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The Application of Information and Communication Technology in the Construction Industry

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ABSTRACT

Many literatures abound on the implementation of IT, both within the construction industry and other sectors of a nation's economy. This paper is aimed at assessing the use of ICT in the construction industry, with a view to establishing the extent of utilization. Data collected was analyzed with Relative Importance Index (RII). The study revealed the construction industry have greatly embraced ICT tools in carrying out different tasks in all stages of construction work,including designs, estimating, data sharing, remote monitoring and reporting. Thebenefits derived from the use of ICT includes increased work output, accurate documentation, real time monitoring amongst other benefits. Value of the project, cost of deploying ICT tools and complexity of the construction industry were identified as the factors affecting the use of ICT in the construction industry. The study concluded that many construction firms are construction firms are embracing ICT in their practices due to its perceived benefits in project management and execution and recommended outline budget for ICT and staff training in relevant ICT tools and packages relevant to the construction industry to enable them keep abreast with new and improved construction techniques for efficient productivity within the industry.

Keywords; Construction, Technology, Communication, Projects.

1. INTRODUCTION

Recent development in the construction industry shows the importance of information technology (IT) in solving immediate communication hitches between parties to construction project which also enables fast and flexible working relationship through electronic and virtual communication tools. The construction industry is faced with the problems of evolving and improving obtainable current practices in order to meet the clients growing and competitive demand through the integration of Information and Communication Technology (ICT) into the workforce as a part of the construction process (Weipert et. al, 2003).

The effectiveness of information technology lies in its ability to support the entire construction process from inception to completion and through its operation management. This requires the use of ICT base tools and technology for specific construction task to create, communicate and exchange information within the construction team.

The integration of communication and technical decision support system which comprises communication and computer aided applications has improved advancement in accurate information sharing and collaboration of project team in real time information flow.

However the Nigerian construction industry is yet to fully embrace Information and Communication Technology tools within its domain which is evident in manual sharing of data such as drawing s and physical site meetings and documentations which can be efficiently carried out with relevant ICT tools.

Evidence abound on the impact of ICT not only in construction but also in globalization generally. All spheres of man's endeavors have successfully hinged on the internet cum ICT which enables the sharing and exchange of information and data thereby increasing the competence of professionals within theconstruction industry.

The nature of the construction industry is complex and multi-disciplinary, consisting of several professionals with specialized areas and duties such as Architects, Quantity Surveyors, Clients, Contractors, Subcontractors, Engineers Builders etc and so needs a collaborative communication structure for the project teams to ensure effective project delivery, this paper seeks to assess the need and effectiveness of ICT in construction project management and delivery.

2. LITERATURE REVIEW

2.1 The prospect of ICT in the built industry

The extensive prospects of ICT in the built industry is overwhelming, with the development of complex and intensive projects and development with the need for automated system and remote monitoring.

The emergence of technology in todays is increasingly essentially with every industry adopting suitable innovations/transformation to improve profitability, efficiency and competitiveness. The construction industry is not left out in this massive technology transformation which has given rise to more innovative ways of achieving task rather than the traditionally/manual methods.

In recent years the construction industry is gradually embracing technology which has paved way to some recorded progress within the sector. The integration of new technology has improved the ease in which tasks are performed within the construction industry, the use of computers for designs, data sharing, robotic manpower which has enabled construction industries achieve efficiency, productivity in complex projects

2.1Information and communication technology and the construction industry

Information technology is an applied science and paraphernalia , that enables the retrieval, storing, transfer and manipulation of data.

Information and communication technology is a specific application of information technology with the integration of communication features and ability.

In the construction industry, information and communication technology play a significant role in construction project development processes through project design, construction and maintenance processes

The use of information and communication technology (ICT) has become a widely use concept both in construction and other sectors of a nations economy, such as business entities, banking, retailing and other enterprises, this is because of its efficiency and effectiveness in operations (Aghimien el al, 2018).

The need for construction industry to meet with the clients expectations, new and improved technologies and competition has led to the integration of Information and communication technology (ICT) tools in the construction process to meet with the growing demand and rolling out solutionsacross the construction industry to the stakeholders irrespective of the geographical location. The successful execution of construction project is often influenced by the quality of information and communication tools and innovation available for use by the stakeholders, the quality of the resources person available to manage the ICT tools and the cost of its application to successfully carry out the project (Aghimien et al, 2018; Alreshidi et al, 2017)

The exchange of information and communication within the construction industry manually has become obsolete with the rapid emergence of a more versatile and unique innovation such as digital data collection tools ,data sharing software, Building Information Model (BIM), and Mobile Computing Devices (MCD) which has bridged the communication gap within the construction industry.

