



## ICT applications adoption by Indigenous building contracting firms in Bauchi metropolis

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### Abstract

*Despite the advantages of ICT systems, indigenous building contracting firms are still reluctant to forgo their paper-based system for ICT systems. This study assesses ICT application adoption among indigenous building contracting firms in Bauchi metropolis. One hundred and fifty questionnaires were distributed to construction professionals working with building contracting firms within Bauchi metropolis through a stratified random sampling technique. The survey records about 82% useful response rate. Descriptive statistics was used to analyze the data. Findings revealed that the firms' ICT facilities application and adoption are moderate. Their ICT applications usages are for communication, administration, marketing, and advanced application. Mobile phones, email, and the internet are ICT for communications with high usage. Word processing and spreadsheet applications, which are ICT facilities for administration recorded high usage. Design software usage is high as against other ICT marketing applications with moderate usage. In contrast, all advanced ICT applications usage is moderate. The firms adopt ICT in 14 areas with high adoption in 6 areas: office administration, pricing of a bill of quantities, communication with the project team, marketing for services, advertisement for services, and design automation. Whereas moderately adopts ICT in price estimation, tendering for contracts, purchasing of goods and services, cost management, human resource management, tracking of projects, project collaboration, and meeting with the project team. It implies that indigenous building contracting firms in Nigeria are yet to fully enjoy the speed and precision offered by ICT applications. Hence, recommended that firms should apply electronic data management, intranet/extranet, voice mail, video conferencing, and webcam for their business communication and highly used ICT in marketing and advanced application. Moreover, they should completely adopt ICT facilities in price estimation, tendering for contracts, purchasing of goods and services, cost management, human resource management, tracking of projects, project collaboration, and meetings with the project team*

**Keywords:** *ICT applications & adoption, Indigenous Building Contracting Firms, Nigerian construction industry.*

### 1. Introduction

Information and communication technology (ICT) acceptance in construction is viewed as a device for the acknowledgment of a viable and manageable construction sector (Yunis *et al.* 2018). ICT acceptance, along these lines, can be characterize as a precise and efficient use of innovation and innovation related thoughts in to an organization which might be for the design of goods and services beneficial to the organization (Waziri *et al.*, 2015). In addition, the construction process demands the exchange of data and information among project participants daily (Narayan & Tan, 2019). And the development of construction projects incorporates several stages, during which a large number of human resources of different specialties interact and cooperate. (Egbu & Botterill, 2002). Besides, present day basic plan programming applications, for example, 3D displaying and Building Information Modeling (BIM), give a model where planning complex structures and sorting out the electrical, mechanical, site, auxiliary and measuring of an undertaking can be accomplished in least time and increment the effectiveness across the board information system, though in the past this was practically inconceivable (Hamma-Adama, *et al.*, 2018). Hence, the adoption of ICT by the Nigerian indigenous contractors is perceived as a significant factor that improves their project management performance and encourages achievement of construction best practices (Datti *et al.*, 2019). This call for the construction industry to have a standard move from traditionally paper-based to digitally based data exchange



which different enterprises, for example, airplane, manufacturing and banking have embraced and advantage sometime in the past (Oladapo, 2006). However, according to Mutesi (2014), the appropriation of ICTs in contracting firms keeps on being 'piecemeal' and that, lone scarcely any contractors are completely ready to incorporate ICTs with their core business. Oyewobi (2015), also observed that a considerable lot of the contracting firms in the Nigerian construction industry are as yet left behind in the appropriation of ICT contrasted and their partners in other developing nations in spite of the globalization in innovative headway. Failure of the Nigerian indigenous construction firms to adopt ICT despite its obvious advantages cannot be explained until a comprehensive study is carried out to ascertain the current level of adoption as well as examine the major areas in which firms utilize ICT. This study assesses ICT adoption among indigenous building contracting firms in Bauchi metropolis to enhance efficient project delivery. To attain the aim, this study outlined the following objectives: to evaluate the ICT applications usage by the indigenous building contracting firms in Bauchi metropolis, and to assess areas of ICT adoption by indigenous building contracting firms in the study area.

