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E-MATURITY OF CONSTRUCTION STAKEHOLDERS FOR A WEB-BASED E-PROCUREMENT PLATFORM IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

It is been over 40 years since the introduction of ICT tools and systems into the construction industry, yet construction organizations are still unable to obtain the many potential benefits of ICT investment. The purpose of the study was to investigate the e-maturity of construction stakeholders for a web-based e-procurement platform in the construction industry. The study utilized an attitudinal survey research design and the design of a web-based e-procurement platform. Using a system block design and a use case diagram in relation with PHP programming language, MySQL, CSS and HTML a web-based e-procurement platform for tendering purposes in the construction process was developed. The study was conducted within a private tertiary institution in South-Western Nigeria that has the desire to exploit the potentials of a web-based e-procurement system. The sample size of one hundred (100) respondents were selected through a non-probabilistic sampling method, while a questionnaire instrument was administered. Statistical tools such as Stacked Bar chart, percentage, Wilcoxon signed rank test and Kolmogorov-Smirnov test were used to analyze the data obtained. The study revealed that there is no significant difference in the e-maturity between client and contractor for a web-based e-procurement platform for tendering purposes within the institution. The study showed that the tertiary institution and its registered contractors have the same positive perspective on the benefits of utilizing a web-based e-procurement solution for tendering purposes. In conclusion, the study developed a prototype web-based e-procurement platform for tendering purposes that can be utilized for construction works within the tertiary institution. The study recommended the use of web-based e-procurement platforms due to the many benefits

that can be acquired from its use. In addition, the construction industry should readily embrace ICT solutions in order to solve diverse challenges pervading the industry.

Key words: Construction Stakeholders, e-Maturity, e-Procurement, IT-Barometer, Web-Based Systems.

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1. INTRODUCTION

Innovation in the Information and Communication Technology (ICT) world has been changing and helping the way activities in the construction industry are run (Issa et al., 2003). The peculiar and complex characteristics of the construction industry such as intensive-information, large number of project stakeholders and diverse phases in the construction process requires that innovative tools are carefully integrated and utilized (Kumaraswamy *et al*., 2006)

One of such innovative ICT tools introduced into the construction industry from the e-commerce world is the e-procurement platform. The concept is not new to the construction industry in developed and developing countries. New South Wales (NSW) Government (1998) and Kajewski and Weippert (2000) have noted that the construction industry is unbending in adjusting to innovative ICT and electronic correspondence tools which is attributable to significant unawareness and low e-maturity among project stakeholders about frameworks and arrangements which may improve value in the procurement, conveyance and life cycle of projects.

A survey on the usage of IT in the construction industry of Sri Lanka revealed that there is organization-wide poor utilization of IT (Mettananda, 2004). While Oyediran and Odusami (2005) studied the extent of usage of the computer particularly among Nigerian quantity surveyors, Oladapo (2007) studied the influence of information and communication technology on professional practice. These studies were geared to measuring the e-maturity of construction stakeholders in the construction industry. E-maturity in this context is the extent of ICT compliance in terms of usage and capabilities in any ICT innovative tool.

The e-procurement platforms are carefully thought out tools to help reduce the many draw-backs associated with the traditional contractual procurement process (Tindsley and Stephenson, 2008). The concept of e-procurement leverages on the existing traditional tendering protocols of an organization and brings about several benefits accrued to the implementing organization and its registered and prospective contractors (Black, Du and Nieto, 2005).

Apart from the tangible benefits which e-procurement offers, to ensure sustainability of the platform, it is important to inquire the level of awareness and participation of construction stakeholders on the use of the innovative e-procurement tool (Adebiyi et al., 2010). Oyediran and Akintola (2011) agreed that awareness measurement of innovative platforms is a basic factor in promoting widespread acceptance and usage as a better alternative to traditional processes. Perera and Karunasena (2008) opined that the inability of construction organizations to effectively exploit ICT solutions often creates a difficulty in justifying future expansion and use of IT innovations. This notion is justified by the ground breaking work by

Samuelson (2002) involving an IT barometer of the Nordic Construction industry (Sweden, Denmark and Finland). The survey produced knowledge about the use of computers, hard- and software, communications, and plans and strategies for the use of IT, thereby construction firms can make better decisions on their IT investments.

Several studies have researched about the use, benefits and limitations of e-procurement platforms. The distinctiveness of this research is the attention given to measuring e-readiness and e-maturity of construction stakeholders in a tertiary institution in the use of an e-procurement platform. Tertiary institutions unlike client organizations are dedicated to education and research and therefore should be a point of reference in the use of innovative ICT tools to transform every sphere of life's endeavours. With funding from several sources, tertiary institutions are engaged in a lot of procurement activities all year round. Most times, these funds are limited and consequently there should be high levels of accountability. In the study by Kareem et al. (2014) on fifteen (15) tertiary educational institutions, findings indicated that in seventy-four (74) construction projects investigated, many of the projects were either completed off time schedule and above cost estimate or abandoned out rightly due to lack of promptness in bid evaluation, contract award and certificate honouring, fraudulent and corrupt practices in bid analysis and evaluation among others. A review of literature revealed that there is not much researched in the implementation of web-based tendering for procurement purposes in tertiary institutions and measuring the e-readiness of clients and contractors. Therefore, the study aimed at investigating the e-maturity of Nigerian Tertiary Institution Construction Stakeholders for a Web-Based e-Procurement Platform. The following research questions would guide the execution of the research work:

- Is there a difference in the e-maturity between client and contractor for a web-based e-procurement platform for tendering purposes within the institution?
- Is there a difference on the importance of using a web-based e-procurement platform for tendering purposes between clients and contractors in a tertiary institution?
- How can a web-based e-procurement platform for tendering purposes for construction works within a tertiary institution be developed?

2. REVIEW OF LITERATURE

The World Bank's meaning of e-procurement is wide in that it accommodates the utilization of ICT in conducting procurement relationships with suppliers for the acquisition of goods, works, and consultancy services (World Bank, 2003). E-procurement is the online purchasing of goods and services through electronic channels (Parida and Parida, 2005). More, specifically, it is the use of electronic means for publishing, processing, exchanging, and storing all of the information related to institutional purchases in public organization (Assar and Boughzala, 2008). Bett *et al.* (2006) described a step by step process for e-tendering as depicted in Figure 1.

