



ADOPTING INFORMATION AND COMMUNICATION TECHNOLOGY IN CONSTRUCTION INDUSTRY

**Amusan Lekan M, Oloniju Leke I, Akomolafe Mariam, Makinde Adebisi,
Nkolika-Peter P. Farayola Hezekiah and Faith Osawaru**

Covenant University, Department of Building Technology,
College of Science and Technology

ABSTRACT

Information communication technology has brought numerous innovative success in the construction industry and this has led to increase in productivity in construction industry. The study presented in this context is about adoption of information telecommunication technology in the construction industry using Nigeria as point of focus with a view to enhancing ICT application for better productivity. Sample size of 195 was used for the study. Finally, it is notable from the survey that the most prominent factors affecting the use of ICT in the Nigerian construction industry are as follows: budget limit for investment, inadequate knowledge about the profit of ICT investment, high cost of employing professionals, lack of staff with appropriate skill and knowledge in ICT and cost of training professionals. These factors explain that the current level of ICT usage in Nigerian construction industry. Uptake of various applications in construction operations would undoubtedly promote productivity.

Key words: Information, Telecommunication, Adoption, Investment, Barrier

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1. INTRODUCTION

In the construction industry today we believe that the use of information technology has been very helpful in solving several problems such as security problems, reduction in overall construction time and home inconvenience.

However in the Nigerian construction sector the use of information technology is scarcely practiced, construction data like drawings are still presented on papers, meetings between construction parties are still being held on site where everyone has to be present for the meeting to hold and smart houses are hardly built due to insufficient information on how to facilitate the use of information technology. Some scholars have given various definitions

based on their different perspective on the subject matter. The construction industry is said to be a very complicated and multi-dimensional [1]. This simply means that the construction industry is very extensive and complex. As a result of the complexity of the construction sector which consists of various construction agents such as contractors, architects, engineers, builders, workers, suppliers etc. a need for a collective communication structure housing these various construction agents is necessary to accomplish a successful project[2] [3] [4]. Therefore the construction industry is in the position where it needs to manage associations and consequently an amplified burden to diminish costs and increase efficiency by decreasing ineffectiveness.

The use of information technology can help in increasing the competence of construction development. In recent times information technology solutions in connection with tele fax machines are used immensely in business communications for the interchange of data like drawings, pictures, schedules, document, and other necessary information[9]. For example, advanced applications of ICT such as Modelling and Visualization Nevertheless, a number of innovations in ICT technologies have provided new chances for improving communication, collaboration and information management in construction (Stewart, technologies, Mobile Computing and internet based data interchange such as project webs, Electronic Document Management Systems, Teleconferencing and E-commerce including integrated software such as Enterprise Resource Planning (ERP) have been used to some success in many other countries[10]; [11]. While these ICT technologies may enhance data and communication in construction industry through decrease of paper document and drawings, better record organization and filing and quicker, less expensive and more precise communication streams, the rampant usage is yet to completely gain grounds in the construction industry when compared with numerous divisions of the economy [12] Disregarding this, ICT has been portrayed as a vital asset in the construction industry furthermore, contractual workers and other industry experts ought to embrace the use of ICT in the construction industry and in their various construction firms and organization (Woksepp, , Stefan Woksepp).

2. LITERATURE REVIEW

2.1. Need for ICT in the Construction Industry

Summaries from some studies like [13], [14] and[15] pointed out that, matters of time constraints, complexity and operational disintegration has forced many organizations both small and large, to incorporate Information and Communication Technologies (ICT) into their commercial procedures Obviously, the implementation of these ICT technologies in construction are aimed at supporting information sharing among individuals and groups since the construction industry of today and of the future demand the use of sustainable systems enabled by information and communication technologies [16].

The importance of ICT application can not be overemphasized, for instance, the Woksepp, , Stefan Woksepp, Thomas Olofsson. (2006 observed that, ICT-based expected improvements and impacts could be envisaged in many activity domains such as: Construction stages(planning, design, procurement and site operations); in Digital sites like introducing ICT and automation in site operations. Also, in business processes, project management, contractual and legal matters. Similarly, application of ICT could further be found in Life cycle performance of building and construction, monitoring and performance measurements; Quick, efficient and cost effective construction, Building Product customization and differentiation; Supply chain management and Costing and accounting operations.

