EFFECTIVENESS OF ELECTRONIC TENDERING FOR CONSTRUCTION PROJECTS

Balogun, Ayodeji; Talukhaba, Alfred Atsango; Opaleye, Oladele
Department of Building Science, Faculty of Built Environment and Engineering, Tshwane University of Technology, Pretoria, Gauteng, South Africa

Abstract
Historically, the construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issuing and receiving of tender documents via internet based platform which makes the procurement of a construction project easier and faster. Despite the benefits that could be derived from the use e-tendering, many construction practitioners are still reluctant to fully use electronic tendering. Therefore, this study is aimed at exploring the factors affecting the wide use of e-tendering, effectiveness of e-tendering infrastructures and awareness level of e-tendering within the South African construction industries. Owing to the nature of the research questions the quantitative approach was used for this study. The questionnaire survey method is the research instrument used. The questionnaire survey was conducted among construction stakeholders actively involved in the planning of construction projects. Using a survey research type of research design, data was sought from quantity surveyors, architects, engineers, project manager and other construction stakeholders in the industry using survey research method. The results of this survey shows that no quantifiable measurement of e-tendering success, once-off nature of construction projects, limited knowledge of legal and security policies governing e-tendering and misunderstanding within the fragmented supply chain management system rank highest among the factors affecting it wide use and e-tendering effectiveness.

Keywords: Construction, E-tendering, Industry, Infrastructure, Practitioners

1 Introduction

The construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issue and receipt of tender documents through an internet based system which facilitates the procurement of a construction project. The present paper based means of tendering has been used significantly over a number of years within the construction industry, and this method is faced with challenges which affect construction projects in terms of cost and timely completion of a project. The need to minimise and eradicate these challenges gives rise to the adoption of e-tendering and adjudication processes. Which would result in improve productivity, greater quality of work during the planning stage of a project, higher profitability and delivery of a construction project.

The construction industry is classified as an information intensive sector and described as one of the crucial industries in developed and developing countries facing a rapid and uneven change in the economy (Kajewski and Weippert, 2004:2). Tendering as related to construction

is the process by which tenders are invited from interested or competent contractors to undertake certain or specific packages of construction work.

Planning for construction projects involving large sum of money is a challenging and complex chore faced by both internal and external stakeholders involved in a project. According to Mohemad *et al.* (2010), a construction project life cycle consists of three phases, namely as pre-construction, construction and post construction. The pre-construction phase involves the planning and tendering process (Mohemad *et al.,* 2010:35). The tendering stage in construction industry is considered a crucial and important stage throughout the project lifecycle (Vee and Skitmore, 2003, p.118). This stage forms the contractual and legislative agreements between client, design engineer, contractor and other stakeholders of the project (Choen and Alshawi, 2009:101).

Tendering in construction was portrayed simply by Connell (2010) as a process that connects the client to the construction firm. Tendering is carried out most importantly to adjudicate competent contractor to undertake specific construction and design activity at the best reasonable cost, realistic time and acceptable quality.

Decision making during tendering has great impact in the successful execution of a construction project (Mohemad *et al.,* 2010, p.35). Mohemad *et al.* (2010) proceeded to say that managing tender is very cumbersome and uncertain. It involves the coordination of several activities and tender participants with different priorities and objectives. Bias and inconsistent decision are unavoidable during tendering if decision making system is dependent on intuition, subjective judgement or emotion (Mohemad *et al*., 2010:35). This unavoidable decision is one of the major reasons why e-tendering should be encouraged and widely used by construction practitioners.

1.1 Problem statement

In spite of the fact that previous researchers generally conclude that e-tendering system is effective, the question is why tendering process is still based on manual activities i.e. traditional tendering system. Despite the benefits of e-tendering and the contribution to the procurement phase of a project, there are factors and challenges that affect the wide use of e-tendering. One of the factors that hinder the used of e-tendering is the isolated nature of processes without extensive integration prior or after tendering (Chilipunde, 2013). However, majority of the construction and consultancy firms are still sceptical of the potential benefits mainly due to limited human resources as regards the operation of the e-tendering process. These includes, financial resources, accessibility of internet, computer literacy amongst tendering participants, e-tendering software not user friendly, ineffective e-tendering infrastructure, legal and security issues, lack of government policy and the people. These are the main factors that hinder the use of e-tendering in the developed countries (Mohemad *et al*., 2010:35). Research has shown that no extensive study has been conducted on this ineffectiveness and wide use of e-tendering in the South African construction industry.

