0.17308	0.001
	Quantity Surveyors	Quality control officers	-0.45556	0.17308	0.010
	Project managers	Quality control officers	-0.34444	0.17308	0.049
	Engineers	Quality control officers	-0.43333	0.17308	0.014

Conclusion

This study assessed the barriers to implementing information technology for quality control within Nigerian construction organisations. Eighteen (18) barriers to implementation of IT within Nigerian construction organisations were identified from the literature and all were proven to significantly influence the implementation of IT for quality control within Nigerian construction organisations. The study concludes that the most critical barriers to implementing IT for quality control are limited technical expertise and resistance to change. While on the other hand, regulatory and compliance issues, limited availability of advanced IT tools, and lack of control over automated systems were the least influential barriers.

Overall, this study confirms that no assessed barrier was found to be insignificant in influencing IT implementation for quality control in the Nigerian construction organisations. This reinforces the need for strategic interventions to enhance IT adoption in the Nigerian construction sector. These interventions should prioritise improving technical training, digital infrastructure, and change management strategies to reduce resistance to IT-based quality control systems.

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