Assessing Barriers to ICT Adoption Among Building Contractors in Kaduna State

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Information and communication Technology (ICT) nowadays have great impact on the construction industry and the way it works. The technology is viewed as crucial for effective and successful project delivery in construction organisations and the industry as a whole. ICT usage in most construction firms have often been described as relatively limited and ineffective compared to other sectors in most economies. The study brings to fore, the need for adequate adoption of ICT in building construction practice in Kaduna State, this research focuses on reasons hindering ICT usage by building contractors in Kaduna State. A survey based on structured questionnaire was used to elicit the relevant data from 45 contractors based on purposive sampling. While thirty-two (32) respondents completed the questionnaire and valid for use. The data was analysed using frequency analysis, mean score. The findings suggested that budget constraints for ICT investments form the financial sub- group, lack of commitment by firm's management towards ICT form the human sub-group and lack of training and technical support for construction professionals in ICT form the technical sub- group with mean scores of 3.61, 3.53 and 3.49 respectively were the top most critical factors hindering use of ICT by building contractors in Kaduna State. The study has shown that there is a need for contractors' financial support for ICT investments, construction client interest in contractors' ICT capacity, improved training and management for ICT and improved ICT content in construction education at all levels to address ICT adoption barriers in building contractor firms in Kaduna and construction industry as a whole**.**

Keywords: Building Contractors, ICT adoption, ICT adoption barriers, Kaduna State

Introduction

The importance of Information and Communication Technology (ICT) in construction cannot be overemphasized due to the great benefits it offers. These benefits include increased productivity of employees, reduced errors/mistakes in contract documents, time-saving, enhanced marketability and competitiveness and ease of doing complex tasks among others (Anene *et al*., 2024; Egege *et al*., 2018). According to UNESCO Institute of Statistics (UIS) (2023), ICT is defined as a set of technological tools and resources used to transmit, store, create, share or exchange information. It includes areas such as; software development, mobile devices, cloud computing, data centres, cyber security, research networks, support and so on. Recently, ICT is responsible for the entire construction process from information being generated, transmitted and interpreted to enabling the project to be built, maintained, reused and eventually recycled (Al Soufi, 2018). The everyday life of individuals is increasingly relevant of information technology and communication. This has totally transformed individuals and organizations to its wide spread use.

In the construction industry (CI), the use of ICT, also referred to as information technology (IT), is becoming essential in fields of engineering, construction planning, cost control and financial planning and computer-aided facilities management among others (Moshood *et al*., 2020; Ugochukwu *et al*., 2022; Ikediashi *et al*., 2016). Ugochukwu *et al*. (2022) mentioned that ICT deals with digitalization, offering a variety of opportunities for more productive and efficient project implementation by stakeholders within the sector.

Contractors can use ICTs as an enabler for integration, collaboration, knowledge management, procurement, site management and process improvement (Sarshar & Isikdag, 2018). However, despite the apparent advantages' ICTs offer, construction firms in general are slow to exploit their potential benefits (Egbu & Botterill, 2017). Anumba and Ruikar (2020) recounted that the traditional information and communication flow within the construction industry are mostly characterized by manual and slow processes. The building construction industry invests little in ICTs compared with the other sectors such as financial services and manufacturing (Construction Industry Board, 2020). Furthermore, the current use of ICTs in contractor construction firms continues to be 'piecemeal' due to the barriers militating against its adoption and that only few contractors are only fully able to integrate ICTs with their business processes (Anene *et al*., 2024; Mark, 2017).

Adoption of ICT in the Construction Industry

Appropriate adoption of information technologies is a key focus area that must be addressed by the construction industry. The uniqueness of the construction industry poses challenges to the adoption of automation and ICT technologies. In the face of these challenges however, there are several factors indicating that the nature of the construction industry is changing (Toyin *et al*., 2024). These factors include: An extensive lack of skilled workers and a growing average age of the staff, an inability to attract and retain talented, educated personnel, increased industry competition, a need for works in dangerous and inaccessible areas of operation, increased requirements on the quality of the work execution and an

increase in performance and reduction in costs is required to maintain a competitive advantage (Perkinson & Ahmad, 2016).

