SupplyPoint: An integrated system supporting E-business in the Construction Sector

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Abstract. The rapid evolution of e-business in the past few years has introduced new ways for organisations to perform standard processes. In the construction sector most of the efforts have been focused on the tendering and bidding process. As a result many electronic tendering systems have already been developed and are currently in use, mainly in the USA, Canada, Europe and Australia, supporting basically the search for tenders and the acquisition of tender documents. The SupplyPoint system has been developed in order to electronically support and automate the whole tendering/bidding process providing, in addition to search facilities of current systems, a collaboration platform that could support - in a virtual manner - the formation of consortia. The system is partly funded by the European Commission under the ESPRIT Programme (EP-27007) and is currently under the final stage of development and testing.

1. Introduction

The rapid evolution of e-business in the past few years introduced has new ways for organisations to perform tendering processes and participate in bidding. The term tendering is used to describe all the actions performed by the awarding authority to produce, publish and manage tendering documents, while bidding incorporates the effort of interested organisations to win contracts by responding to tenders. The new abilities of the tendering/bidding process are especially important for industries where business is performed on a project-by-project basis and in many cases by consortia formed especially for each project. This is the case of the construction sector, where timely opportunity identification and adequate consortium formation are the key factors for winning a contract.

The goal of this paper is to twofold:

- To analyse the opportunities (and risks) of e-business for electronic tendering and bidding in the construction sector, by examining the chain of business processes and reviewing the pros and cons of existing systems;
- To present SupplyPoint, an innovative European-wide research and development effort, which is partly funded by the European Commission under the ESPRIT Programme - project EP-27007. The SupplyPoint system will support the whole bidding process electronically providing and in addition to what existing systems provide, services for forming virtual consortia that bid for construction projects.

2. Managing Virtually the Tendering/Bidding Process in the Construction Sector

The tendering/bidding process in the construction sector is characterised by the involvement of a large number of actors and requires a substantial investment of time and effort often with a limited success ratio. The set of actors involved includes the contracting authority, architectural and engineering firms, general contractors, specialised contractors, suppliers, manufacturers etc.

Those actors perform different roles during the tendering/bidding procedure. Based on the nature of the activities three roles have been identified:

- Client,
- Info Broker and
- Provider.

The main subject of the Client role is the successful completion of the tendering/bidding procedure. The Client prepares tender documents, evaluates bids and assigns the contract to the winner of the tender. This role is performed by the contracting authority but also by any other actor who wishes to purchase services or products for the implementation of their work within a project. A typical example would be a general contractor searching for suppliers or subcontractors.

The role of Info Broker is to collect, organise, amalgamate and dispatch information about tenders in progress, potential partners, contract awarded and so on. As will as the above mentioned typical Info Brokers, this role is also performed by the contracting authority and occasionally by any of the actors when for example passing information to partners or subcontractors.

A typical provider could be a general contractor, who after searching for tenders and choosing one to bid, forms with others a Virtual Consortium (VC – see [6]). The VC then prepares and submits a bid to the client. However, this is also the case when specialised contractors, suppliers or manufacturers send their bids to a general contractor that is preparing a bid for a tender.

Managing virtually the tender/bidding process consists of supporting electronically the execution, partially or in total, of the activities executed by the above roles. From the client 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. Since very often after the publication of the tender, clarifications are made, the module should in more advanced systems provide the ability to amend clarifications to tender documents after they are uploaded and to notify providers who have already downloaded the tender documents. This functionality is provided in some systems (for example Elpro see [5]) for further details of the European environment.

Having made all the tender documents electronically accessible, focus is now on the way to access them. Thus a sophisticated search engine is required. This engine should enable quick multi-parameter search of tenders and flexible presentation of results. Additionally this module could automatically send e-mails informing the user of any new tenders that match a predefined profile(s). This profile is defined by the user and contains priorities and interests, which are the basis for the screening of new tenders. Another important issue is the ability to search for and gather information about potential partners, subcontractors and suppliers as well as to have a secure environment ensuring on-time and quick communication with them.

Virtual support has also to deal with the need of exchanging documents and messages with the VC after the its formation, when the preparation of the bid begins. An effective solution could be the commitment of adequate space in a web server dedicated to the consortium, managed by the consortium leader and accessed by all partners (depending on rights). Towards the end of the tender/bid process, virtual management should support the

electronic submission of the bid, the communication between client and provider and the electronic dispatching of the results. If this is accomplished in a way that does not endanger confidentiality of the bids, then substantial advantages could be gained from the minimisation of the response times to tenders.

