Barriers to Electronic Tendering Adoption by Organisations in Nigerian Construction Industry

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Tendering is an important aspect of procurement that requires the use of information technology to enhance project performance. This study has identified the barriers to e-tendering adoption leaning upon Technology, Organisational, and Environment (TOE) framework and innovation diffusion theory. Googleforms was used to administer questionnaire to practitioners in construction organisations in North Central Nigeria. Confirmatory factor analysis through structural equation model was used to analyze the data. The study found that there is a positive relationship between external barrier and e-tendering adoption ($\beta = .12$, $p<0.05$) on one hand and internal barrier on the other hand ($\beta = .18$, $p<0.05$). External barriers factors are availability of hardware and software, government policy, poor ICT infrastructure to support e-tendering and competitive pressure from rival organisations in the industry. While internal factors include the size of firm, legal protection of online transactions security (hacking and tracking of user data) and lack of agreed standard have significant impact on the organisation's intention to use e-tendering. Also, IT skill of organisation's labour force has a positive effect on e-tendering adoption ($\beta = .41$, $p<0.05$). These findings will enable policy makers and other industry players to understand the barriers to the implementation of e-tendering adoption and develop strategies to overcome them.

Keywords: Barriers, Environment, E-tendering, Technology, Organisation

Introduction

Construction project is becoming increasingly complex in the developing economy because of lack of knowledge and awareness about innovative information and communication technology (ICT) (Ugwu & Kumaraswamy, 2007). Tendering is an important aspect of procurement that requires the adoption of information technology to enhance project performance. The use of e-tendering in the construction industry of developed countries is well documented but the situation is different in less developed countries (Oyediran & Akintola, 2011; Altayyar & Beaumont-Kerridge, 2016). E-tendering is the process of adopting Electronic Data Interchange (EDI) for tender purposes (JCT, 2002). An important requirement of e-tendering is for all the appropriate firms, document and drawings to be converted into an electronic format which may then be uploaded onto the server (Ramus *et al.*, 2006). According to Oyediran and Akintola (2011), adoption of e-tendering could significantly reduce normal tender period, improve efficiency of tendering process and secure access to tender information to construction industry practitioners. However, the Nigerian government procurement procedures has been paper-based and highly susceptible to delays in tender processing, excessive human interference and lack of transparency (Adebiyi *et al.*, 2010). The long procurement circle has made it difficult for some Ministries, Departments and Agencies to meet budget circle for their capital projects leading to abandonment and non-

implementation of important capital projects (Adebiyi *et al*., 2010). Document preparation, review, approval, duplication, and distribution are time-consuming. Paper processing is slow and increases the risk of mistakes. It provides opportunity for data entry error and the resultant mistakes in document production, packaging and delivery. The Bureau of Public Procurement (BPP) has commenced the implementation of unified e-government procurement (e-GP) system (Chiejina, 2018). This is aimed at integrating the existing systems to provide a centrally and unitary collaborative government procurement at the federal level to cover the entire public procurement lifecycle in line with the procurement Act (Chiejina, 2018). Essentially, e-procurement incorporates an easy-to-use self-documenting infrastructure which arms a procurement unit with valuable data to analyse current sourcing practices, leverage volume discounts with suppliers and manage compliance (Chilipunde, 2013).

The aim of the study is to examine the barriers to the adoption of electronic tendering by contracting organisations in Nigerian Construction Industry. Oyediran and Akintola (2011) observed that limited number of studies have been conducted on e-tendering practices in Nigeria. According to the authors, research efforts in the country have only concentrated on the implementation of ICT tools in the Nigerian Construction Industry.

The need to adopt electronic media for procurement in the construction industry is pushing organizations to move away from the traditional paper based practice to modern and efficient ways of working. However, small businesses in Nigeria still face the barriers of E-tendering adoption. These barriers have been identified to include risk, uncertainty, losses, complexity, uncertainty and logistics, lack of ICT infrastructure and government support (Adebiyi *et al*., 2010). Evidence of a rigorous study on the various factors affecting e-tendering adoption based on some existing theories is scanty in Nigeria. Therefore, this study examined the interplay of internal and external factors on e-tendering adoption in Nigerian construction industry using Technology - Organization –Environment (TOE) framework propounded by Depietro *et al*. (1990) with incorporation of diffusion of innovation theory (Rogers, 2003). The interplay of various constructs in the structural model developed through this research contributes to the body of existing knowledge on innovation adoption.