In the study by Eadie, Perera and Heaney (2010), a cross-discipline comparison of rankings for e-procurement drivers and barriers within UK construction organisations revealed the strategic developments required in e-procurement adoption. Findings in the Northern Ireland study by Eadie *et al.* (2007) showed that the drivers in the use of e-procurement platforms by the contractors were improving communication and reduced administration costs, while the two most important barriers were security of transactions and the uncertainty surrounding the legal issues of e-procurement. Other studies on the driver and barriers have been carried out in the US (Davila *et al.*, 2004), Australia (Hawkings *et al.*, 2004) and Europe (Westcott and Mayer, 2002). In the South African construction industry,

the factors with the highest positive impact on the use of e-procurement technologies in construction firms were the speed of transactions, lower transaction cost and ease of use; unreliable IT infrastructure, established cultures and security concerns were the main impediments to the uptake of e-Procurement technologies (Ibem and Laryea, 2015). In Bangladesh civil society leaders called for introducing e-procurement system in public tenders to eliminate corruption and collusive bidding practices to ensure transparency.

The benefits of integrating an e-procurement platform with the existing traditional procurement process cannot be overemphasized. Oyediran and Akintola (2011) noted that it is a veritable tool for increasing productivity and empowering construction industry professionals to take better control of the construction process. Kajewski and Weippert (2004) added that the e-solution offers additional opportunities for industry businesses, contributing to a globally competitive economy, and helping secure a sustained economic growth. A significant benefit to cost ratio must be achieved for the use of such technology to be acceptable (Davila and Gupta, 2002).

Organizations already using e-tendering technologies report a savings of up to forty two percent in transaction costs; most of this is associated with less paper work, which translates to fewer mistakes and more efficient procurement process (Oyediran and Akintola, 2011). Albano and Dae (2010) revealed that while the USA, Australia and New Zealand make use of e-procurement solutions to pursue best value for money in awarding public contracts, Korea seems to put more importance on e-procurement as a way to improve transparency and reduce transaction cost. Despite these benefits, Martin (2008) showed that the uptake of e-procurement solutions have not been as expected within the construction industry. European Commission (2007), Grilo and Jardim-Gonclaves (2010) and Eadie *et al.* (2011) viewed that the AEC sector has been lagging behind other sectors in the adoption of e-procurement. Martin (2008) reported that less than 20% of construction organisations use e-procurement in the UK, while across Europe, Westcott and Mayer (2002) noted that the use is 24%. The scenario is not different in developing countries such as Nigeria with only 15.8% of the professionals having actually participated in tendering through electronic means (Oyediran and Akintola, 2011). In the study by Oyediran and Akintola (2011), this was attributed to the relatively low education of a large number of contractors in the Nigerian construction industry. In the Canadian Architectural, Engineering, and Construction industry (AEC), Rankin *et al.* (2006) admitted that the industry wants to remain with the traditional procurement process, even after admitting the advantages of e-procurement solutions. Reasons include the need for personal contact in a competitive environment and the effect that it will have on long-term relationships with customers, as well as the learning curve of using new technologies.

Rezgui *et al.* (2004); Brewer, Gajendran, and Chen (2005); Pasupathinathan and Pieprzyk (2008) suggested reasons for poor adoption of e-tendering as issues relating to the legal ramifications of electronic communications, vague security framework, ownership of intellectual property, and the capture/management of the knowledge generated during the project, as well as issues of trust have been prominent in these postulations. On the issues of poor security, Betts *et al.* (2006) proposed a new e-tendering architecture, using distributed trusted third parties to ensure the integrity of the platform. Kajewski and Weippert (2004) hinged the barriers obstructing the successful implementation and adoption of an e-tendering system or process on three main themes employment barrier, security barrier and legal barrier. Oyediran and Akintola (2011) examined the state of e-tendering among construction professionals. The study found out that general lack of basic e-tendering infrastructure, low proficiency in the use of e-tendering technologies, irregular power supply, cost of e-tendering

technologies and absence of legal backing for electronic transactions were the key barriers to the uptake of e-tendering in Nigeria. Table 1 showed issues raised by some authors on e-procurement platforms for tendering purposes. It is evident that a lot of research has been skewed towards identifying theoretical success factors without measuring the e-maturity of prospective users of the platform and development of such e-procurement platform for use.

Table 1 Some studies on e-procurement from different authors

S/N	Scope	Country	Description	Authors
1.	Benefits, Challenges and Recommendation	Australia	Overall 'snapshot' of current public and private construction industry sector opportunities and practices in the implementation and application of e-Tendering.	Kajewski & Weippert (2004)
2.	Implementation	Bangladesh	e-Government in public procurement	Mahmood (2013)
3.	Security and Legality	Australia	Critical examination of the security and legal requirements for e-tendering systems in the design of e-tendering systems	Bett *et al.* (2006)
4.	E-tendering Prototype	Malaysia	Document flow speed in a prototype e-tendering system	Ezanee *et al.* (2005)
5.	Success factors for e-tendering	UK	People, Process and e-tendering environment, Key Success factors, Case Studies	Lou & Alshawi (2009)
6.	Public sector	Nigeria	Drawbacks of existing procurement process, development of a prototype e-GP system to improve procurement cycle process flow in the public sector	Adebiyi *et al.* (2010)
7.	Awareness and Facilities	Nigeria	Facilities, Benefits and Proficiencies needed for e-tendering, Benefits & Challenges, Legal framework and level of awareness	Oyediran & Akintola (2011)
8.	Activities of e-procurement and key challenges	Canada	Survey of general and trade contractors, suppliers and associates on the use of e-procurement	Rankin *et al.* (2006)
9.	Limitations in adoption	Turkey	Barriers to e-Procurement in the AEC industry.	Isikdag *et al.* (2011)

