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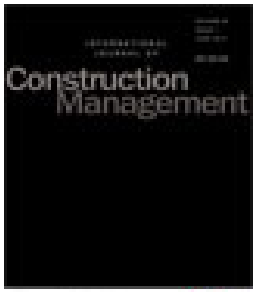
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Gauging parameters for e-procurement acquisition in construction businesses in Nigeria

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ABSTRACT

e-Procurement tools build on traditional methods of procurement by integrating the processes and people involved in construction businesses through Internet-supported information and communication technologies. In spite of how crucial these tools are there is a need to for strategic management decision making before they are procured and used because of the cost and technical implications involved. The study examined the gauging parameters for e-procurement acquisition in the construction businesses by firms and organisations in Nigeria. The study utilized a survey approach of actual users of e-procurement tools and technologies in the Nigerian construction industry. A total of 759 actual users were identified from several cities in the study area. Data obtained were analyzed in stacked bars, frequencies and categorical regression. The study presented the significant gauging parameters that can influence e-procurement technology acquisition. They include staff strength of the construction business, presence of quality internet facilities, security level and validation capacity of e-procurement transactions, supportive policy and legislative framework in e-procurement usage and computer literacy level of construction stakeholders participating in an e-procurement environment. In conclusion, the study developed a framework to guide construction businesses in e-procurement technology acquisition. Every construction organization should have unique metrics for measuring and predicting technology acquisition in order to avoid obsolescence and waste of scarce resources. There is a need for supportive policies and legislative frameworks that encourage e-procurement usage among construction stakeholders in the different countries.

KEYWORDS

Acquisition; construction businesses; construction industry; e-procurement; parameters

Introduction

The Nigerian construction business environment like its counterparts in other countries is riddled with several challenges from stiff competition, poor image of the industry, low capital, to poor record on construction projects in terms of time, cost, quality and safety. In the face of these challenges, construction businesses continue to identify innovative ways and tools to reduce or eliminate the adverse influence of these challenges on the productivity and efficiency of construction sector (Ibrahim 2013; Laryea and Ibem 2014; Dallasega et al. 2018; Ibem et al. 2018). The introduction of information and communication technologies (ICTs) in the construction business has been able to reduce the gap between construction clients and contractors. One of such tools is the use of e-procurement tools and technologies. Notably,

e-procurement tools and technologies are gaining traction in the construction industry due to their seamless benefits of bettering the unique characteristics associated with the sector (Zunk et al. 2014; Nawi et al. 2017). Although, e-procurement systems are used in other sectors ranging from manufacturing, telecommunication, energy to retailing and so forth, the distinct features of high volume of data and project participants associated with construction businesses make e-procurement a venture to think about.

In the Nigerian context, regardless of the slow and low adoption of e-procurement tools, construction businesses use different e-procurement technologies. Ibem et al. (2018) identified the simpler ones such as the use of email to the more advanced ones of customized or third party web-based/cloud procurement technologies. Studies from Oladapo (2007) and

Afolabi et al. (2017) showed that most construction professionals possess the simpler components to support e-procurement infrastructure such as emails, computers and smart devices. All these tools have cost implications which construction businesses must adequately consider. The study by Aduwo et al. (2016) showed that construction businesses in the Nigerian building sector considered the cost of investing in the physical facilities used in the e-procurement process as a major barrier. The case is not different in the South African construction industry where cost of providing the e-procurement infrastructure and the construction business policies played crucial factors in e-procurement utilization (Ibem and Laryea 2015). In their study, construction businesses were also concerned on whether the e-procurement systems would actually deliver the expected benefits.