2 Literature Review

Oyediran and Akintola (2011) noted that African countries such as South Africa and Nigeria lack comprehensive technological development and standards which affect the use of the system with all tendering participants on board. Construction practitioners are also lacking the initiative in changing practice to embrace e-tendering for the procurement of a project (Eei et al., 2012:17). Poole (2010) argued that Supply Chain Management (SCM) is the management of interconnected businesses involved in the manufacturing of a product or service required by customers. Poole (2010) continue to state that construction supply chain management consists of the planning and management of all construction activities involved in sourcing, procurement, monitoring and logistics management. Procurement as related to construction is

a step-by-step process that typical involves; determining project criteria, setting contractual framework, setting tender and adjudication processes, inviting tenders and finally award of tender (Masunda, 2014:2). In simple definition, procurement also means how to execute a project. This definition show e-tendering is a crucial section of the procurement system. Black, Rong and Gonzalez (2005) according to the findings proposed a typical e-tendering processes generally engaged by most systems which include Pre-qualification and registration, Public invitation, Submission of tender, Close of tender, Evaluation of tender, Award tender and Archiving. . The above mentioned processes will facilitate the successful completion of a project. The effectiveness and factors affecting the wide use of e-tendering cut across the above listed processes. E-tendering is receiving more attention these years most especially as an isolated solutions to problems related to traditional tendering system (Jacobsen and Koch, 2013). The need to have a secured, simple, standard, efficient, cost effective and curbing corruption stems governments of many African countries to adopt and implement e-tendering. Despite the benefits (both managerial and administrative) e-tendering offers to the procurement of construction projects in the South African construction industry, there are still several put offs in the South African construction industry (Oyediran and Akintola 2011:561). The examination of these put offs is what this study is all about.

From the literature review conducted by Laryea and Ibem (2014) few empirical studies have been done on the barriers to e-procurement in the AEC industry. Laryea and Ibem (2014) proceeded to set South African construction industry as an example, the magnitude of barriers to e-procurement up-take has not been examine and properly put into words in the literature; leading to inadequate understanding of the factors that affects the wide use of e-tendering in the construction industry of this country. Prior to the implementation of e-tendering into any construction industry worldwide, electronic readiness need to be investigated and the level of e-readiness among individual, societies, companies and nations should be critical examined (Cheon, 2007). World Information Technology & Service Alliance (WITSA) stated that e-ready country requires end user trust in e-commerce security & privacy, improved security technology, well trained workers & low training costs, minimal restrictive public policy, latest business environment and reduced costs for e-tendering technology. Drawing from the survey conducted by Laryea and Ibem (2014) and relating the survey findings to the standards established by WITSA, it could be vividly seen that the ICT environment in developing countries are not e-ready for the wide use of e-tendering into the operations of the construction industry. Lavelle and Bardon (2009) concluded based on his findings that there is existing recognition of the benefits but several factors affecting the wide use of e-tendering are presently responsible for the slow uptake and limited use of e-tendering.

3 Research Methodology

This section emphasizes the method used in this study. Owing to the nature of research topic, quantitative research methodological approach was adopted which embraces literature findings and industry based questionnaire survey. The research instrument suitable for this study is the questionnaire survey which was prepared and designed according to the Tshwane University of Technology ethical committee. Data are obtained through the use of survey questionnaire amongst construction practitioners actively involved in the planning of construction projects and the researcher distributed the questionnaire via hand and email. Random sampling technique was used during the data collection stage of the study. The professional Association within the South African construction industry (South African institute of Civil Engineers SAICE, Engineering Council of South Africa ECSA, The South African Council for the Project and Construction Management Professions SACPCMP, and Association of South African Quantity Surveyors ASAQS) serve as the data base for this study. The descriptive analysis was conducted to analyse and interpret data collected. The statistic package for social science

(SPSS) was used to analyse collected data. The descriptive analysis used in this study comprises of frequencies test, percentages, standard deviation and mean.

