



E-procurement: A Strategic Approach to Public Works Tendering

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

With the Public demanding efficient and transparent procedures and the clients as well as the vendors seeking lower cost and flexibility in Public Procurement Process (PPP), PPP is becoming more complicated, expensive and fragile. Proper methods of feasible benefits of Public E-Procurement (PEP) are quickly becoming a major influence in the mainstream of Public Procurement Enterprises (PPE). PEP is intended to improve transparency, efficiency, and value for money by exposing various procurement activities as tasks over the internet. Current PEP Procedures lacks an organized framework to capture the essential tasks required for successful Procurement Processes, it also pays little attention to task complexity as an important key design feature that impacts other internal PEP attributes. Although traditional Procurement methods have been with us for sometimes, until now no one has provided a reliable PEP framework. This paper proposed a framework based on Business Process Management and Notation Approach (BPMN) for the implementation of PEP by dealing separately with strategic tasks. The BPMN can help PPE simplify and regulate PEP implementation by explicit identification of PEP specific tasks in the BPMN. We provide an example case study to demonstrate proposed PEP task. Twenty users were engaged, the result showed the tool to be a preferred choice to the traditional method of a bidding process. The benefits of PEP to its adopters were also investigated.

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1. INTRODUCTION

The arrival of the internet through the World Wide Web has motivated various schemes and developments [1]. Its low cost and ease of access coupled with the timely distribution of information provide continuous data across various public and private sectors. Improvement in internet bandwidth has benefited E-Procurement in process development, improved management, and cost savings. Public sectors can use public procurement as a control of economic, technological, or social transformation. Procurement is a documented technique for the delivery of goods, works and services within a time frame [2]. Whereas, Public E-Procurement is the automation of the procurement processes across web-based systems for public consumption. The systems allow clients and vendors to locate each other quickly and submit relevant bids for products and services thus reducing costs. Public procurement can also be viewed as an “overall process of acquiring goods, civil works and services which includes all functions from the identification of needs, selection and solicitation of sources, preparation and award of contract, and all phases of contract administration through the end of a services’ contract or the useful life of an asset” [3]. Procurement Strategy is the starting point of Public Procurement which is usually captured in the procurement plan [4]. It normally includes but not limited to; objectives, budgets, requirements, condition of supply, approval authority and time frames/review dates. Procurement is a discipline sparingly thought, but yet mostly applied in both public and private sectors of the economy. This paper offers an attempt for the understanding of the public procurement process for the acquisition of works, goods and various services. The purpose of this research is to also explore procurement life cycle systems and develop a procedure to attain such systems. Existing procurement effort lack organized architectural framework; It is also deficient in capability to collaborate between the client and the vendors. These challenges arose because the parties involved in procurement are deeply entrenched in the manual approach of submitting bids [5]; the vendor must cope physically by searching for procurement opportunities especially through the newspapers and submitting bids physically or through the courier services into the bid box. The concept of

E-Procurement is not new, what is new is the procurement transaction through the web services. Therefore, many public contracting agencies adopt the latest computer technologies based on web services to facilitate the sharing of information between the procurers and vendors [6]. This paper follows this line of thought through the development of a strategic method to public works e-tendering. The overall guiding principle for the framework architecture is the web service design ideologies which rely on components that offer services through standard communication protocols and enabling the client and bidder’s interface to orchestrate and organize bidding opportunities from conception to award stage with an attempt to boost e-procurement to its full potential. The civil works e-tendering tool is a web-based system with the ability to pass bi-directional messages between the procurement entity and bidders; the procurement administrator publishes civil works opportunities on its web site, potential bidder log-in to get a detailed advertisement for the work. Bidders download and respond to the bidding document and thereafter upload response to the client server. Procurement entity evaluates bids, publishes result and letter of award to the successful bidder through its interface. Successful bidder uploads its letter of acceptance and draft agreement to the client server. The procuring unit invites successful bidder to be physically present for the signing of the contract agreement. A proof-of-concept prototype and its testing were presented to illustrate how civil works e-tendering works. The objectives of this paper are to; Provide a rich conceptual model for the development and description of public works e-tendering procurement systems that enable the client communicate meaningfully with intending vendors through the web service interface and also evaluate the performance of the system.

