E-Tendering System for Construction Projects

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Abstract: This project is carried out to develop a system prototype of an electronic tendering (e-Tender) system. Several steps have been taken starting with information gathering and analyzing, developing a prototype, and ending in system testing. The prototype was further tested with real users to analyze the document flow speed. In conclusion, e-Tendering system has a better approach compared to the manual process of tender. The document flow speed was increased by 58.5% which suggests a more efficient process.

Keywords: Construction, Electronic Tendering, Tender.

1.0 INTRODUCTION

Governments all around the world have embraced information, communication and technology (ICT), specifically the Internet, as a means to streamline public sector processes, while providing citizens with easy access to government services as well as making their operations more efficient and transparent. These increased information flows between the public and private sector help to establish an environment of trust and reliability between citizens and elected officials in many parts of the world. Through greater use of information technology, the government expects to create an efficient administration by providing better and faster service to the people, thus bringing a distinctive change from traditional practice (Ibrahim and Goh, 1998).

Currently, Malaysian government is increasing efforts to bring all government procurement processes online under the electronic Perolehan (e-Perolehan) programme. e-Perolehan is part of a wider electronic government project being implemented by the Malaysian government. E-Government is one of the seven flagship applications under Malaysia's Multimedia Super Corridor high-tech development plan. E-Perolehan has been successfully launched on 6 October 2000 with two modules; Central Contact and Supplier Registration.

The objectives of e-Perolehan are:

- Reengineering, automation and reschedule the existing rules of procurement;
- Ensure the supplier will get the benefits in term of payment, faster press and secure;
- Reduce the operation cost and enhance the efficiency of turnaround time;
- Accountability and transparency of procurement activities in government service;
- Enhance the cooperation within the private sectors and government agencies.

e-Perolehan is Malaysia's electronic procurement system for government-to-business (G2B) exchanges on which suppliers maintain product and pricing information for access by government buyers. Suppliers who register with e-Perolehan can access the system using smart cards and then gain access to a variety of applications including:

- Placing product catalogs online in a form, which can be viewed from any computer with a Web browser;
- Allowing suppliers to process purchase orders and receive payment from government agencies via the Internet;
- Submitting quotations, obtaining tender document and submitting tender bids;
- Registering or renewing registrations with the Ministry of Finance through the Internet and paying the registration fees.

With the above applications, the government has a common platform to implement paperless environment to for example, tendering and awarding of construction projects (Abdul Rahman, 2002).

This project will investigate the issue concerning paperless tendering or better known as electronic tendering, which is discussed in the next section. Then, the problems pertaining to the proposal of this project and its objectives are described. Finally, the methodology and significance of this study are elaborated.

2.0 WHAT IS E-TENDER?

Traditional process of tendering starts when the owner of the tender published the notification of tender through print media such as newspapers within a period of time. Then, the contractor will respond to the tender advertisement by purchasing the documentation, filling the requirements and submitting before the closing date. Refer to Figure 1, which shows the details flow of the tender process in traditional ways.

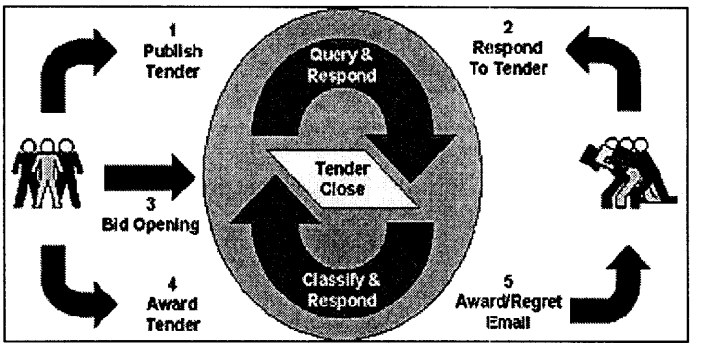

Figure1: Traditional Tender Process

In contrast, electronic tendering (e-Tender) has evolved over the past decade from a dial up modem-to-modem computer access to a more elaborate Internet based tendering system. In today's terms, electronic tendering may be defined on a broad spectrum from a simple Internet based system that displays only a brief description of the commodity being procured to a more sophisticated Internet system that provides contractors with the ability to download and pay for complete tender documents (specifications included) in electronic form, all without any paper being produced – paperless (refer to Table 1) and benefits to lower the cost to the organizations (Shapiro and Varian, 1999). Among the e-Tendering system features is the pricing module, which is used by the tenderers and sub-contractors to receive and price electronic bill of quantities (BQs) being produced.