According to Perkinson (2016), a construction contractor can increase his competitive advantage by integrating the automation and ICT technologies thereby creating a total jobsite management tool capable of analysing the construction project in the areas of: project performance control, materials/ equipment management, and human resource management. Furthermore, some notable potential advantages of integrating automation and ICT for use as a total jobsite management tool may include: real-time monitoring and documenting of construction operations, reduced paperwork, improved project management capabilities in terms of tracking people, equipment, and assets, early detection and fast response time to problems, standardization of data collection and management, more accurate performance data which can be used for planning of future projects, creation of a history or baseline for dispute resolution, and reduced contractor reporting requirements because the owner/engineer can continuously observe what is happening onsite (Perkinson, 2016)

Barriers to the Adoption of ICT in Construction

According Gyampoh-Vidogah *et al.* (2013), most problems with information management in companies are due to the slow and cumbersome and numerous information management processes, the lack of a policy on information management in companies, cultural issues are barriers to the adoption of ICT. Usman and Said (2024) and Waziri *et al*. (2017) asserted that one of the reasons for the difficulty of implementing ICT is the misalignment of current organizational structures and cultures with ICT models for integrated and collaborative work environments. This is because, the construction industry is largely decentralized and composed of separate organizations, which must participate together on a project by project basis. The multi-participant, multi-organizational framework is a significant barrier to implementing ICT in the industry (Young & Davis, 2011). According to the Roadcon Project (2013), different barriers have in the past restrained the take up and advanced use of different ICT tools and that, these barriers need to be overcome for the industry to progress further in the exploitation of ICTs to support its business activities. To this effect, some of the notable barriers such as lack of a coherent ICT strategy, Low ICT competencies and lack of resources especially in SMEs, reactive approach to ICT investment, differing demands from customers for systems and functionalities, switching costs related to replacing old systems with new integrated solutions (Chandani *et al*., 2025).

Furthermore, some studies have also identified various factors that explain the reluctance of the construction industry to adopt and use ICTs (Rivard, 2016). According to Turk (2020), technical and financial factors best characterize the overall attitude of construction firms towards ICTs. (Rauch *et al*., 2019) observed that apart from technical and financial problems (e.g. continuous demand for upgrading and high investment costs); environmental, cultural and psychological factors are increasingly receiving attention as barriers to the many widespread adoption of ICTs.

The fact that construction professionals are often satisfied with their traditional business methods and tools is a common barrier (Doherty, 2010; Samuelson, 2013). Thirdly, there is no single magic ICT solution for the whole construction market. The type of the ICT solution required by construction firms is likely to depend on the context of the work done (Egbu & Botterill, 2017). Concerning the last argument, Samuelson (2012) argued that the lack of effective applications for the core businesses of contractors might be one explanation for the low use of ICTs by contractors, when compared with other parties in the construction industry. Similarly, e-business Watch Report (2015) on the construction industry stated that implementation of ICT collaborative systems is hampered by a number of barriers such as: legal and contractual issues regarding for example data ownership and copyright holders, the legal validity of contracts, and digital signatures, oral culture and traditions where information is typically shared face-to-face, lack of shared standards for information exchange and lack of financial resources, ICT competencies, and knowledge about the cost and financial benefits of ICT investments (Onyejeakor et al.,2024)