Onyegiri et al (2011) in their study stated, the use of ICT base tools such as Revit, AutoCAD, Planswift facilitates cost estimation, scheduling, sequencing, integration of subcontractors and supplier models, system coordination, layout and field work, fabrication, operation and maintenance, this conforms with (Staub-Fisccher and Fischer 2017; Stephen and Thomas, 2008) assertion on using ICT digitalized tools exposes clashes in design and facilitates outline of schedules in construction process, thereby minimizing the occurrences of rework and change order and ensure effective cost control of the entire construction process.

The administrative challenges encountered by construction firms and industry such as time to prepare their documents, nature and complexity of their operation has led to the integration of innovative communication tools into their daily administrative routine for sending and retrieving information through computers and internet connections, these tools includes emailing systems, electronic document and management system and project planning systems has provided the firm innovative ways of impacting their management process and ensure accuracy, transparency and ease of sharing dataand collaboration amongst the stakeholders irrespective of geographical location to ensure a sustainable system administration (Mohamed wahaj et al 2017).

New innovative communication tools have been introduced into the construction firms for sending and retrieving information through computers and internet connections. These tools include emailing systems, electronic document and management system and project planning systems.

However the emergence of the Covid-19 pandemic with its safety measures stressed the need to incorporate information and communication technology paraphernalia into the construction process, for management, communication and monitoring process. The use of Drones and Unmanned Aerial Vehicle (UAV) which has the potential to monitor job progress in restricted or hazardous work site without requiring the presence of human in the site, the use of these information technology tools is possible because of its high maneuverability to obstacles, high speed, safer and accurate data collection, efficiency in accurate data generalization for aerial monitoring and inspection (Dupont et al2017)

The need for the project team to make data driven decision to maintain a competitive edge and profitability requires prompt access to data and information with the use of digital data collection techniques such as cloud computing, integrated software platforms and mobile application to enable them assemble, analyze and share quality data faster with other team members from the jobsite to the administrative unit for instant reporting and real time collaboration, enhanced workflow, time saving, reduced data entry errors, improved safety, collaborative team interaction

Several studies have been conducted in area of information and Communication Technology (ICT) and digitalization of construction process, Hashim et al (2013) in their study, identified benefits of utilizing digital technology in procuring construction projects as Improved quality, cost savings, clients and stakeholders satisfaction, increased productivity, market expansion amongst other benefits.

Many advantages abound in utilizing ICT base in the construction industry such as preparation of progress report, project drawing, estimating purposes and technical calculations, project cost control and calculation through the integration of ICT base tools in both design, tender and construction phases of the project(Lekan et al 2018; Gopalakrishnan et al, 2017)

3. RESEARCH METHODOLOGY

For the purpose of the study, the data collection instrument was a structured questionnaire distributed to construction professionals in five states of South East Geopolitical zone, comprising ofArchitects, Engineers, Quantity Surveyors, and Project Managers with a minimum of seven years' experience within the construction industry.

The questionnaire was designed using 5-point likert scale of 1-5 and was distributed through electronic means to the respondents,

A total of 468 questionnaires were distributed to the respondents, out of which 407 usable and effective questionnaire was retrieved and used for analysis which represents 86 %

Data collected was analyzed using Relative Importance Index (RII) to rank the adoption of ICT tools in construction stages, the level of utilization of ICT in the activities performed within the construction firms, benefits of ICT and factors militating the use of ICT within the construction industry.The reliability of the research instrument was done using crombach Alpha and value obtained was greater than 0.7. This suggests that the instrument was appropriate and authentic.

4. DATA ANALYSIS AND DISCUSSION

Table 1. The use of ICT tools in construction stages.

S/no	Construction phases	**RII**	**RANK**
1	Design Phase	3.984	1st
2	procurement Phase	3.721	2nd
3	Maintenance Phase	1.744	4th
4	Construction Phase	2.550	3rd
5	Operation Phase	1.342	5th

Source: Field Survey, 2022

The use of ICT tools in different construction phases within the construction industry is presented in Table 1. The analysis therein shows construction stages where ICT is significantly utilized as Design stages with RII of 3.984, procurement stage (3.721), construction stage (2.550), this is followed by maintenance phase (1.744) and Operation phase (RII= 1.342), the findings in this study conforms with Woksepp et al (2006) Onyegiri et al (2011) and Staub-Fisccher and Fischer (2017), the implication is that the design stage is the most significant stage in which ICT base tools is utilized within the construction industry.