4 Data Collection

The primary data adopted in this research were acquired and collected via the administering of a structured industry based questionnaire to construction practitioners within the Tshwane Districts of Gauteng Province of South Africa. Total numbers of 80 questionnaires were distributed to construction practitioners and of these 80, 56 were returned, showing a response rate of 70%. From the questionnaires returned, 5 were unusable as information supplied was non-conforming to require standards and some had incomplete data. The questionnaires were passed out by hand (hardcopy) and via email (soft copy). This was facilitated as follows:

1. The questionnaires were sent via email to the sample population and were supported with introductory letter.
2. Reminder emails were sent to the targeted respondents who did not return the questionnaire after two weeks.
3. Another reminder email was sent to the respondents who did not return the questionnaire after two weeks.
4. The researcher made sure the questionnaires administered by hand were returned immediately after completing the questionnaire, they were picked up by the researcher.

5 Summary and Research Findings

The survey questionnaire was used for data collection. A five point likert scale ranging from not suitable to extremely suitable was used to determine the building procurement method best suitable for the use of e-tendering. Also a five point likert scale ranging from strongly disagree to strongly agree was used to determine the challenges of traditional tendering system, factors affecting the wide use of e-tendering and challenges of e-tendering infrastructures. Finally a five point likert scale ranging from never to always was used to measure the awareness level of e-tendering amongst construction practitioners in the Tshwane district of Gauteng Province.

5.1 Factors affecting the wide use of E-tendering

This section was based on a 5 point Likert scale ranging from 1-stongly disagree to 5-stronlgy agree. The descriptive analysis was used to indicate how respondents answered the questions relating to the factors affecting the wide use of e-tendering. The average of answers for each construct was given by the mean as indicated in Table 1. Furthermore, the standard deviation indicates how much variation occurred from the average mean. A high standard deviation indicates that the data is spread across a large range of values, while a low standard deviation indicates that the data points tend to be very close to the mean.

Table 1. Descriptive statistics of factors affecting the wide use of E-tendering

Descriptive Statistics							
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
People are intimidated by technology	51	1.00	5.00	3.7647	1.19312	-.773	.333
Lack of awareness	51	2.00	5.00	4.2941	.75615	-.844	.333
No quantifiable measures/ indicator of success	51	1.00	5.00	3.1373	1.07740	.116	.333
Poor Cross Communication between stakeholders	51	1.00	5.00	3.0000	1.14891	-.494	.333
Misunderstanding within the fragmented supply chain management system	51	1.00	5.00	3.1569	1.08393	-.815	.333
Inadequate Industry standards for sharing information.	51	1.00	5.00	2.6471	1.09222	.374	.333
Once-off nature of construction projects	51	3.00	5.00	4.5882	.53578	-.773	.333
Low awareness level of government policy guidelines for e-tendering within construction industry	51	1.00	5.00	3.4902	.98737	-.620	.333
No quantify information technology systems	51	1.00	4.00	2.5490	.85589	-.357	.333
Limited Internet coverage for all geographical regions	51	1.00	5.00	3.1961	.98020	-.810	.333
E-tendering portal is not user friendly	51	1.00	5.00	2.2353	1.25838	.537	.333
Difficult to convert paper base documents	51	1.00	5.00	3.6275	.89355	-1.276	.333
Limited knowledge of legal and security policies	51	1.00	5.00	3.3333	.86410	-.330	.333
Limited Human Resources and operators	51	3.00	5.00	4.1373	.40098	1.149	.333
Financial resources for	51	1.00	5.00	4.0588	.73244	-2.635	.333

initial installation of e-tendering infrastructures							
Not all Forms of contracts used in the construction industry is e-tendering supportive	51	1.00	5.00	3.5098	1.02708	-.719	.333
Low level knowledge about e-tendering benefits	51	1.00	5.00	3.3922	1.04074	-.864	.333
Inadequate e-tendering infrastructure	51	1.00	5.00	2.9412	1.02785	.236	.333
Total average mean	51	2.00	4.00	3.4314	.53870	-.116	.333
Valid N (listwise)	51						

