



Adoption, Implementation Information and Communication Technology Platform Application in the Built Environment Professional Practice

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Abstract. The impact of ICT on professional practice has been mainly in making jobs easier for the professions, facilitating decision-making and savings in operating costs, among others. The inefficient national electric power supply system and the high cost of computer hardware and software in relation to the dwindling fortunes of the professions in Nigeria's depressed economy are the key obstacles to increased investments in ICT. The aim of this study is to understand the extent of ICT applications by professionals in built environment related vocations, with a view to improving the level of ICT application and adoption in Nigeria. A sample size of 82 respondents were used in this study, with questionnaires distributed to construction professionals. Three methods of data analysis were employed for this research. The study assessed the level of ICT application by professionals in built environment related vocations, with a view to improving the level of ICT application in Nigeria via a questionnaire survey with its respondents comprising of Architects, Builders, Engineers, Surveyors, and Quantity Surveyors. It examined the current status of ICT use in the built environment. The study discovered that the most commonly used softwares are; Microsoft Excel (100.0%), Microsoft Word (98.8%) and Microsoft PowerPoint (93.8%). Whereas, AutoCAD is the most popular at 87.7% for Architectural/ Engineering design and drawing, QSCAD (21.0%) for quantity surveying, BIM 360 at 32.1% for project management and Co-Construct at 19.8% for Building Management. The top three benefits of ICT as perceived by the respondents include time saving, makes job easier, and enhances productivity. Three major challenges faced were erratic power supply, high cost of purchasing ICT related softwares and/ or hardwares, job size and fees. The study recommend the following based on research results; the government should enable provision of steady power supply, as well as each organization to also provide back up options for power in case of power failure.

Keywords: Integration · Adoption · Information · Construction

1 Introduction

Information and Communication Technology can be broadly defined as any technology that provides an enabling environment for physical infrastructure and services development of applications for generation, transmission, and processing, storing and disseminating of information in all forms. The sustainability of both the high economic growth and efficiency in operations of both the private and public institutions, are dependent on the use and effective utilization of ICT and its various tools. Information is a stimulus that has meaning in some context for its receiver while communication is a process whereby information is enclosed in a package and is discrete and transferred by a sender to a receiver through a channel or medium. Communication entails that all parties involved have an area of communicative similarities. Information and Communication Technology entails any product that will store, retrieve, manipulate, transmit or receive information electronically. Literally every construction project involves; the clients, consultants, contractors, local authority; residents; workers and suppliers, who all have differing interests in the project which demands heavy exchange of data and information [1].

Therefore, the built environment is one of the most information-intensive environments, and requires close coordination of a large number of specialized interdependent organizations/individuals to achieve cost, time and quality goals of a project [1, 2].

2 Research Design and the Study Population

Research is defined as structured inquiry that utilizes acceptable scientific methodology to solve problem and creates new knowledge that is generally applicable. This study was designed to study integration of information and communication technology application in the built environment professional practices in Lagos State. In this regard, it will be a survey research because questionnaires will be used as tool to collect data for the purpose of answering the postulated research questions. The study, Integrating of ICT Application in the Built Environment Professional Practice in Lagos State will involve major stakeholders/practitioners in the construction industry within Lagos State Nigeria. They are Contractors, Quantity Surveyors, Surveyors, Architects, Engineers and Builders within the study area [2, 3].

3 Research Design and the Study Population

Samples are normally used in response to time and financial constraint. The adequacy of a sample is assessed by how it represents the whole population of participants from which the sample is to be drawn. The total population for this study will include all registered Quantity Surveyors, Architects, Surveyors, Builders as at December/January 2018/19 in Lagos State as obtained from respective institution/ professional bodie. The sample size in respect of this study, include categories of respondent as shown from the following formula as used by [4, 5] study as cited in [6]. To be able to rank the factors identified by the respondents to impact the various aspects of the study, it will be necessary to highlight the relative importance of the factors [7]. Due to certain challenges