In this context many electronic tendering/bidding systems have already been developed and are currently in use, supporting the tender/bid process in the construction sector. Outside Europe most of the systems operate in the USA (Trns•port Expedite™, Bid Express, Bid Line), in Canada (MERX, BIDDs) in Autsralia (DCIS System) and in Hong-Hong (ETS). In Europe a very important factor in the tendering process is the obligation of authorities to publish in the Official Journal of the European Union (Supplement S) tenders, when their values exceed the established thresholds. Thresholds vary, depending on the subject of the tender (e.g. services, procurement, works). In the case of public works the threshold is set at 5.000.000 EURO. In other words Europe has developed a database of medium and high value tenders fed daily by members states. The existence of this database has resulted in the development of two categories of systems supporting the tendering/bidding process in the construction sector; pan European systems based on TED (Tenders Electronic Daily, the electronic version of Supplement S) and national systems fed by tenders published by national and local authorities.

Functionalities provided by the electronic tendering/bidding systems vary from system to system and could include:
- electronic search of ongoing or assigned tenders,
- tender documents download,
- search for partners in the systems database
- e-mail exchange between primes, subcontractors and suppliers,
- automatic search of new tenders based on defined user profile and user notification by e-mail,
- electronic creation and submission of bids

Most of the non-European systems are initiated by and focus on the support of tendering authorities, whereas systems in Europe aim more often to support companies, including the construction sector. The main scope of most existing systems is to support the search for tenders and the acquisition of tender documents. Few of them provide also the ability to search for potential partners through a database containing companies validated by the authority, or members of local official construction companies records.

Some systems offer also ability to submit electronic documents after appropriate registration. With the exception of systems operated by tendering authorities, where services are provided for free, the most common pricing policy is to provide free tender search and requiring subscription to the service before providing access to the full service package. However, many of the systems covering the national level in European countries require subscription before proving any service.

Closing this section, it is important to note that none of the systems reviewed provide a solid collaboration platform that can support - in a virtual manner - the formation of a consortium. Another area that these systems lack is the integration and automation of the whole tendering/bidding process. Such integration could be obtained by incorporating technologies like workflow management systems; see for example [4] & [8].

3. Supplypoint Architecture

As previously mentioned, SupplyPoint is an innovative European-wide research and development effort partly funded by the European Commission under the ESPRIT Programme; see also [2]. The scope of the project is to develop a system, that will support

the whole tendering/bidding process electronically, providing also services for forming virtual consortia (VCs) that bid for construction projects. Figure 1 shows the main components of the Supplypoint (SPP) architecture. The system consists of two main parts, the SPPClient and the SPPServer. It also allows integration with external systems (Elpro is shown as an example). It also interfaces with an authentication system, acting as a trusted third party.
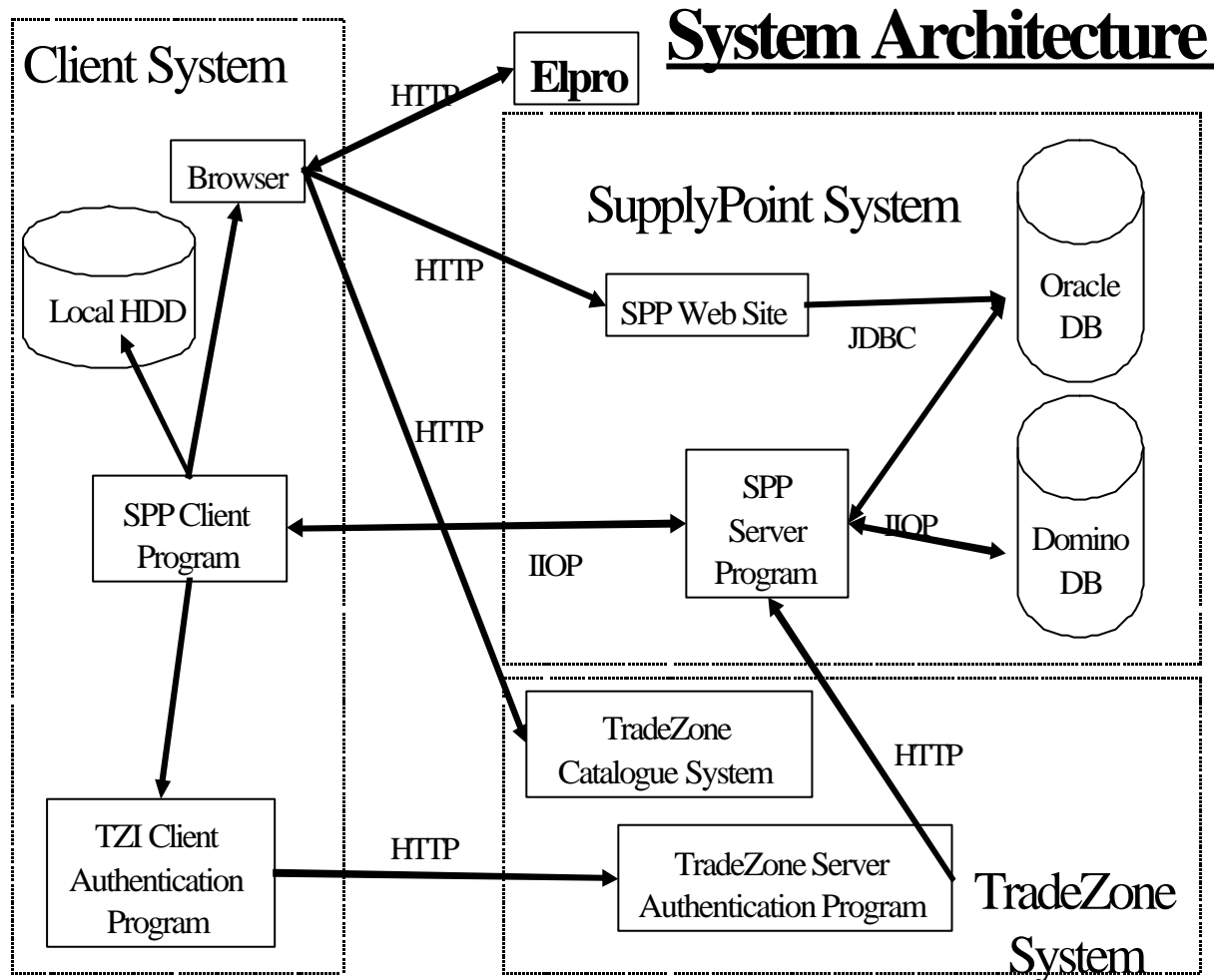