Sadiq *et al*. (2022) grouped barriers in three (3), technological, organizational and environmental related barriers. Giotopoulos *et al*. (2017) studied organizational barriers and Moshood *et al*. (2020) categorized ICT barriers into three (3), social, economic and environmental barriers. Turk (2023) categorized ICT barriers into six (6) major groups with sub- factors. These include: environmental with factors such as global worming awareness, scarcity of row material, pollution and carbon foot print. Technological with factors such as technological innovations and how it affects business aspect: operation and industry, legal with factors such as law and regulations**.** Economic with factors such as economic efficiencies, cost savings and cost reduction among others. Political with factors such as policies and social with factors such as human and industry social tensions: norms, customs and values. Zhang and Li (2017) and Zeng *et al*. (2017) categorized ICT barriers into three (3) organizational structures, individual behaviours and the technical requirements of data in the industry as some of the barriers that hinder the flow of information among the participants in a construction project. These barriers are further classified as financial barriers which are lack of finance, high cost of ICT investments, maintenance cost, budget constraints. Organizational barriers which are lack of business incentives, poor ICT strategies, lack of training, lack of appropriate ICT support. People barriers which are lack of personal incentives, lack of education/training/continuous professional development, cultural issues, reluctance to changes in business processes. On the other hand, the importance given to ICT training, re-design of current processes and support from software vendors appeared as the most critical factors for successfully implementing ICT (Isikdag *et al*., 2017). Technological barriers which are difficulties in using new technologies, lack of support from ICT providers (or ICT department), incompatibility/interoperability problems, lack of (use of) standards, inefficient use of software, ill-

defined processes and infrastructure related problems. Legal barriers which are risks for liability, lack of legal support for use of ICT, security of ICT transactions, other issues for electronic information and documentation (Onyejeakor *et al*., 2024)

Although different barriers are identified by literature, this study recast and focused on only twenty-The barriers are summarised in Table 1.

Table 1: Barriers to the Adoption of ICT in Construction

Factors	Sub- Factor's description	Source
Financial	Budget constraints for ICT investment	e- business Watch Report (2015); Adenuga (2010); Rasaq (2019); Andipakula (2019); Sekou (2012); Ofide *et al*. (2015); Belonwu (2022); Onyejeakor *et al*. (2024)
	Cost of implementing ICT	e- business Watch Report (2015); Rivard (2016); Sepasgozer and David (2018); Rasaq (2019); Anene *et al*. (2024); Turk (2020); Belonwu (2022)
	Perceived limited benefits/low return an investment in ICT	Rasaq (2019); Belonwu (2022); Onyejeakor *et al*. (2024)
Human	Perceived limited benefits/low return an investment in ICT	Rasaq (2019); Belonwu (2022); Onyejeakor *et al*. (2024)
	High cost of employing ICT professionals	Belonwu (2022)
	Inadequate ICT content of construction education	Belonwu (2022); Vasista *et al*. (2018)
	Lack of commitment by firms' management towards ICT	Roadcon Project (2013); Perkinson and Ahmad (2016); Sekou (2012); Andipakula,I (2019)
Technical	Rapid changes in ICT technologies	Rivard (2016): Roadcon project (2013); Rasaq (2019) Akande *et al*. (2018); Belonwu 2022, Ozum and Shakunu 2018, Usman *et al*. (2019); Zhang and Li (2017); Zeng *et al*. (2017)
	Problem of ICT integration / compatibility in the organization	Gyampoh-Vidogah *et al.* (2013) P;erkinson and Ahmad (2016); Owolabi and Ojebabi 2017,
	Software and hardware reliability problems	Usman et al. (2018); Anene et al. (2024)
	Lack of training and technical support for ICT professional	Rivard (2016); Toyin *et al*. (2014) Perkinson and Ahmad (2016); Sekou (2012); Turk (2020); Rasaq (2019); Belonwu (2022); Andipakula (20190; Okafor (2018)
	High rate of obsolescence of ICT products in the market	Roadcon project (2013); Rasaq (2019); Turk (2023)
	Access to relatively cheap work	Usman *et al*. (2019); e-business Watch Report (2015)
Environmental	Majority of clients not interested in firm's ICT base	Usman *et al*. (2019); Sadiq *et al*. (2022)
	Highly dispersed natured of the industry/projects and participants	Young and Davis (2011); Gyampoh-Vidogah et al. (2013) Belonwu (2022); Eze *et al*. (2019); Moshood *et al*. (2020)
	Resistance/mistrust in ICT technology	
	Security implications of ICT transaction	Amusan *et al*. (2018); Zachiang (2017), Anene *et al*. (2024); Waziri *et al*. (2017); Onyejeakor *et al.* (2024)

Research Methodology

The study used a purposive sampling technique of 45 building construction contractors that have their headquarters situated within Kaduna metropolis in 2024 were targeted. This is because information available at the Ministry of Public Works and Infrastructure (MOPWI) Kaduna revealed that these firms are active building contractors' firms carrying out public construction activities within the geographic scope of the study.