Electronic tendering

E-tendering is the process of adopting Electronic Data Interchange (EDI) for tender purposes, and relates to the management of o the contractor selection and price determination process as part of the procurement of construction works (Joint Contract Tribunal (JCT), 2002; Royal Institution of Chattered Surveyors (RICS), 2010). The process is predominantly paperless and conducted through the internet. The e-tendering software solutions could provide additional support such as archiving completed tender process, document management, early warning of opportunities to suppliers, and maintenance of approved supplier lists (Chilipunde, 2013).

Previous studies have identified a number of advantages and disadvantages of the use of e-tendering. According to Chilipunde (2013), e-tendering leads to cost savings. Levelle and Bardon (2009) pointed out that when tender are processed electronically, there is potentials for fairer and fuller assessment of tenders with the use of computerised analysis. In addition, many web-based systems have facilities to check automatically for incomplete entries, reducing the need for additional communications, re –tendersand time spent at the analysis stage of the process. The organization decision to adopt e-tendering may be influenced by the environment of the organization (customers, suppliers other trading partners, competitors and government regulations that provide barriers and incentives to technology adoption) (Weng, Lou & Ashawi, 2009).

Technology, Organization, Environment (TOE) Framework

The TOE framework was developed by Depietro *et al.* (1990) to explain the organisational concepts that affects the firm's decision to accept innovative technology. The framework posits that three principal constructs influence the process by which an organisation adopts and accepts a new technology, these three constructs are technological, organisational and environment. Each of these factors comprises of one or more variables that defines their attributes.

The technology constructs considers the available technologies that are important to the firm, both internal and external that might be useful in enhancing organisational performance. These include technology that are already in use by the firm, as well as those that are available in the market place but are not currently in use. The variables that affects the technology constructs are uncertainty, compatibility, complexity and triability (Bahatia & Gupta, 2016).

The organisation contentt is related to the resources and the characteristics of the firm available to surpport the acceptance of innovation. This relates to firm size, complexity of managerial structure, available human resources and the centralisation (Lippert & Govindarajulu, 2006). The likely barrriers to organisation are lack of access to sufficient resources and some organisations cannot afford the in-house staff required to plan, design, execute and manage necessary software and hardwares as well as networking kit required for technology uptake (Levelle & Bardon, 2009). The environmental factor refers to the locality where the firm transacts its business and influenced by competitors, the firm's interactions with government. the resources available to the firm and government regulations that provide barriers to technology adoption (Dedrick & West, 2004).

Internal and External barrier

External barriers are barriers such as technological factor (hardware and software) organization factor and IT infrastructure (computers, databases and communication networks, stable power supply) are conceived as external barrier (Weng, Lou & Ashawi, 2009). Zhu and Kraemer (2005) considered competitive pressure, regulatory influence and availability of open-standard of information exchange as external factors inluencing the adoption of innovative technology. Competitive pressure refers to the level of pressure that an organisation is experienceing from other rivals in the same industry and adoption of innovative technology might alter the rules of competition and thereby changing the competitve environment (Lippert & Govindarajulu, 2006). While regulatory support is viewed as government policy that affect technological innovation adoption in a firm. Organisations operating in an environment where government policies are restrictive will have low adoption (Zhu & Kraemer, 2005). Internal barrier is conceived as complexity to which an innovation is perceived as being difficult to use or understand. The complexity of a technology has major effect on its adoption (Chwelos *et al*., 2001; Akbulut, 2002). This relate to firm size, security of information systems, reliability and legal protection of online transactions (Zhu & Kraemer, 2005).

Information Technology Skill/Competency (ITS)

Information technology skill/competency capability defines the degree to which IT personnel possess the skills and knowledge to perform tasks outside of their original area of training or original domain. (Byrd *et al*., 2004). High level of proficiency in the use of ICT tools is a pre-requisite for the use of e-tendering facility by industry stakeholders (Oliveira *et al*., 2014). Therefore, knowledge/skill of technological innovation is considered in this study as another component of the organization that can influence the adoption of e-tendering by firms. Technology skill considers the totality of knowledge within a particular organization. This relates to the quality of the human resources in terms training received. Similarly, according to Rogers

(2003), knowledge is the first stage in innovation adoption process.