e-Procurement tools are defined as the procurement process carried out through the pioneering efforts of the Internet (Croom and Johnston 2003; Vitkauskaitė and Gatautis 2008). This includes all transactions involved in the procurement process carried out via the internet or web-based systems are referred to as e-procurement technologies (Hawking et al. 2004; Farzin and Nezhad 2010). Afolabi et al. (2019) observed that e-procurement tools are innovative tools that are able to address procurement challenges in the construction business. Most problems faced in the traditional procurement strategy of bid advertisement, contract document circulation, bidding and awarding construction contracts are tackled using information and communication technologies (Becerik 2004; Tindsley and Stephenson 2008; Kim et al. 2013). Productivity and close monitoring of the construction life-cycle is made possible using e-procurement tools and technologies (Oyediran and Akintola 2011). The cost-saving benefit of the platform is made evident in the elimination of paperworks attributed to the traditional process of procuring buildings (Albano and Dae 2010). By using the innovation of e-procurement systems, construction businesses have been able to compete favourably and increase the opportunities of participating in tender submissions they would have been previously excluded (Kajewski and Weippert 2000).

In spite of the underlying benefits identified in several studies, construction businesses need to consider adequately the conditions that should necessitate the investment in the acquisition of e-procurement systems due to the limited resources available to them. This aspect has not been comprehensively dealt with in the research literature, especially from the context

of a developing economy in sub-Saharan Africa. Therefore, the study examined the gauging parameters for e-procurement acquisition in the Nigerian construction businesses environment. In order to achieve this aim, the following objectives were formulated;

- To identify the channels that increase awareness level on e-procurement technologies.
- To examine the gauging parameters influencing e-procurement technology acquisition.
- To develop a framework to guide construction businesses in e-procurement technology acquisition.

This study is considered valuable in a number of ways. First, it identifies the various channels through which knowledge of e-procurement spreads amongst the stakeholders in the Nigerian construction environment. Second, that study also unearths the various parameters that prospective users of e-procurement in Nigeria need to pay specific attention to in making decisions to invest in the technology. Lastly, the study provides a framework that guide construction firms in their quest to acquire and use e-procurement technologies and tools to support the execution of construction businesses.

Review of literature

e-Procurement adoption in construction business

The construction sector in Nigeria brings together a large number of project stakeholders ranging from the construction clients, contractors, consultants, regulators and policy makers. In order to ensure efficiency and effectiveness in the communication among project stakeholders there is need for close coordination (Toole 2003). In addition, the close coordination become necessary because each of the project stakeholder generate one form of information needed for the successful completion of the project and these data becomes cumbersome overtime. In the Nigerian construction industry, the close coordination used to be mostly traditional, where most information on construction projects are prepared, transmitted and stored in paper-based modes. These paper-based methods were prone to difficulty in accessing the information, loss of data, inadequate information and huge corruption. However, with the introduction of information and communication technology (ICT) in the construction process, data and information are transmitted at high speed, low cost and a guarantee of easy and adequate storage. Adam et al. (2007)

noted that construction businesses have integrated information technologies in their operations in order to maximize limited construction resources. Despite the numerous benefits associated with the use of ICT in construction businesses, Anumba and Ruikar (2002) argued that some crucial challenges still exist. Goulding and Lou (2013) identified in their study that ICT integration in construction businesses are hampered by organizational factors, that is, people and process; a supportive ICT atmosphere/infrastructure and the innovative ICT tool itself. Considering the organizational factor which appears in several studies, Peansupap and Walker (2005) stated that poor user acceptance creates resistance to change from transiting from familiar to unfamiliar terrain. Oladapo (2007) noted that in spite of construction businesses' investment in computers, not all aspect of ICT innovation has been fully embraced. This is evident in that many construction businesses are connected to the Internet but most of them have not invested in owning company websites despite the accompanying benefits.

Diffusion of e-procurement in construction business and associated factors

From the literature search we found a plethora of theories used in diffusion and adoption of research. The major ones include Rogers diffusion of innovation (DOI) theory, the technology, organization and environment (TOE) framework; the technology acceptance model (TAM); theory of planned behaviour (TPB) and unified theory of acceptance and use of technology (UTAUT) (Tran et al. 2011). In apply any of these theories to the current study; we view e-procurement adoption in construction business as an innovation.