faced in obtaining accurate and reliable data on the population of built environment professionals within the specified class, a total sample size of 100 was adopted and used for the study [8]. This can also be carried out using purposive sampling method. Where total respondents can be taken at random. Again, a sample size of 100 agrees with Kish, (1965) formula. Using Formula: $n = n1 / (1 + n1 / N)$ [7] where n = Sample size $n1 = S2 / V2$. N = Population size, V = Standard error of sampling distribution = 0.05 $S2 = P(1-P) = (0.5) (0.5) = 0.25$, P = the proportion of standard deviation in the population element (total error = 0.1 at 95% confidence level). Based on the above parameters, a sample size of 100 is also adequate for larger. Populations because as the population size (P) increases, the sample (n) size approaches one hundred (100). Research is defined as structured inquiry that utilizes acceptable scientific methodology to solve problem and creates new knowledge that is generally applicable. This study was to study integrating of information and communication technology application in the built environment professional practices in Lagos State. In this regard, it will be a survey research because questionnaires will be used as tool to collect data for the purpose of answering the postulated research questions. The study, Integrating of ICT Application in the Built Environment Professional Practice in Lagos State will involve major stakeholders/practitioners in the construction industry within Lagos State Nigeria. They are Contractors, Quantity Surveyors, Surveyors, Architects, Engineers and Builders within the study area.

4 Data Collection Instrument, Data Presentation and Discussion

Data for the study was generated through an opinion - based questionnaire survey. This approach was used in this study due to the surveying nature of the research. The questionnaire was structured in a way that the respondents are expected to choose from the options provided. The questionnaire is aimed to reflect the main area of interest to the researcher and thus providing relevant information to the research questions which brought about the objectives.

From the Table 1 above, gotten through field survey, it can be deduced that the use of ICT tools is wildly accepted by clients, with it ranking first on the index ranking. It means the clients have encouraged building environment professionals to use these tools as they find it effective and easier to understand. Secondly, professionals in the industry have taken the use of these ICT tools on board, as they find it effective in carrying out their various activities related to their various professions. Also, it can be said that the professionals find it very easy to use, with that ranking third on the index rankings. Which has in turn improved productivity and work effectiveness. With acceptance by management coming 4th on the index rankings, it can be said that those in authority are starting to get on board with the use of ICT tools in carrying out various construction related activities. It can also be said that government policies been implemented are not best suited to the use of ICT tools in the built environment. Also, professionals find these tools hard to access, which can be due to scarcity in some of these tools, or their expensive cost, limiting their use of them, and with it been last on the list, professionals agree that these tools are very hard to procure due to their cost, with these ICT tools not coming at a cheap price. For the hardware been used, it can be said that all professions

Table 1. Evaluation of extent to which ICT applications are been deployed in construction operations by built environment professionals

Status	Index	Rank
Section A		
Accepted by The Client	0.4123	1 st
Accepted by Professionals	0.4370	2 nd
Easily Usable	0.4444	3 rd
Accepted by Management	0.4716	4 th
Hindered by Government Policies	0.5284	5 th
Easily Accessible	0.5457	6 th
Aided by Government Policies	0.5728	7 th
Cheap to Procure	0.6099	8 th
SECTION B		
Laptops	0.3358	1 st
Printers	0.3630	2 nd
Desktops	0.3753	3 rd
Projectors	0.3852	4 th
Scanner	0.3951	5 th
Notebooks	0.5605	6 th
Fax Machine	0.5654	7 th
Mainframe	0.6247	8 th

Source: Field Survey (2019)

happen moving along with the times, with majority of them citing laptops as their major tool of work, followed by the use of printers to create hard copies of their work. The mainframe is a type of old age computer, which is basically more or less out of use in the present times, and can be at testified to with it coming last in the ranking for hardware tools been used by the professionals in the built environment [2, 4, 5, 7] and [9] (Table 3).

