Determinants of e-Procurement Implementation in Construction in Nigeria

Egidario B. Aduwo[1], Eziyi O. Ibem[2], Emmanuel A. Ayo-Vaughan[3], Adedeji O. Afolabi[4], Uwakonye O. Uwakonye[5] and Adedamola A. Oluwunmi[6]
[1]*Senior Lecturer, Department of Architecture, Covenant University, Ota, Ogun State, Nigeria.*
[2]*Professor, Department of Architecture, University of Nigeria, Enugu Campus, Enugu State, Nigeria.*
[3]*Senior Lecturer, Department of Archiecture, Bells University of Technology, Ota, Ogun State, Nigeria.*
[4]*Lecturer, Department of Building Technology, Covenant University, Ota, Ogun State, Nigeria.*
[5]*Lecturer, Department of Architecture, Covenant University, Ota, Ogun State, Nigeria.*
[6]*Senior Lecturer, Department of Estate Management, Covenant University, Ota, Ogun State, Nigeria.*

ABSTRACT: Electronic (e-) Procurement has been acknowledged as one of the technologies capable of promoting efficiency in supply chain management in the construction industry in the developing countries. However, there is a scarcity of empirical studies on the implementation of this technology in the construction sector of many developing countries, including Nigeria. Consequent upon this there is a lack of understanding of the factors prospective users need to give attention for a successful implementation of e-Procurement in the acquisition of construction works, services and materials/equipment in Nigeria. This study, therefore investigated the determinants of e-Procurement implementation in construction business in Nigeria. The research was based on the administration of structured questionnaire to a randomly selected 759 users of this technology in the six geo-political zones in Nigeria. The data were analysed using frequency and percentage distributions and categorical regression analysis. The results revealed that whereas e-Procurement implementation in construction business in the study area varied with organizational characteristics, the key determinants of implementation of this technology amongst construction entities were the organizations'/firms' role and areas of construction procurement experience, lower transaction cost, challenges associated with signing electronic contracts, reliability and security of e-Procurement systems and processes. This study is instructive in noting that for a sustained use of e-Procurement in construction business, organizations/firms in Nigeria and other developing countries should as a matter of necessity give adequate attention to issues such as their role in the industry, areas of their construction procurement experience, the number of offices they have, availability of reliable and secured electronic systems and applications, cost of Internet services and acceptability of electronic contracts.

Keywords: Construction industry, e-Procurement, e-Procurement implementation, Internet, Nigeria, Supply chain management, Technology,

I. INTRODUCTION

Information communication technologies (ICTs) have been recognised as key drivers of efficiency in supply chain management in the different industrial and business sectors across the world. One of the vital aspects of ICTs with applications in supply chain management is the Internet [1]. Studies [2-4] have shown that the commercialisation of Internet services in the mid-1990s has resulted in the application of Internet-based technologies in the acquisition of goods and services by both public and private entities. The use of Internet-based technologies and processes in the acquisition of goods and services is commonly referred to as e-Procurement. Electronic (e-) Procurement involves business-to-business or business-to-consumer or business-to-government acquisitions and sale of supplies, work, and services using the Internet [5]. In construction, it is referred to as the use of Internet/web-based ICTs like e-Informing/Announcing/Notifying, e-Tendering, e-Awarding, e-Cataloguing, e-Invoicing, e-Contracting, e-Payment, e-Reverse Auctioning, e-Tracking and others systems in the procurement of construction works, services and materials/equipment [6-8].

Evidence in the research literature shows that the use of the Internet technology by firms/organizations can lead to business expansion, enhanced customer service delivery, improved competitive advantage, reduction in operational costs, efficiency and productivity [9]. In spite of these benefits, Klinc *et al.*, (2014) [10] noted that the construction industry was at its early stage of adoption of modern Internet-based technology. However, there is copious evidence in the existing studies [6-7, 11-12] indicating that the construction sector has been leveraging Internet-based technologies and processes in the delivery of buildings and other physical infrastructure projects. These evidences seem to have triggered research into the different aspects of e-Procurement in construction. Amongst the several aspects researchers have investigated are the level of adoption of e-Procurement [6-7, 12, 13], the associated benefits of e-Procurement [14-15], the barriers [14, 16-17] and critical success factors for its adoption [18], users' experience [19] and others.

Notable among the existing studies are those on the factors that influence the initial adoption of e-Procurement in construction [2, 6, 11-12, 18, 20-21]. A careful review of these studies revealed that many of

the existing studies on e-Procurement adoption are based on the general assumption that adoption of e-Procurement is influenced by a myriad of technological, organizational and environmental factors. In as much as these studies provide useful insight into adoption issues, they however, failed to recognize the fact that there is a difference between initial adoption decision and continuous use (i.e. implementation) of new technology, process, ideas or products as articulated by Rogers [22]. Based on the above, the existing studies tend to focus more on the initial adoption of e-Procurement than its implementation in construction. As a result, there is knowledge gap in the area of implementation factors of e-Procurement in construction, especially in the developing countries. In view of the foregoing, it has become necessary to understand the key variables that can promote sustained use of e-Procurement in construction after the initial adoption in a developing country like Nigeria that often lacks the requisite infrastructure and policies that engender proper ICT implementation. This study, therefore investigated the factors that determine the implementation (i.e. continuous use) of e-Procurement in the acquisition of construction works, services materials/ equipment in Nigeria. The study was guided by two key research questions:

–To what extent does the implementation of e-Procurement vary among firms/organizations in the Nigerian construction industry?

– What are factors that determine the implementation of e-Procurement in construction business in Nigeria?