Primary data were collected through structured questionnaires, which were administered to construction professionals in contractors' firm in Kaduna. the questionnaire was employed to establish the perception of the respondents on the factor (Financial, Human, Technical , Environmental major and sub-factors) that best describe reasons hindering the use of ICT in your organization on a 5 point Likert scale 1=Very Weak; 2=Weak;3=Average;4=Strong;5=Very Strong) (Ugochukwu *et al*., 2022). The data collected were analysed using descriptive statistical methods. The results were presented in tables, bar charts and pie charts (Egbu & Botterill, 2017; McCaffer & Edum-Fotwe, 2001).

Results and Discussion

All the companies (100%) surveyed indicated that they use computers to aid their operations. As much as 82.35% of the firms indicated they have access to computers and actually use them both at their offices and project sites, while 17.65% indicated access and usage at their offices only. Again, the data analysis revealed that varied

professional backgrounds in the contractor organisations were represented in the survey.

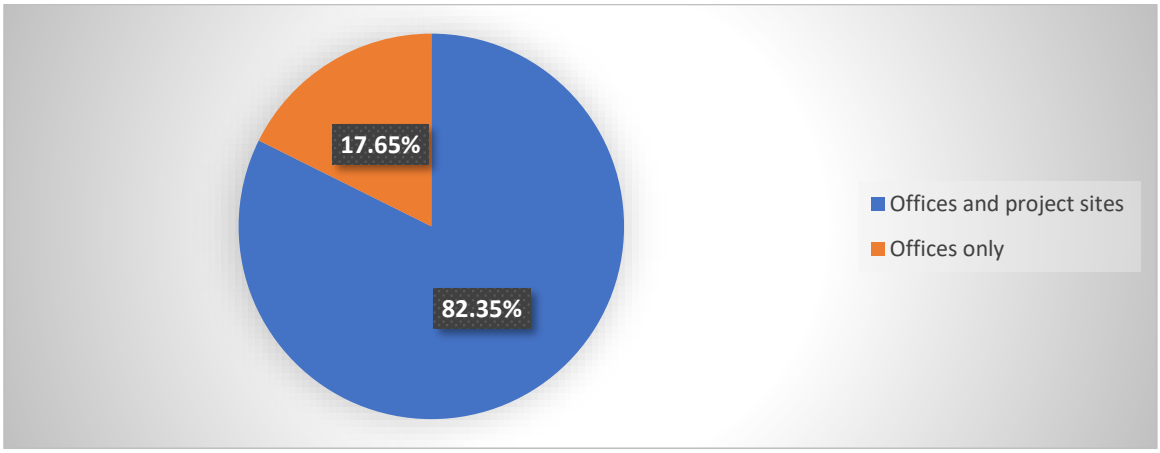

Figure 1: Access and use of computer

Figure 2 presented the background of the respondents, which comprised 2 Managing Directors (6.25%), 6 Project Managers (18.75%), 7 Quantity Surveyors (18.75%), 7 Engineers (21.88%), 8 Architects (25%) and 2 IT Managers (9.38%). The high representation of engineers, quantity surveyors and architects were inevitable as these are the very key professionals usually engaged by contractor organizations in Kaduna State.