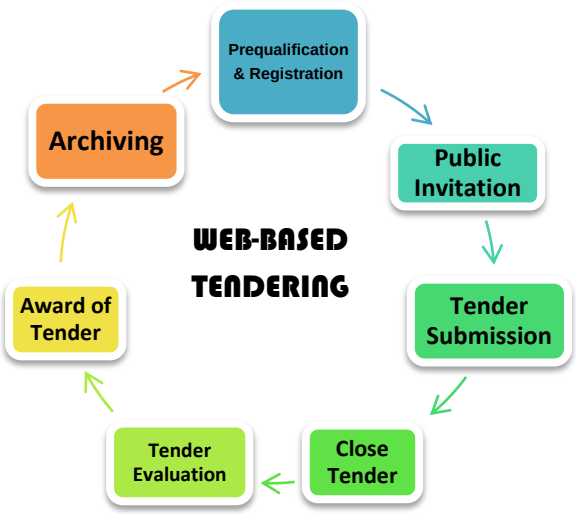

Figure 1 Steps in a typical web-based e-tendering system

Adapted from Betts et al. (2006)

3. METHODOLOGY

Many web tendering systems have been developed for procurement purposes in the construction industry of some developed countries. This research developed a system for procurement of tenders in a tertiary institution in Nigeria. Using survey research design, this study also examined the readiness of contractors and client in the use of ICT in tendering

activities within the tertiary institution in Ogun State. The use of survey research ensured that the data is able to reveal the trends and opinions of the population when a sample of the population is studied (Cresswell, 2014). The study adopted an attitudinal research strategy as well as quantitative research method in eliciting data for the research.

The survey was conducted among professionals contracting organizations procuring construction contracts as well as professionals with Covenant University, Ota, Ogun state. The institution was chosen because of its desire to exploit the potential of a web-based e-procurement system in order to increase productivity and efficiency. The institution was selected for the study because of the non-uniqueness of their construction projects, stakeholders involved, procurement methods used for procuring construction projects and the special planning procedure required for their construction projects.

The population of the study comprised of construction professionals such as architect, builders, quantity surveyors and civil engineers from the tertiary institution as a client organization. These set of professionals from client organization include four (4) groups of people; management staffs, academician, CSIS (Centre for systems and information services) staff in charge of their ICT solutions and the Physical planning development department (PPDD). The second class of professionals represent the interest of contracting organizations registered with the institutions. The contractors are in three categories; Class A, Class B and Class C. The research adopted a non-probabilistic sampling method; convenience sampling. This techniques was used because of the failure to obtain the comprehensive list of professionals within the outlined categories as at the time of carrying out this study.

The study used a research questionnaire as the data collection instrument. However, before administering the instrument, it was made available to information technology experts and two experienced construction professionals within the institutions for review. Corrections were made and used in eliciting data from the target respondents. Two questionnaires were self-administered, each to contractor and client respectively. The research instrument is divided into three sections; Section A consists of demographic information of respondents, while Section B examined the e-maturity for e-procurement solutions for tendering purposes of the contractor and client and Section C assessed the importance of using e-procurement systems for tendering purposes.

The study sets out to test the readiness/maturity and importance of contractors and client in the use of ICT in tendering activities by setting up the hypotheses of the study. While the first hypothesis examined the maturity/readiness of construction stakeholders in the use of ICT in the procurement of construction works, the second hypothesis assessed the significant difference of contractors and client on the importance of e-procurement solutions in construction.

One hundred (100) copies of the research questionnaires were administered to the target respondents via email, 61 were completed and returned. This represents 58% response rate. The returned instrument were scrutinized for errors, omissions and completeness and 58 were adequately completed and thereafter used for analyzing the collected data. Stacked Bar chart, percentage, Wilcoxon signed rank test and Kolmogorov-Smirnov test were used to analyze the hypotheses of the study.

The study also engendered the development of a web app using an incremental model. The Unified Modelling Language (UML) approach was used to capture the system requirements and design. A system block diagram that described the various interfaces on the e-procurement site was presented and a use case diagram to show the various interaction

between the users and the system is described in the study. The web-based tendering system developed is a web application that can be accessed from online browsers connected to the internet. The website was designed using PHP, MYSQL, CSS and HTML. PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language, MYSQL is an open-source relational database management system (RDBMS and the 'SQL' abbreviation stands for Structured Query Language, Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language. CSS is designed primarily to enable the separation of document content from document presentation, including aspects such as the layout, colors, and fonts while Hyper Text Markup Language, commonly referred to as HTML, is the standard markup language used to create web pages. Web browsers can read HTML files and render them into visible or audible web page and this is why it was used for this project.

4. RESULTS AND FINDINGS

Before interpreting the research findings, it is important to consider general characteristics of the respondents.

4.1. Background information

Descriptive statistics about the respondents and their corresponding organizations are presented in Figure 2.