Table 1
Comparison of Conventional and e-Tender

Conventionally	e-Tender
Poor audit trail	Every action, may it be downloading of tender or submitting a tender is logged. A receipt of purchase and submission is automatically generated giving you a systematic and accurate audit trail
High paper usage and storage	Paper usage is minimized by over 90% as tenders can be viewed and submitted online. With e-Documentation, there is no need for physical storage space of tender documents.
Long lead-time is required for bidders to physically come to a centralized location to purchase tender	Tender documents can be viewed and downloaded via the Internet, hence there is no geographical boundaries making it fast and convenient, reducing lead-time by over 80%.

Poor information safety and availability	As all tender documents are securely stored online and backed up via remote servers, and are assured of 99.9% information safety, and availability.
Poor Information security and integrity	All activities online are logged and access to different types of information can be granted based on "need to use" basis. This gives the absolute control over tender information and documents.
High processing cost	Cost is fixed through process automation. Access to documents online further eliminates the need to manage documents requested by bidders saving more resources.
Time consuming and slow processing	Automated documentation flow reduces over 80% of tedious data entry and compilation, making it a breeze to process hundreds, even thousands of tenders.

(Source: www.ehealth4all.com)

2.1 e-Tender Initiatives in Malaysia

A number of local higher institutions Malaysia have utilized the Internet to advertise and notify tenders. Universiti Teknologi MARA (UiTM) and Universiti Putra Malaysia (UPM) are examples of such adopters (see Figure 2 and 3).

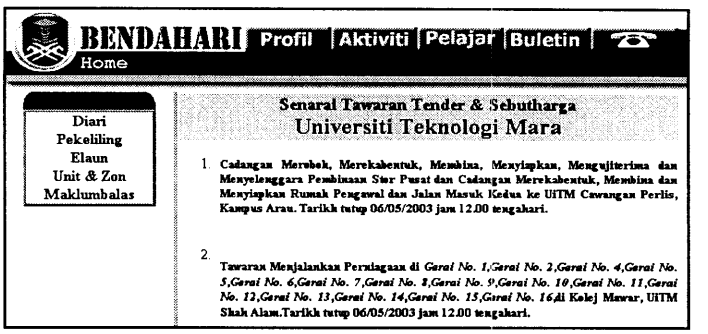

Figure 2: UiTM Tender Notification

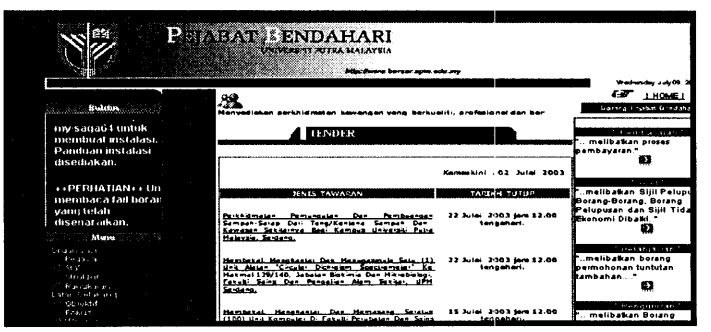

Figure 3: UPM Tender Notification

However, these examples use the web only to display their tender lists. All tendering activities are still performed manually.

3.0 PROBLEM STATEMENTS

As discussed in the previous section, most of the universities in Malaysia have their own channels to publish the notification of tenders through the Internet, which are displayed in their official web sites. However, in Universiti Utara Malaysia the tendering process is still based on manual activities. According to Mak (2000), this will resulted in a poor process control, time-consuming document flow, requires excessive co-ordination efforts, and unable to establish a centralized purchasing data resources.

For the above reasons, this project has explored the existing manual system, produced an alternative and therefore tackled the above mentioned problems. The objectives of this project are discussed in the next section.

4.0 RESEARCH OBJECTIVES

Rapid changes in the global economy force businesses to find innovative ways to tighten their operations budget, and many turned into Internet and Web technology as a tool to cut unnecessary costs. Online tender is providing so much flexibility to organizations to reengineer and streamline their business processes to improve speed, service and quality (Lydiard, 2002). The objectives of this project are:

1. To analyze the requirements of an e-Tendering system for Contract Management Unit, Jabatan Pembangunan dan Penyenggaraan (JPP), Universiti Utara Malaysia.
2. To design a prototype of the system based on the obtained requirements.
3. To assess the document flow speed.