2. LITERATURE REVIEW

Though the arrival of E-procurement is a subject for debate [7,8], there is no doubt that the use of the internet greatly influenced E-procurement and provides several advantages over earlier E-commerce tools. For instance, Electronic Data Interchange has been used for E-purchasing over a period of almost sixty years. Enterprise Resource Planning was developed in the 1970s which later complement the World Wide Web with its multimedia capability and other essential

resources for the automation of e-procurement systems [9]. E-Procurement according to Elliff [10] is any acquisition related activity that involves internet-based communication and related software to enhance improved value. In a nutshell, E-Procurement is an in-depth solution to initiate procurement process over the internet at a very low cost [11]. Though the early adopters of E-Procurement could not achieve many improvements because they were coerced to be involved through management pressure with little or no training, the emphasis was more on making the technology work instead of ensuring an acceptable framework methodology that tailored towards existing business structure [6]. Purchasing E-Procurement solutions that are not user-friendly can discourage objective assistance of both the client and the vendor [12]. Since businesses are competing increasingly in supply chain management, it is important that the choice of an E-Procurement solution should involve more than only system aspects but also its strategic process, supply selection, and system business models [11]. According to [13], procurement in the public sectors has been an abandoned subject of academic research, although government agencies and procurement professionals have paid a great deal of attention to procurement developments and restructurings. Though public procurement legislation has been established in many developing countries to limit discrimination in government procurement, its successful implementation has been doubted [14]. However, [15] maintains that the research subjects covering early public-sector implementation of E-procurement are also inadequate. Some of the commonly used tools in the public-sector procurement include E-auctions, E-catalogs, and E-invoicing. Regardless of the numerous styles and procedures in the E-procurement systems, it has been argued by OGC [9] that the basic methodological process is the same across the public agencies which can consequently be solved with standard processes. Although various governments are encouraging public sector agencies to adopt E-procurement, its development and implementation do not appear to have been smooth and the rate of E-procurement implementation success has been less than spectacular [16]. Government E-procurement projects have been notoriously unsuccessful while engaging vendors in the process have been tedious due to the level of investment expected in terms of providing catalogue information to bidders using diverse languages and technologies [9]. Problems arose

from the pressure of imbibing local rules and guidelines to promoting the local economy, and the benefit to be derived from large volume purchases from well-established sellers [5]. Although numerous public agencies are pursuing E-procurement, the efforts are not meeting expectations. The execution rate of public procurement systems has been low. Moreover, several government enterprises do exaggerate their involvement in E-procurement [17]. Despite the benefits that can be achieved from a successful E-procurement implementation in the public sector, the business press has reported many failures of E-procurement initiatives in many public-sector agencies. As observed by [18], E-procurement is a large investment that involves cost, and there is no certainty that the cost benefit will be achieved in the long run. These views were also supported by KableNet [19,20]. In a similar vein, [21-23] reported that the E-procurement system had proved more difficult to develop and many procurement agencies had not achieved expected savings in terms of cost and time ever since its adoption [20]. According to Garson [23], some procurement agencies abandoned their E-procurement system while pilot projects were shut down. The assertion that E-procurement was moving towards extinction was grossly exaggerated by Harris [24]. According to a survey by Davila et al. [25], E-procurement technological progress will soon be part of management policy in the supply chain system and its quick adoption will accelerate the knowledge sharing among its adopters which at the long run, will eliminate the perceived risks. Similarly, there is the need for a much better understanding of experts in respect of the implementation of E-procurement in the public sector [26]. Tonkin [15] also provides a summary of the public sector's connection with E-procurement with confidence that the future is very bright in the field of E-business. World Bank [27-31] observed the level of end-user participation and the organizational and management operation initiative and the need for additional training. The success of E-procurement ingenuity will depend on the E-readiness of suppliers, and effective communication with them [32]. The high-level project management practice can also be applied to the management and implementation practice of E-procurement initiative for an improved outcome [30]. The collaboration between the E-procurement solution and existing information systems is a critical area needed to be fully integrated [31]. Even though the integration issues may look complex, the business