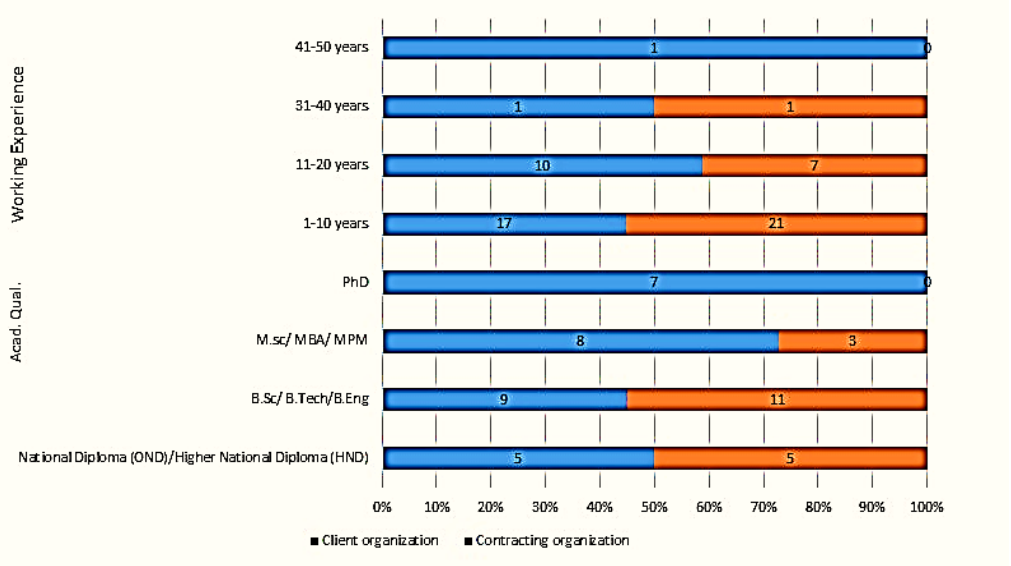

Figure 2 Summary of Background Information

Figure 2 revealed that majority (83%) of respondents from client organization have formal education to participate in the survey, while 49% of the respondents of contracting organizations have minimum of Bachelors (B.Sc.) degree. As depicted in Figure 2, 12 (41%) of the respondents working with the client organizations have more than 10years construction industry experience, while 8 (28%) of respondents with the contracting organizations have more than 10years working experience. This shows that considerable number of respondents have requisite construction industry experience to provide relevant information to participate in the survey.

4.2. Experience obtaining tendering documents through the internet

This section examined the experience of construction professionals with contracting and client organization in obtaining tenders through the internet. The result was provided in the bar chart shown in Figure 3. As shown, the figure indicated that 18 (62%) of respondents (client organization) have not used internet for tendering purposes. Similarly, 14 (48%) of respondents (contracting organizations) have not used the internet to obtain tender documents in time past.

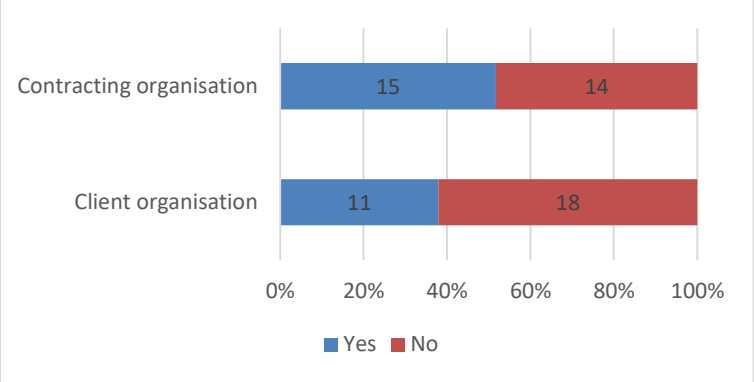

Figure 3 Experience obtaining tendering documents using the internet

Figure 3 showed that 11 (38%) and 15 (52%) of respondents have obtained tender documents via the internet for client and contracting organizations respectively. This is in agreement with the study by Oyediran and Akintola (2011) which indicated that more that 50% construction professionals have knowledge of obtaining contract documents via the World Wide Web (WWW). Since a large percentage of the respondents have participated at one time or the other in electronic transmission of tender documents, there is need to measure the e-maturity of the respondents in terms of ICT tools that the respondents possess in order to participate in an e-procurement solution for tendering purposes.

4.3. E-maturity of construction stakeholders for a web-based e-procurement platform

This section showed the e-maturity of stakeholders for a web-based e-procurement platform for tendering purposes using certain ICT parameters such as personal or company email, Microsoft Word, Personal Computer, Microsoft Excel, Microsoft PowerPoint, Power Supply, Internet Facilities, Mobile Device, company Website, Microsoft Project, Autocad, Trained IT Specialist, Ipad/Notebook. The study tested a hypothesis statement to find out whether construction stakeholders are able to significantly participate on an e-procurement platform. The hypothesis statement where H_0 is the null hypothesis and H_1 is the alternate hypothesis;

H_0: There is no significant difference in the e-maturity between client and contractor for a web-based e-procurement platform for tendering purposes.

H_1: There is significant difference in the e-readiness between client and contractor for a web-based e-procurement platform for tendering purposes.

The study deployed Wilcoxon signed rank test; a non-parametric test alternative of paired sample test and the output is presented by Table 2. The decision states that when p-value < 0.05, the null hypothesis is rejected while the alternative hypothesis is accepted. The test conducted a mean rank to determine the respondents that are more willing to adopt ICT in the procurement process. Table 2 showed that the client has higher mean rank for most of the ICT

parameters than the contractor, therefore it can be implied that client organization have more ICT tools than the contracting organizations.

Table 2 revealed the number of differences among respondents from contracting and client organization. It can be confirmed that there are higher number of respondents (client and contractor) that indicated there is no significant difference on the e-maturity of ICT parameters between the two classes of respondents. As depicted by Table 2, p value > 0.05 for all the parameters except the use of personal computer and website. This confirmed that there is no significant difference between contracting and client organization under review in their e-maturity in the use of personal computers and website in procuring construction works. In addition, the significance two tailed test further confirmed that there is no significant difference for almost all the ICT parameters. Hence, the null hypothesis is accepted which states that 'there is no significant difference in the e-maturity between client and contractor for a web-based e-procurement platform for tendering purposes' and reject the alternative hypothesis.

Table 2 Wilcoxon signed rank test for significant difference of the e-maturity

		N	Respondents	Mean rank	Z-score	Sig
	Positive difference	10	Client	7.30	-2.066	0.039
Pair 1 (Personal computer)	Negative difference	3	Contractor	6.00		
	No difference	16				
	Positive difference	5	Client	4.40	-1.403	0.161
Pair 2 (Email)	Negative difference	2	Contractor	3.00		
	No difference	22				
Pair 3 (Internet facilities	+ difference	6	Client	9.75	-0.089	0.929
	- difference	9	Contractor	6.83		
	No difference	14				
Pair 4 (Website)	+ difference	14	Client	10.71	-2.234	0.025
	- difference	5	Contractor	8.00		
	No difference	10				
Pair 5 (Microsoft word)	+ difference	8	Client	6.50	-1.155	0.248
	- difference	4	Contractor	6.50		
	No difference	17				
Pair 6 (Microsoft Excel)	+ difference	9	Client	7.00	-1.252	0.210
	- difference	4	Contractor	7.00		
	No difference	16				
Pair 7 (Microsoft power point)	+ difference	14	Client	10.21	-2.623	0.009
	- difference	4	Contractor	7.00		
	No difference	11				
Pair 8 (Microsoft project)	+ difference	12	Client	11.63	-0.046	0.963
	- difference	11	Contractor	12.41		
	No difference	6				
Pair 9 (Autocad)	+ difference	7	Client	8.50	-0.839	0.401
	- difference	10	Contractor	9.35		
	No difference	12				
Pair 10 (I-pad/Notebook)	+ difference	8	Client	6.56	-0.820	0.412
	- difference	8	Contractor	10.44		
	No difference	13				
Pair 11 (constant power supply)	+ difference	6	Client	10.29	-1.718	0.086
	- difference	12	Contractor	7.92		
	No difference	11				
Pair 12 (Trained IT specialist)	+ difference	14	Client	14.14	-0.597	0.550
	- difference	12	Contractor	12.75		
	No difference	3				
Pair 13 (Mobile device)	+ difference	8	Client	6.50	-0.034	0.973
	- difference	6	Contractor	8.83		
	No difference	15				