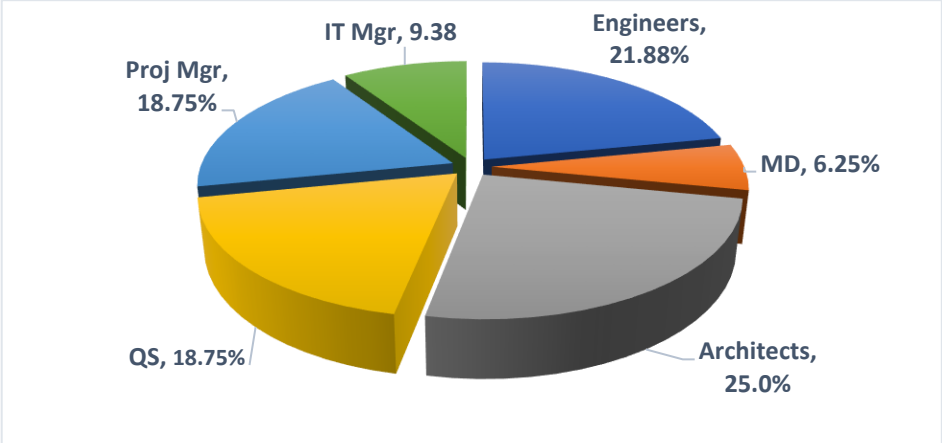

Figure 2: Respondents' Profession

On the issue of respondents' viewpoint on the extent of current usage of ICT in their firms, Table 2 shows a high percentage (64.71%) of respondents believe their current ICT usage is average while 31.37% consider their ICT usage as low. Only 3.92% thought they are using ICT to a high extent in their company. Given the perception of the respondents, there is some level of recognition that their current ICT usage appears ordinary suggesting some aspects for improvements.

Table 2: Respondents' views on the extent of ICT Usage in their Firms

	No of Respondents	High	Medium	Low	Total
Contractors	32	3.92%	64.71%	31.37%	100%

Barriers hindering the use of ICT in contractors' organisations

From Table 3, it was observed that three of the financial factors are most important reasons hindering ICT usage by contractors and have mean scores above 3.00. Budget constraints for ICT investment with a mean score of 3.61 ranked 1st; cost of implementing ICT ranked 2nd; high cost of employing ICT professionals ranked 3rd and perceived limited benefits/low return an investment in ICT ranked least with mean score of 2.82.

Table 3: Financial factor assessment

Financial factor	Mean	Std. Deviation	Std. Error Mean	Rank
Budget constraints for ICT investment	3.61	1.22	0.17	1
Cost of implementing ICT	3.14	1.20	0.17	2
Perceived limited benefits/low return an investment in ICT	2.82	1.29	0.18	4
High cost of employing ICT professionals	3.06	1.39	0.19	3

The results in Table 4 indicated that three out of the six human factors are most important reasons hindering ICT usage by contractors and have mean scores above 3.00. These factors are: Lack of commitment by firms' management towards ICT ranked 1st; Inadequate ICT content of construction education ranked 2nd and Inadequate knowledge about ICT return on investment ranked 3rd. While three out of the six human factors below 3.00 are: Lack of staff with appropriate skill and knowledge in ICT ranked 4th; Fear of job losses making professionals redundant ranked 5th and Satisfaction with exiting method of working ranked 6th.

Table 4: Human factor assessment

Human factor	Mean	Std. Deviation	Std. Error Mean	Rank
Inadequate ICT content of construction education	3.33	1.34	0.19	2
Lack of commitment by firms' management towards ICT	3.53	1.35	0.19	1
Inadequate knowledge about returns on ICT	3.18	1.21	0.17	3
Lack of staff with appropriate skill and knowledge in ICT	2.86	1.31	0.18	4
Fear of job losses making professionals redundant	2.76	1.32	0.18	5
Satisfaction with exiting method of working	2.66	1.18	0.16	6

Table 5 revealed that two out of the six technical factors are most important reasons hindering ICT usage by contractors and have mean scores above 3. 00. These factors include: Lack of training and technical support for ICT professional 1st and Rapid changes in ICT technologies ranked 2nd. While four out of the six technical factors below 3. 00 are: Problem of ICT integration / compatibility in the organization ranked 3rd; Access to relatively cheap work 4th; High rate of obsolescence of ICT products in the market ranked 5th and Software and hardware reliability problems ranked 6th.