Figure 1: SPP Architecture

The two main parts are now described in more detail.

3.1 SPPClient

SPPClient is the first part of the SupplyPoint system offering services to the users of the system. It provides a Graphical User Interface developed in Java 1.2 that allows the user to access the required functionality from almost any workstation. Within the SPPClient the user is able to communicate with other SupplyPoint system users via a communication/E-mail system developed (or rather integrated) for that purpose.

The concept of "Rooms" (e.g. BSCW, see for example [3]) has been developed and this provides the users with a readily comprehensible metaphor for their "location" within the SupplyPoint system. Both documents and users are associated with Rooms. The organisations/users of the system can Create, Delete and Edit Rooms. They can also add or remove both documents and user access from the Rooms. The GUI representing the notion

of rooms is currently implemented as a tree structure in much the same way as for example windows explorer.

From the SPPClient the user can read, edit, delete and add documents in rooms depending on the permissions that have been set for the specific rooms/documents. This is analagous to a standard hierarchical filing system with links, but implemented with an Oracle database for security.

A number of external facilities are also included in the SPPClient and these include:

- electronic catalogue - to purchase through the world wide web and
- electronic procurement - to find contracts and prepare tenders.

It should be noted that the Common Object Request Broker Architecture (CORBA) is used to provide a communications protocol between the client and the server. The SPPClient establishes a connection with the SPPServer via IIOP. The Lotus Notes Domino Server is used to provide the basic workflow components and infrastructure. The visual elements are rendered in the client using a Java GUI thus providing a high degree of integration.

The SPPClient is installed on the user's workstation but it invokes methods, through IIOP, that are implemented on the SPPServer. This thin client approach has been followed in the SupplyPoint system thus offering a minimal footprint for the client program and reducing the computing requirement on the SME's (Small or Medium sized Enterprise's) computer system.

3.2 SPPServer

The SPPServer is the second part of the SupplyPoint system. This part contains all the functionality for querying, inserting and updating the database for permissions, documents, user details, etc. The SPPServer connects to the Oracle database via a thin JDBC driver in order to be able to query the database. The SPPClient makes a request via the IIOP to the SPPServer, the SPPServer then executes a specific method related to the request from the SPPClient and queries the database via the JDBC driver.

As indicated, the connection between the SPPServer and the SPPClient is via IIOP for CORBA objects, however in order to provide support for workflow and authentication, an XML wrapping technique for documents is used. This process is not described here for brevity and would command a separate paper for a full description.