This section ranks the factors that influence the implementation of ICT in the built environment by professionals. The Table 2 shows the ranking of these factors. The results obtained showed that Technical Know How was the most relatable factor, as it ranked 1st on the index ranking, meaning that professionals consider their ability to be able to operate these ICT tools as very important in their use of it. Also, Management Preference ranked 2nd, meaning that the choice of the employers decides what ICT tools can be used, and when these ICT tools can be used. The availability of these tools is also considered a huge factor in the application of ICT tools in the built environment, which can be if these tools are cheap to procure or readily available to procure for use. The type of profession also serves as a factor for the use of these ICT tools, with some professions feeling they need less of these tools to carry out their work as they feel it makes less to no difference

Table 2. Evaluation of factors that influence the implementation of ICT by professionals

Factors	Index	Rank
Technical Know How	0.3778	1 st
Management Influence	0.4049	2 nd
Availability of Tools	0.4148	3 rd
Profession	0.4222	4 th
Ease of Use	0.4247	5 th
Job Size	0.4346	6 th
Client Preference	0.4420	7 th
Changing Trends in Technology	0.4469	8 th
Technical Certifications	0.4469	9 th
Construction Industry Demands	0.4519	10 th
Government Policies	0.4790	11 th
Lack Awareness	0.4840	12 th
Language Barrier	0.5753	13 th
Virus Attack	0.5852	14 th

Source: Field Survey (2019)

on their, while some see it as a more effective means to carrying out their activities in their own profession. Ease of use rounds off the top 5 most important factors considered by professionals in the application of ICT tools in the built environment. They consider this to be important, so that they don't spend of their work period figuring out how to use these tools, instead of actually using it. The least ranked factors included Virus Attack, with professionals not finding it as an important factor in using these tools, can be due to the ease at which these virus attacks can either be prevented or removed. Language Barrier is also ranked low among the factors considered in the use of these tools, due to these tools been available in an understandable language for the professionals. To round up the least three considered factors is lack of awareness, indicating that professionals are well aware of these tools that can be applied to their various professions.

Based on survey, most professionals (93% upwards) who were involved in the research, agreed to using presentation software, whereas, software made for Designing, Project management, building management, and Quantity Surveying professions, are in use by an average of 25%. Building management softwares are tools used mainly by builders and management to help plan and coordinate their various activities as related to the built environment. Project management softwares are tools used to help coordinate various project works in the built environment. Quantity Surveyors softwares are tools used to help quantity surveyors in their taking off for quantities and calculation of prices of materials. Design softwares, are tools used to make designs in different aspects of construction, from site plans, to design of buildings, structures, electrical grids, pipelines

Table 3. Evaluation of uniqueness in ICT tools used by different professions in the built environment

S/N	Softwares	% Of Users
Building Management		
	Coconstruct	19.8
	Procore	16.0
	Buildertrend	18.5
	Plangrid	14.8
	Buildtools	17.3
	E-Builder	16.0
	Eclipse	12.3
Project Management		
	Bim 360	32.1
	Bim Track	18.5
	Stack	12.3
	Sage 300 Construction	11.1
	Oracle Primavera	19.8
	Quantity Surveying	
	Workmate	16.0
	Qscad	21.0
	On-Screen Takeoff And Quick Bid	14.8
	Qsplus	18.5
Design		
	Electrical Bid Manager	16.0
	Matlab	13.6
	Catia	12.3
	Cogo	9.9
	Geniebelt	9.9
	Xcircuit	16.0
	Staad	21.0
	Archdesk	33.3
	Revit	53.1
	Autocad	87.7
	Lumion	34.6
Presentation		

(continued)

Table 3. (continued)

S/N	Softwares	% Of Users
	Microsoft Power Point	98.8
	Microsoft Excel	100.0
	Microsoft Word	93.8

Source: Field Survey (2019)

among others. Presentation softwares, are tools used to give a more comprehensive representation of data and information garnered from other tools used or through general knowledge [9, 10].

Table 4. Evaluation of challenges and opportunities relevant to ICT tools deployment by professionals

Challenges	Index	Rank
Erratic Power Supply	0.3778	1 st
High Cost Of Hardware/Software	0.3951	2 nd
Job Fees	0.4370	3 rd
Job Sizes	0.4395	4 th
Inadequate ICT Content In Construction Education	0.4790	5 th
Scarcity Of Professional Software	0.5111	6 th
Lack Of Management Desire	0.5111	7 th
Security	0.5235	8 th
Low Return On Investment	0.5235	9 th
Personnel Abuse	0.5556	10 th
Makes Professionals Redundant	0.5778	11 th