Table 5: Technical factor assessment

Technical factor	Mean	Std. Deviation	Std. Error Mean	Rank
Rapid changes in ICT technologies	3.16	1.39	0.19	2
Problem of ICT integration / compatibility in the organization	2.71	1.18	0.17	3
Software and hardware reliability problems	2.33	0.99	0.14	6
Lack of training and technical support for ICT professional	3.49	1.22	0.17	1
High rate of obsolescence of ICT products in the market	2.39	1.06	0.15	5
Access to relatively cheap work	2.57	0.98	0.14	4

From Table 6, it can be seen as depicted that one out of the five environmental factors is the most important reason hindering ICT usage by contractors with mean score above 3.00. The factor is Lack of training and technical support for ICT professional ranked 1st. While four out of the five environmental factors below 3.00 include: Highly dispersed natured of the industry/projects and participants ranked 2nd; Lack of legal support for use of ICT ranked 3rd; Security implications of ICT transaction 4th and Resistance/mistrust in ICT technology ranked 5th.

Table 6: Environmental factor assessment

Environmental factor	Mean	Std. Deviation	Std. Error Mean	Rank
Majority of clients not interested in firm's ICT base	3.33	1.48	0.21	1
Highly dispersed natured of the industry/projects and participants	2.75	1.28	0.18	2
Resistance/mistrust in ICT technology	2.18	0.97	0.13	5
Lack of legal support for use of ICT	2.29	0.99	0.14	3
Security implications of ICT transaction	2.24	0.92	0.13	4

Based on the findings, there is a need for a proper understanding of the four main and the twenty-one sub-factors hindering the use of ICT by contractors in building construction. This will encourage and aid contractors' organisations and the construction industry in general, to use ICT in any building construction projects scenario.

The survey indicates that, 9 out of 21 sub-factors obtained from literature as hindrances on the use of ICT were identified as important. These include: Budget constraints for ICT investments (Mean= 3.61), lack of commitment by firm's management towards ICT (Mean= 3.53), lack of training and technical support for professionals in ICT (Mean= 3.49), inadequate ICT content of construction education (Mean=3.33), Majority of clients not interested in firms' ICT base (Mean= 3.33), Inadequate knowledge about return on ICT investment (Mean= 3.18), rapid changes in ICT technologies (Mean= 3.16), cost of implementing ICT in firms (Mean= 3.14) and high cost of employing ICT professionals (Mean= 3.06).

Furthermore, almost all the variables had standard deviation values of more than 1.0. This provides the indication that the respondents had different interpretations for the factors. Nevertheless, five (5) of the factors had their standard deviation values less than 1.0, suggesting some level of agreement among respondents in how those factors were interpreted.

Conclusion

The study concluded that, the five most significant factors hindering the use of ICT by building contractors in Kaduna were budget constraints for ICT investments, lack of commitment by firm's management towards ICT, lack of training and technical support for construction professionals in ICT, inadequate ICT content of construction education and the fact that majority of client not interested in firm's ICT base. It is therefore plausible to acknowledge that, whilst the posture and interest towards ICT by building contractors in Nigeria seems promising, these factors continue to be a major issue that stakeholders and individual organisations need to address in order to increase usage and derive the full benefit of ICT. From the findings of this study, the following recommendations are hereby made:

Financial support for ICT investment in building firms is necessary to provide some proportion of their internal budget for ICT investments. This will aim to improve both productivity and profitability for their benefits. Adequate ICT training and technical support for professionals in building construction firms be vigorously promoted by contractors, other stakeholders such as various professional bodies and associations of the industry in Kaduna. This should be able to provide the necessary awareness and build capacity to meet future challenges in this marketplace. Clients' interest in contractors' ICT capacity, this could be used as a criterion for selection, tendering on-line, scheduling tools, cost control systems and communication systems, to promote the use of ICT technological capabilities in the building firms. Increase and robust ICT content in construction education at all levels by recognizing the importance of ICT education in construction courses at all levels to facilitate the necessary change and innovation in various fields of construction study in general.

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