This research is based on a survey of 759 users of e-Procurement in the Nigerian construction industry. The adoption of the survey research method was helpful in collecting data from users of e-Procurement in construction across the six geo-political zones in Nigeria. This study makes contribution to scientific knowledge by improving understanding of how the implementation of e-Procurement in construction varies across organisational characteristics. It is also valuable in identifying the specific factors that need to be considered in order to achieve sustained use of e-Procurement technology in the Nigerian construction sector. Therefore, the findings are expected to inform both policy and practice as they affect the continuous use of e-Procurement in construction supply chain management in Nigeria and other countries in sub-Saharan Africa with similar experiencein construction business environment.

II. THEORETICAL BACKGROUND

A. Concept of implementation of e-Procurement
E-procurement consists of several systems, applications, tools and processes used to support the execution of procurement activities such as the identification and selection of suppliers or service providers, placement of order, order fulfillment, and payment for goods and services [5-7]. In view of the fact that there are different stages leading to the use of one or many e-Procurement systems and processes by firms or organizations [22], it is important to distinguish between initial adoption and implementation of e-Procurement systems and processes.

Adoption has generally been described as a decision-making process by an adopting unit to accept the use a product or service [23]. As it relates to e-Procurement, Kahiu (2015) [24] explained that whereas adoption occurs when an organization makes decision to deploy one or many e-Procurement systems to execute procurement activities, implementation occurs when there is continuous use of e-Procurement systems to support the execution of procurement tasks. This view is consistent with the submission by Rogers [22] that adoption stage of a new idea or technology involves a decision to either accept or reject the technology/idea, while the implementation stage entails putting the new idea/technology into continuous use. This suggests that adoption precedes implementation; and thus implementation entails acceptance, routine use and infusion into the organization's business framework. It was on this premise that authors [25] noted that the successful implementation of e-Procurement is the most prominent aspect of leveraging ICTs to overcome the challenges confronting organizations in their procurement activities in the developing countries.

B. Theoretical framework
The survey of research literature reveals that there are different theories to support research work on the adoption of new idea, technology or process. However, the two theories considered in the current study are the Rogers diffusion of innovation theory (DIT) and the technology acceptance model (TAM) because according to Bilali and Bwisa (2015) [26], these are the most accepted models for predicting user acceptance of a technology. In the DIT, Rogers [22] explained that the process of adoption of a new idea or technology involve five states: knowledge stage, persuasion stage, decision stage to either accept or rejects the innovation (i.e. initial adoption stage), implementation stage (i.e. putting innovation into continuous use) and confirmation stage. The current research is however on the implementation stage.

Studies has shown that implementation is the stage in the innovation adoption process where the user has fully deployed the technology with possible readjustments to suits his/her situation. This readjustment process is called reinvention, and the more reinvention that occurs the higher the chances for continuous use of the technology/idea [22, 27]. Rogers [22] further identified five attributes of a new idea/technology, that can influence its initial adoption decision to include its relative advantage, compatibility, complexity, observability and triability. Others factors are the communication channels, characteristics of the adopting units; and how the innovators, their representatives or trading partners try to sell the technology to potential adopters and others. This theory however, did not account for the factors that can influence continuous usage of the new idea or technology.

The Technology Acceptance Model (TAM) posits that the decision to accept and use information systems(IS) and Information Technology (IT) is determined firstly by the perceived usefulness of the IS and IT, and secondly, the perceived ease of use of the system [28]. Whereas the perceived usefulness refers to the extent to which the individual or organization believes that the use of the system will help and improve job efficiency and productivity, the perceived ease of use is concerned with the extent to which the system is put to use with

little or no effort (i.e. ease of use) [28-29]. This submission appears to be similar to evidence in the literature on the relative advantage and complexity attributes of a technology as previously highlighted [22]. In the context of the current research, it is argued that both the usefulness, benefits and ease of use of e-Procurement, which are characteristics of this technology are among the key determinants of its implementation in construction business. The is not forgetting the influence of the characteristics of the adopting units such as the size, scope of activities and resource base and environmental factors external to it as identified in the literature [30]. It was based on the above premise that Sandler [31] noted that the continuous use of products and services is a function of their ease of use and functionality, suggesting that amongst other factors, user's experience has a significant influence on the extent of adoption of a new technology or idea like e-Procurement.

C. Review of empirical works

The review of literature revealed that a number of empirical studies have been carried out to identify the determinants of e-Procurement adoption decision by firms in the construction sector. For examples, in a study of the Atlantic Canadian architecture, engineering and construction (AEC) industry, Rankin *et al.* (2006) [11] reported that the decision to adopt e-Procurement by 226 organizations was influenced by its perceived benefits in increasing access to bigger markets and opportunities; reducing paperwork, transaction and procurement cycle time as well as increasing productivity. Also in 141 AEC firms in Singapore, it was reported that the size of firms, top management support, perceived benefits, and business partners influenced their adoption of e-Procurement [2].

In Europe, Eadie, *et al.*, (2011) [6] reported that the extent of e-Procurement adoption in construction by public and private sector entities in the UK was influenced by the perceived benefits of the technology in time and cost savings, increased quality, visibility in supply chain business and efficiency in inter and intra-organizational communication, improved inventory management and elimination of errors. Similar findings were also reported in construction supply chain management in Kuwait [32]. In Malaysia, Daud *et al.*, (2013) [20] found that the perceived usefulness of e-Procurement, the intention to use and attitudes towards using and perceived ease of use were among the key factors that influenced the decision to adopt e-Procurement by 178 contracting firms investigated. Similarly, evident in the literature [18, 33] suggests that e-Procurement adoption can be influenced by technological, organizational, environmental, and managerial factors.

In Africa, it was reported that in the South African construction industry, the benefits of the speed of transactions, lower transaction cost and ease of use positively influenced e-Procurement use [7]. In the Nigerian building industry, another study revealed that the three most important factors that influenced the adoption of e-Procurement in the delivery of building projects were the perceived benefits of the technology, organizational characteristics, the availability and cost of e-Procurement technologies, the size of organizations and the level of awareness on e-Procurement among people in construction industry in this country [21]. A most recent study in Nigeria revealed that the availability of reliable, affordable and fast Internet services were the most critical success factors for the adoption of e-Procurement in construction business [18].