Theoretical Hypotheses

H1: Internal barrier positively affect IT skill /competency

H2: External barrier positively affects IT skill/competency

H3: Internal barrier positively affects E-tendering Adoption

H4 External barrier positively affects E-tendering Adoption

H5 IT skill/competency positively affects E-tendering adoption

H6: IT skill/ competency mediates between internal barrier and E-tendering adoption

H7: IT skill / competency mediates between external barrier and E-tendering adoption

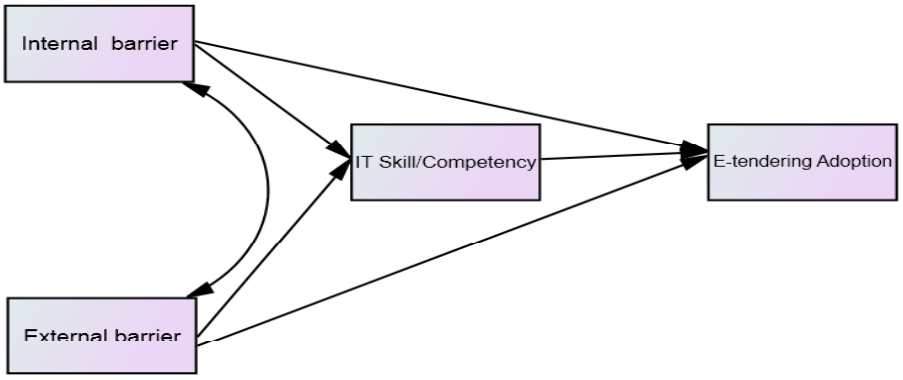

Figure 1 Hypothesized Model

Method

The questionnaire was administered on professionals in the construction industry (architect, quantity surveyors, engineers, builders and estimators in consulting and contracting organizations). The questions are rated on a 5 point Likert scale ranging from strongly agree (SA) =5 to strongly disagree (SD) =1. The study used a total of 270 questionnaires received from industry practitioners in various organisations in the North Central Nigeria including Abuja. The data was analysed using SPSS and AMOS through structural equation modelling (SEM).

Test for Sample Size Adequacy

In order to ascertain the appropriateness of data for confirmatory factor analysis through SEM, the Kaiser-Meyer-Olkin (KMO) test as proposed by Lewis *et al.* (2005) was conducted. The results in Table 1 below illustrates that the KMO test yields an acceptable score of 0.94.

Reliability and convergent validity of constructs

The results in Table 2 show that all constructs have their alpha value >7 .0.

Holmes-Smith (2007) recommended 0.7 item loading as the acceptable threshold for the evaluation of convergent validity.

Table 1: KMO test on sample size adequacy

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.935
Bartlett's Test of Sphericity	Approx. Chi-Square	9965.840
	df	780
	Sig.	.000

Table. 2 Reliability and convergent validity of constructs

Constructs	Item Code	Description	Factor Loading	Cronbach's Alpha
Internal Barrier	Int1	Size of firm	.606	.764
	Int2	Legal protection of online transactions	.756	
	Int3	Security (Hacking and tracking of user data)	.579	
	Int4	Lack of agreed standard	.755	
External Barrier	Ext1	Availability of hardware and software	.706	.815
	Ext2	Regulatory influence (government policy)	.631	
	Ext3	Poor ICT infrastructure to support e-tendering	. 781	
	Ext4	Competitive pressure	.787	
IT skill/competency	ITS1	I am skilled in multiple operating systems	.876	.913
	ITS2	I am skilled in multiple programming languages	.886	
	ITS3	I am able to adapt quickly to changes in business processes using new technologies	.882	
E-T Adoption	ET1	I am mostly likely to use e-tendering in my next contract bidding	.865	.912
	ET2	I am motivated by the level of efficiency using e-tendering	.929	
	ET3	I am satisfied with the outcome of contract bids done via e-tendering	.840	
	ET4	Using E-tendering improves our operational efficiency	.765	

