A Dissertation Proposal

Secure Web Services in E-Tendering Process

Prepared By

Tam Siu Pik, Jolly
02100055U@polyu.edu.hk
13 April 2004
Introduction

The explosion of Internet technologies facilitates web application development for marketing strategy, on-line business and also business process reengineering (BPR). The Internet provides a cheap, open, distributed and easy-to-use environment for organizations to conduct business at anywhere of the world. Many organizations and government bodies leverage the technologies and implement electronic solution over the Web. They aim to improve performance, to increase profits and also to cut cost.

E-tendering system is one of an electronic solution implemented by many organizations to replace traditional tendering process. General Electric Information Service Inc in USA has Trading Process Network [8]. Mexican Government has on-line tendering project called Compranet in 1999 [8]. Context Ltd. produced Tenders on the Web in 1999 to service as a gateway provider for Tenders Electronic Daily which hosted by European Commission Host Organization [8]. In April 2000, Government of Hong Kong Special Administrative Region (HKSAR) launched the Electronic Tendering System to enable tender issue, submission and notification of award over the Internet [7]. Those solutions let organizations or government bodies to cut manpower costs in dealing with tendering activities, reduce administrative and transaction costs in tendering process, improve the tender quality and shorten the tendering process life cycle.

In E-tendering system, information is required to disseminate and exchange over an open network. Although the tendering process can be performed more effective and efficient over the Web, it also introduces another problem - the security issues. Organizations open their internal networks for external parties to access tender information or submit proposals. The information is transmitted over an open and insecure network – the Internet. The situation brings out the serious concern about information integrity, confidentiality and access control. The security issues let organizations reluctant to adopt or implement web applications. Obviously, security is a critical successful factor for all web applications.
Today, internet technologies are growth far beyond than past few years. The innovation of web service eliminates the difficulties of integration between different vendors or partners having proprietary interfaces or standards. Web services enable a dynamic e-business model, promote collaboration between business partners and also open up new business opportunities. It is the quick and easy way to integrate with external business processes or services provided by partners using a secure, low-cost and manageable solution [10].

In recently years, implementation of web applications by organizations has steadily increased. One of the reason is security management standard for information exchange over open network has been setup. Now, we can implement web applications in a more effective and secure way. Thus, by reviewing existing articles about e-tendering processes or systems, I want to identify the critical areas of e-tendering processes for revamping using web services to demonstrate latest web technology is applicable and secure for organizations.

**Background Review**

**E-Tendering Process**

E-tendering process is a kind of sealed auction program involving three parties to automate buy and sell activities through the Internet. The three parties are buyer, seller and the mediator. The e-tendering process increases efficiency and effectiveness of the procurement process in terms of costs, quality, performance and time for both buyers and sellers.

According to Ahmad Kayed and Robert M. Colomb, there are four approaches to perform the tendering process [8]. First, buyers set out their own tender and let sellers to feed into the required information. Second, sellers define the standard for buying their services or goods and let buyers to follow. Third, both buyers and sellers must follow the pre-agreed
standard to perform the tendering process. Forth, the mediator will matches between buyers and sellers according to their defined criteria.

Each party in the process has his own role and activities. In table 1, the activities in tendering process for each party can be summarized.

<table>
<thead>
<tr>
<th>Buyer</th>
<th>Seller</th>
<th>Mediator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Interaction Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workflow Management</td>
<td>Catalogs Building</td>
<td>Templates Repository</td>
</tr>
<tr>
<td>Tender Forming</td>
<td>Bid or not to Bid (DSS)</td>
<td>Data Maintenance</td>
</tr>
<tr>
<td>Bids Evaluation</td>
<td>Bid Forming</td>
<td></td>
</tr>
<tr>
<td>Interaction Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tender Invitation</td>
<td>Information Collection</td>
<td>Advertising</td>
</tr>
<tr>
<td>Tender Advertising</td>
<td>Bid Submission</td>
<td>Reputation Building</td>
</tr>
<tr>
<td>Buyers’ Collaboration</td>
<td>Catalogs Interoperability</td>
<td>Auction Application</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standardized Application</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Buyer-Seller Matching</td>
</tr>
</tbody>
</table>

Table 1. The Roles and Activities of Tendering Process (Source from [8])

Basically, activities can be classified into non-interaction and interaction activities. Non-interaction activities are those tasks performed only by one party. In contrast, interaction activities involve more than one party. From the table, it can find that all interaction activities of buyers and sellers involve information exchange or information dissemination.

In general, sealed-bid auction is used by government or large organizations to purchase or sell valuable things. The mediator will be the purchasing office of an organization or a government department like Government Supplies Department of HKSAR. The mediator provides mediation, coordination, integration, negotiation, matching and searching services for internal buyers and reduces the gap between buyer specification and seller specification. The participants do not learn the status of an auction until the end of the
In figure 1, it shows a simple tendering process flow for a sealed-bid auction. The buyer prepares the tender from mediator’s templates and then let the mediator to advertise the tender information for seller invitation. Sellers who interest in the tender offer will collect the tender information from mediator and prepare corresponding bid. Then, the prepared bid will be submitted to the mediator. After the deadline for bids’ submission, the mediator will match the bids using the specification of buyer to identify which bids will satisfy the criteria. The matching result will pass to buyer for further evaluation. The buyer makes the final decision to choose the seller for tender award and let the mediator to publish the result. The process flow in figure 1 has briefly demonstrated the interrelation of activities between buyer, seller and mediator as stated in table 1.