According to the DOI theory by Rogers (2003), the four basic factors, namely innovation attributes, time, communication channels and social system and other multitude of factors, interact to facilitate or impede the dissemination of information (knowledge) on, and adoption of a specific product/service or practice among members of a particular adopter group. Focusing on the attributes of the technology and the communication channels, Rogers argued that the key features considered before organisations and individual acquire and use a new technology are: (1) the merits of the technology over the existing ones, (2) how well the new technology is consistent with the existing work practices (compatibility), (3) the effort intended users require to understand the technology

and put it into use (complexity or user friendliness) (4) extent to which user can experiment on the technology for its actual use (Trialability) and (5) the tangibility of the gains, benefits and changes resulting from the use of use technology (observability). Ibem et al. (2016), however, observed that amongst these factors compatibility, relative advantage and complexity seem to have the greatest influence on the decision to adopt a new technology. In addition to these, the communication channels, which refer to the means or avenues through which potential adopters are aware or informed about a new technology also have significant influence on the level of adoption of a new technology by firms and individuals. Examples of communication channel are mass media, word of mouth or face-to-face communication, conferences and others (Ibem et al. 2016). To buttress the role of attributes of technology and communication channels, Rogers (2003) explained that communication channels and the attributes of technology often interact to slow down or speed up its rate of adoption between and among members or organizations in a social system.

Further enquiry into the Rogers' DOI theory in ICT diffusion and adoption showed that predicting use of a new technology is hinged on mostly the attributes of the innovative tool. Nazari, Khosravi and Babalhavaeji (2013) noted that the characteristics of innovative ICT tools explain why some are swiftly integrated into business operation and some are neglected. According to Rogers (2003), when an organization decides to adopt a new system that means all necessary infrastructural facilities are deployed. Rogers' DOI is all about reducing uncertainties through the knowledge about the gains and shortcomings of an innovative tool. Ibem and Laryea (2015) broke this down as identifying the benefits attributed to the use of the ICT tool compared to existing systems, ability to easily integrate the new system in business operations and the measuring the level of complexity in the use and understanding of the tool.

From the unified theory of adoption and use of technology (UTAUT), Venkatesh et al. (2003) noted that an organization or individual's behavior to accept an innovative ICT tool can be influenced by expectations attached to the tool and the prestige it adds. Their model noted that the characteristics of the potential adopter have a role to play in their acceptance of new technologies. In line with the foregoing, Ibem et al. (2016) noted that beyond the characteristics of the users and the attributes of the innovative ICT tool, there is a need to consider other

externalizing factors. Therefore, this study posits that beyond adoption, construction businesses need know the gauging factors that can guide whether to acquire the new technologies or not.

Research methods

In order to gauge the parameters that are necessary for advising on e-procurement technology acquisition, there is need to engage actual persons that possess the technology. The study was carried out under the aegis of the Building Informatics Research Cluster to explore e-procurement diffusion in the Nigerian construction industry. A well-structured questionnaire was designed as the data instrument for the study. In the data instrument, it was essential to understand the characteristics of the construction businesses and the parameters they considered adequate for e-procurement acquisition within their operation. These parameters were critically drawn from previous studies of Al-Moala and Li (2010); Hosseini (2012); and Ibem et al. (2018).

To ease the processing of extracting the data from the participants in the survey, the questionnaire instrument was divided into three main sections. The first section help the researchers top gather data on the profiles of actual users of e-procurement in the study area. The second part contained question on the communication channels through which they get to know about e-procurement in construction, while the in last part of the questionnaire, the respondents were asked to indicate their levels of agreement or disagreement with statements related to the gauging parameters for e-procurement technology acquisition and use in construction businesses. The instrument reliability was conducted through the Cronbach alpha in SPSS v. 23. The value obtained at 0.88 was considered adequate as it is above the standard value of 0.70 recommended by Pallant (2011). The study is a perception study of the human behavior to acquire or not to, therefore, a five-point Likert scale ranging from Strongly Disagree to Strongly Agree was considered appropriate on the gauging parameters.