developments in any public enterprise should be reformed and entrenched [29]. The E-procurement structure should also be linked to the financial administrative system to facilitate the development of online payment to vendors [33]. Purchase transactions carried out through an electronic ordering transaction support system must be reflected in an agency's financial management systems and communicated to suppliers for fulfillment [34]. According to S&A [35], Security initiative should be considered as a crucial factor in E-procurement, users must be authorized and authenticated before any e-transaction could take place. The top management level support is very important with the organization and management implementation perspective of an E-procurement initiative and the greater level of use of the performance measures will go a long way with the practices and processes implementation perspective of an E-procurement initiative. The extended markup language defines standard for communication in E-procurement required for various buyer/supplier systems [31]. In defining E-procurement requirements, Birks et al. [30] observed a key issue in the standard configuring of electronic catalog systems. World Bank [33] suggests that developing an E-procurement system in an open environment allows its linkage to inter-operate with other systems. According to [34], the future adoption and acceptance of E-procurement in the public sector will depend on the ease with which data relating to procurement are exposed between the public agencies and the vendors.

Research and social innovation are the main drivers of future growth [36]. Public authorities are to make the best strategic use of public procurement to spur innovation by relying on its key advantages. Public procurement rules provide a uniform set of guidelines binding on all public authorities which also guarantee a potential tenderer to be fairly treated. However, the framework agreement for Works, Goods, and Services have been well accepted since its beginning due to its efficient and importance in the public procurement domain [37]. Also, the framework agreements had been found to be more efficient than the traditional procurement methods because it saves time for both the purchaser and supplier, as well as resources and costs associated with negotiating terms and conditions. The public procurement rules levy only the contracting authorities [38]; if a contracting authority breaches these rules, it may be held liable for damages caused by such

infringement. It is likely that a contractor, regardless of whether the ineffectiveness is prospective or retrospective, suffers damages due to contract's cancellation. The no case law and ambiguous legislative preparatory work and the rules applicable to contracting authority towards its contractor in the event of contractual ineffectiveness is still open to interpretation. The efficiency is particularly important because procurement represents 18% of the GDP in many of the European countries. Nevertheless, the regulation of concessions within the EU and particularly in public procurement law is very limited and scattered [39]. Current public procurement directive contains few provisions on the concession. Construction concessions do not entail a procurement obligation in line with those applying for public contracts. Legal issues related to the enforcement of the rules with remedies according to Simovart [40] have not received attention due to the ineffectiveness of the de-facto public contracts and its rules. Also, the public procurement reform across the African continent which made the countries within engage in extensive legal, institutional and organizational reform of their procurement framework to make the procurement system fit for purpose, transparent, accountable and less prone to corruption, fraud and mismanagement have not been well established [41]. Although, there are similarities in procurement challenges faced by African countries and similarities in reforms and efforts. Two of the main Africa regional trade communities have taken the initiative to harmonize procurement at the regional level to deepen trade integration and eliminate the difference in the substance of their procurement regulation. Regional procurement harmonization will provide many benefits from the economy of Africa countries and is a goal that ought to be pursued by the other regional economic community in Africa even though it will not be an easy task. However, corruption has become an increasingly debated issue in the public contract area [42]. For example, the direct public loss that can be attributed to corruption in public contracts amounts to 13 percent of the overall project budget. Nevertheless, [43] has observed that it is difficult to determine whether a public contract is involved in a particular situation due to its broad definition. The principle of proportionality in equal treatment in the drafting of the contract clauses was also an issue examined by Simovart [44]. For example, the penalty clause in public contracts must be appropriate, necessary and reasonable regarding the function and purpose that the penalty serves.