## 2 Literature Review

### 2.1 Nigerian Construction Industry

In Nigeria, construction industry was the predominant supporter of the country's GDP during the 1980s, representing about 70% of the GDP (Planning Committee on the National Construction Policy, 1989). This made the business vital to Nigeria's improvement efforts. Sadly, be that as it may, business has been bothered by a mix of low interest and reliable low efficiency and horrible showing throughout the (Adeyemi *et al.*, 2005; Oladapo, 2006). This has diminished its commitment to the national economy to an insignificant 1% of the GDP in 2002 (Inuwa, 2014). It then becomes pertinent to the indigenous contracting firms to up their game by embracing innovative project management approach through ICT adoption for them to be able to contribute meaningfully to the nation's economy.

### 2.2 Construction Contracting Firms

Construction contracting in developing countries arose as a business during pioneer rule and not long after World War II colonial rule and shortly after World War II (Laryea & Mensah, 2010; Inuwa 2014). Contractors are the owners of contracting business, and their statutory business registration can either be sole proprietorship, partnership, or corporation (Harris & McCaffer, 2005). The primary responsibility of a contracting firm is to ensure that all resources used in discharging construction contracting business are optimally managed for the effective delivery of a project and for obtaining maximum profit for their investors (Inuwa, 2014).

### 2.3 ICT in the Construction Industry

ICTs are embedded in systems and services that influence the progression of information which may cover web access arrangements, media communications and broadcasting, libraries and documentation focuses, business data suppliers, network-based data administrations and other related data and communication exercises. Throughout the decades, the traditional methods for communication, for instance, face-to-face meetings and exchange of paper document in type of specialized drawings, particulars and site instruction have controlled the utilization of ICTs in the construction industry. As of late, the move from customary paper-based to computerized based data has extraordinarily upgraded the sending of ICT in development ventures, specifications, and site instructions, which have controlled the utilization of ICTs in the construction industry. In recent times, the shift from traditional paper-based to computerized based data has great specialization, cost demands, and technical complexity, which require adequate information and communication exchange to achieve results (Lofgren, 2012). The mutual nature of construction activities necessitates the enhanced deployment of ICT in construction projects. This information exchange can be accomplished through specification of the resulting product, which is regarded as design information, and control of activities required for constructing the facility known as management information (Rivard *et al.*, 2004). ). The headways in ICTs have recorded huge effect in the strategies for training of all development exercises including procurement, schedule, tendering, and other on-site activities. Various ICT-based strategies have been created to encourage best execution in construction.



## 2.4 ICT Tools and Applications in the Construction Sector

According to Dubem (2014), some of the important ICT tools and applications being used by the construction sector should support the entire construction procedure initiation through to the operational support of the structure resource. This include utilizing ICT devices and innovation to make, impart and trade data and information among the different members in the project team. Generally, the use of ICT on a construction project can be classified into communication systems and technical decision support systems (Adriaanse *et al.*, 2010). Grise and Zuniga, (2013) reported that the communication field includes all the common means of communication, which are now computerized, while the technical decision support domain consist of other computer uses other than for communications drawing. The following are the key ICT tools and applications for the construction sector: electronic communication and data exchange systems in construction, project extranets or project-specific web sites, internet and electronic mails, teleconferencing, intranet & electronic data interchange administration, business and information management systems, computer-aided estimating systems, site management tools, planning, scheduling systems & mobile computing.

## 3. Methodology

A quantitative technique was embraced as a research design in both data collection and analysis stages. A structured questionnaire was used as the primary instrument for data collection. Internal consistency test through Cronbach's Alpha was utilized to test the internal consistency (reliability) of the questionnaire. It records Cronbach's alpha values of 0.833 and 0.865 for the two constructs (usage & adoption), which reveals a highly reliable questionnaire. Subsequently, 40 seasoned construction academics were used to pilot test it for comprehensibility and error free. One hundred and eighty three core construction procurement professionals working with Indigenous Building Contracting Firms in Bauchi metropolis structure the populace for this research. These professionals included: architects, builders, civil engineers, and quantity surveyors. These samples were drawn from the indigenous Building Contracting Firms that are registered in the Due Process Office of Bauchi State Government, Nigeria. A sample size of 118 was arrived at in similarity with the dependable guideline for a sample size of the population of 183, according to Krejcie and Morgan's (1970) table for determining sample size. The sample size was rounded up to 150 to take care of inadequate questionnaire responses. The questionnaires were distributed using a stratified random sampling technique because of the population stratified nature. Subsequently, descriptive statistics was used to analyze the questionnaire responses. SPSS version 22 was used as the tool in conducting the analyses.