Results

Results shows that about 45.6% of respondents are from the contracting organization, 41.2% from consulting and 13.2% from client organization. In terms of educational qualification, 42.6% had MSc degree, 29.4% had HND/BSc degree, 23.5% PhD and 4.4% Diploma certificate. More than half (52.5%) of the respondents have work experience that ranged between 6-15 years, 16.2% between 16-20 years, 23.5% < 5 years and 7.4% >20 years. About 36.8% of the respondents are quantity surveyor, while 25% are architect, 19.1% Estimator, 11.8% engineer (civil and services) and 7.4% builder.

Structural model:After the reliability and validity tests, SEM through AMOS was utilized to test the research model (Figure 1), in order to examine the relationships that exist between the constructs and confirm the hypotheses. In this research, three model fit indices: (i) Root mean square error of approximation (RMSEA), (ii) Comparative fit index (CFI) and (iii) Goodness of fit index (GFI) were adopted for model evaluation.

The RMSEA value of 0.07, CFI of 0.94, and GFI 0.90 are all within acceptable range (Bentler, 1999; Hu & Bentler, 1999). What this means therefore, is that the data fits the hypothesized structural model.

Table 4: Model fit indices

RMSEA					
Model	RMSEA	LO 90	HI 90	PCLOSE	
Default model	.078	.066	.090	.000	
Independence model	.288	.279	.298	.000	
Baseline Comparisons					
Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.911	.889	.941	.926	.941
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000
RMR, GFI					
Model	RMR	GFI	AGFI	PGFI	
Default model	.050	.907	.867	.635	
Saturated model	.000	1.000			
Independence model	.374	.302	.202	.264	
χ^2 = 246.103					