The conducted analysis on the factors affecting the wide use of e-tendering as shown in the table 1 presents the results that indicated people Intimidation by technology, lack of awareness, once-off nature of construction projects, difficulty in converting paper base documents, limited Human Resources, financial resources for initial installation and contracts that are not in support of e-tendering resulted in an average mean ranging between 3.5 and 4.7. The mean values were 3.7647, 4.2941, 4.5882, 3.6275, 4.1373 and 4.0588 respectively. The result shows that participants are in agreement on the factors affecting the wide use of e tendering. Once-off nature construction projects had the highest mean of 4.5882, which shows that participants strongly agree that once off nature construction project is the main factor affecting the wide use of e-tendering. The following are disagreement among the participants in this study: unquantifiable measures, poor cross communication, misunderstanding, government policy, inadequate industry, inadequate quantified information technology, limited internet, limited knowledge of legal and security policies, low level knowledge about e-tendering and inadequate infrastructure had their mean values oscillating between 2.5 and 3.4. Furthermore, the average mean for portal not user friendly is 2.2353 which suggest that most participants strongly disagree to e-tendering system are not user friendly. The study also investigated the collected mean of all factors affecting the wide use of e-tendering (Total average mean), the results in the table 1 show that the mean value is 3.4314, this value is equivalent to 3 when rounded off to the nearest whole number. This means, not all investigated factors affects the wide use of e-tendering in the South African construction industry.

5.2 E-tendering infrastructures

Table 2 shows the descriptive statistics of challenges of e-tendering infrastructure. The results show that the average mean of e-tendering Server Operating system hinders tenderers from submitting tenders and tenderers do not get confirmation after submitting tenders was below an average mean of 3.000 with the following values respectively; 2.2549 and 1.9804. While with Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals, Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers, their average mean was 2.9020, 3.2353, 3.0588, 3.3529 and 3.1569. These mean values indicate that participants are generally neutral and unsure to the following questions: Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals,

Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers. On the other hand; submission of tender do not reflect on the e-tendering portal, limited trained technical staff with ICT support skills and no knowledge on electronic signature capturing and encryption system had an average mean of 3.8824, 4.2157, and 3.8235. This means most of the participants agree to the listed questions above. The total effect of challenges of e-tendering infrastructure was computed, and its average mean was found to be 3.3333 which means generally all respondents are evenly distributed around the neutral to e-tendering having challenges with infrastructure.

Table 2. Descriptive statistics of Challenges of E-tendering Infrastructure

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Submission do not reflect on e-tendering server	51	1.00	5.00	3.8824	1.03242	-1.005	.333
Management of data traffic	51	1.00	5.00	2.9020	1.00509	-.166	.333
Server Operating system hinder tenderers from submitting tenders	51	1.00	5.00	2.2549	1.05533	.417	.333
Tenderers do not get confirmation after submitting tenders	51	1.00	5.00	1.9804	1.17457	.964	.333
Limited training technical staff	51	1.00	5.00	4.2157	.94475	-1.491	.333
e-tendering portal does not support all formats of tender documents	51	1.00	5.00	3.2353	1.25838	-.152	.333
High internet connectivity rate	51	1.00	5.00	3.0588	.92546	.038	.333
Little knowledge on electronic signature capturing	51	2.00	5.00	3.8235	.88783	-.174	.333
Tenderers have difficulties accessing and updating submitted tenders	51	1.00	5.00	3.3529	1.23002	-.317	.333
Issuing the same login details to more than one tenderers	51	1.00	5.00	3.1569	1.20619	-.385	.333
TChalETenderingInfrastructure	51	2.00	5.00	3.3333	.65320	-.017	.333
Valid N (listwise)	51						

5.3 Awareness level of E-tendering

The results of Table 3 illustrates that a good number of 52.9% of respondents are aware of e-tendering, this is followed by 23.5% of the respondents who rarely know e-tendering. 17.6% of the respondents frequently know e-tendering. These results show that more than half of the respondents are quite aware of e-tendering.

Table 3. Awareness of E-tendering

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	2.0	2.0	2.0
	Rarely	12	23.5	23.5	25.5
	Occasionally	2	3.9	3.9	29.4
	Frequently	9	17.6	17.6	47.1
	Constantly	27	52.9	52.9	100.0
	Total	51	100.0	100.0	

Figure 1 below shows the distribution of the respondent's awareness to e-tendering, and it is clear that more respondents are aligned to the right of the graph which shows that majority of the participants who participated in the study are aware of e-tendering.