This means that all stakeholder in the tertiary institution are at par in the necessary facilities to implement a web-based e-procurement solution for tendering purposes. Oladapo (2007) observed that contrary to expectation, the level of use of computers is very high (98.5%) for a developing country like Nigeria. Lou and Alshawi (2009) stated that construction businesses are gradually moving away from traditional processes to modern and efficient ways of working, mainly through electronic media. Oladapo (2007) noted that over 60% of construction professionals are currently connected to the internet either through desktops and smartphones. In the study by Oyediran and Akintola (2011), construction industry professionals had high availability of computer systems, client operating systems and computer aided design software, while the availability of all other facilities were adjudged marginal and despite this below average level of availability, the available facilities are in good condition to facilitate participation in e-procurement for tendering purposes. It is adjudged that both client and contractor base of the Nigerian tertiary institution are e-matured to engage in implementing an e-procurement solution for their construction works.

4.4. Importance of using a web-based e-Procurement solution for tendering purposes

This section shows the importance of using a web-based e-procurement platform for tendering purposes for construction works in the tertiary institution considered. The importance of this section is to find out if the client base, that is, the tertiary institution and their registered contractors see benefits that can be derived from the use of a web-based e-procurement solution in the construction works process. A synergized benefit from both quarters could result in a greater success and speedy implementation of the innovative solution. Variables identified from literature such as Faster tendering process, Reduction in the use of paper, Ease of documenting transactions, Increased level of accountability, Ease of accessibility to tendering documents, Increased level of transparency in process, Reduction in cost of tendering, Increased competition among tenders, Increased innovation and creativity and Reduced corruption were used for the study. Using the hypothesis testing of where H_{01} is the null hypothesis and H_2 is the alternate hypothesis;

H_{01}: there is no significant difference on the importance of using a web-based e-procurement platform for tendering purposes between clients and contractors in a tertiary institution.

H_2: there is significant difference on the importance of using a web-based e-procurement platform for tendering purposes between clients and contractors in a tertiary institution.

The analysis deploys two-sample Kolmogorov-Smirnov test to carry out inferential investigation on the importance of e-procurement platforms for tendering purposes between client and contractor. The result of the analysis is presented in Table 3.

Table 3 Kolmogorov-Smirnov test for Significant Difference in importance of using e-Procurement platforms for tendering purposes between contractor and client

		Importance
Most Extreme Differences	Absolute	.138
	Positive	.069
	Negative	-.138
Kolmogorov-Smirnov Z		.525
Asymp. Sig. (2-tailed)		.945

Grouping Variable: Type of Organisation (Contractor and Client)

The decision rule states that when p-value < 0.05, the null hypothesis is rejected while the alternative hypothesis is accepted and vice versa. Table 3 revealed that p-value > 0.05, the null hypothesis is accepted while the alternative hypothesis is rejected. This confirms that there is no significant difference between the client and contracting organizations in a tertiary institution on the importance of utilizing a web-based e-procurement solution in the construction works process. This means that from the perspective of the client base which consists of the department in charge of works (PPD), CSIS, lecturers and Management staff and the contractor base agree that the implementation of a web-based e-procurement platform for tendering purposes for their construction works would impact the construction project delivery. This is in conformity with findings by Oladapo (2007) which stated that there is a general consensus in the Nigerian construction industry about the benefits of using ICT. Oyediran and Akintola (2011) argued that the importance of e-procurement solutions for tendering purposes are numerous and immediately obvious to both client organizations and contractors. With over 50% of construction stakeholders aware about e-procurement solutions for tendering purposes over a decade ago (Oyediran, 2005), Oladapo (2007) and Oyediran and Akintola (2011) opined that the use of e-procurement solutions for tendering purposes in the Nigerian construction industry has high prospects, because industry professionals are not ignorant of the benefits. Several researchers have reported on the benefits of implementing e-procurement solutions for tendering purposes from reduced cost of tender documentation (Lou and Alshawi, 2009), streamlined process (Adebiyi et al. 2010), increased efficiency and transparency (Ezanee et al., 2003), paperless economy (Shapiro and Varian, 1999), reduce corruption and misuse of power (Sohail and Cavill, 2008), ease of monitoring (Aman and Kasimin, 2011), remote accessibility (Oyediran and Akintola, 2011) to increased quality, timeliness and cost-effectiveness of a tender process (Kajewski and Weippert, 2004). The general belief is that e-procurement solutions for tendering purposes increase productivity from the traditional way of tendering. Oyediran and Akintola (2011) assured that e-procurement solutions for tendering purposes does not interfere with the traditional roles of project team members and therefore is not seen as a threat in the construction industry, noting that private and public institutions that have implemented e-procurement solutions for tendering purposes have recorded significant gains. Savings as much as forty two percent in transaction costs.