Since the actual population of registered and unregistered construction professionals in the Nigerian construction industry is undefined and to ensure that adequate sample that is representative of stakeholders in the Nigeria involved in construction business is selected for this study, the Cochran (1963) formula for determining sample size for infinite population presented in Equation (1) was used. In apply this formula, $p = 0.5$, that is, the maximum

variability of the population of e-procurement users at 95% confidence level and q represented by $(1 - p)$.

$$n_0 = \frac{z^2 pq}{e^2} \quad (1)$$

The calculated minimum sample size was 385. Totally, 1750 hard copies of the questionnaire were given by hand and 250 via email attachment, construction industry stakeholders in majors cities in Nigeria, including Kaduna, Abuja, Lagos and Ibadan, Port-Harcourt, Uyo, Owerri and Enugu and several others. A total of 1100 questionnaires were retrieved but 1092, which is around 55% of the total questionnaires administered to randomly selected participants were correctly filled. The distribution of the data instrument was facilitated with research assistants and carried out within the space of 10 months from November 2017 to August 2018. Only construction professionals with understanding of e-procurement systems and decision rights to acquire new technologies were selected from construction businesses. These construction professionals were actual users of e-procurement tools and technologies in the Nigerian construction industry. This was achieved by sifting out the non-users from actual users in the completed data instrument. Out of the 1092 copies of questionnaires retrieved, a total of 759 participants indicated to be active users of e-procurement tools and technologies in their construction business. The data obtained was analyzed using stacked bars and categorical regression (CAT-REG).

Results and discussion

This section details the characteristics of the study participants and analysis of the gauging parameters to predict e-procurement technology acquisition by construction businesses from the perspective of actual users of the technology. The educational qualification, registration with professional bodies and work industry experience (in years) were measured in this study to show the credibility of the construction professionals in their various fields. Figure 1 shows the summary of the study's participants. A review of Figure 1 revealed that most of the construction participants were learned with most of the participants having a minimum of Bachelor's degree in the construction profession. A pointer to note in Figure 1 based on the educational qualification shows that around 35.2% (267) of the construction professionals had improved their educational standing by obtaining Master's degree in their respective professions. One of the qualities in ensuring continuous professional

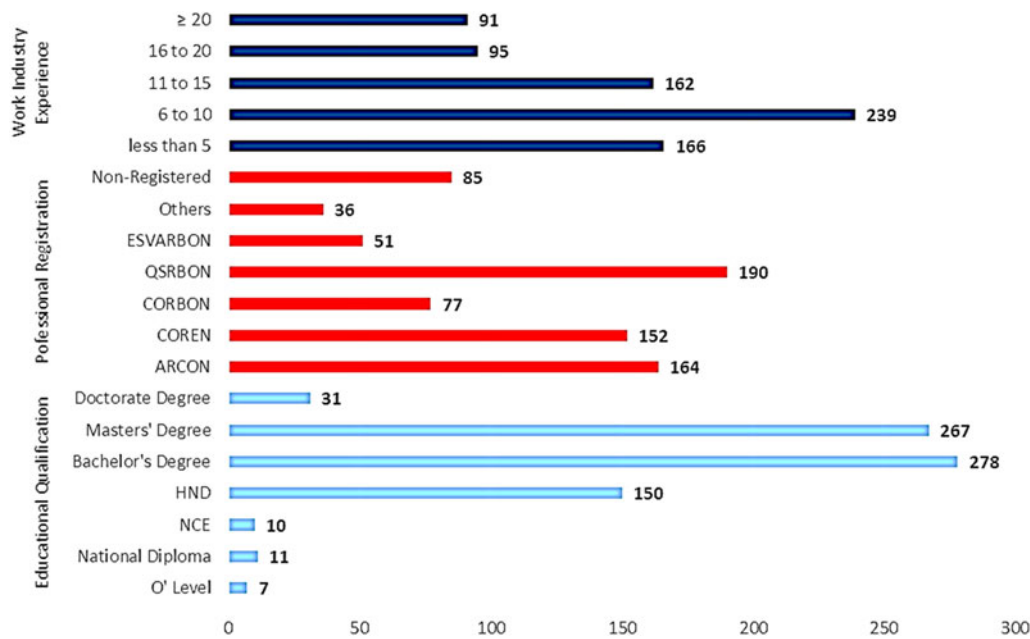


Figure 1. Summarized details of construction professionals.