## 4. Results

One hundred and twenty-nine (129) questionnaires were returned out of the 150 appropriated. This represents an almost 86% response rate. However, only 123 were used in the analyses after removing incomplete ones and data screening for outliers. The overall response rate after data screening was 82%. The analysis was carried out using frequency to identify missing data and wrong postings, which were treated by reviewing the particular questionnaire to correct the wrong posting, and the data mean method in SPSS was used to fill in the missing values.

### 4.1 Respondents Demographic Information

Table 1 shows the demographic information of the respondents. The frequency and percentage of analyses carried out were presented to explore the respondents' profile. Table 1 shows that most of the respondents were male (87%), and only 13% were female. This confirms that the construction industry is male-dominated. In terms of academic qualification, most of the respondents holds bachelors' degree (49.6%) followed by master's degree holders with 17.9%, then the Higher National Diploma (16.3%). Those with Ph.D. represent a mere 2.4% of the respondents, while National Diploma holders and others with Post Graduate Diploma are 13.0% and 0.8%, respectively. The percentage of professionals with years of experience from 6—10 years is 36.6%, followed by 11-15years having 34.1%. Those with less than 5years of experience are 23.6%. Then 16 years and above are having 5.7%. The result shows that the industry is male-dominated and that most of the respondents are educated enough for a study of this nature.



The classification of the respondents according to the professional affiliation indicated 31.4% are architects, 25.2% are quantity surveyors, and 25.2% are builders, while civil engineers represent only 15.4%. This shows that the group of respondents are core procurement professionals engaged in the contracting business.

Table1: Demographic characteristics of the respondent

| S/N | Code          | Attributes              | Frequency | Percentage |
|-----|---------------|-------------------------|-----------|------------|
| 1   | Gender        | Male                    | 107       | 87         |
|     |               | Female                  | 16        | 13         |
| 2   | Qualification | National Diploma (ND)   | 16        | 13.0       |
|     |               | Higher National Diploma | 20        | 16.3       |
|     |               | Degree (B.Tech/B.sc)    | 61        | 49.6       |
|     |               | Master's Degree         | 22        | 17.9       |
|     |               | Doctor of philosophy    | 3         | 2.4        |
|     |               | PGD                     | 1         | 0.8        |
| 3   | Experience    | Less than 5 years       | 29        | 23.6       |
|     |               | 6-10 years              | 45        | 36.6       |
|     |               | 11-15 years             | 42        | 34.1       |
|     |               | 16 years & above        | 7         | 5.7        |
| 4   | Profession    | Architect               | 42        | 34.1       |
|     |               | Quantity surveyor       | 31        | 25.2       |
|     |               | Builder                 | 31        | 25.2       |
|     |               | Civil engineer          | 19        | 15.4       |

#### 4.2 Major ICT Applications Usage by Indigenous Building Contracting Firms in Bauchi Metropolis

Table 2 shows the result of data analysis on the major ICT application used by indigenous building contracting firms in Bauchi metropolis. A 5-point Likert scale used throughout the study with different constructs having similar or different scale descriptors. However, the difference in descriptors, the construct has a uniform mean ranking scale. As needs be, the positions were numbered between level one (1), which was the most reduced level to level five (5), which was the most significant level. This study adopted the mean score decision interval based on the works of Ramli *et al.* (2017) from which the following interval decisions were deduced. 1-1.80-(Very low), 1.81-2.60- (Low), 2.61-3.40 (Moderate). 3.41-4.20 (High), and 4.21-5.0 (Very high). The SD ranges from 1.008 to 1.354, implying that there is agreement among the respondents' responses.