The SPPServer provides an Administration tool in order to be able set-up new users and organisations in the system. It can also monitor the database and the system logs. The required configuration tools are also available to initialise the SupplyPoint system properties such as the ORB and the database connection.

The Supplypoint system has **interfaces** to the following external services and systems:

- TZI Authentication Package

  The Tradezone International authentication service is being utilised to provide secure and reliable authentication of both the server application and the user. In the prototype system the authentication is by a simple UserID / PIN method. Having authenticated the user the server will then hold a token for the duration of the users session.

- TZI Payment Package

  Within the SupplyPoint project the Tradezone payment service is being developed as a means of on-line payment for registration fees. It is envisaged that as a stand alone plug-in service this can be utilised for other payment requirements at a future date

- Elpro Public Procurement System

  Under EU Legislation, public authorities are obliged to invite tenders from across Europe for (Works) contracts over 5.000.000 EURO, and give notice of this in the

Official Journal of the EU (sometimes referred to as the OJ) S Supplement. These tenders are also currently announced electronically via TED (Tenders Electronic Daily) – see [5] for further details. The ELPRO system provides support for the entire procurement cycle for both procurers and suppliers, starting with the announcement of intention to invite tenders through to the award of the contract. There is an interface to the ELPRO system.

4. Formation of Virtual Consortia Using Supplypoint

It should be noted that there are potentially various differences between virtual enterprises (see for example [1], [7]) and virtual consortia, these are described in [6]. SupplyPoint utilizes the concepts for Virtual Consortia (VCs) rather than the more formal Virtual Enterprises (VEs).

The formation of virtual consortia within the SupplyPoint system involves the direct interaction and collaboration between potential partners, who enter into discussions, through the system, to form a collaboration to deal with a specific tender/project. The concepts behind this process are described in [6].

An organization can identify potential partners using various searches or through suppliers/partners held within their current contact list (implemented as a room). Discussions with these potential partners can be carried out and an agreement made to form a virtual consortium (VC) by creating a shared working area containing various collaboration sections.

Within this on-line business area, or virtual company building (extending the metphor), the partners are given access to discussion rooms, data storage rooms and workflow procedures to facilitate in the collaborative procedures required to prepare and submit a bid for tender.

When creating the VC and virtual consortium building various information is required:
- the VC name
- a list of partners
- access rights to the partners (and individuals from the partners)
- a Technical manager
- a Company manager
- a "contract" of interest to the VC (i.e. that it intends to bid for)

This will produce a virtual company building containing a room of partner details and a contract room for the contract of interest to the VC.

Once formed, the VC can do anything that a single company can do within the SupplyPoint system (link suppliers to the project, prepare a bid for tender, and create sub-contracts). Additionally however, internal workflow will be required to ensure that all the relevant parties have agreed on a particular action. For example, the partners must electronically agree any tender documents before they can be submitted as a bid. To prepare a bid a workflow procedure is used allowing all partners to contribute and agree to the bid before it is sent to the awarding body. This workflow includes:
- From within the contract room a workflow procedure can be initiated
- A tender bid document is created and circulated to all partners in turn
- Tender details are entered into the document by each partner
- After each partner has contributed the final document is prepared for submission
- Each partner must access the final document and "Approve" or modify it's contents
- When the document is modified the approved list is cleared and all partners must re-"Approve" the document

- Once fully approved the document will be sent for submission

The ability to create a virtual consortium building (i.e. collection of rooms) and the workflow procedures of the SupplyPoint system facilitate the formation of and intra-actions of the virtual consortium.

5. Conclusions and further research

The tendering/bidding process in the construction sector is a very important process involving a large number of actors in three different roles. In order to support the process taking advantage of e-commerce technologies numerous systems have been developed. The majority of those systems support search for tenders and the acquisition of tender documents and few of them provide additional services such as search for potential partners, electronic submission and so on. However, existing systems do not provide a solid collaboration platform that can support the formation of a virtual consortium. That was the opportunity for the development of Supplypoint, a new system aiming to support the whole bidding process.

The Supplypoint system will be available for validation and verification from May 2000 and a critical mass of users has been identified. The project will end in September 2000, when the system will be available for commercial purposes.

Further work will be required on many issues, including for example the close integration with new and existing 3rd party services, in order to provide a seamless environment for the Supplypoint user.

The virtual room concept can be utilised in the education arena to form a virtual campus with students and tutors being able to upload notes, tutorials etc online. The permissions architecture would use the same principles as in the Supplypoint system.

Although this paper does not address the legal implications of virtual company formation the Supplypoint consortium have done extensive research into the subject. The final report will be publicly available shortly.

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