This section evaluates the challenges and opportunities relevant in deployment of ICT tools in the Built Environment Professions by professionals. Table 4 shows the ranking of the challenges faced. Erratic Power Supply is ranked as the most relevant challenge that faces the deployment of ICT tools in the built environment, with virtually all the tools been power intensify, and the erratic power situation in the country having an effect on its deployment. The High Cost of Hardware/ Software serves as a stumbling block in the deployment of these ICT tools, with them not been cheap to procure. Job Fees and Sizes also serves as an important challenge, with the job fees been paid not worth the cost and hassle of using these tools, or the job size been too small to consider using ICT tools to carry them out. Inadequate ICT Content in Construction Education also serves as a challenge, with most professions not been exposed to the various tools available for use in the built environment at an early age. However, Table 5 shows the

Table 5. The challenges and opportunities relevant in deployment of ICT tools in the built environment professions by professionals

Opportunities	Index	Rank
Time Efficiency	0.3259	1 st
Increased Productivity	0.3358	2 nd
Ease Of Work	0.3506	3 rd
Reduction In Errors	0.3827	4 th
Competitive Advantage	0.4049	5 th
Cost Reduction	0.4222	6 th

Source: Field Survey (2019)

ranking of the opportunities relevant in ICT tools deployment in the Built Environment Professions by professionals. The Table 5 shows that these tools tend to be time efficient, meaning less time is spent in carrying out their respective tasks while using them, as compared to the excess time spent when they're not in use. Increased productivity is also seen as a big opportunity that can be derived from the use of these ICT tools, with more work covered at a relative shorter period. It can also be said that the works become relatively easier to carry out thanks to the deployment of these ICT tools [7, 8] and [11].

Table 6. Evaluation of professionals' opinions on effectiveness of ICT tools deployment in built environment professions.

Opinion	Index	Rank
Saves Time	0.2889	1 st
Makes Job Easier	0.3111	2 nd
Enhances Productivity	0.3333	3 rd
Improves Document Presentation	0.3432	4 th
Increases Speed of Work	0.3531	5 th
Reduces Difficulty of Work	0.3556	6 th
Reduces Construction Error	0.3778	7 th
Gives Competitive Advantage	0.3975	8 th
Facilitates Decision	0.4099	9 th
Reduces Operational Cost	0.4296	10 th

Source: Field Survey (2019)

From these Table 6, it shows that the Professionals believe ICT tools to be effective in saving time in carrying out and completing of their various tasks. Its also seen to make the job easier to carry out, with less difficulties encountered due to the use of these ICT tools. Enhancement of productivity rounds off the top 3, with ICT tools

believed to help increase productivity of work been done overtime. It can also be said that the deployment of ICT tools has no effect on operational cost with it been bottom of the survey with an index score of 0.4296, Though few still consider it to help in the facilitation of decision making in their own field of operations. Whereas some agree it gives no competitive advantage which can be as a result of majority of professionals already using the same tools, making it an even playing field for all. The study assessed the level of ICT application by professionals in built environment related vocations, with a view to improving the level of ICT application in Nigeria via a questionnaire survey with its respondents comprising of Architects, Builders, Engineers, Surveyors, and Quantity Surveyors. It examined the current status of ICT use in the built environment. While also discovering that the most commonly used softwares are; i. Microsoft Excel (100.0%), ii. Microsoft Word (98.8%) and iii. Microsoft PowerPoint (93.8%). Whereas, i. AutoCAD is the most popular at 87.7% for Architectural/ Engineering design and drawing, ii. QSCAD (21.0%) for quantity surveying, iii. BIM 360 at 32.1% for project management and iv. CoConstruct at 19.8% for Building Management. The top three benefits of ICT as perceived by the respondents were i. Saves Time, ii. Makes Job Easier, and iii. Enhances Productivity. Three major challenges faced are: i. Erratic Power Supply, ii. High Cost of Purchasing ICT Related Softwares and/Or Hardwares, iii. Job Size and Fees [12, 13] and [14, 15].

5 Recommendations

On erratic power supply, the government should enable to provide steady power supply, as well as each organization should also provide back up options for power in case of power failure. The cost of procuring this hardwares and softwares should be made relatively cheaper, and affordable. Job sizes and fees also should be of equal proportion to encourage the use of ICT related tools to improve and enhance the built environment operations. Also, professionals should take more advantage of the various available ICT tools to carry out their operations.

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