2.2. Role of ICT in the Construction Procedure

Applications of the ICT in the construction field is presented above, the role of ICT is presented in this section. The roles of ICT as presented in this context covers the following aspects: the tender phase and design and construction phase

2.2.1. Tender Phase

The importance of ICT at this stage is basically publicizing and circulates delicate reports, select successful tenders and honor contracts. Softwares are majorly in use and utilize at this stage, Some of the advantages at this stage include: Accelerating the conveyance of documentation and tenderers' interchanges; Enroll tenderers on the web and download tenders/work bundles electronically. Also, it includes further, delivering simple environment to assess the tenderers' reactions through standard formats; unapproved access through implicit security devices and Communicate changes in the tender documents, amid the tender procedure, rapidly and easily.

2.2.2. Design and Construction Phase

Both design and creation of construction project share a requirement for quick access to data and communication progressively (Enhancing data and communication bolster for the important exercises at the design and construction arrange has turned into a vital challenge for the construction industry to build productivity and profitability in the construction procedure.

Project managers and contractual workers control and manage the trading of documents between individuals from the project team so that the general due dates of the project are met [17].

2.2.3. Drivers for ICT execution in the construction industry

As indicated by [17], ICT The need for improved profitability in construction is provoked through enhanced operational effectiveness, reduce cost and project cost. However some drivers of ICT application includes the following: The need for improved profitability; Support data combination; Enhance cooperation by supporting communication among project team members;(Support from E-commerce for broaden business or enhanced client benefit [18].

3. MATERIALS & EXPERIMENTAL PROCEDURES [AHEAD]

3.1. Analysis of Data and Implications

3.1.1. Methodology

For the purpose of this study, the data collection instrument used was coded questionnaire designed in Likert scale point 1 to 5. The questionnaire is further divided into three (3) sections. Section A contained background information of respondents as concerns, professional background, highest qualification, professional qualification, grade of membership, industry experience, size of organization, type of organization, computer literacy, years of computer literacy. Section B determining the effectiveness of ICT in specific activities in there organization, Section C determining the level of usage of following ICT tools in there company. Section D determining the factors reducing the use of ICT in the construction industry. SPSS software is used in data processing and results presented in tables.

3.1.2. Data Analysis and Presentation of Results

Table 1 Computer Usage in Firm

Parameter	Frequency	Percent
Yes	41	82.0
No	9	18.0
Total	50	100

Table 1.0 shows the usage of computers in the firm of each respondent. According to the table respondents makes use of computer in their firms, the percentage of respondents in this category is 82% of the total number of the respondents while 9 respondents indicated that they do not make use of computer in their firms, this constitutes 18% of the total number of respondents. This implies that majority of the respondent use computers in their firms which means firms of most respondents make use of ICT.

Table 2 Extent of computer usage in organization

Parameter	Frequency	Percent
low	9	18.0
medium	19	38.0
High	22	44.0
Total	50	100.0

Table 2 presents the extent to which the respondents make use of computer in their various organizations. This table explains that out of a total number of 50 respondents, 9 respondents which is 18% of the total number of respondents have low extent of computer usage in their organizations, 19 respondents which is 38% of the total number of respondents have medium extent of computer usage in their organizations while 22 respondents which is 44% of the total respondents have high extent of computer usage in their organizations. This implies that a greater percentage of respondents have high extent of computer usage in their organization.

Table 3 Determining Level of Effectiveness of ICT in the Following Activities in Your Organization

Effectiveness Parameter	RAI	Rank
Progress reports	0.872	1st
Project drawings	0.856	2nd
Estimating	0.844	3rd
Technical calculation	0.832	4th
Project cost control	0.828	5th
Communication	0.828	6th
Subcontractors and suppliers information	0.82	7th
Financial management	0.82	8th
Book keeping	0.816	9th
Scheduling and works planning	0.816	10th
Distribution of project document	0.812	11th
Costing and budgeting	0.808	12th
Site management and security	0.796	13th
Purchases and invoicing	0.792	14th
Resources management(labour, material and equipment)	0.768	15th

In the Table 3 above, effectiveness of the use of ICT is in the firms of the respondents is presented. In this section several activities was listed out for the respondent to provide response on how effective the use of ICT is in the various activities.