Table 2. Level of usage of ICT tools in firms activities

S/no	Firm activities	**RII**	**RANK**
1	Remote monitoring	0.967	3rd
2	Project drawings	0.984	1st
3	Estimating	0.968	2nd
4	Project cost control	0.813	7th
5	Communication/Reporting	0.906	4th
6	Costing and budgeting	0.845	6th
7	Scheduling and works planning	0.867	5th
8	Purchases and invoicing	0.675	10th
9	Financial management	0.772	9th
10	Data management	0.775	8th

Source: Field Survey, 2022

Table 2 summarizes the view of the respondents on the level of utilization of ICT in the construction firms activities, all the listed variables are considered to be relevant. The most significant as perceived by the respondents are, Project drawing is ranked 1st with RII of 0.984, this is followed by estimating (0.968), remote monitoring (0.967), communication/reporting (0.906) Schedule and work planning (0.867), costing and budgeting(0.845), Project cost control (0.813), data management (0.775), financial management (0.772) and lastly purchasing and invoicing (0.675). The findings from the above study collaborates with (Lekan et al 2018; Gopalakrishnan et al, 2017)

Table 3. Perceived benefits of ICT in the construction industry.

S/no	**Variables**	**RII**	**RANK**
1	Increased Performance	0.377	1st
2	Increases Productivity	0.311	5th
3	Real-time Monitoring	0.311	5th
4	Improves quality of work	0.336	4th
5	Speeds up response times	0.302	6th
6	Simpler working methods	0.299	7th
7	More accurate documentation	0.373	2nd
8	Reduces danger of physical presence on site	0.341	3rd
9	Reduces construction error	0.294	8th
10	Improves project management capabilities	0.207	9th

Source: Field Survey, 2022

Table3 Focuses on the benefits of ICT in the construction industry, this section presents several benefits ranked by the respondents, increased performance is ranked 1st with RII of 0.377, followed by More accurate documentation(0.373), reduces danger of physical presence on site (0.341), improves quality of work (0.336) real time monitoringand increased productivity with RII of 0.311 respectively, Speeds up response times(0.302), Simpler working methods(0.299), Reduces construction error(0.294), improves project management capabilities (0.207). The result of the analysis collaborated with (Ornellaet al, 2021)

Table 4. Factors affecting the Use of ICT in the Construction Industry

S/no	Variables	RII	RANK
1	Inadequate budget for ICT investment.	0.360	7th
2	Lack of knowledge on ICT implementation processes	0.378	4th
3	Technical capabilities of the parties	0.362	6th
4	Value of the project	0.398	1st
5	Cost of deploying ICT tools	0.382	2nd
6	Dearth of staff with knowledge in ICT skills	0.375	5th
7	Complexity of the construction industry	0.381	3rd

Source:Field Survey, 2022

Table 4 shows the responses of the professionals on the factors affecting the use of ICT in the construction industry. The result shows that the RII score of all the listed variables evaluated are possible challenging factors to the use of ICT in the construction industry were greater than 0.3. The study further shows that value of the project was ranked highest with RII of 0.398, followed by cost of cost ofdeploying ICT tools (0.382), complexity of the construction industry(0.381), Lack of knowledge on ICT implementation processes(0.378), Dearth of staff with knowledge in ICT skills (0.375), technical capabilities of parties (0.362) and Inadequate budget for ICT investment. (0.360). this result is in alliance with (Ayekum et al 2015, Lekan et al, 2018)

5. CONCLUSION

This study assessed the application of ICT in construction industry, adoption of ICT base tools for different construction stages, the level of its utilization, benefits and factors hindering the application of ICT in construction industry in Nigeria. A structured questionnaire was administered to the professionals in construction industry through electronic means, the data collected was analyzed using Relative Importance Index (RII).

The following conclusions were drawn from the study; The study revealed that there is a significant use of ICT and ICT tools in all phases of construction project both in design and construction process, to model and visualize the construction process and also boost communication, progress report, estimating, costing and budgeting, remote monitoring, scheduling and distribution of project documents between stakeholders for ease of communication

The study also revealed the immense benefit of utilizing ICT in the construction industry which includes increased performance, more accurate documentation, reduces danger of physical presence on restricted sites, real time monitoring and collaboration amongst the project team, increase productivity amongst other perceived benefits, the use of ICT has reduced the traditional method of manual documentation, thereby reducing the occurrences of error, rework and time taken in manual documentation, a click with the appropriate ICT tool eases the stress of manual work with efficiency and speed.

The study also shows the factors militating against the use of ICT in construction industry as value of the project, cost of deploying ICT tools and complexity of the construction industry. From this, it can be deduced that the use of ICT is capital intensive and requires a considerablefinance to deploy ICT in construction projects and firms. Accordingly many construction firms are embracing ICT in their practices due to its perceived benefits in project management and execution though challenges abound in its application due to its high cost of deployment and technical capabilities of the parties to construction project. The study recommended construction firms to invest in the procurement of appropriate ICT tools and packages with concomitant staff training programmes. These steps will position the construction firms better for efficient project delivery.

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