Table 2 shows the major ICT application used among indigenous building contracting firms in Bauchi metropolis. It shows ICT application for communication that has high usage are: mobile phones, Email, and the Internet. Electronic data management and Intranet/Extranet records moderate usage. In contrast, the low ICT application usages for communication are video conferencing and webcam. The ICT application for administration with high usages are word processing and spreadsheet applications. Design software (CAD) has a high usage for marketing.

In contrast, project management software, company website, online marketing of products to clients, and online archive photograph for completed projects are moderately used for marketing. The Advanced ICT applications for cost estimating software, electronic data interchange, supply chain management, and enterprise resource planning are all moderately used. The SD of the responses is 1.008 to 1.354. This shows that there is agreement among the respondents.

#### 4.3 Major Areas of ICT Adoption by Indigenous Building Contracting Firms in Bauchi Metropolis

Table 3 shows the major areas of ICT adoption by Indigenous Building contracting firms in Bauchi metropolis. Office administration, pricing of bills of quantities, communication with the project team, marketing for services, the advertisement for services, and design automation are ranked as high areas of ICT adoption by indigenous building contracting firms in Bauchi metropolis. While price estimation and tendering



for contracts, purchasing of goods and services, cost management, human resource management, tracking of projects, project collaboration, and meeting with project team are the areas with moderate ICT adoption by indigenous building contracting firms. The range of the SD is 0.849 to 1.229, which signifies that the respondents agree in their rankings.

**Table 2: Major ICT Applications used by Firms**

|  | Mean | Std. Deviation | RANK | Remark   |
|--|------|----------------|------|----------|
| <b>ICT For Communication</b>                     |      |                |      |          |
| Mobile phone                                     | 4.29 | 1.143          | 1    | High     |
| E-mail   | 4.21 | 1.065          | 2    | High     |
| Internet   | 4.16 | 1.051          | 3    | High     |
| Electronic data management                       | 2.96 | 1.211          | 4    | Moderate |
| Intranet/Extranet                                | 2.95 | 1.354          | 5    | Moderate |
| Voice mail                                       | 2.55 | 1.168          | 6    | Low      |
| Video conferencing                               | 2.49 | 1.283          | 7    | Low      |
| Webcam   | 2.34 | 1.273          | 8    | Low      |
| <b>ICT For Administration</b>                    |      |                |      |          |
| Word processing application                      | 4.24 | 1.056          | 1    | High     |
| Spreadsheet application                          | 4.02 | 1.204          | 2    | High     |
| <b>ICT For Marketing</b>                         |      |                |      |          |
| Design software (CAD)                            | 4.00 | 1.032          | 1    | High     |
| Project management software                      | 3.30 | 1.008          | 2    | Moderate |
| Company Website                                  | 3.18 | 1.242          | 3    | Moderate |
| Online marketing of products to clients          | 3.12 | 1.219          | 4    | Moderate |
| Online archive photograph for Completed Projects | 3.09 | 1.159          | 5    | Moderate |
| <b>Advanced ICT Application</b>                  |      |                |      |          |
| Cost estimating software                         | 3.25 | 1.252          | 1    | Moderate |
| Electronic data interchange                      | 3.09 | 1.274          | 2    | Moderate |
| Supply chain management                          | 2.95 | 1.172          | 3    | Moderate |
| Enterprise resource planning                     | 2.81 | 1.237          | 4    | Moderate |

**Table 3: Major Areas of ICT Adoption by Indigenous Building contracting firms**

| ICT ADOPTION                          | Mean        | Std. Deviation | Rank | Remark   |
|---------------------------------------|-------------|----------------|------|----------|
| Office administration                 | 4.00        | 0.849          | 1    | High     |
| Pricing of a bill of quantities       | 3.60        | 1.226          | 2    | High     |
| Communication with project team       | 3.58        | 0.992          | 3    | High     |
| Marketing for services                | 3.54        | 0.994          | 4    | High     |
| Advertisement for services            | 3.48        | 1.133          | 5    | High     |
| Design automation                     | 3.47        | 1.096          | 6    | High     |
| Price estimation                      | 3.36        | 1.229          |      | Moderate |
| Tendering for contracts               | 3.35        | 1.032          | 8    | Moderate |
| Purchasing of goods and services      | 3.33        | 0.920          | 9    | Moderate |
| Cost management                       | 3.28        | 0.928          | 10   | Moderate |
| Human resource management             | 3.26        | 0.982          | 11   | Moderate |
| Tracking of projects                  | 3.18        | 1.087          | 12   | Moderate |
| Project collaboration                 | 3.07        | 1.168          | 13   | Moderate |
| Meetings with project team            | 3.05        | 1.108          | 14   | Moderate |
| <b>Average mean index of Adoption</b> | <b>3.39</b> |                |      |          |