All these objectives will be achieved through the methodology explained in the next section.

5.0 RESEARCH METHODOLOGY

The method involved four main phases namely requirements analysis, prototype development, testing with users, and flow process analysis.

5.1 Requirements Analysis Phase

The process started by seeking and gathering requirements information through various methods such as in depth interviews, articles, books, journal, magazines, and Internet which are conducted in this phase. The interview questions were prepared based on the literature review. The questions were carefully designed in order to encourage interviewees to reveal accurate and detailed information as much as possible including tactics or illegal behaviors in the past transactions.

Basically, the requirements analysis phase was conducted to answer the following questions:

(Q1) What are the requirements that need to be prepared for the document tender?
(Q2) What are the procedures for submitting the document tender?
(Q3) What are the procedures to advertise the tender?
(Q4) What are the qualifications that contractors need to have to buy the tender?
(Q5) How the JPP authorities identify the qualification of the contractors?
(Q6) What are the procedures of the contractors to buy the tender?
(Q7) How the JPP authority selects the contractor's winner for the tender award?
(Q8) How many days are taken for one opening of tender?
(Q9) What are the flows of the overall process?
(Q10)What are the problems faced when delivering the tender?
(Q11)What are the effects of these problems to the organization e.g. cost, time and document flow speed?

The tendering process in the construction sector is characterized by the involvement of large number of actors, and requires a substantial investment of time and effort often with a limited success ration (Halaris and Papavassiliou, 2000). The set of actors involved includes the contracting authority, architectural and engineering firms, general contractor, specialized contractors, suppliers, manufacturers and many more.

The contracting authority prepares tender documents, evaluates bids and assigns the contract to the winner of the tender. This role is also performed by any other actor who wishes to purchase services or products for the implementation of their work within a project. Managing the tendering process in an electronic manner consists of supporting electronically, partially or in total, the execution of the activities. From the contracting authority point of view, it is important to develop a module providing the ability to upload tender notices and tender documents, making them directly available to interested parties and eliminating lead times. Refer to Figure 4 to see the flow of document e-Tender process.

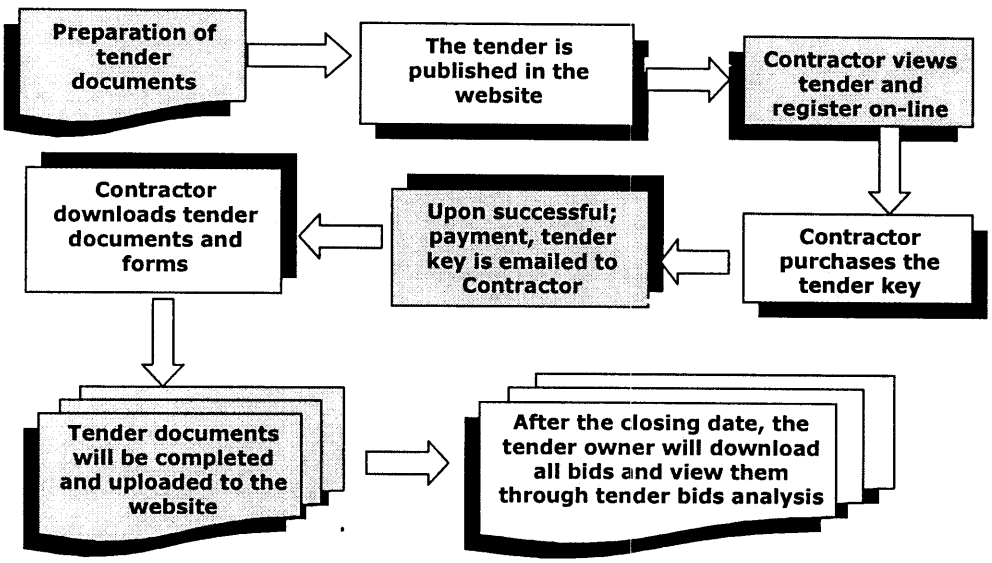

Figure 4: Electronic Tender Workflow Process

e-Tendering must also be capable of handling the full life cycle of the tendering process for JPP or contractors, from initial notification of requirements through expressions of interest, the issuance of invitation to tender and the receipt and evaluation of final tenders, including optional reverse auctions within this process. The exchange of information between JPP and contractors has to be conducted in a secure environment across the Internet to gain the confidence of contractors and to ensure that genuine offers are made and accepted. This system reaches an ever wider audience at a much more cost-effective rate (Callahan, 1999).