From the foregoing review, it is evident that the existing studies have focused on the adoption aspect of e-Procurement and identified the specific attributes of this technology, organizational factors, industry environment and the benefits of e-Procurement as the main factors influencing its adoption in construction in the different countries. However, very few empirical studies have given attention to the implementation aspect of e-Procurement in construction. From the factors identified by previous authors, it can also be inferred that factors related to the attributes and benefits of e-Procurement technology and industry environment influence users' experience with this technology, which in turn might determine its continuous use beyond the initial period of adoption. This suggests that pleasant experience such as reduction in transaction cost and time, improvement in the efficiency of procurement process and others reported by previous studies [7, 34] can have a positive influence on the continuous use (implementation), while unpleasant experiences such as lack of flexibility and confidentiality, high cost of Internet services, non-interoperability of e-Procurement systems, insecurity of data and others, also reported in previous studies [11,13,16-17] may lead to discontinuity in the use e-Procurement in construction after initial adoption. In the light of the above, it is argued that the key determinants of e-Procurement implementation in construction business in Nigeria are users' experience with the technology, construction environment and characteristics of the implementing entities.

III. MATERIALS AND METHODS

The data used in this paper are part of a larger research project on the use of e-Procurement in the Nigerian construction industry. The research design used was a cross-sectional survey, and this was informed by the nature of the research questions and the benefits it offered in the collection of the data from geographically-dispersed population within a short period of time at relatively lower cost. Besides, previous authors on this subject [11, 13, 16-17] adopted the same research design. The research subjects were drawn from professional consulting firms, contractors, clients' organizations in both the private and public sectors, building materials suppliers/vendors and procurement officers. The survey covered major urban centers in the six geo-political zones in Nigeria: North central, Northeast, Northwest, Southeast, South-south, and Southeast.

Although several approaches were considered in the determination of the sample size for the survey, the formula for infinite population developed by Cochran [35] as shown in Eqn. 1 was adopted.

$$\text{Minimum Sample size, } n_0 = \frac{Z^2 pq}{e^2} \qquad (1)$$

Where n_0 is the minimum sample size, Z is the critical value (i.e. 95% level of confidence), being 1.96; p=0.5; q= 1– p and e is the desired level of precision in the statistical estimates. In choosing the parameters used in

this formula, it was assumed that there was maximum variability in the population of actual users of e-Procurement in the Nigerian construction sector. This was informed by non-availability of accurate records on the actual number of users of e-Procurement in the Nigerian construction sector. In using the formula in equation 1, a total of 385 participants was obtained as the minimum sample size for the survey.

A structured questionnaire designed by the authors was used in the extraction of data from the participants. The questions included in the questionnaire were derived from findings from the review of previous studies [7-8, 18-19]. The questions were put into five distinct sections, but the data presented here were those collected in sections A, B and C of the questionnaire. These comprise data on the participants and their firms/organizations, the actual users of e-Procurement, and duration of their use of e-Procurement, respectively. In identifying the actual users of e-Procurement in construction, the participants were asked to indicate using 'No' and 'Yes' options if their firms/organizations had participated in construction project(s) in which e-Procurement technology was used. Those who ticked the Yes option were further requested to indicate how long they have been using e-Procurement based on five options: 1= Not Sure, 2= less than 1 year, 3 = 1-5 years, 4 = 6-10 years, 5 = Over 10 years. Section C of the questionnaire contained questions on the different factors that influenced initial adoption decision and continuous use (implementation) of e-Procurement in construction.

In a bid to ensure reliability of the questionnaire and validity of the findings of this research, the questionnaire was reviewed by experts in the field and later pre-tested in architectural, building construction and quantity surveying firms in Lagos Metropolis, Southwest Nigeria. The review process and pre-testing exercise resulted to amendments in the structure and number of questions in final version of the questionnaire used in the main survey. The main survey took 10 months (i.e. from November 2017 to August 2018) to complete. It involved the administration of 2000 questionnaire comprising 1750 hard copies and 250 electronic copies to randomly selected participants in main urban centers in Nigeria. The electronic copies of the questionnaire were administered to the participants via e-Mail in the urban areas in the North-east geo-political zone and other towns the researchers and trained field assistants could not visit due to insecurity challenges in the North-east geo-political zone of this country. The random sampling method was adopted in the selection of one participant from each of the firms/organizations for the administration of the questionnaire. This ensured that every member of the target population had equal chances of being selected, and thus eliminating bias in the selection of the participants in the research.

Of the 2000 copies of questionnaire administered, 1100 copies were actually retrieved. However, 1092 copies, translating to around 55% of the total number of questionnaires administered were correctly filled. From the preliminary analysis of the data, it was observed that 759 copies, which is about 69.5% of the total number of questionnaires retrieved were filled by participants who had indicated that their firms/organizations had participated in construction projects that involved the use of e-Procurement technology. Consequent upon this, the data derived from the 759 actual users of e-Procurement identified in the survey were analyzed using both descriptive and inferential statistics.

The descriptive statistics used were frequency distributions and percentages, while the inferential statistics used was categorical regression (CATREG) analysis. Specifically, frequency distributions and percentages were used in addressing the first research questions as stated. The categorical regression analysis was used to investigate the factors that determine the implementation of e-Procurement in construction by the firms/organizations sampled in the research. In carrying out the CATREG analysis, the criterion was the duration of use of e-Procurement, while the independent variables were 20 factors describing the users 'experience with e-Procurement as identified in previous studies [7-8, 18-19] and the following organizational characteristics: role in the construction industry, type, age, number of offices in Nigeria, staff strength and areas of construction procurement experience. For a better understanding, the results of the analyses are presented using tables, charts and texts.