In sealed-bid auction, the ultimate goal is to let buyer or seller choosing the best bid. However, it is a complicated process. It depends on auction strategy and the nature of auction. It can use a strategy-proof mechanism like second-price sealed bid (Vickrey) auction to bid a single item, where the highest bidder wins and pays the second highest price. Or, it can use the secure dynamic programming method proposed by Koutarou.
Suzuki and Makoto Yokoo to solve the combinatorial auctions problem [4] that selling multiple items with interdependent values for bidders to bid on any combination of items. Jianli Gong also proposed an optimal matches mechanism [3] for exchanging complex commodities using qualify, price and order size function and also the market attributes as trade constraints to compute the optimal trade result. The auction strategy and nature of auction have shown great impact on bid matching mechanism and also affect the choice of best bid.

E-Tendering System

In traditional tendering process, all documents are paper based and quality is not satisfactory. The process is time consuming and lack of transparency. The transaction cost is high due to labor intensive activities such as tender preparation, supplier invitation, document flow between buyers and sellers and bids evaluation etc. The traditional tendering process is inefficiency. Thus, many organization or government bodies had automated the tendering process and implemented electronic tendering system in the past few years. The e-tendering system can reduce procurement time and cost and increase the efficiency and quality of tender activities. In addition, past document can be reuse and past tendering experiment can support decision making and information exchange during negotiation. Functionality of e-tendering system can be varying. Christos Halaris and Georgia Bafoutsou had summarized twenty-four existing e-tendering systems like MERX, TED and Bid Express. They had identified six functional areas in an e-tendering system [5]. However, only MERX has been implemented all the functional areas.

In figure 2, it presents an e-tendering system may consist all or part of functional areas identified by Christos and Georgia. It may also include some other explicit functions for e-tendering system or specific value-added function for system achievement. One example is the virtual consortium proposed by Christos and Georgia for construction sector [5]. The virtual consortium allows sellers or providers jointed together virtually on the Web for bidding a tender. Internal workflow will be required for all partners in the
virtual consortium to agree on any action taken. The functionality of e-tendering system depends on the objective of system owner for achievement. However, tender document download, bid submission and communication between involved parties are core activities in e-tendering system.

Except the functionality, system workflow is another important factor in e-tendering system. Workflow is used to guide tendering processes step by step in order to identify the best bid for buyer. According to Ivan Silveri, the system workflows can be divided into three categories [13]. They are naming “Tendering Workflow”, “Bidding Workflow” and “Inter-Organization Workflow”. Tendering workflow includes tender preparation and tender approving activities. Bidding workflow includes bid preparation and internal document exchange activities of sellers. Inter-organization workflow is a kind of process flows that define the sequence of processes between buyer and seller in tendering process. Table 2 highlights the major processes in inter-organization workflow. The system workflow is supported by both tendering and bidding activities. Tendering activities are performed by buyer and bidding activities are performed by sellers.

<table>
<thead>
<tr>
<th>Process</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>Sellers make registration to show interest for the tender.</td>
</tr>
<tr>
<td>Document download</td>
<td>Sellers download tender or related documents prepared by buyer.</td>
</tr>
<tr>
<td>Bid or Document Submission</td>
<td>Sellers submit bid for buyer to evaluate.</td>
</tr>
<tr>
<td>Tender Award Notification</td>
<td>Buyer notifies the tender award result to sellers.</td>
</tr>
</tbody>
</table>

Table 2 Major processes in inter-organization workflow
The functionalities and workflows are two main factors affecting the capability and usability of an e-tendering system. Functionalities are used to achieve different tasks in tendering process and workflows are used to guide the system for goal achievement. Both factors are important to a successful e-tendering system.

Security Concerns

In traditional tendering process, business transactions run under closed environment. All the security concerns are handled manually. However, most e-tendering systems run under an open environment – the Web, the security concerns become a critical issue. Organizations use the internet technologies to implement electronic solution for tendering process in order to minimize procurement time, reduce transaction cost and streamline the process. All things have two sides, e-solution increases efficiency and effectiveness of tendering process but create problem of security. The problem can be categorized into two areas. One is information accessing authentication and the other is information integrity during transmission.