After the JPP received the tender form the contractors, the tenders should be stored in a secured environment until the closing date and time is reached. JPP should not be allowed to view any information with regard to the responses until the time is reached. Contractors will be able to submit amended documents to the secured environment up until the closing date and time, as set by the server clock. Previous copies will be overwritten, but available through an audit check. All documents and communication must have a date and time stamped.

After the closing date and time, server should not accept further submission against the tender. Therefore, an automatic electronic message should be issued to the late contractor with particular text that is set by the system administrator.

5.2 Prototype Web Based Development of e-Tendering System (ETS)

In this phase, a number of software development methodologies were studied, and these include Rational Unified Process (RUP) and Unified Approach (UA), which are object-oriented approaches. However, due to limited development time, no one methodology was adopted. Instead the Unified Modeling Language (UML) notations were utilized solely for the purpose of presenting ETS design.

ETS was developed using the following software tools:

i. Hypertext Markup Language Page (HTML Page) – It is a set of instructions for web browsers to display some texts or images on web page.

ii. Active Server Page (ASP) - It is a server-side scripting environment that can be used to create and run dynamic, interactive Web server applications.

iii. Relational Database Management System (RDBMS) with Microsoft Access XP.

iv. Microsoft FrontPage XP.

This phase was highly iterative and involved many units and user interface testing.

5.3 Prototype Testing With Users

The completed prototype was tested with real users in JPP. The following stages were used:

i. Prototype was put online at www33.brinkster.com/ets2003/; (see Figures 5 & 6)

ii. JPP advertised a tender;

iii. Interested contractors registered to perform the tendering process;

iv. Based on the registration, JPP selected only suitable contractor who could buy the tenders;

v. After further processes such as payment of fees, the registered contractors received the tender keys and downloaded the tender documents;

vi. Upon completing the document, the selected contractors sent back the documents to the JPP using the same system before the closing date. This document could not open until after the closing date by a JPP authority.

Mock up tenders were utilized for the process of collecting data. Six participants from Contract Management Unit (CMU), JPP were involved in the testing of prototype. They were Senior Quantity Surveyor, Quantity Surveyor, 2 persons of Technical Assistant of Quantity Surveyor and 2 CMU clerks. The participants were new to electronic transactions but heavily involved in tendering process. One small workshop was conducted to explain and demonstrate of the prototype system. To evaluate the prototype's usefulness, participants were guided throughout the process. They were testing the system within five hours and also completed a document flow speed evaluation form at the end of the workshop. The results are discussed in the findings section.

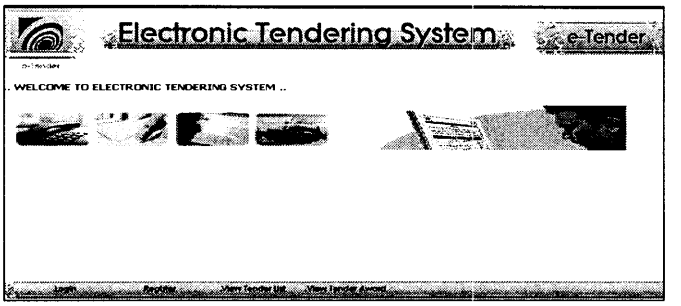

Figure 5: Electronic Tendering System Main Page

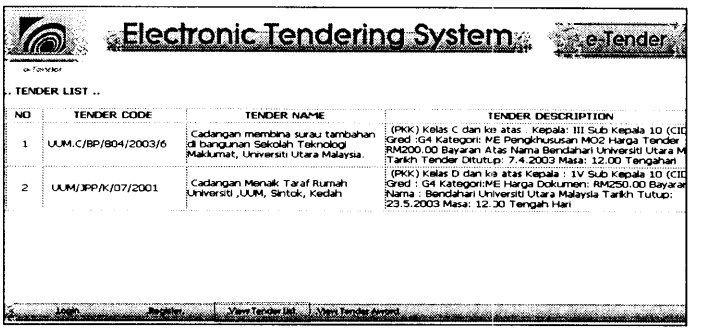

Figure 6: Tender List Advertisement

The workflows for the above system are depicted in Figure 7 and 8. Figure 7 shows the system work flow for Contractor of the construction project in order to buy the tender form, while Figure 8 indicates of the system work flow for Owner (JPP) which acts as administer for the ETS.