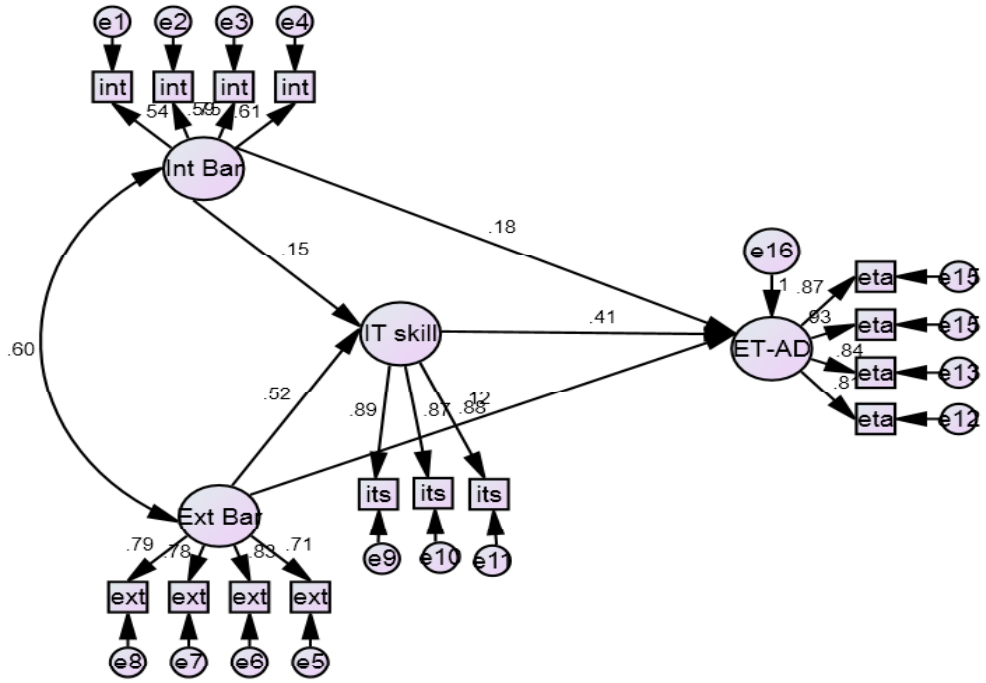

Figure 2: Full structural model

Discussion

Having established that the data fits the model, the next stage is to examine the relationship that exists between the constructs in order to confirm the hypotheses. The path coefficients of the constructs are presented in Figure 2. Results from the path coefficient show that H1: a positive relationship exist between internal barrier and IT skill/competency (β =. 15, p<0.05), H2: positive relationship exists between external barrier and IT skill/competency (β = .52, p<0.05), H3: positive relationship exists between internal barrier and E-tendering adoption (β= .18, p<0.05), H4: positive relationship exists between external barrier and E-tendering adoption (β= .12, p<0.05) and H5:IT skill/competency positively affects E-tendering adoption (β= .41, p<0.05). Furthermore, the mediating role of IT skill/competency on E-tendering adoption was examined.

IT skill mediates between internal barrier and E-tendering adoption

In a bid to identify the type of mediation that exists between IT skill, internal barrier and E-tendering adoption, the regression equations represented by the diagram in Figure 2 are presented:

A= U0 + U1K +e is the path from K to A
B = U0+U3K+e is the path from K to B
A= U0+ U2W+e is the path from B to Y
A = E-tendering Adoption
K = Internal barrier
N= External barrier
B = IT skill

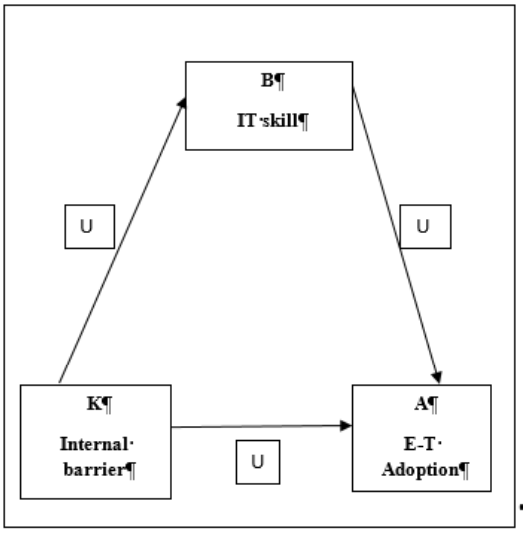

Figure 3 Testing Mediatory role of IT skill

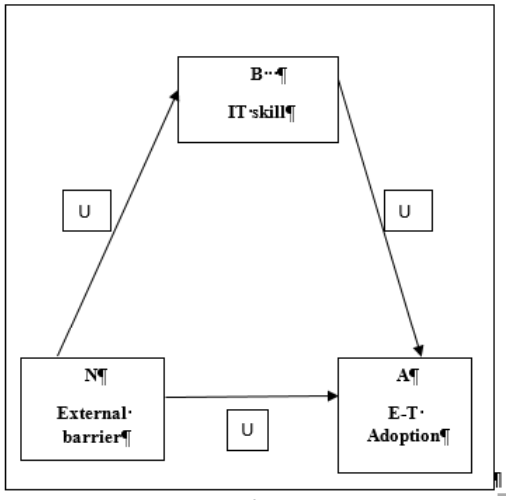

Figure 3: Mediating role of IT skill between Internal and External barriers and E-tendering adoption**.**

The path analysis to examine the effect of B (IT skill/competency) in mediating the relationship between K (Internal barriers), N (External barriers) and A (E-tendering Adoption) could result in one of the three possibilities:

I. B plays a complete mediation role in the relationship between K and A
II. B plays a partial mediation role in the relationship between K and A
III. B plays no mediation role in the relationship between K and A

Complete mediation role of B occurs if: (1) the regression coefficient of U1 is not significant, (2) regression coefficient of U2 is significant and (3) regression coefficient of U3 is significant

Partial mediation role of B occurs if: (1) the regression coefficient of U1 is still significant, (2) regression coefficient of U2 is significant (3) regression coefficient of U3 is significant and (4) the absolute value of U2*U3 is higher than absolute value of U1

No mediation role of B occurs if: (1) the regression coefficient of U1 is not significant, (2) regression coefficient of U2 is not significant and (3) regression coefficient of U3 is not significant