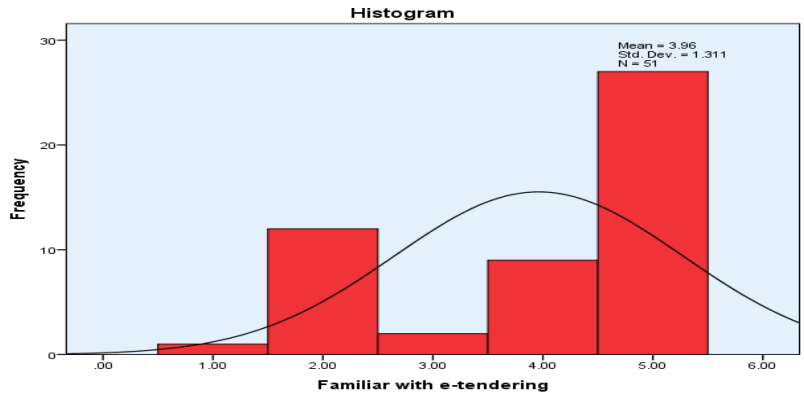

Figure 1. E-tendering awareness

6 Conclusion and Recommendations

6.1 Factors affecting the wide use of e-tendering

The following conducted analysis on the factors affecting the wide use of e-tendering indicates that:

- people are Intimidated by technology,
- lack of awareness,
- once-off nature of construction projects,
- difficulties in the conversion paper base documents to electronic formats,
- limited Human Resources and operators of e-tendering portals,
- financial resources for initial installation of e-tendering infrastructures, and
- Not all forms of contracts supports the use of e-tendering.

Based on the above listed factors, participants agreed that these factors are responsible for the limited use of e-tendering. Once-off nature of construction projects rank the highest factor that affect the wide use of e-tendering. In spite of these factors identified, the prospect of e-tendering in the South African construction industry is high. This could be assumed true since all the factors identified can be eradicated or managed without posing serious obstacle to the wide use of e-tendering. The only factor which seems to be inevitable is the once-off prototype of construction projects.

6.2 Challenges with E-tendering infrastructures

The basic infrastructures necessary for e-tendering are computer hardware, computer software, the internet connectivity and the human resources (operator). This study critically examined these infrastructures to obtain findings based on the challenges of e-tendering system as these challenges will affect the wide use of the system.

From the investigation conducted around the e-tendering infrastructures, results shows that the following challenges have been encounter by construction practitioners who have being used the e-tendering in the tendering stage of construction projects:

- submission of tender do not reflect on the e-tendering server,
- limited trained technical staff with ICT support skills,
- no knowledge on electronic signature capturing and encryption system,
- e-tendering portal do not support all forms of tender documents,
- tenderers have difficulties accessing and updating submitted tenders.

Of all the identified challenges of e-tendering infrastructures, limited trained technical staffs with ICT support skills and construction practitioners having no knowledge on electronic signature capturing system and encryption system were seen to be the most important challenges of the infrastructures. The signature capturing and encryption is very important in electronic transaction as it serves as a means of authenticating exchanged documents between construction stakeholders.

High level of trained technical staff with ICT skills proficient skills in signature capturing system and encryption system is required in order to increase the wide use of e-tendering system amongst construction practitioners.

6.3 Awareness level of e-tendering

According to the finding obtain from the survey conducted around the awareness of e-tendering in the South African construction industry, the result illustrates that a good number of participants are fully aware of e-tendering system and benefits that can derive from the wide use of the system. Specifically 52.9% of the participants are adequately aware of e-tendering while the other participants are not well knowledgeable of the e-tendering system. With this level of awareness amongst construction practitioners e-tendering is definitely gaining attention and this will eventually lead to the wide use of the system in the nearest future.

Though it is evidential that significant numbers of the participants are adequately knowledgeable of e-tendering the usage of the system is notably elementary. Practitioners in the quantity surveying profession have participated in the use of e-tendering than any other practitioners. It is confidently seen that the quantity surveyor are more aware of the e-tendering system than other stakeholders in the South African construction industry.

Based on the research findings the following recommendations are suggested by the researcher:

- Proper briefing on the use of e-tendering should be done during the planning stages of construction projects.
- The adoption of e-tendering, training, education and support from senior management are important requirements for the effectiveness of the system.
- Government being the largest construction clients should develop more competent e-tendering platforms and enforce the use of e-tendering.
- The sales of e-tendering infrastructures especially the software infrastructure monopolised in order to reduce purchase price and installation.
- Effective means of communication should be established to minimise the fragmented nature of the industry.

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