In case of doubt, the clauses can be challenged in the public procurement review board. For instance, the newly introduced European Single Procurement Document (ESPD) to the European Union restrict contracting authorities for the documentation of all bidders but instead only the winner should submit such document. Though all participants are expected to fill a form indicating that they have such document and will be tendered upon winning the contract. This is expected to save cost on the part of the tenderer [45]. Nevertheless, [46] had suggested that the contracting authority should describe what it wants and on what terms it wants it. For a contracting authority that does this, the actual performance of a contract can be measured. The purchasing is easier and the contracts will have a high performance. A shift of focus from procurement to performance will add tremendous value to any contracting authority. Yet, [47] had developed, identified and estimated a principal agent model in which the procurer chooses whether to solicit more than one bid and if so, how much effort to exert for a more competitive field; the model negotiates with prospective contractors, offers a menu of contracts, and chooses a winner and the payment schedule. The structural model shows that the optimal contract yields a lower equilibrium number of bidders than a first price sealed-bid auction. In

the counterfactual analysis, they showed that, if procurers are stripped of their discretion and their project-specific knowledge, the total cost of procurement would rise even if the average bidding costs per contractor were halved.

3. METHODOLOGY

Procurement follows due process. In the different organization with different people, the process may be different. The basic process in Public Procurement normally involves a formal request for proposals in the case of consultancy service or invitation to Bid in the case of Goods and Works sent out to the public on an electronic tendering platform through which potential vendors can review documentation, submit responses and receive their evaluation

Fig. 1 proposed a solution to assist the client (purchaser) manage every step of the procurement process. And, interact with bidding firms in a secured environment. In addition, bidders could monitor the procurement process online to view opportunities, express interest, obtain bidding documents, and start the bidding process. The solution is designed as a bidirectional interface to provide a real-time solution for bidding and transaction process.