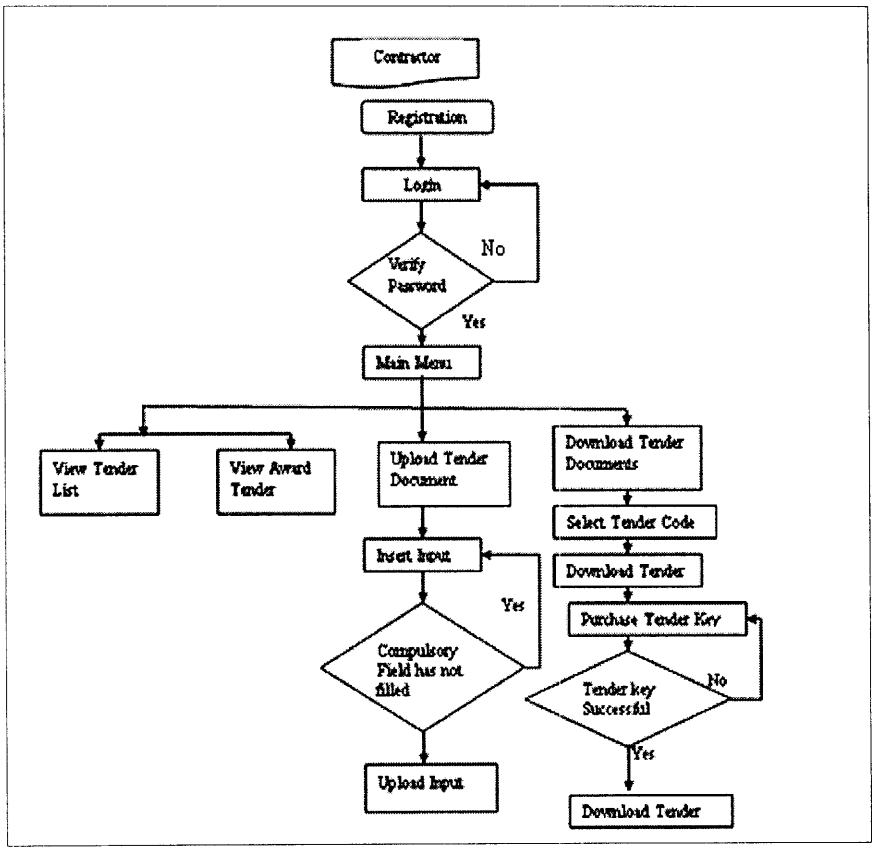

Figure 7: System Work Flow of Contractor

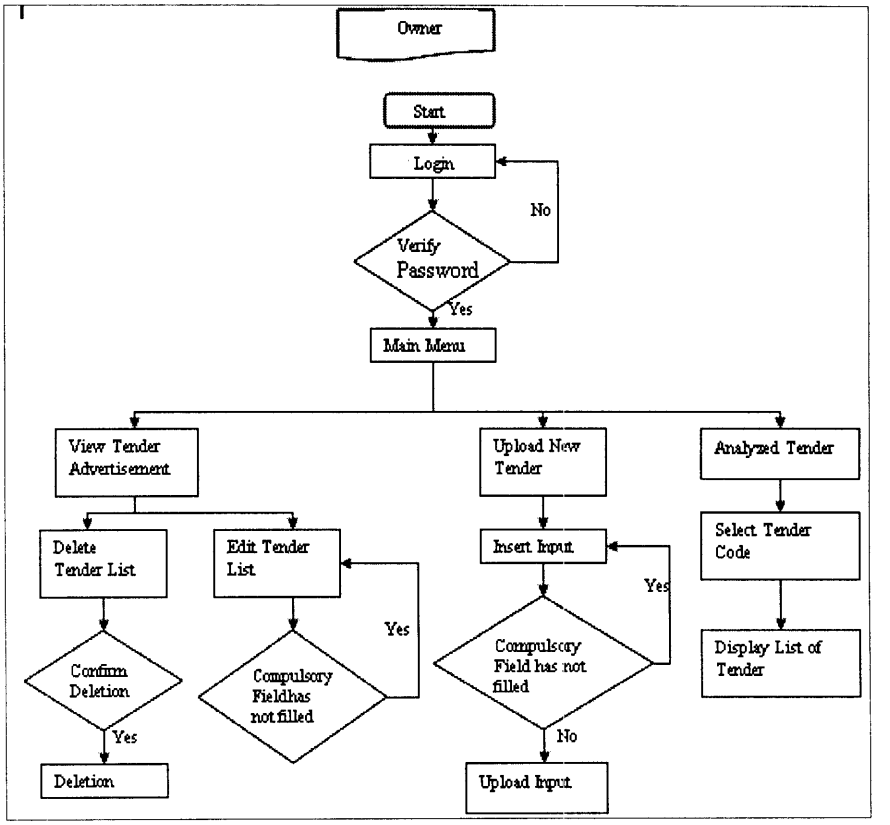

Figure 8: System Work Flow of Owner

5.4 Flow Speed Analysis.

In order to analyze the flow speed, a listing of tender activities was prepared. The record of the times/days taken using the new system was noted. These results were compared with the times/days taken by the traditional process. See the comparison analysis in the findings section.

6.0 FINDINGS OF FLOW SPEED ANALYSIS

This section presents the process and outcomes of evaluating the e-Tendering System (ETS) prototype.

It is evident from the response received from participants involved in the evaluation that the system is more useful, flexible and transparent. The actual manually-based tender activities take about 73 days. However, for ETS the participants took only about 30 days to complete one tender life cycle. (see Tables 2 and 3)

Table 2: The Actual Tender Document Activity

Tender Document Activity	Duration
Part 1 – Tender Document Preparation	14 days
Part 2 – Invitation Offer Preparation	2 days
Part 3 – Preparation of Document Tender	1 days
Part 4 – Duration of Selling Tender	21 days
Part 5 – Payment Method	30 minutes
Part 6 – Tender Analysis	21 days
Part 7 – Tender Award	14 days
Total	73 days and 30 minutes

Table 3: ETS Document Activity

e-Tendering System (ETS)/Participant	1	2	3	4	5	6	Mean
Part 1 – Tender Document Preparation	7 days	7 days	7 days	7 days	7 days	7 days	7 days
Part 2 – Invitation Offer Preparation	10 min	13 min	15 min	18 min	12 min	15 min	13.8 min
Part 3 – Preparation of Document Tender	12 min	15 min	13 min	10 min	14 min	15 min	13.2 min
Part 4 – Duration of Selling Tender	21 days	21 days	21 days	21 days	21 days	21 days	21 days
Part 5 – Payment Method	3 min	1 min	2 min	3 min	1 min	2 min	2 min
Part 6 – Tender Analysis	1 min	2 min	1 min	2 min	2 min	1 min	1.5 min
Part 7 – Tender Award	1 day	2 days	3 days	1 day	3 days	2 days	2 days
			Total	30 days and 30.5 minutes			