development (CPD) is registration with professional bodies. Most of the participants in the study were registered members with their regulatory bodies. This would help expose them to current trends such as the use of e-procurement systems in the construction industry. Only a fraction of 11.2% (85) of the construction professionals encountered in this research were not registered. The depth of construction experience is also revealed in Figure 1, where the work industry experience was measured. In Figure 1, most of the construction professionals surveyed had more than 5 years' work experience. The data obtained in this study showed that 24.5% of the surveyed participants had more than 15 years' work experience. The characteristics of the study participants highlighted in this section showed that the construction professionals were well-grounded in the construction industry in terms of professionalism and years of experience.

Furthermore, the organizational characteristics was also measured to show the attributes of the construction businesses where the professionals worked. Characteristics such as number of years of company's existence, staff strength and number of year the company had used e-procurement technologies were measured. Figure 2 shows the summary of the characteristics of the construction businesses where the professionals worked. From Figure 2, more than half of the construction firms surveyed have been in existence for more than 11 years. This shows that most of the firms had depth in the construction industry and investments in the use of e-procurement system by the companies are issues that can foster economic

sustainability for the companies. Most of the firms surveyed had more than 10 persons in staff strength as shown in Figure 2. Crucial to this study is the measurement of how long the construction firms have been engaged in the use of e-procurement tools and technologies. Figure 2 shows that most of the construction firms invested in the use of e-procurement systems within the last five years. Overall, all the construction firms have e-procurement tools and technologies in their respective companies. Only 5% of the construction firms have used e-procurement tools and technologies for over 10 years.

The study sought to understand the channels of e-procurement tools and technologies' awareness among the construction professionals. Table 1 depicts the distribution of the channels where construction professionals picked up the information about e-procurement systems. In Table 1, most construction professionals became aware about e-procurement systems through workshops/conferences and through their professional associations. These are among the channels of communication channels of e-procurement identified by previous authors (Ibem et al. 2016). This is a pointer to the importance of such mediums in disseminating information on new and innovative trends in the industry. In order to achieve improved continuous professional development among construction practitioners there is a need to use these channels to keep stakeholders informed of methodologies that aims to achieve best practices. As this study is directed at actual users of e-procurement systems, it is ideal to conclude that these channels