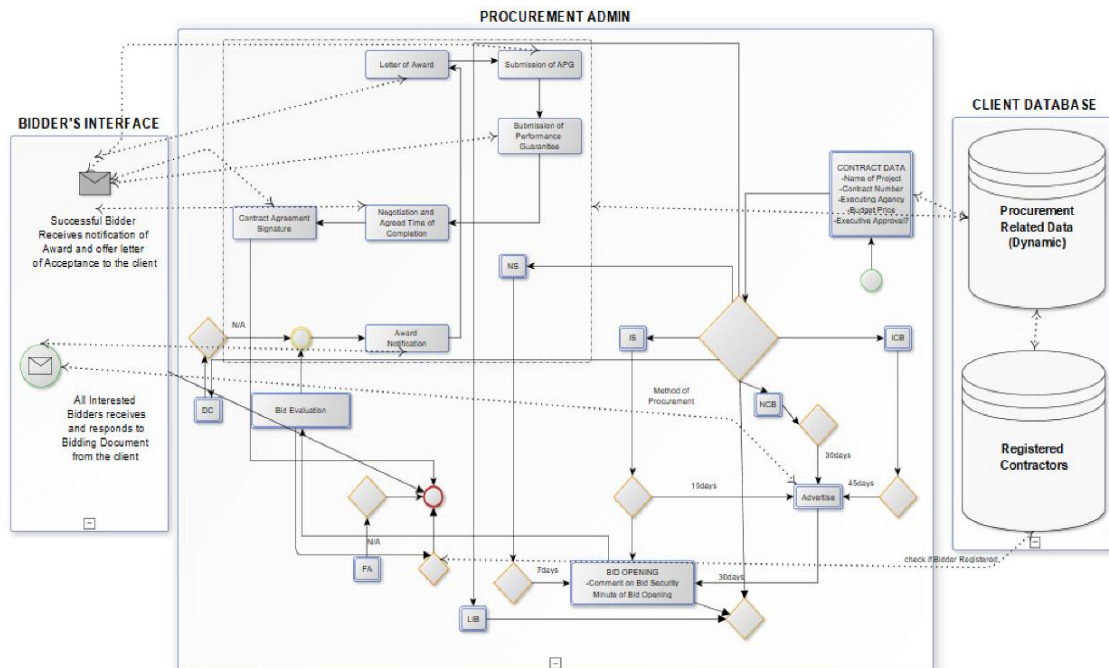


Fig. 1. Business process management framework for E-Procurement in a typical Public Organization

E-Procurement is about due diligence and project monitoring which commences with the name and identification number of the project. The proposed project must be in the fiscal year budget which must have been consented to by approving authority. The method of procurement is usually determined based on the magnitude and the budgeted amount of the project as entrenched in the procurement policy of the Public Enterprise. Different procurement methods identified for this research work are:

International Competitive Bidding (ICB), Limited Competitive Bidding (LIB), National Competitive Bidding (NCB), International Shopping (IS), National Shopping (NS), Direct Contracting (DC) and Force Account (FA). In ICB, which is the preferred method of procurement for large contracts for Goods, Works, and related services usually involve foreign suppliers or contractors. Although efficiency is important, there is usually no specific urgency in processing the procurement which can take between 45days to 60days. In LIB, there are only a few known contractors involved, it is normally used when a small amount of money is involved and in exceptional cases such as emergency actions related to a major natural disaster, which may justify the waiving of advertising or competitive bids. The procurement process can take up to 30days. Where the capability and competitiveness of local bidders make it unattractive for foreign bidders to compete for contracts below a certain value, NCB or IS can be adopted. DC is used where the extension of an existing contract is necessary and already underway or similar goods as those already purchased under an existing contract is required subject to the fact that no benefit can be gained from the competition. In NS, Goods required are already available off-the-shelf in small quantity value. In small works that require little or no expertise, NS can also be adopted. Lastly, when procuring entity has ascertained that a schedule of rates, cost-plus or target contract would not be feasible because quantities of work to be carried out cannot be defined in advance, then FA also referred to as Direct Labour is adopted. Also, when works are small and scattered in remote locations with no local contractors and mobilization and demobilization costs for outside contractors would be too high or where national security would be compromised if any other method is used, then FA can also be used.

After the proper identification of the appropriate procurement method, especially for ICB, NCB

and IS, Advertisement is placed on the internet through appropriate and popular websites (for example, dg-market) and at least two widely read national daily newspapers notifying prospective bidders of the opportunity to provide certain goods, works or services. Bidders are also provided the links to the client website for further information and the need to submit bids electronically through the client website within six weeks and four weeks in the case of ICB and NCB respectively.

Assembling the team of relevant experts as evaluators is the next important stage after the bid opening. The goal at this stage is to achieve the "best value for money" for the client in terms of performance, delivery time, and cost while ensuring that all bidders submitting bids are treated in a fair and equitable manner. Evaluation team should be appointed to include professional staff within the government agencies. Occasionally, an elected official or a representative of the community can be appointed to the committee. It is also important that the committee include a representative from the central procurement office and the user agency. The evaluation criteria must have been included in the invitation to bid or request for proposal in a clear and concise manner. The integrity of the process must be maintained and must be seen to be transparent.

The last major action of the procurement phase is contract award. The procedure for contract award varies depending on whether the contract results from ICB, LIB, NCB, IS, NS, DC procedure. Unsuccessful bidders should be debriefed of the basis the selection decision and contract award, as well as what was wrong with their proposals. The successful bidder may also request debriefing whenever an award is based on competitive proposals. The aim is to provide bidders with information that will help them submit better proposals in the future through frank open dialogue. The contract is thereafter awarded to the bidder with the lowest evaluated, most responsive, qualified bid and that have affirmatively demonstrated its responsibility and, where necessary, the responsibility of proposed subcontractors.