4.5. System Design and Implementation for the a web-based e-procurement platform for tendering purposes

The facilities required for the implementation of a viable a web-based e-procurement solution for tendering purposes may be grouped into three separate categories, hardware, software and internet/network facilities (Oyediran and Akintola, 2011). The web-based e-procurement platform for tendering purposes would be designed to be user friendly by providing help tools without a complicated process of operation. The protocol will have a database to archive information on tenders and the information of respective contractors of the platform. Following the typical steps identified by Betts et al. (2006) in e-tendering process, this e-procurement platform for tendering purposes is designed. Figure 4 described the system block diagram of the e-procurement site for a tertiary institution. The system block diagram takes into cognizance the steps to e-tendering as described in Figure 1. Figure 5 showed the use case diagram of the users and their interaction with the e-procurement platform designed. There are three (3) main users of the system, the administrator, the contractors and the tender board of the institution.

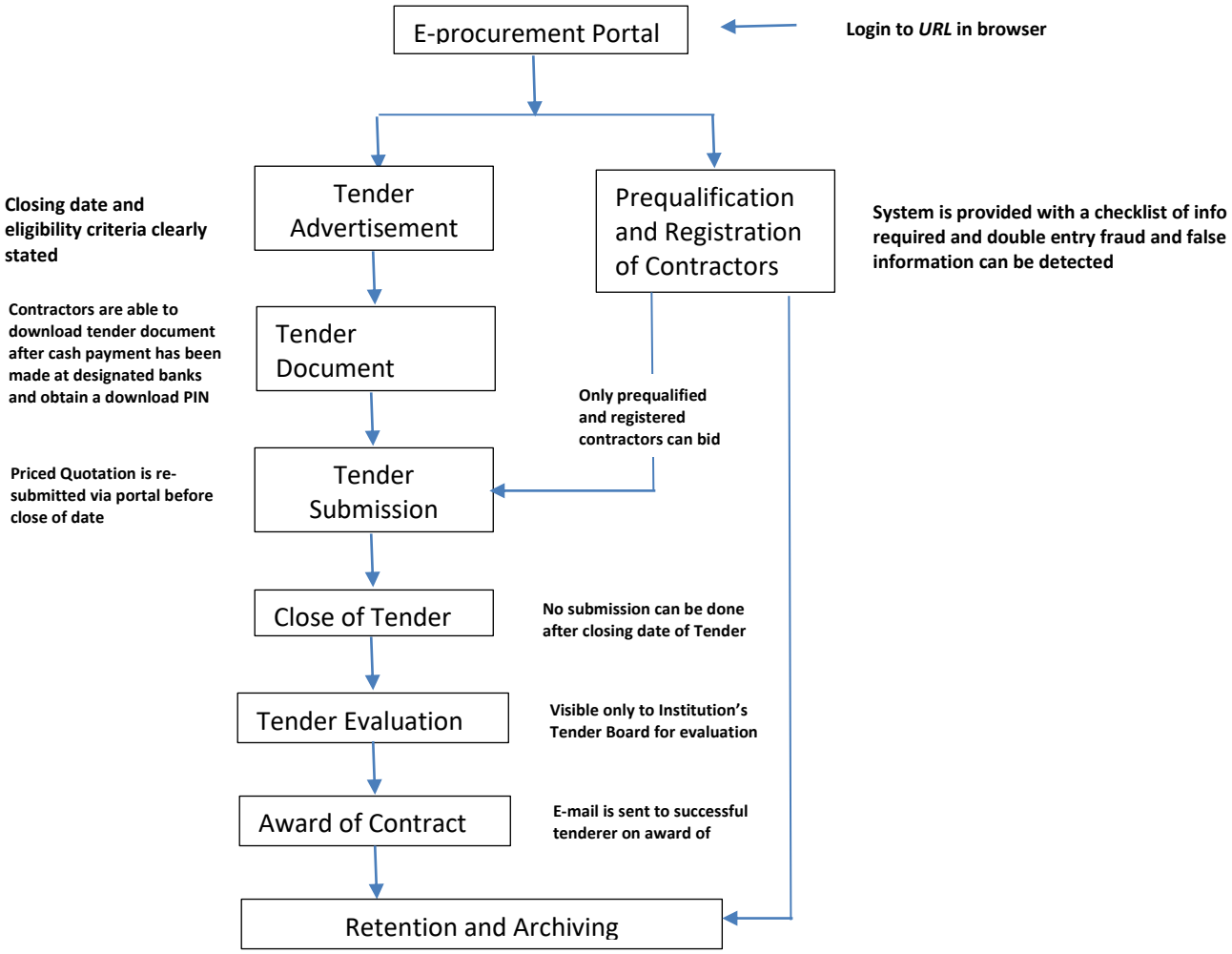

Figure 4 System Block Diagram of the web-based e-procurement site

Author's Design

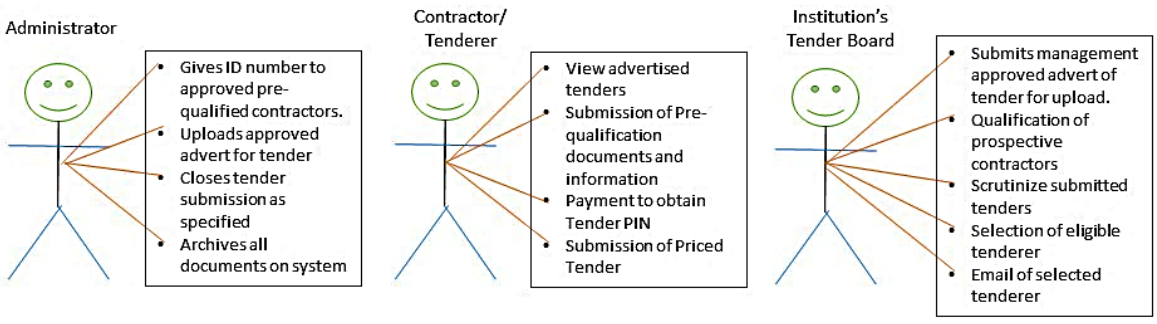

Figure 5 Use Case Diagram for the web-based e-procurement site

From Figure 4, the web-based e-procurement site is designed such that it is hosted with a domain name on the World Wide Web (WWW) and can be accessed via an internet browser. Prospective Contractors can log in to the URL to view advertised tenders and register their company profile and other information required for pre-qualification and registration by the

institution on the Home interface, there after they are given a unique identification number for easy identification in the system. The system should be able to filter and detect double entry of information.