## 5. Discussion

This study attempts to identify the ICT application used by indigenous Building contracting firms in Bauchi metropolis as well as the major areas of ICT Adoption. Mean ranking was used to rank the most used ICT application in the study area. The result reveals that the most used ICT applications for communication are mobile phone and Email, while the least used among them are Video conferencing and webcam. The result reveals that firms mostly used MS word and MS excel for administrative purposes. The major ICT application used for marketing is design software (CAD), while the least used application is an online archive photograph for completed projects. The result also reveals that ICT applications used for core services were moderately used by the firms, which are cost estimating software, electronic data interchange, supply chain management, and enterprise resource planning. These findings are in agreement with that of Mutesi and Kyakula (2014), where 87% of the firms' surveyed used a mobile phone for communication, and about 64% of them connected to the internet used Email. The findings agreed with that of Saka (2011), which reveals that about 70% of contracting firms use either Email or fax to communicate.

Additionally, this study concurs with Oyediran's (2014) findings that intranet, webcam, and video conferencing facilities are very low in terms of usage in southwestern Nigeria. The use of video conferencing, which could save management staff a lot of time and money on travelling to attend site meetings, is still very rare. This is probably due to the low level of awareness about it, as revealed by Oyediran (2014). Similarly, this result agrees with the findings of Achuen (1999), Oladapo (2007) and, Usman and Said (2012). However, the finding of this study contrast with the findings of Achuen and Olaoye (2002), that the level of usage of ICT applications for communication, general office administration, and marketing is high. The useful tools for project and site management, i.e., Project planning software, Cost estimation software, Electronic data interchange, and supply chain management, enjoy only a moderate level of usage.

Moreover, the findings also show that the major areas to which indigenous contracting firms embrace ICT in their business activities are: office administration, pricing of Bills of Quantities, communication with the project team, and marketing for services. They also deploy ICT for purchasing goods and services, Tendering for contracts, Cost management, Tracking of Projects, and Project collaboration at a moderate level. This result agrees with Oyediran (2014) and Olalaye and Abdullahi (2014) studies, which reveal that there is a moderate level of ICT Acceptance in the Nigerian construction industry. These findings implied that the most important ICT facilities used for efficient project management are not fully deployed in the Nigerian construction industry. Consequently, the industry is deprived of fully reaping the advantages of ICT facilities' speed and precision in their operations

## 6. Conclusions

This study assessed ICT application usage by indigenous Building Contracting Firms in Bauchi metropolis, as well as their major areas of adoption. The study adopted a quantitative design through a questionnaire survey. Findings show that the major ICT applications usage by indigenous building contracting firms are the basic ICT tools of communications, which include: mobile phones, Email, and the internet, word processing, and spreadsheet application. ICT applications usage for administration and advanced applications are moderate and low. At the same time, the adoption of ICT among Indigenous Building Contracting Firms is Moderate in Bauchi metropolis.

Because of the above, it was concluded that indigenous building contracting firms in Nigeria have not fully employed major ICT facilities in their operations, and as such, limiting them inadequately enjoying its advantages of speed and precision for better project performance. Hence, for optimum project performance in contracting business operation, this study recommended that indigenous building contracting firms in Nigeria: should highly improve on their application of electronic data management, intranet/extranet, voice mail, video conferencing, and webcam for their business communication. Moreover, completely adopt ICT facilities in the following project management areas: price estimation, tendering for contracts, purchasing of goods and services, cost management, human resource management, tracking of projects, project collaboration, and meetings with the project team.



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