In awarding a contract, the procurement unit prepares the contract for the execution of the work. The contract establishes a legal and binding agreement between the client and the successful bidder. After a contract is awarded, the public procurement unit ensures that the parties complied with the contract by tracking

receipt of the deliverables, performance, and payment under the contract.

4. IMPLEMENTATION

E-Procurement for Civil-Works Contract was implemented as a bi-directional process between Procurement Administrator and Bidders using Visual Studio.Net Express 2017 Community Edition on Window 10 Professional, 64-bit Operating System with Intel core duo CPU at 2.60 GHz, 12 GB memory. Visual Basic.Net was used in implementing the core program while Microsoft Visual Web Developer Express 2017 was used to execute the web application services. Two main web forms were created, one for the Procurement Administrator while the second was for the bidders. The two web forms exchange messages between the contracting authority and the tenderers. For example, E-Procurement for Civil Works is a location transparent website which can be visited by bidders that are interested in executing newly proposed civil works project opportunities as depicted in Fig. 2.

Prospective bidder “Log In” or register in order to authenticate its registration as an authorized

bidder, otherwise the link to the bidder’s page will not be active. The client page shows the procurement opportunities available with the contract identification number, the bidding method, advertisement date, closing date and the contract tracking link where bidders are updated on the status of each contract.

When the name of a contract is clicked; the client page is re-directed to the bidder’s page where the advertisement for the contract can be read as shown in Fig. 3. The Bidding Document is thereafter downloaded by clicking the "Download Bidding Document" button. The Bidding document contains the instruction to bidders, bidder's data, template for bid security and so on. The bidder reads and responds to the bid and thereafter browse through the tender file using browse button. The tender is thereafter uploaded to the client server using "upload bidder's tender" button.

Bidders can check the status of their bids by clicking Status/Information link. The evaluation result and award recommendation can also be viewed through the link.

The screenshot shows a web browser window with the URL localhost:57571/Default. The page title is "Civil Works E-Procurement" and it includes navigation links for Home, About, Contact, Register, and Log in. The main heading is "Public Works Department Civil Works E-Procurement". Below this, a table lists various procurement opportunities with columns for Contract ID, Name of Contract, Method, Advert Date, Closing Date, and Contract Tracking. The footer indicates "© 2017 - Civil Works Procurement Application".

Contract ID	Name of Contract	Method	Advert Date	Closing Date	Contract Tracking
OGSMW/12/1	Construction of Ojere/Adatan road	ICB	24-Oct-12	14-Dec-12	Status/Information
OGSMW/12/2	Construction of Ogtv/Brewery road	ICB	17-Dec-12	01-Feb-13	Status/Information
OGSMW/13/1	Construction of Sagamu/Ogijo road	ICB	18-Jan-13	05-Mar-13	Status/Information
OGSMW/14/3	Construction of Obalende/Ikangba road	ICB	21-Jul-14	08-Sep-14	Status/Information
OGSMW/15/1	Construction of NNPC Flyover Bridge	NCB	17-Aug-15	23-Sep-15	Status/Information
OGSMW/15/3	Construction of Sango/Ojodu-Abiodun road	ICB	19-Nov-15	04-Jan-16	Status/Information
OGSMW/16/2	Construction of Ilaral/johun road	ICB	12-Feb-16	30-Mar-16	Status/Information
OGSMW/17/1	Construction of Panseke Pedestrian Bridge	NS	13-Apr-17	15-May-17	Status/Information
OGSMW/17/2	Construction of Ake/Adatan road	ICB	19-Jun-17	03-Aug-17	Status/Information
OGSMW/17/3	Construction of Imeko/Afon Bridge	NS	20-Aug-17	18-Sep-17	Status/Information