The ranking according to the table was arranged in descending order in which project reports was ranked first with a mean index of 0.872, project drawings was ranked second with a mean index of 0.856, estimating ranked third with a mean index of 0.844, technical calculation was ranked fourth with a mean index of 0.832, project cost control was ranked fifth with a mean index of 0.828. Also, communication ranked sixth with a mean index of also 0.828, subcontractors and suppliers information ranked seventh on the table with a mean index of 0.82, financial management ranked eighth with a mean index of 0.82, book keeping ranked ninth on the table with a mean index of 0.816, scheduling and work planning ranked tenth with a mean index of 0.816, distribution of project document ranked eleventh on the table with a mean index of 0.812, costing and budgeting ranked twelfth with a mean 0.808, site management and safety ranked thirteenth on the table with a mean index of 0.796, purchases and invoicing ranked fourteenth on the table with a mean index of 0.792, resources management (labour, material and equipment) ranked fifteenth on the table with a mean index of 0.768.

Similarly, progress report ranked the highest by construction professionals as the activity in which the use of ICT is most effective. According to the table the total number of respondents who chose very effective and effective were more than the number of respondents who chose averagely effective, slightly effective and not effective so therefore according to the objective which is to determine the level of effectiveness of ICT in the Nigerian construction industry, it has been determined that the level of effective of ICT in various activities in the construction industry is high.

Table 4 Determining the Level of Usage of the Following ICT Tools in Your Company

ICT Application	Index	Rank
Email and short message services (SMS)	0.876	1st
Mobile internet	0.856	2nd
Modelling and visualization (3D-CAD, 4D-CAD)	0.808	3rd
Electronic document management system (EDMS)	0.74	4th
Site surveillance technologies (CCTV)	0.728	5th
Video conferencing	0.712	6th
Project specific websites (Extranets)	0.692	7th
Electronic tendering	0.688	8th
Electronic purchasing	0.676	9th
Tele conferencing	0.652	10th
Radio frequency identification (RFID) and barcodes	0.596	11th

Level of usage of ICT tools in construction companies is presented in Table 4. This table is to help achieve the objective of determining the level of ICT usage in the construction industry by determining how often the respondents use the selected ICT tools on. The ranking according to the table is arranged in descending order in which email and short message services (SMS) has been ranked first with a mean index of 0.876, mobile internet is ranked second with a mean index of 0.856, modelling and visualization (3D-CAD, 4D-CAD) ranked third with a mean index of 0.808, electronic document management system. (EDMS) ranked fourth with a mean index of 0.74, site surveillance technologies (CCTV) ranked fifth with a mean index of 0.728, video conferencing ranked sixth with a mean index of 0.712, project specific websites (Extranets) ranked seventh with a mean index of 0.692, electronic tendering ranked eighth with a mean index of 0.688, electronic purchasing ranked ninth with a mean

index of 0.676, tele conferencing ranked tenth with a mean index of 0.652, radio frequency identification (RFID) and broads ranked eleventh with a mean index of 0.596.

Email and short message services (SMS) ranked the highest as the most used ICT tool in there organization while radio frequency identification and barcodes ranked the lowest as the least ICT tool used in there organization. According to the table only 3 ICT tools had above 25 respondents who chose ‘always’ that is other ICT tools are not always used in their organization which means the level of ICT usage in their various organizations and also in the Nigerian construction industry is on the average and that ICT hasn’t been fully embraced in the industry.

3.1.3. Identifying the Factors Reducing the Use of Ict in the Construction Industry

Table 5 Factors Reducing the Use of Ict in the Construction Industry

S/N	Factors	RAI	Rank
1	Budget limits for ICT investment.	0.836	1 st
2	Inadequate knowledge about the profit on ICT investment	0.788	2 nd
3	High cost of employing ICT professionals	0.766	3 rd
4	Lack of staff with appropriate skill and knowledge in ICT	0.764	4 th
5	Cost of training professionals in ICT	0.756	5 th
6	Inadequate education in ICT	0.758	6 th
7	Lack of commitment by firms management towards ICT	0.748	7 th