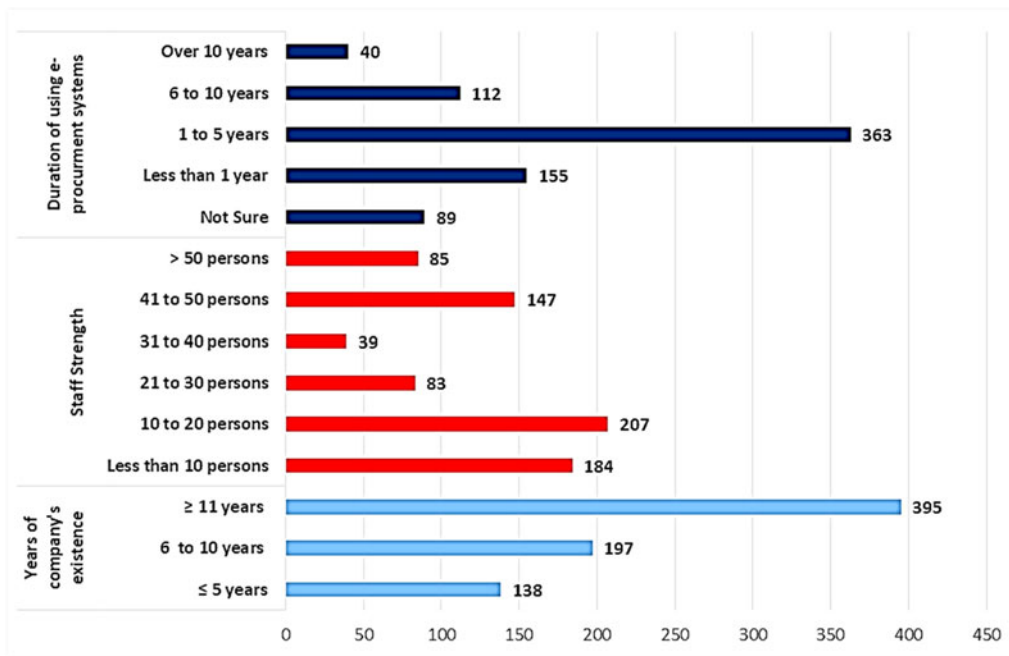


Figure 2. Summarized details of construction businesses.

Table 1. Channels of e-procurement system awareness.

Channels	Frequency	Percent	Cumulative percent
Professional associations	170	22.4	22.4
Mass media	141	18.6	41
Workshops/conferences	265	34.9	75.9
Vendors of e-procurement technologies	67	8.8	84.7
Business associates	77	10.1	94.8
Cannot recollect	39	5.2	100

have been effective in making construction professionals to uptake the use of the technology.

Gauging parameters for e-procurement acquisition

Gauging parameters as defined in this study describes the actions, supporting infrastructures and friendly environment that encourage and promote e-procurement acquisition. For this study, 24 gauging parameters were identified from Ibem et al. (2016) and Afolabi et al. (2019). The study sought to highlight the significant gauging parameters that can influence or predict e-procurement acquisition by construction firms from the perspective of actual users of the system. The statistical tool of categorical regression (CATREG) was used to determine the influential parameters in the study. The categorical regression was done on the categorical data obtained in the study while numerical values were assigned. Table 2 shows the categorical regression of the gauging parameters that influence e-procurement acquisition in construction businesses.

From Table 2, the model summary of the categorical regression on the gauging parameters contribute 36.2% of R square value ($F=5.074$; Asymp. Sig. = 0.000) to the acquisition of e-procurement systems by construction businesses in the study area. Furthermore, Table 2 shows that 5 gauging parameters were significant in this study. This indicates that these parameters have become crucial as influencing factors for e-procurement technology acquisition by construction businesses. The beta factor was also extracted to show the level of influence the gauging parameters had on the dependent variable. These parameters include staff strength of the construction business which had a beta factor of 52.3%, the presence of quality internet facilities which had a beta factor of 17.7%, security level and validation capacity of e-procurement transactions had an influence of 11.3%. Other gauging parameters for e-procurement technology acquisition include having a supportive policy and legislative framework in e-procurement usage and computer literacy level of construction stakeholders participating in an e-procurement environment which both contributed 13% beta factor.

Table 2. Categorical regression of gauging parameters influencing e-procurement acquisition.