The information would be inputted into the system as required for registration as shown in Figure 6. Figure 6 showed the contractor's profile registration page. Information such as company name, area of specialization, company profile in terms of business registration, experience, tax information, VAT registration certificate etc. and Bank Verification Number (for identifying double entry and authenticating the identity of the contractor). Once the registration has been approved, an approval page as shown in Figure 7 is presented. All tenders are advertised on the home page of the e-procurement site by the institution. All requisitions and detailed specification of what is needed is carefully described in the advert on the e-procurement site.

Registered Contractors would be able to download tender documents relating to their area of specialization from the web-based e-procurement site as shown in Figure 8. Figure 8 showed the Login page for downloading and re-submission of the tender. The tenderer using their unique registration number as username while the password is a PIN obtainable at a designated bank after tender fees have been paid in the institution's account name can access the tender. After download of attached documents, pricing of the project is done and resubmitted via the same portal. There would be a section to indicate what total price and duration to carry out the work that the contractor has submitted. This would help to prepare a summary sheet of company name of contractor, price submitted and duration expect to carry out the project as shown in Figure 9. Figure 9 showed the administrative panel where access can be given to contractors, tender board and summary tender information can be generated. Each tender advertised must be assigned a closing date.

The timeline must be clearly stated and tenderers would not be able to submit tenders after the closing date and time. When all the tender comes in, no-one should be able to download the tenders until all the Tender Board members are present for the download of the documents submitted, to ensure the integrity of the system. On the day of the tender board's meeting to open the tenders submitted, a Tender evaluation profile can be generated as shown in Figure 10. It is worthy to note that the integrity of the e-procurement site is maintain so far the administrators of the system and the tender board are committed to eliminating corruption in the procurement process.

The Tender Board scrutinize all documents that have been submitted by tenderers and is responsible for selecting the most qualified contractor to award the contract. An email notifying the successful contractor is sent out. It is important that all documents in the procurement process is retained on the system. All tender documents are archived on the platform since it is a web-based system and this has several benefits to the accountability of the tendering process. Archived documents can be visited from time to time on lessons learned and also for selective or negotiated contracts.