Table 5 focuses on determining the factor that are limiting the use of ICT in the construction industry. In this section several factors was listed out for the respondents. The ranking according to the table is arranged in descending order with budget limits for ICT investment ranked first with a mean index of 0.836, inadequate knowledge about the profit on ICT investment ranked second on the table with a mean index of 0.788, high cost of employing ICT professionals ranked third with a mean index of 0.776, lack of staff with appropriate skill and knowledge in ICT ranked fourth with a mean index of 0.764, cost of training professionals in ICT ranked fifth on the table with a mean index of 0.756, inadequate education in ICT in educational institutions ranked sixth with a mean index of 0.756, lack of commitment by firms management towards ICT ranked seventh with a mean index of 0.748, majority of clients not interested in ICT due to lack of exposure ranked eighth with a mean index of 0.74, fear of job losses/making professional out work ranked ninth with a mean index of 0.736, no access to relatively cheap workforce ranked tenth with a mean index 0.732, software and hardware reliability problems ranked eleventh on the table a mean 0.708, rapid changes in ICT ranked twelfth with a mean of 0.704, satisfaction with existing/conventional method of working ranked thirteenth on the table with a mean of 0.7, security concerns/privacy fears ranked fourteenth on the table with a mean index of 0.7, limited benefits/low return on ICT investment ranked fifteenth with a mean 0.692, some soft wares are designed to solve only foreign problems ranked sixteenth on the table with a mean index of 0.676.

So according to the survey budget limit on ICT investment ranked the highest on the table which means that the issue of limited budget is a major factor limiting the use of factor along other factors listed on the table.

4. CONCLUSIONS

The following conclusions have been drawn from this study: The study has indeed revealed that there a lot of factors militating against the use of ICT in the construction industry but the most important factors are budget limit for investment, inadequate knowledge about the profitability nature of ICT investment, high cost of employing professionals and lack of staff with appropriate skill and knowledge in ICT and cost of training professionals. This simple means that the usage of ICT is financially expensive, also there is limited knowledge about awareness of ICT in the Nigerian construction industry and due to this facts the Nigerian construction industry is suffering a very slow growth in the use of ICT. Also the study revealed that there is a significant level of campaign in the use of ICT in the Nigerian construction industry but the use of some selected ICT applications, tools and equipment like email and short messages services (SMS), mobile internet, modelling and visualization (3D-CAD, 4D-CAD), electronic document management system (EDMS) is in order. Therefore, more advanced ICT appliances like site surveillance technologies (CCTV), video conferencing, project specific websites (extranets), electronic tendering, electronic purchasing, tele conferencing and radio frequency identification (RFID) and barcodes are averagely used or rarely used. However current level of ICT usage in general appears to be slightly above average. However the effect of ICT in virtually all activities in the Nigerian construction industry is undeniably significant hence the more reason why ICT needs to be facilitated in the Nigerian construction industry.

Finally, it is notable from the survey that the most prominent factors affecting the use of ICT in the Nigerian construction industry are as follow: budget limit for investment, inadequate knowledge about the profit of ICT investment, high cost of employing professionals, lack of staff with appropriate skill and knowledge in ICT and cost of training professionals. These factors explain that the current level of ICT usage in Nigerian construction industry. It is therefore reasonable to acknowledge that whilst the effects and advantages of ICT in construction are much these factors continue to be a major issue that stakeholders and individual organizations need to address in order to increase usage and derive the full of ICT.

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REFERENCES

- [1] ÇAGLAR ÇİFTÇİ, Egbu, C.O. and Botterill, K.,. (2005). Information technologies for knowledge management: their use and effectiveness. *Electronic Journal of Information Technology in Construction (ITcon)*.
- [2] Popoola, S.I., Atayero, A.A., Badejo, J.A., Odukoya, J.A., Omole, D.O. (2017) *Learning analytics for smart campus: Data on academic performances of engineering undergraduates in Nigerian private university*. Data in Brief. 17, pp. 76-94.
- [3] Amusan Lekan Murtala, Joshua Opeyemi, Oloke Olayinka (2013). Performance of Build-Operate-Transfer Projects: Risks' Cost Implications from Professionals and Concessionaires Perspective. *European International Journal of Science and Technology* 2 (3), 239-250.
- [4] Becerik, . (2004). A review on past, present and future of web based project management & collaboration tools and their adoption by the US AEC industry. *International Journal of IT in Architecture, Engineering and Construction*, 2.