Gauging parameters	Standardized coefficients				
	Beta	Bootstrap (1000) estimate of Std. error	df	F	Sig.
<i>R</i> Square	0.362				
<i>F</i>				5.074	0.000
Company's existence (in years)	0.096	0.183	2	0.274	0.761
Staff strength of construction business	0.523	0.116	4	20.199	0.000
Physical structures of the construction firm	-0.132	0.098	1	1.808	0.179
Accessibility to affordable e-procurement tools and applications	0.079	0.085	1	0.873	0.350
Presence of quality internet facilities	-0.177	0.085	3	4.295	0.005
Supportive ICT Infrastructure	0.094	0.103	2	0.819	0.441
Stable power supply	-0.068	0.058	4	1.365	0.245
Commitment and backing from Top management	-0.088	0.109	3	0.653	0.581
Ease in sourcing for e-procurement skilled personnel	0.094	0.100	4	0.870	0.482
Ability to operate the e-procurement software packages	-0.137	0.120	2	1.313	0.270
Awareness level of e-procurement systems to stakeholders	0.013	0.104	1	0.016	0.900
Ability of e-procurement systems fitting into existing procurement framework	0.085	0.108	1	0.623	0.430
User friendliness of e-procurement tools and operations	0.049	0.096	3	0.258	0.856
Security level and validation of e-procurement transactions	-0.113	0.065	4	3.072	0.016
Privacy of e-procurement platform transactions	0.079	0.076	3	1.089	0.353
Recognition of electronic contracts as legal entities	-0.080	0.078	3	1.050	0.370
Level of government support for e-procurement uptake	0.102	0.086	2	1.407	0.246
Supportive policies and legislation on e-procurement usage	-0.130	0.076	4	2.929	0.020
Availability of uniform standards for e-procurement operations	0.060	0.078	2	0.596	0.552
Level of resistance to change by employees	-0.034	0.083	1	0.166	0.684
Computer literate level of construction stakeholders	0.130	0.063	4	4.225	0.002
Awareness of the benefits of e-procurement use	-0.096	0.106	1	0.820	0.366
Level of change management procedure within construction firm	0.123	0.111	3	1.226	0.300
Confidence level of e-procurement technology usage by industry stakeholders	-0.057	0.087	4	0.421	0.793

Dependent Variable: Construction businesses involved in e-procurement systems.

The study showed that apart from the characteristics associated with e-procurement tools, there is a need to consider the characteristics of the construction firm before acquisition of innovative ICT tools can be acquired. Several studies have found easy diffusion among large private firms and public enterprises than smaller firms (Aduwo et al. 2016; Afolabi et al. 2019). It is important that construction firms consider their staff strength in order to adequately allocate resources. In most cases, a new section is created within the firm to handle e-procurement opportunities on behalf of the construction firm. Another significant gauging parameter identified in the study is the presence of quality Internet facility to support e-procurement tools and technology. Oyediran and Akintola (2011) and Afolabi et al. (2019) addressed the importance of having an internet provider that supplies fast and reliable services. e-Procurement tools and technologies become practically unusable mainly because of the web-based characteristics. Presently, the cost implication attached to owning a fast internet bundle is quite on the high side. Quality Internet service has shown to be a major barrier to the acquisition of e-procurement tools from studies in several countries (Aduwo et al. 2016; Obat 2016; Afolabi et al. 2017). There is a huge market for potential investors in the broadband internet market for the supply of adequate internet service to the teeming

over 200 million population. Going further, the perceived attribute of e-procurement's security and validation features is crucial for construction businesses to invest in them. This attribute can discourage construction businesses once it is realized that the security features are porous. Afolabi et al. (2017) noted that construction information are quite sensitive in a highly competitive sector. e-Procurement tool developers should be able to assure businesses of an end-to-end encrypted secured platform for privacy of transactions. The study also noted that for e-procurement systems to be readily embraced by construction businesses, there is a need for policy makers to provide policies and legislations that support its usage. Oyediran and Akintola (2011) noted that this is a challenge in most developing countries. In that some stakeholders find it hard to accept the validity of e-procurement systems as a contractual tool. In order to avoid impending disputes from users of e-procurement tools for electronic transactions existing contractual laws need to be revisited. The United Kingdom and Northern Ireland which have close similarity with the Nigerian construction industry also place great emphasis on legal and security issues in the use of e-procurement systems. Lastly, construction businesses should consider the technical manpower that would use the e-procurement tool or any other ICT product purchased by the firm. This can be

improved through strategic recruitment process that attracts IT savvy construction professionals and providing in-house digital training for employees within the firm. Bringing these gauging parameters together, the study developed a framework to guide construction businesses in e-procurement technology acquisition as shown in Figure 3. It is crucial that construction business ask the pertinent questions identified in Figure 3 before proceeding to acquire e-procurement tools and technologies.