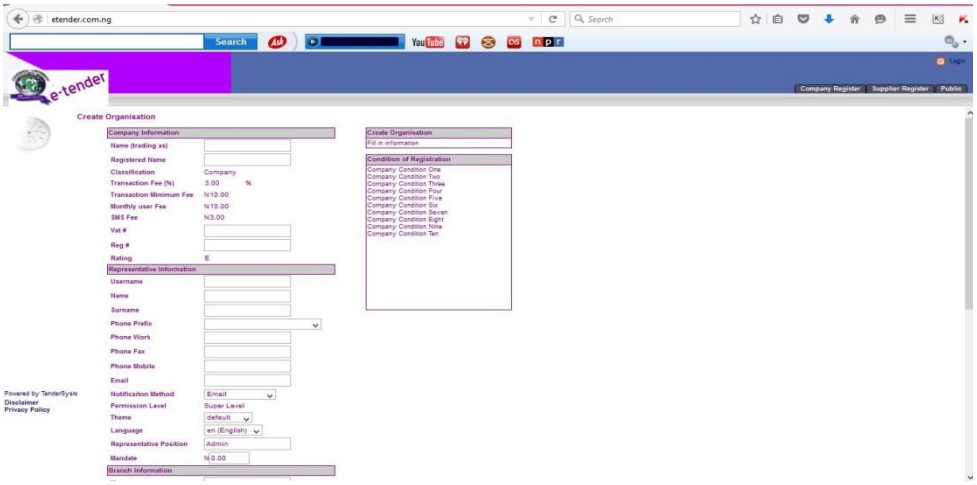

Figure 6 Contractor Registration Page

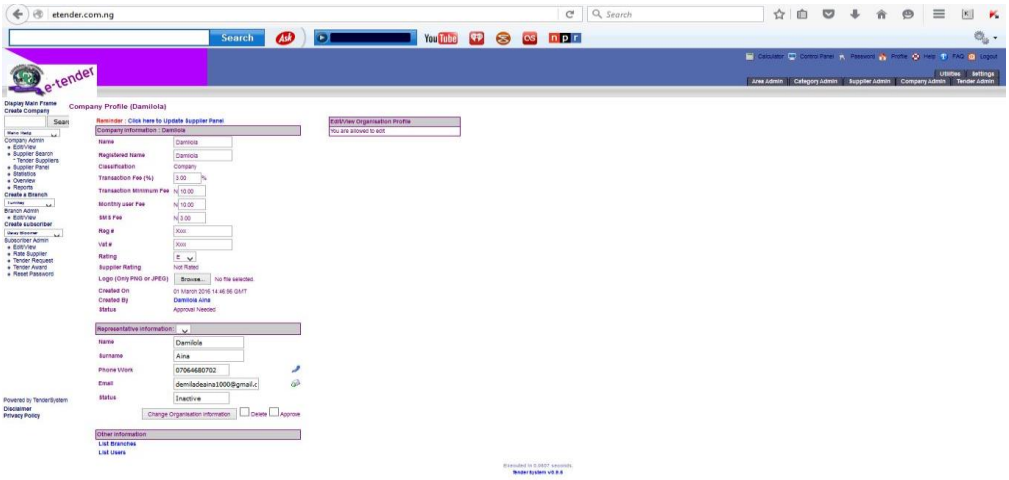

Figure 7 Company profile and Approval Page

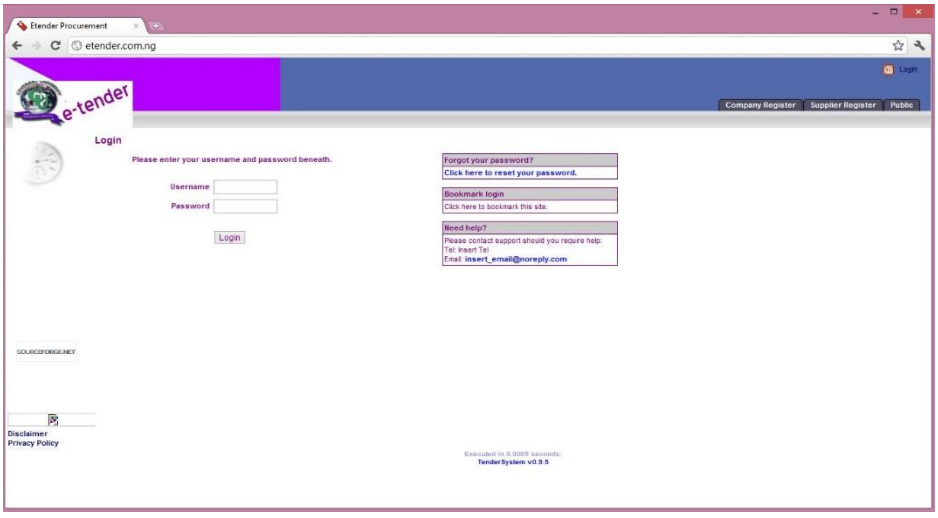

Figure 8 Login Page for downloading and re-submission of contract documents

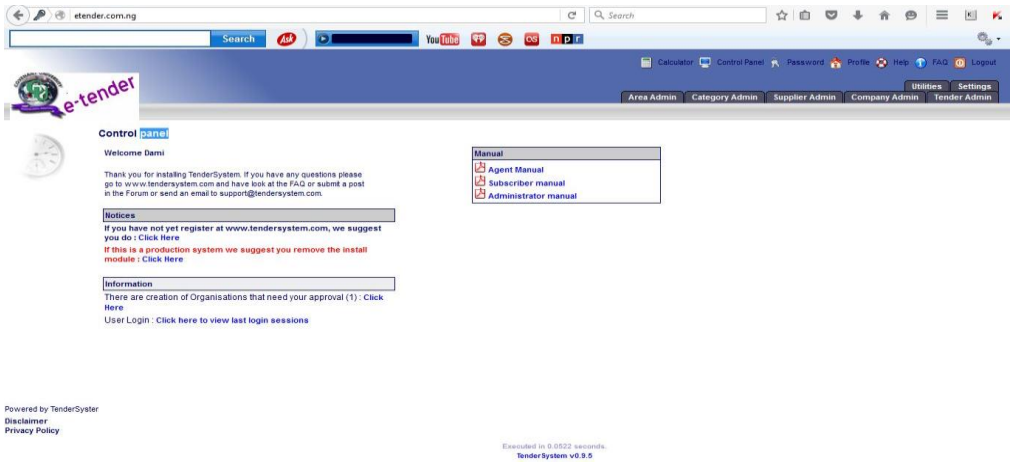

Figure 9 Administration Panel

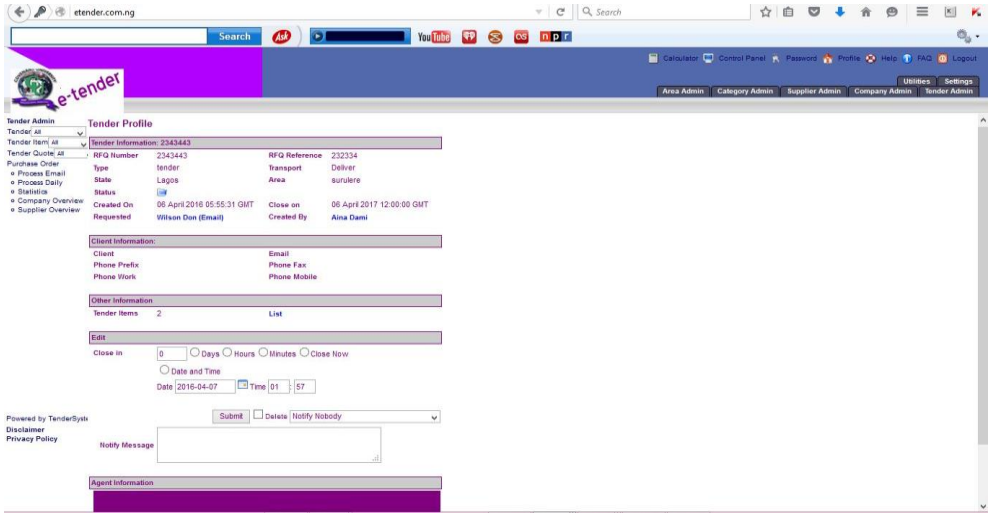

Figure 10 Tender Evaluation Profile

5. CONCLUSIONS

The study investigated the e-maturity of construction stakeholders for a web-based e-procurement platform for tendering purposes. Using a 100% stacked bar chart, the study revealed that some of the client base (tertiary institution) and their registered contractor, have in one time or the other participated in obtaining or sending tendering documents through the internet. The study revealed that there is no significant difference in the e-maturity between client and contractor for a web-based e-procurement platform for tendering purposes within the institution. This means that the client base and their registered contractors had substantial ICT investments that is able to participate in a web-based e-procurement solution for tendering purposes. The study indicated that there is no significant difference on the importance of using a web-based e-procurement platform for tendering purposes between clients and contractors in a tertiary institution. It is adduced that the construction client and its registered contractors have the same positive perspective on the benefits of utilizing a web-based e-procurement solution for tendering purposes. A framework and a use case diagram was used in developing a prototype web-based e-procurement platform for tendering purposes that can be utilized for construction works. Using PHP programming language, a HTML interactive interfaces for creating the web pages, and a MYSQL for the relational database

management for storing, retrieval and archiving of registration and contract documents, a web-based e-procurement platform for tendering purposes in construction works in a tertiary institution was developed. The study recommended the use of web-based e-procurement platforms due to the many benefits that can be acquired from its use. In addition, the construction industry should readily embrace ICT solutions in order to solve diverse challenges pervading the industry. Tertiary institutions which should be at the forefront of research, education and innovation should implement innovative tools for other industries and client organizations to emulate. There is still need to increase the awareness on innovative tools in order to engender the speedy implementation. Client organizations need to understand that it is not enough that there are ICT investments in the organizations rather they should be properly deployed and utilized in the right channel.

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