IV. RESULTS AND DISCUSSION

A. Duration of Use of e-Procurement in the firms/organizations

The results on the duration of use of e-Procurement reveals that greater proportion (47.8%) of the organisations/firms sampled have been using e-Procurement for between 1 year and 5years, 20.4% have been using the technology for less than 5years, 14.8% have been using it for between 6years and 10years, while 5.3% has been using the technology for over 10years. However, about 11.7% were not sure of how long they have been using e-Procurement in construction. From these results, it can be inferred that a majority of the organizations and firms involved in the procurement of construction works, goods and services have been using e-Procurement for less than 11 years. This suggests many (62.6%) of the entities in the Nigerian construction industry encountered in this research started using e-Procurement between around 2007 and 2012, while about 5.3% of them implemented e-Procurement before 2007. Going by the evidence in the literature [2,5] indicating that e-Procurement was implemented in advanced countries like the USA, Australia and UK around the mid-1990s, it can be inferred that the implementation of this technology in the Nigerian construction industry began around 15 years later. This was to be expected given the digital divide between these countries and the developing countries in Africa.

B. Variation in the duration of e-Procurement use in the firms/ organizations

Table 1 shows the results on the role of the organizations/firms sampled and duration of e-Procurement use. As can be seen in Table 1, the highest proportion (24.6%) of the participants in the survey were quantity surveyors, followed by 25.2% and 15.8% who were architects and engineers, respectively. In addition, other stakeholders in the Nigerian construction industry whose views were also captured in the survey were contractors (6.9%), estate/facilities

managers (7.3%) and construction project managers (4.9%). This results indicate that the key stakeholders in the Nigerian construction industry participated in the survey. This implies that the findings of this research can be generalised in the context of Nigerian construction industry.

Furthermore, the results in Table 1 also reveal that quantity surveyors have the longest history in the implementation of e-Procurement in the Nigerian construction sector, followed by engineers, builders and architects, respectively. This result did not come as a surprise because quantity surveyors are directly involved in procurements issues than other professionals in the Nigerian construction environment.

Table 2 is a display of the results on the type of firms/organizations that have implemented e-

Procurement in construction in Nigeria encountered in the survey. As shown in Table 2, the highest proportion (35.9%) were contracting firms, followed by 32.8% of the sample who were consulting firms. Further analysis of the results in Table 2 reveals that the contracting firms have the longer history of e-Procurement implementation in the Nigerian construction environment followed by the consulting firms. This result suggests that both the contracting and consulting firms, which are private sector entities are taking the lead in the implementation of e-Procurement in the Nigerian construction industry. This is contrary to the findings of the study showing that the public sector was leading in e-Procurement use in the UK construction sector [6].

Table 1: Role in the industry and duration of e-Procurement use.

Role in the industry	Duration of use of e-Procurement in years					Total
	Not sure	<1	1-5	6-10	>10	
Architect	46 (24.1)	54 (28.3)	61 (31.9)	22 (11.5)	8 (4.2)	191 (25.2)
Builder	3 (4.4)	15 (21.7)	32 (46.4)	18 (26.1)	1 (1.4)	69 (9.1)
Engineer	10 (8.3)	22 (18.3)	52 (43.3)	31 (25.8)	5 (4.2)	120 (15.8)
Contractor	10 (19.2)	12 (23.1)	19 (36.5)	8 (15.4)	(5.8)	52 (6.9)
Construction/Project Manager	4 (10.8)	8 (21.6)	16 (43.2)	6 (16.2)	3 (8.1)	37 (4.9)
Quantity Surveyor	0 (0.0)	23 (11.5)	145 (72.5)	18 (9.0)	14 (7.0)	200 (26.4)
Estate/ Facilities Manager	9 (16.4)	10 (18.2)	31 (56.4)	2 (3.6)	3 (3.6)	55 (7.3)
Supply Chain Manager/ Procurement Officer	5 (20.0)	5 (25.0)	4 (20.0)	5 (25.0)	2 (10.0)	20 (2.6)
Construction Materials/Equipment Vendor	0 (0.0)	1 (20.0)	3 (60.0)	1 (20.0)	0 (0.0)	5 (0.7)
Others	3 (30.0)	5 (50.0)	0 (0.0)	1 (10.0)	1 (10.0)	10 (1.3)
Total	**89 (11.7)**	**155 (20.4)**	**363 (47.8)**	**112 (14.8)**	**40 (5.3)**	**759 (100)**

Table 2: Type of organization/firm and duration of e-Procurement use.

Type of organization	Duration of use of e-Procurement in years					Total
	Not sure	<1	1-5	6-10	>10	
Consulting firm	32 (13.2)	53 (21.9)	112 (46.2)	30 (12.4)	15 (6.2)	242 (32.8)
Contracting firm	25 (9.4)	59 (22.3)	127 (47.9)	42 (15.9)	12 (4.5)	265 (35.9)
Private sector client organization	4 (6.9)	7 (12.1)	31 (53.5)	14 (24.1)	2 (3.5)	58 (7.9)
Government Ministry/Parastatals/ Institution	20 (11.7)	33 (19.3)	84 (49.1)	23 (13.5)	11 (6.4)	171 (23.1)
Building materials Manufacturer/Vendors	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	3 (0.4)
No Response	—	—	—	—	—	20 (2.6)
Total	**81 (11.0)**	**153 (20.7)**	**355 (48.0)**	**110 (14.9)**	**40 (5.4)**	**759 (100)**

The areas of organizations'/firms' construction procurement experience and duration of e-Procurement use were also investigated and the results are as shown in Table 3. It is evident in Table 3 that most (62.5%) of the organizations/firms sampled who have implemented e-Procurement have procurement experience in residential buildings, while about 24.6% of them have experience in the procurement of non-residential buildings. The results indicate that most the participants in this research have been involved majorly in building construction. The results in Table 3 also show that the

firms/organizations with procurement experience in non-residential building have a longer history in the implementation of e-Procurement than those with procurement experience in residential buildings. This is understandable because a large proportion (68.7%) of the construction entities sampled are contracting and consulting firms, who are most often small and medium scale enterprises (SMEs) involved in the procurement of residential buildings. The results on the age of the organizations/firms and their duration of e-Procurement use are also presented in Table 4.