- [5] Löfgren, A. (2006). *Mobile computing and Project communication – mixing oil and water*. Licentiate thesis, Royal Institute of Technology, Stockholm.
- [6] Azeta, A.A., Iboroma, D.-O.A., Azeta, V.I., Fatinikun, D.O., Ekpunobi, E. (2017) *Implementing a medical record system with biometrics authentication in E-health*. IEEE AFRICON: Science, Technology and Innovation for Africa, AFRICON 2017 8095615, pp. 979-983
- [7] Ozumba, A. O. U., and Shakantu, W. M. W. . (2008). Improving The Site Management Process through ICT". *CIDB 2008 Post Graduate Research Conference*. Bloemfontein, South Africa.
- [8] Murray M., Nkado R. & Lai A. (2001). The integrated use of information technology in the construction industry. *Proceedings of the CIB 78 Conference: IT in Construction in Africa*, (pp. 39-1 to 39-13). Pretoria, South Africa.
- [9] Lekan M Amusan, Charles Ayo (2017) Multi-Parameter Optimization Of Cost Entropy For Reinforced Concrete Office Building Projects Using Ant Colony Optimization. *Journal of Engineering And Applied Sciences*.12(9). 2260-2275.
- [10] Vadhavkar, S; Pena-Mora, F. (2000). Geographically Distributed Team Interaction Space. *Computing in Civil & Building Engineering, Proceedings of the Eighth International Conference, ASCE*. Virginia.
- [11] Field, B and Ofori, G . (1988). Construction and Economic Development – a case study. *Third World Planning Review*, 10(1), 41-50.
- [12] Hassan, T M; McCaffer, R. (2002). Vision of the large scale engineering construction industry in Europe, *Automation in Construction*,. 11, 421-437.
- [13] Hassanain . (2000). IFC-Based Data Model for Integrated Maintenance Management. *Computing in Civil & Building Engineering. Proceedings of the Eighth International Conference*. ASCE, Virginia.
- [14] Peansupap, V. (2004). *An Exploratory Approach to the Diffusion of ICT in a Project Environment*. PhD, RMIT University, School of Property, Melbourne.
- [15] Mohammad Wahaj, Shumank Deep, Raj Bandhu Dixit and Mohd Bilal Khan , A Study of Project Success and Procurement Frameworks in Indian Construction Industry . *International Journal of Civil Engineering and Technology* , 8(3), 2017, pp. 167–174
- [16] G. Gopalakrishnan and Dr. G. Brindha, A Study on Employee Welfare in Construction Industry, *International Journal of Civil Engineering and Technology*, 8(10), 2017, pp. 07–12.
- [17] G. Gopalakrishnan and Dr. G. Brindha, A Study on Maternity Benefit and its Effectiveness in Construction Industry . *International Journal of Civil Engineering and Technology*, 8(10), 2017, pp. 130 – 136 .
- [18] Dr. Vinod N Sambrani, A Study of Information and Communication Technology (ICT) Adoption by SHG's in Banking Activities - Dhawad District. *International Journal of Management* , 7(6), 2016, pp. 145–155.
- [19] X. Mercy Angeline, Impact of Information and Communication Technology on Information Needs and Information Seeking Behavior of Users of Arts and Science College Libraries In Trichy District: A Study. *International Journal of Library & Information Science* , 6(6), 2017, pp. 75–81.
- [20] B.Mahadevan and Dr.K.Vijayakumar. A Study on the Use of Information and Communication Technology (Ict) Tools In Pharmacy College Libraries of Tamilnadu and Puducherry. *International Journal of Library & Information Science* , 1(1), 2012, pp. 81–88.
- [21] Ahood m.a. Al-sawaha, mansour e. Abou gamila and khalid a. Bubshait. Assessing The Effect of Information and Communication Technology on Enhancing Higher Education Systems in the Kingdom of Saudi Arabia. *International Journal of Advanced Research in Engineering and Technology (IJARET)*, 4(4), 2013, pp. 134–149.