ETS has reduced the tender life cycle by about 43 days and this seems to suggest that the document flow speed was increased by about 58.5%. Below are the details of the results:

- Part 1 – Tender Document Preparation: Reduce from 14 days to 7 days.
- Part 2 – Invitation Offer Preparation: Reduce from 2 days to 13.8 minutes.
- Part 3 – Preparation of Document Tender: Reduce from 21 days to 13.2 minutes.
- Part 4 – Duration of Selling Tender: Same
- Part 5 – Payment Method: Reduce from 30 minutes to 2 minutes.
- Part 6 – Tender Analysis: Reduce from 21 days to 1.5 minutes.
- Part 7 – Tender Award: Reduce from 14 days to 2 days.

(See Appendix A for full description on tender document activities)

8.0 RESEARCH SIGNIFICANCE

This research ought to simplify the process of traditional tender. It will give a new environment to UUM as a tenderer, whereby tender advertisements will be published through the web, and the interested contractors will be able to collect, fill in and submit the form electronically.

9.0 CONCLUSION AND SUGGESTIONS

A study was undertaken to evaluate the process of document flow on a tendering activity in construction project. Several e-Tendering initiatives were studied and then used as input to create a JPP e-Tender System (ETS) prototype.

The document flow process was reduced approximately from 73 days to 30 days. Other benefits involved such as reduction in printing and copying costs (currently over 250 pages printed), halved of total costs on telephone and faxing volume between the JPP and contractors. Overall the usage of ETS provides a more efficient way of contracting construction services by easing the current manual process of tender compilation and distribution. However some improvements could be made into this ETS which are (1) Virtual Reality – make use of 3D for diagram and location of construction site and (2) Pursuing to other tender civil fields such as building maintenance services and landscaping.

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