Table 3: Areas firms'/organizations' construction procurement experience and duration of e-Procurement use.

Areas of construction procurement experience	Duration of use of e-Procurement in years					Total
	Not sure	< 1	1-5	6-10	>10	
Residential Buildings	62 (13.1)	110 (23.2)	228 (48.1)	55 (11.6)	19 (4.0)	474 (62.5)
Non-Residential Buildings	11 (5.9)	29 (15.5)	102 (54.6)	33 (17.6)	12 (6.4)	187 (24.6)
Energy	3 (18.8)	2 (12.5)	5 (31.3)	5 (31.3)	1 (6.25)	16 (2.1)
Transportation	3 (11.5)	4 (15.4)	6 (23.1)	9 (34.6)	4 (15.4)	26 (3.4)
Telecommunication	1 (8.3)	0(0.0)	7 (58.3)	4 (33.3)	0 (0.0)	12 (1.6)
Water Supply	1 (33.3)	0(0.0)	2 6.7)	0 (0.0)	0 (0.0)	3 (0.4)
Sanitation	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	2 (0.3)
Others	0 (0.0)	0 (0.0)	1 (3.3)	1 (33.3)	1 (33.3)	3 0.4)
No Response	—	—	—	—	—	36 (4.7)
Total	81 (10.7)	146 (19.2)	352 (46.4)	107 (14.1)	37 (4.9)	759 (100)

Table 4: Age of the organizations/firms and duration of e-Procurement use.

Age of organizations/ firms	Duration of use of e-Procurement in years					Total
	Not sure	<1	1-5	6-10	>10	
<5 years	35 (25.3)	39 (28.3)	64 (46.4)	—	—	138 (18.2)
6-10 years	23 (11.8)	41 (20.8)	98 (49.7)	33 (16.8)	—	197 (26.0)
11 years+	42 (10.5)	74 (18.4)	191 (47.5)	64 (15.9)	31 (7.7)	402 (53.0)
No Response	—	—	—	—	—	24 (2.9)
Total	100 (10.7)	154 (20.3)	353 (46.5)	111 (14.6)	31 (4.1)	759 (100)

It can be seen in Table 4 that although 2.9% of the respondents failed to indicate the age of their organizations/firms about 53% of the firms/organizations sampled were more than 10 years old, suggesting that they were established not later than 2006. The results however reveal that many of the older organizations implemented e-Procurement between 2012 and 2013, while many (46.4%) of the younger ones appeared to have implemented e-Procurement from the first year of their establishment.

Table 5 shows the results of the staff strength of the organizations/firms whose employees were involved in the survey. It is evident from Table 5 that more than one-half (51.5%) of them encountered in the survey have staff strength of less than 21 persons, supporting the claim that they are mostly SMEs. Further examination of the results in Table 5 reveals that the organizations/firms with staff strength of over 40 persons have longer history of e-Procurement implementation. This suggests that firms/organizations with larger workforce have longer experience than those with smaller work force in e-Procurement use in the Nigerian construction sector. This is understanding because previous studies [2-3] have shown that larger firms and organisations are known to experience greater challenges in intra and inter-firm communication, coordination and integration of tasks; hence the need to implement e-Procurement technology and processes that can help in effective communication and seamless coordination and integration of activities resulting to efficiency and enhanced productivity in their procurement tasks.

Table 5: Staff Strength of organizations/firms and duration of e-Procurement use.

Staff strength of organizations/Firms	Duration of use of e-Procurement in years					Total
	Not sure	< 1	1-5	6-10	>10	
<10 persons	31 (16.9)	49 (4.9)	79 (42.9)	20 (10.9)	5 (2.7)	184 (24.2)
10-20 persons	18 (8.7)	43 (20.8)	103 (49.8)	38 (18.4)	5 (2.4)	207(27.3)
21-30 persons	6 (7.2)	19 (22.9)	43 (51.8)	10 (12.1)	5 (6.0)	83 (10.9)
31-40persons	2 (5.1)	4 (10.3)	24 (61.5)	5 (12.8)	4 (10.3)	39 (5.1)
41-50 persons	25 (17.0)	25 (17.0)	57 (38.8)	28 (19.1)	12 (8.2)	147 (19.4)
50+ persons	0 (0.0)	12 (14.1)	54 (63.5)	11 (19.0)	8 (9.4)	85 (7.6)
No Response	—	—	—	—	—	14 (1.8)
Total	82 (10.8)	152 (20.0)	360 (47.4)	112 (14.8)	39 (5.1)	759 (100)

It was also of interest to investigate the number of offices the firms/organizations sampled have in Nigeria. The results are presented in Table 6. From the results in Table 6 it is evident that most (66.2%) of the organizations have less than three offices, while around 22.7% of them have more than three offices in Nigeria. This result is a further confirmation that besides the government institutions, most of the organizations/firms surveyed are SMEs.

The results in Table 6 also reveal that those firms/organizations with three offices and above have a longer history of e-Procurement implementation that those with less number of offices, and thus considered to have taken the lead in e-Procurement implementation in the Nigerian construction sector. This result is not out place because e-Procurement technology helps to integrate people and process involved in procurement activities irrespective of their geographic location.

Table 6: Number of offices in Nigeria and duration of e-Procurement use.