Conclusion and recommendations

The study examined the gauging parameters for e-procurement acquisition in the Nigerian construction businesses. The characteristics of construction professionals and their construction business affiliations were highlighted in the study. The study showed that most construction professionals became aware about e-procurement technologies through workshops/conferences and through their professional associations. This emphasized the role of professional bodies in disseminating information on new and innovative trends as an aspect of continuous professional development for the construction professional. The study presented the significant gauging parameters that can influence e-procurement technology acquisition. They include staff strength of the construction business, presence of quality internet facilities, security level and validation capacity of e-procurement transactions, supportive policy and legislative framework in e-procurement usage and computer literacy level of construction stakeholders participating in an e-procurement environment.

In conclusion, the study developed a framework to guide construction businesses in e-procurement technology acquisition. The following recommendations are observations for construction businesses and stakeholders in the construction industry.

- Every construction organization should have unique metrics for measuring and predicting technology acquisition in order to avoid obsolescence and waste of scarce resources.
- Smaller firms need to increase capacity through partnering thereby the cost of technology investment can be borne in a collaborative environment in order to compete favourably on e-procurement platforms.
- For the success of e-procurement tools and technologies, there is a need for fast and affordable data bundles by Internet service providers. This can encourage the use of innovative tools in the construction industry and other sectors.
- Developers of e-procurement technologies should continuously ensure the security and authentication capacity of e-procurement platforms.
- Construction businesses need to invest in ensuring that their employees are up-to-date in current trends in the construction industry. This can be achieved when construction businesses drive professionalism among workers, encourage them to attend conferences and continuous professional development.
- There is also a need for supportive policies and legislative frameworks that encourage e-procurement usage among construction stakeholders. This

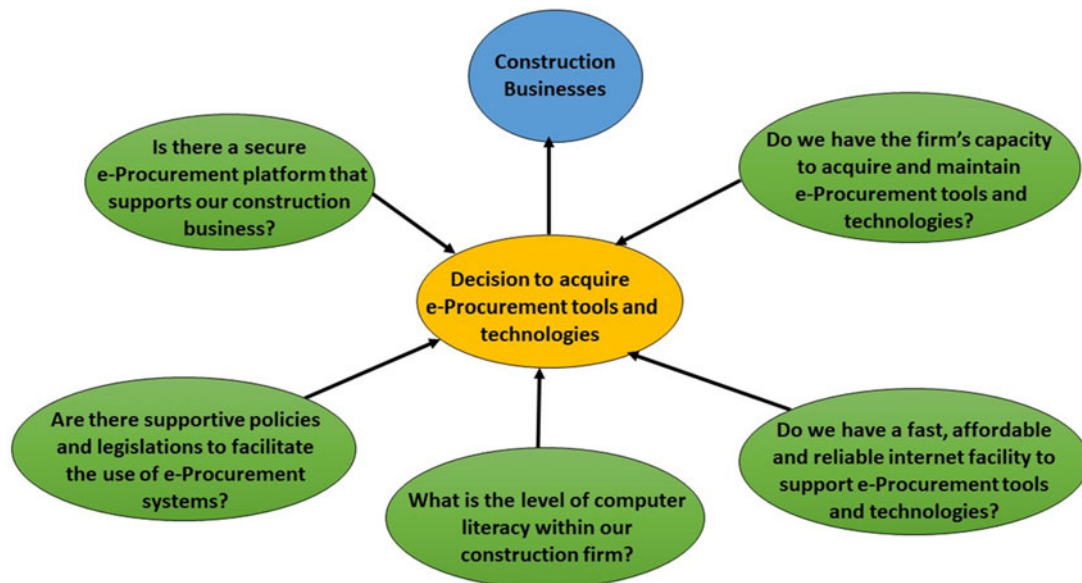


Figure 3. Framework to guide construction businesses in e-procurement technology acquisition.

can be achieved through promotion of e-procurement in the public sector, as the government is the biggest client in the construction sector in the Nigerian environ.

Disclosure statement

No potential conflict of interest was reported by the authors.

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