Fig. 2. Client Site for Civil Works E-Procurement Opportunities

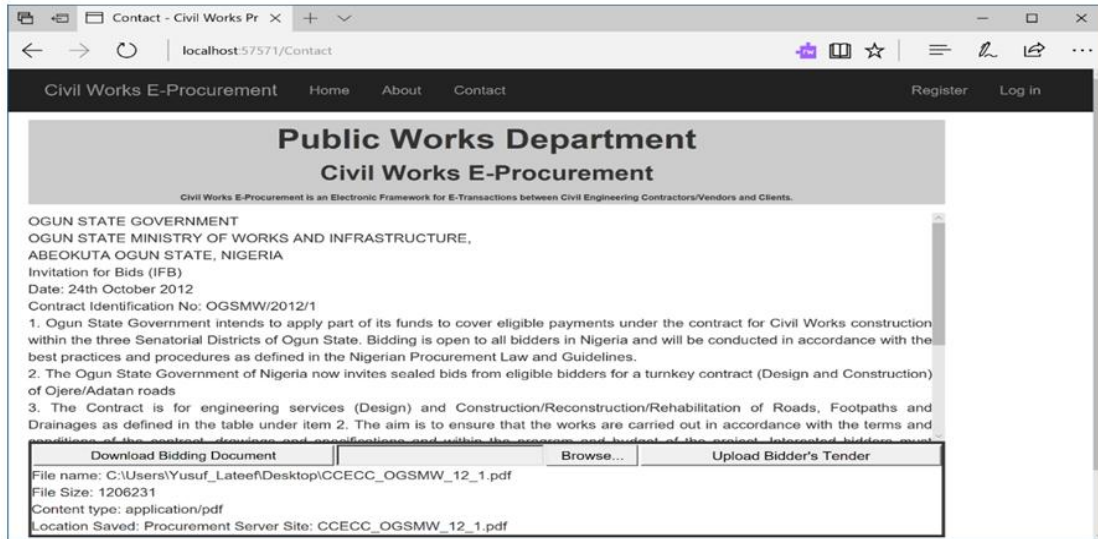


Fig. 3. Bidder's Site to Download Bidding Document and Upload Tender

5. USABILITY TESTING OF CLIENT/ BIDDER E-TENDERING TOOL

The design process includes User-centred design (UCD) philosophy that embraced the representatives of prospective bidders, most especially the civil engineering contractors. They were involved throughout the product development and testing process. This was to place them at the center of the design process by ensuring that the client/bidder interface meets the needs and capabilities of the stakeholders, particularly in terms of safety and user experience [48]. The user-testing sessions were conducted in a laboratory setting [49]. Twenty users took part in user tests. They were asked to evaluate their experience with the application interface. The Twenty participants (Fourteen males and Six females) were recruited through the established lists of registered contractors at the contract registry of Ogun State Ministry of Works and Infrastructure, Abeokuta, Nigeria. The sample average age of participants was 36.75 years with standard deviation of 11.89 years (minimum age is 23, maximum age is 64). All the participants were employees of their various companies. 80% of the participants were familiar with the use of internet especially on handheld devices. 20% of the participants use web application software several times in a week while 60% uses it once in a month. The remaining 20% rarely uses web application software. All the test users found the tool to be a preferred choice to the traditional method of the bidding process. The tool scored excellent under

ease of navigation, look, feel, upload/download of information, access to information, remote client/vendor interaction, time and cost savings. All the users agreed to the understanding and ease of use of the system.