Number of offices in Nigeria	Duration of use of e-Procurement in years					Total
	Not sure	< 1	1-5	6-10	>10	
1	58 (19.7)	69 (23.4)	126 (60.9)	31 10.5)	11(3.7)	295 (38.9)
2	10 (4.8)	48 (3.9)	100 (48.3)	38 (18.4)	11 (5.3)	207 (27.3)
3	1 (1.4)	12 (16.2)	44 (59.5)	11 (14.9)	6 (8.1)	74 (9.8)
>3	17 (9.9)	22 (12.8)	90 (52.3)	31 (18.0)	12 (7.0)	172 (22.7)
No Response	—	—	—	—	—	11 (1.5)
Total	86 (11.3)	151 (19.9)	360 (47.4)	111 (14.6)	40 (5.3)	759 (100)

Therefore, firms or organisations with more offices are more likely to embrace e-Procurement.

C. Determinants of e-Procurement implementation in the organizations/firms

Table 7 shows the coefficients of the regression analysis of the determinants of e-Procurement implementation in construction business in Nigeria. The regression model produced $F_{(194.16, 544.85)} = 3.40$, $p < 0.000$ with R^2 value of 0.563. This means that the regression model explained around 56.3% of the variance in the determinants of e-Procurement implementation in the firms/organizations sampled. From the p-values in Table 7, it is evident that of the 26 variables investigated in this research, only nine, namely: ease of use, lower transaction cost, reliability and security of e-Procurement systems and processes, difficulties associated with signing electronic contracts, cost of Internet services in this country, acceptability of electronic contracts in the construction industry, role of the organizations/firms in the construction industry, the number of offices in Nigeria, areas of construction procurement experience, and acceptability of electronic contracts in the construction industry emerged as the determinants of e-Procurement implementation in construction business in Nigeria.

The β coefficients also indicate that in the order of ranking, role in the construction industry (β = 0.226), lower cost of transaction with e-Procurement (β = 0.159), difficulties associated with signing electronic contracts (β =0.152), areas of organization's construction procurement experience (β = 0.141), reliability and security of e-Procurement systems and processes (β = 0.127), number of offices in Nigeria (β = 0.127), ease of use e-Procurement systems, tools and processes(β = 0.117), and the cost of Internet services (β = 0.111) contribute most to understanding the determinants of e-Procurement implementation in the survey, respectively. These results mean that these are the main factors that determine the implementation of e-Procurement in construction business by the organizations/firms in the Nigerian construction environment. In addition, these results also mean that e-Procurement implementation will change by 0.226, 0.159, 0.152, 0.141, 0.127 times per unit increase in standard deviation in the firms'/organizations'role in the construction industry, lower cost of transaction with e-Procurement, difficulties associated with signing electronic contracts, areas of organization's construction

procurement experience, reliability and security of e-Procurement systems and processes and the firms/oragnisations' number of offices in Nigeria, respectively. The results of the regression analysis further reveal that three of the determinants: the organization's role in the construction industry, their areas of construction procurement experience and number of offices operated in Nigeria are related to organizational characteristics. This finding seems to tally with the evidences in Tables 1, 3 and 4 on the variations in the duration of e-Procurement use across these three organizational attributes, and also provides support to earlier studies [21-22, 30, 33] indicating that the characteristics of adopting units have influence on the adoption of a new technology.

The emergence of lower transaction cost with e-Procurement as a determinant of e-Procurement implementation in this study is also consistent with the findings of previous studies in the Canadian [6], UK [7] and South African [11] construction sectors as previously highlighted in this paper.

Furthermore, the findings on the reliability and security of e-Procurement systems and processes, ease of use e-Procurement tools and processes and difficulties associated with signing contracts electronically as determinants of e-Procurement implementation can also be linked to the features of e-Procurement technology. Moreover, the specific finding on the ease of use e-Procurement tools and processes also seems to provide support to that by previous authors [20, 28-29, 33] on ease of use of a new technology as one of the key factors that influence the decision to adopt e-Procurement by construction entities as previously highlighted. Also of note is the result on acceptability of electronic contracts in the construction industry as one of the determinants of e-Procurement implementation. This seems to be line with the evidence in the literature [30] indicating that environmental factors external to the implementing units can also influence the use of a new technology, idea of process. Based on the forgoing findings, it can be argued that the current study aligns with those of the previous studies [22, 29, 31] suggesting that the continuous use of products and services like e-Procurement is determined by users' experience with this technology in the execution of construction procurement activities, the characteristics of the implementing entities and their operational environment.

Table 7: Regression Coefficients of the Determinants of e-Procurement Implementation.

Coefficients					
Independent Variables	**Standardized Coefficients**		**df**	**F**	**p**
	Beta	**Bootstrap (1000) Estimate of Std. Error**			
Access to adequate and reliable ICT and Internet service to support e-Procurement implementation	-0.080	0.071	4	1.266	0.282
Ease of use e-Procurement technology	0.117	0.090	1	1.700	0.001*
Ease of integration of e-Procurement technology and process to the existing construction procurement process in our firm/organization	0.046	0.076	2	0.369	0.692
The degree of engagement with e-Procurement by consultants and contractors	0.038	0.077	3	0.240	0.868
Knowledge base of construction industry people on e-Procurement	-0.043	0.093	2	0.216	0.806
Lower cost of transaction with e-Procurement	0.159	0.048	2	10.825	0.000*
Greater speed of transaction with e-Procurement	-0.107	0.079	2	1.841	0.159
Reliability and security of e-Procurement tools, applications and processes	0.127	0.049	5	6.785	0.000*
Existence of favourable public police on e-Procurement	0.108	0.073	2	2.155	0.117
Challenges witnessed in switching from paper-based procurement method to e-Procurement	-0.035	0.080	2	0.190	0.827
Adaptability and willingness of construction industry stakeholders to switch to e- Procurement tools, applications and processes	-0.046	0.057	1	0.638	0.425
Ease at which consultants, contractors/vendors respond to procurement requirements electronically	-0.092	0.093	2	0.972	0.379
Difficulties with signing contracts electronically	0.152	0.042	2	13.245	0.000*
Inability of firms without access to the Internet to participate in construction procurement activities	-0.027	0.079	2	0.115	0.892
Issues with authenticating electronic documents	-0.030	0.074	3	0.166	0.919
Cost of Internet services in this country	0.111	0.051	3	4.738	0.003*
Absence of flexibility in the use of e-Procurement in construction business	-0.076	0.104	3	0.541	0.654
Acceptability of electronic contracts in the construction industry	0.105	0.042	3	6.162	0.000*
Interoperability issues with e-Procurement systems/applications	-0.113	0.092	4	1.503	0.200
Availability and accessibility to e-Procurement tools and applications	0.075	0.061	4	1.487	0.204
Organization's role in the construction industry	0.226	0.048	5	22.348	0.000*
Type of organization/firm	0.045	0.031	4	2.157	0.072
Age of organization/firm	0.039	0.030	3	1.709	0.164
Number of offices the organization has in Nigeria	0.127	0.046	1	7.737	0.000*
Staff strength of the organization/firm	0.036	0.035	3	1.037	0.375
Areas of organization's/firm's construction procurement experience	0.141	0.040	2	12.284	0.000*
Dependent Variable: Duration of use of e-Procurement					