Information accessing authentication is a complicated issue. First of all, we have to determine who can access the information and who cannot. Within an organization, not everyone can access tender information and not all outsiders are blocked to access the tender information. It is because tendering process is an inter-organization activity. Once people are authorized, we have to determine what information can be accessed by whom. It is because different groups of people may access different kind of information. For example, sellers may only access tender document and related information. Or, some insiders cannot access the bids information submitted by sellers. According to IBM, such authentication process is classified as identify management [14]. From the blueprint of IBM, the basic identify management is a three levels architecture called identify foundation, identify control and identify lifecycle management. Identify foundation is an enterprise-wide reference to provide a single authoritative set of identify information. It is the layer to collect, store and protect user identities. Identity control is a layer to provide accessing control to applications and middleware. Identify lifecycle management is used
to enroll user or maintain user profile and identify policy such as access rights and password information. So, the identify management aims to protect our information from unauthorized access.

Except the basic identify management, there is a higher level of identify control. This is the authentication between organizations. We called it as identify federation. Nowadays, advancing technologies facilities the collaboration works between organizations. Organization may allow other enterprises’ application to use its’ own resources through the Internet in order to increase efficiency and effectiveness of inter-organization activities. Whatever how to perform the collaboration works, it is also a security concern about unauthorized access. So, e-tendering process should also consider the identity federation since the nature of tendering process is a kind of inter-organization activities.

Information integrity is another big issue in e-tendering process. Integrity means the correctness, consistency and accurate of information. Information transmission over a network can be captured and modified without any indication by internet hackers. It may have great impact on those users who are using the information. The impact may be a lost of million dollars due to misleading or incorrect business information. For example, a seller is downloading a tender document and his competitor has modified the content of the document over the network. Then, the seller will have a tender document contain incorrect information and may cause his bid document prepared in a wrong direction. In another case, a seller blocks out the bid document transmission of his competitor over the network and pretends his competitor to send a poor quality bid document to the buyer. Then, the buyer collects fake bid documents and may make wrong decision during bids evaluation process. Thus, information integrity is an important issue in e-tendering process.

Clearly, e-tending process has security concerns on both authentication and integrity issues. Even though an organization has implemented identity management, information still can be accessed without authorization over an open network. We should use some
methods to protect the tender or bid information without authorized access or attacked by anyone in order to provide a fair competition for all sellers in tendering process.

**Interoperability and heterogeneity**

Tendering processes are inter-organization activities which involving three parties – buyers, mediator and sellers. Three parties may have their own system to dealing with the tendering activities. Those systems may be run on different platform even though all systems can be connected together through an open network – the Internet. Information is required to across heterogeneous systems. The integration among disparate information systems is needed to facilitate the automation of the tendering processes. Moreover, information dissemination and exchange during the processes may come from heterogeneous information sources.

As most e-tendering systems are using the Internet as an underlying platform, thus, the tendering process should be utilized the Internet technologies for supporting interoperability between different systems and solving the exchange problems of heterogeneous information sources. Currently, using web services is a latest approach on the Web which enables interoperability between heterogeneous systems via a set of open standard [11]. Besides, the Extensible Markup Language (XML) plays an important role in data exchange over the Web in recently years.

In short, an e-tendering system has to consider auction strategy, functionalities and workflow design, security concerns and also interoperability and heterogeneity issues between different systems for success. Due to limited resources and my own interest, only the security concerns and the interoperability and heterogeneity issue will be further study in this paper.
Problem Statement

E-tendering process has been adopted by many organizations and government bodies in past few years. Due to the explosion of internet technologies, the processes can be revamped in more effective and secure way. In this paper, it tries to demonstrate how web services and XML can be applied in e-tendering processes to tackle the security concerns and interoperability and heterogeneity issue of information dissemination and exchange in tendering processes.

Methodology

In the paper, it will be divided into two parts. The first part is to understand web services, XML and their dependency using literature review. The second part is a prototype of e-tendering process using web services to disseminate and exchange information by XML document under a secure situation.

The review will focus on architecture of web services, web services security and XML document security issue. First, it will present what web services are and its critical elements of a basic architecture. Basic architecture of web services can be viewed as three requirements in network, services and format [15]. The element of network requirement is the Internet to serves as common network for web-enabled applications. The elements of service requirement are Web Services Description Language (WSDL) to publish web services, Universal Description, Discovery, and Integration (UUDI) to find a particular web service and Simple Object Access Protocol (SOAP) for using the web service. The element of format requirement is XML to use as common format for data and information presentation. Second, it will present what XML is and its relation to web services. Third, it will present XML and Web Services security standard and their dependencies as shown in figure 3. I will mainly focus on secure web services framework - WS-Security, data confidentiality and integrity using XML Encryption and XML Digit Signature and also accessing control on XML document using SAML.
In the prototyping, it will present a conceptual model of e-tendering process. It shows the basic architecture and requirement for information dissemination and exchange. Then, it will identify what web services will be implemented and describe the employed security policies in the prototype. In the final step, resources requirement for developing the prototype will be highlighted and IBM’s WebSphere Studio Application Developer (WSAD) will be employed as development tool to design and develop the corresponding secure web services.
References


(7) Phoebe Ho. Government E-Procurement: Electronic Tendering System in the Hong Kong SAR. Hong Kong : Centre for Asian Business Cases, University of Hong Kong, c2002.