The results from the full structural model (Figure 2) show that the regression coefficient between Internal barriers (K) and E-tendering adoption (A) is significant (β=.18, $p<0.05$), regression coefficient K to B (IT skill) significant (β=.15, $p<0.05$), B to A significant (β=.41, $p<0.05$) and lastly, the absolute value of U2* U3(i.e. regression coefficient of K to B and B to A) is higher than the value of U1 (i.e. regression coefficient of K to A). Similarly, results reveal that regression coefficient between external barriers (N) and E-tendering adoption (A) is significant (β=0.12, $p<0.05$), between N to B significant (β= $p<0.05$), B to A significant (β=.41, $p<0.05$) and U2* U3 is higher than UI. Based on these results, IT skills partially mediate between internal and external barriers and E-tendering adoption.

Table 5: Summary of the hypotheses

Hypothesis Statement for path Analysis	**Estimate (β)**	**p-value**	**Results on hypotheses**
H1: Internal barrier positively affect IT skill /competency	.15	P<0.05	Supported
H2 : External barrier positively affects IT skill/competency	.52	P<0.05	Supported
H3 : Internal barrier positively affects E-tendering Adoption	.18	P<0.05	Supported
H4 External barrier positively affects E-tendering Adoption	.12	P<0.05	Supported
H5 IT skill/competency positively affects E-tendering adoption	.41	P<0.05	Supported
*/H6: IT skill/ competency mediates between internal barriers and E-tendering adoption	.15*.41 > .18	regression coefficient of K to B and B to A) is higher than regression coefficient	Supported

Hypothesis Statement for path Analysis	Estimate (β)	p-value	Results on hypotheses
		of K to A (Partial mediation)	
H7: IT skill / competency mediates between external barriers and E-tendering adoption	.52*.41>.12	regression coefficient of N to B and B to A) is higher than regression coefficient of N to A (Partial mediation)	Supported

This study has identified the factors that influence e-tendering adoption in a developing country like Nigeria. The result suggests that external barrier (β= .52) and internal barrier (β=.15) have a strong positive influence on IT skill/competency which inurn influences its adoption. External barrier implies availability of hardware and software, regulatory influence, poor ICT infrastructure to support e-tendering and competitive pressure. Fernandes and Vieira (2015) who ranked external factors in order of priority have also observed that government influence ranked highest in the external factors affecting e-procurement. This is also in line with Oliveira and Martins (2011) that security threats to online transaction such as hacking and cracking user data.

IT skill on the other hand, has strong positive effect (β= .41) on E-tendering adoption. Also Internal (β=.18) and external barriers (β=.12) respectively have a direct positive effect on E-tendering adoption. The result also indicates that IT skill partially mediates between internal and external barriers and E-tendering adoption. In general, it could be seen from the predicting power (standardized coefficients) of the constructs in the structural model, that IT skill has the strongest influence on E-tendering adoption. What this suggests therefore, is that a sound IT skill will influence E-tendering adoption among the various professionals in consulting and contracting firms in Nigeria. This finding is in line with Ugwu and Kumaraswamy (2007) that knowledge creation, sharing, diffusion and re-use constitute the main underpinning for executing innovative technology in construction business process, without these there will be increasing difficulty in for knowledge creation, storage, re-use and increasing difficulty for standardization.

Conclusion

This paper has revealed that the important factors that constitutes barriers to e-tendering were classified into external factors, internal factors and IT skill. The study shows that there is positive relationship between external barrier and e-tendering adoption. External barriers are factors are availability of hardware and software, government policy, poor ICT infrastructure to support e-tendering and competitive pressure from rival organisations in the industry. Similarly, internal factors include the size of firm, legal protection of online transactions security (hacking and tracking of user data) and lack of agreed standard have significant impact on the organisation's intention to use e-tendering. In addition, the IT skill of organisation's labour force will determine organisation's readiness to adopt new technology such as e-tendering. In the structural model developed through SEM, the overall fit shows a good one with RMSEA value of.078 and CFI of.941. IT skill plays mediatory role between external and internal barriers and e-tendering adoption. In general, the study has revealed the external and internal barriers to e-tendering adoption as well as the mediating role of IT skill. These findings will enable the policy makers and other industry players to understand the barriers to the implementation of e-tendering adoption and develop strategies to overcome them.

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