6. BENEFITS OF THE E-TENDERING TOOL

Successful e-procurement implementation can best be implemented by those who best understand the procurement processes and outcomes to be achieved. Therefore, they have a key role to play in identifying and assessing the benefits of e-procurement tools and in providing input into how existing tools may be enhanced. The benefits of adopting this e-tendering tool are many and include; Cost reductions and process efficiencies which effectively enhanced procurement performance [50]. The savings derived from e-tendering are usually due to automation of the process which eliminates paper work and human intervention, reduction in transaction costs and cycle time and streamlining and automating the audit trail approval process. E-tendering supports control over unnecessary spending and management budgetary control, reduce data entry failures, offer greater transparency, accessibility, and accountability to corporate wide spending, improved system reliability and managerial information. Other benefits include; equal treatment of bidders, transparent selection process, clear audit trail, more efficiency in the tactical procurement process, improved time management of

tendering procedures and reduction in legal errors [51]. The accepted legal framework guiding e-procurement is the UNCITRAL model law on electronic commerce which states that “in the context of contract formation, unless otherwise agreed by the parties, an offer and acceptance of an offer may be expressed by means of data messages” and “where a data message is used in the information of a contract, that contract should not be denied validity or enforceability on the sole ground that a data message was used for that purpose [52].

7. CONCLUSION

Procurement is made up of rules, processes, policies, regulations, and laws. This paper focused on the development of civil works e-tendering and its Design Strategies for the exchange of messages between the procurer and vendors using system enabled web services. Civil works e-tendering is an internet-based procurer/vendor-initiated system. The procurement administrator publishes civil works opportunities on its web site, potential bidder log in to access advertisement for the work. Bidders download and respond to the bidding document and upload response to the client server. Procurement entity evaluates bids, publishes result and letter of award to the successful bidder through the bidder's interface. Letter of acceptance and draft agreement is uploaded to the client server by the successful winner who also, upon invitation by the client presents himself for the signing of the contract agreement. The effective nature of the world wide web truly makes bid solicitation, submission, evaluation and award process effective. The E-procurement infrastructural tools can facilitate Efficiency, Transparency, Quality of Service, and compliance in the bid selection process. Furthermore, E-procurement has the potential to promote operational efficiency and cost savings in public sector procurement [53]. Network connectivity influences E-procurement system performance [54]. Therefore, reliability with secure connectivity will improve the organizational intents to use E-procurement. Electronic networks that are highly integrated between procurer and their vendors will positively influence the procurer intention to use electronic procuring technologies. This study brought major understanding to the procurement process and its associated architectural approach. The work also proposed an intelligent web service system for orchestration of tenders that satisfies the

bidder's preference. The architectural model also promotes a better understanding of the procurement process as a service concept and laid a foundation for the formulation of due process in public enterprises. The tool can be used in the development of an effective self-directed tool for open learning via the web in the area of public procurement process and with little effort, procurement will make mediocre become an expert in the business discipline of public procurement. The dynamics of procurement is already changing. More businesses are expected to use E-Procurement Systems for the procurement of Goods, Works, and Services. Conquering Public Corruption through E-Procurement is a vision achievable. Civil works e-tendering is a tool expected to minimize corruption. For the sake of transparency, there is no procurement where there is no documentation to define a process through which procurement takes place. The outcome of procurement is not when the contract has been awarded, but once the Goods, Works or Services get delivered or when the contract has been successfully achieved and procurement audit is implemented. For Works Procurement, it is advisable that contract management be part of Procurement. Although transparency can aid partaking and added oversight functions in the part of the public, the more proactive involvement of societies should be made vital in public procurement systems [55]. In future, further studies will be done to break down the user experience factors by altering the elements present in the interface. Such studies would hopefully clarify the relative importance of the functions and the looks that the prototype implements. Studies must also be carried out on how to incorporate the tool into handheld devices with pens and touch screens rather than the mouse and keyboards that necessarily had to be employed in the reported studies. Poor communication between the client and vendors is a major issue to be addressed further. the problem will be mitigated by designing an ontology to aid deeper understanding and serve as a basis for model-driven communication process. Our framework was designed for the acquisition of public works tendering only which can also be adapted for procurement of goods. In the future, the framework will be extended for the procurement of consultants and other services.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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