*significant predictors.

V. CONCLUSION

The purpose of this research was to investigate the determinants of e-Procurement implementation in construction business in Nigeria. Based on the results, these two conclusions were arrived at. The first conclusion is that the implementation of e-Procurement by construction entities in Nigeria varies according their roles in the industry, staff strength, type, age and areas of the construction procurement experience and the number of office they have in the country.

The second conclusion is that the main factors that determine the implementation of e-Procurement in construction by firms/ organizations are: the firms'/organization's role in the construction industry, lower transaction cost associated with e-Procurement, difficulties associated with signing electronic contracts, areas of organizations' construction procurement experience, and reliability and security of e-Procurement systems and processes among others.

The findings of this research have a number of implications that deserve closer attention. Firstly, the study implies that when it comes to the implementation of e-Procurement by entities involved in construction procurement activities in Nigeria, differences exist based on their characteristics. This means that the organizational characteristics identified in this research can be used to study and understand organizations/ firms that are more likely to implement e-Procurement within the Nigerian construction environment.

Secondly, the study also implies that sustained use of e-Procurement in construction business by organizations/firms in Nigeria is a function of several factors, including their role in the construction industry, the benefits derivable from continuous use of this technology, the firms/organizations' experience with signing of electronic contracts and the implementing units' area of construction procurement experience and the number of office operated by them. Others are the ease to use, reliability and security, the cost of using Internet services and the extent to which electronic contracts are acceptable in the country.

Again, what these mean is that firms/organizations wishing to implement e-Procurement in construction business should give adequate consideration to their role in the industry to ensure that it is consistent with current and emerging needs of stakeholders in the sector. They should also consider the area of their construction procurement experience and the number of offices they have, to ascertain that the implementation of e-Procurement will add value to them and their business associates. In addition, they need to acquire relevant manpower that would make it possible for them to find e-Procurement technology easier to use in all stages of construction procurement activities, including the signing of construction contracts electronically. Beside these aspects, more investments are required in the provision of quality ICT infrastructure to ensure that the availability of reliable and secured electronic systems and applications. Moreover, government needs to put in place appropriate legalisation and enforcement frameworks to ensure regular access to affordable Internet services by all categories of firms/organizations, and that electronic contracts in the construction industry are acceptable in the country.

VI. FUTURE SCOPE

From this study it is evident that the regression model explained about 56.3% of the factors that determine e-Procurement implementation in construction business in Nigeria. This implies that the current study is not conclusive, and thus further study is needed to identify the factors that account for the remaining 33.7% of the determinants of e-Procurement implementation in construction business by public and private sector entities in Nigeria. In addition, the e-Procurement implementation practices in the entities should be further investigated for overall improvement in the use of e-Procurement technology to enhance the general performance of the Nigerian construction sector.

REFERENCES

[1]. Ruikar, K., Anumba, C. J., & Carrillo, P. M. (2006). VERDICT-An e-Readiness Assessment Application for Construction Companies. *Automation in Construction*, *5*, 98-110.
[2]. Teo, T. S. H, Lin, S., & Lai, K. (2010). Adopters and non-adopters of e-Procurement in Singapore: An Empirical Study. *Omega*, *37*, 972-987.
[3]. Gunasekaran, A., & Ngai, E. W. T. (2008). Adoption of e-Procurement in Hong Kong: An empirical research. *International Journal of Production Economics*, *113*(1), 159-175.
[4]. Neupane, A., Soar, J., & Vaidya, K. (2012). Evaluating the Anti-Corruption Capabilities of Public e-Procurement in a Developing Country. *The Electronic Journal of Information Systems in Developing Countries, 5*(1), 1-17.
[5]. Bausa, P. O., Kourtidis S., Liljemo, K., Loozen N., Rodrigues F. J., & Snaprud, M. (2013). *e-Procurement Golden Book of Good Practice.*www.pwc.be, (last visited 15 May 2014).
[6]. Eadie, R., Perera, S., & Heaney, G. (2011). Analysis of the use of E-Procurement in the Public and Private Sectors of the UK construction Industry. *Journal of Information Technology in Construction, 16*, 669-686.
[7]. Ibem, E. O., & Laryea, S. (2015). e-Procurement use in the South African construction industry. *Journal of Information Technology in Construction, 20*, 364-384.
[8]. Ibem, E. O, Aduwo, E. B., & Ayo-Vaughan, E. K. (2017). e-Procurement Adoption in the Nigerian Building Industry: Architects' Perspective. *Pollack Periodica, 12*(3), 167-180.
[9]. Ghobakhloo, M., Arias-Aranda, D., & Benitez-Amado, J. (2011). Adoption of e-Commerce applications in SMEs. *Industrial Management & Data Systems, 11*(8), 1238-1269.
[10]. Klinc, R., Turk Ž., & Dolenc M. (2014). ICT enabled communication in construction 2.0.*Pollack Periodica, 9*(3), 109-120.
[11]. Rankin, J., Chen, Y., & Christian, A. (2006). e-Procurement in the Atlantic Canadian AEC industry. *Journal of Information Technology in Construction*, *11,* 75-87.
[12]. Hashim, N., Said, I., & Idri,s I. (2014). e-Procurement Implementation in Malaysian Construction Industry. *Aust. J. Basic & Appl. Sci.*, *8*(6), 231-238.
[13]. Eadie, R., Perera, S., Heaney, G. & Carlisle, J. (2007). Drivers and Barriers to Public Sector e-procurement within Northern Ireland's Construction Industry. *Journal of Information Technology in Construction, 12,* 103-120.
[14]. Nawi, M. N. M., Deraman, R., Bamgbade, J. A., Zulhumadi, F., & Riazi, S. R. M. (2017). E-Procurement in Malaysian Construction Industry: Benefits and Challenges in Implementation. *International Journal of Supply Chain Management, 6*(1), 209-213.
[15]. Zunk, B. M., Marchner, M., Uitz, I., Lerch, C., & Schiele, H. (2014). The Role of E-Procurement in the Austrian Construction Industry: Adoption Rate, Benefits and Barriers. *International of Industrial Engineering and Management*, *5*(2), 13-21.
[16]. Aduwo, E. B., Ibem, E. O., Uwakonye, O., Tunji-Olayeni, P. F., & Ayo-Vaughan, K. (2016). Barriers to the uptake of e-Procurement in the Nigerian building industry. *Journal of Theoretical and Applied Information Technology*, *89*(1), 133-147.

[17]. Isikdag, U. (2019). An Evaluation of Barriers to e-Procurement in Turkish Construction Industry.*International Journal of Innovative Technology and Exploring Engineering, 8*(4), 252-259.

[18]. Afolabi, A., Ibem, E. O., Aduwo, E. B., Tunji-Olayeni, P. F., & Oluwunmi, A. A. (2019). Critical Success Factors (CSFs) for e-Procurement Adoption in the Nigerian Construction Industry. *Buildings, 47*(9), 2-18.

[19]. Ibem, E. O., Aduwo, E. B., Afolabi, A. O., Oluwunmi, A.O., Tunji-Olayeni, P. F., A. Ayo-Vaughan, E. A., Uwakonye, O., & Uwakonye, U. O. (2020). Electronic (e-) Procurement Adoption and Users' Experience in the Nigerian Construction Sector, *International Journal of Construction Education and Research*, 1-19.

[20]. Daud, N. M., Mohammad, N., Azmi, A. E., & Mohamed, I. S. (2013). Factors influencing the usage of e-Procurement among contractor companies in Malaysia. *Business and Management Quarterly Review*, *4*(3, 4), 62-80.

[21]. Ibem, E. O., Aduwo E. B., Tunji-Olayeni P., Uwakonye O. U. & Ayo-Vaughan E. K. (2016). Factors affecting e-Procurement adoption in the Nigerian building industry, Construction Economics and Building, *16*(4), 54–67.

[22]. Rogers E. M. *Diffusion of innovations* (5th ed) (2003). New York, Free Press.

[23]. Woodside, A. G., & Biemans, W. G. (2005). Modeling innovation, manufacturing, diffusion and adoption/rejection processes. J*ournal of Business & Industrial Marketing,* 20(7), 380–393.

[24]. Kahiu, B. K. (2015). Determinants of Implementation of Electronic Procurement in Procuring Entities at the County Level in Kenya. (Case Study of Lamu County Service Delivery Coordinating Unit). *International Journal of Scientific and Research Publications, 5*(9), 1-15.

[25]. Mathenge, M. M., & Wausi, A. (2018). Critical Factors for Successful Implementation of E-procurement in the Kenyan Public Sector. Current *Journal of Applied Science and Technology*, *29*(4), 1-23.

[26]. Bilali, J., & Bwisa, H. (2015). Factors influencing the adoption of e-procurement: a case of Garissa county government. *The Strategic Journal of Business & Change Management, 2*(35), 662-682.

[27]. Sahin, I. (2006). Detailed review of rogers' diffusion of innovations theory and educational technology-related studies based on rogers'. *The Turkish Online Journal of Educational Technology – TOJET, 5*(2&3), 14-23.

[28]. Venkatesh, V., & Davis, F. D. (1996). A Model of the Antecedents of Perceived Ease of Use: Development and Test. *Decision Sciences,* 27(3), 451-481.

[29]. Davis, F. D. (2013). Perceived usefulness, perceived ease of use, and user acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319-340.

[30]. Tornatzky, L., & Fleischer, M. (1990).*The process of technology innovation*, Lexington, MA, Lexington Books.

[31]. Sandler, J. (2015). What Users Want: Functional User Experience? International Conference on Interactive Collaborative Learning (ICL), Florence, Italy.

[32]. Baladhandayutham, T., & Venkatesh, D. S. (2012). Construction Industry in Kuwait–an analysis on E-Procurement adoption with respect to Supplier's Perspective. *International Journal of Management Research and Development*, *2*(1), 1-17.

[33]. Tran, Q., & Huang, D. (2014). E-Procurement Institutionalization in Construction Industry in Developing Countries: A Model and Instrument. *WSEAS Transactions on Computers, 13*, 152-176.

[34]. Aduwo, E. B., Ibem, E. O., Ayo-Vaughan, E. A., Uwakonye, O., & Owolabi, J. D. (2017). E-procurement use in the Nigerian building industry. *International Journal of Electronic Commerce Studie*s, *8*(2), 219-254.

[35]. Cochran, W. G. (1963). Sampling Technique. 2nd Edition, John Wiley and Sons Inc., New York.