

The E-NTRY Web-based E-commerce Platform: an advanced infrastructure supporting Tendering, Bidding and Contract Negotiation

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Abstract The E-NTRY Project is focused on the design and development of an innovative Internet-based E-Commerce platform (E-NTRY) to support the 3 key processes of: Tendering, Bidding and Contract Negotiation. The E-NTRY goal is to enable more open, transparent, fair and, at the same time, more efficient and cost-effective industrial procurement practices. Users will be assisted to avoid ambiguities and incompleteness in Tender and Bid documents, to reuse materials produced in similar past experiences, to send and receive the Tendering Documents electronically with full account taken of security aspects. For this purpose, XML (eXtensible Markup Language) is used to give standard structure to the large amount of information managed by the E-NTRY tools and to enhance the interoperability among all the different tools. The use of HTML pages, Java applets and servlet, and HTTP protocol provides user-friendly GUIs to electronically browse, retry and exchange documents in a secure way, using the Internet.

1. Introduction

The E-NTRY Project intends to design, develop, pilot and evaluate an **innovative Internet-based E-Commerce Platform** enabling more open, more efficient and more cost-effective industrial procurement practices. E-NTRY is a software system aiming to support the **Tendering, Bidding and Contract Negotiation** processes involved in the Procurement Process. To ensure a common understanding of the scope of the E-NTRY tool, we give a brief description of the processes involved. The Procurement process can be divided into two major phases each of which has several sub-phases:

- Creation of Tender; construction of documents; preparation of bids; receipt and evaluation of bids; selection of successful bidder(s)
- System purchase; installation; post sales support.

The successful Bidding Organisations (BOs shortly) move from the first to the second phase up to signing of the contract. E-NTRY is only concerned with the first phase and the rest of the paper will not address the issue arising from the second phase. There are however many points of contact between the two major phases and it is expected that the systems developed for the first phase and described in this paper will be readily usable in the second phase of a particular procurement activity. The figure 1 outlines the procurement process as it is effected by European Directives. Phase 1 starts when the Tendering Organisation (TO, shortly) decides to create a Tender, because of the need of some product or service, in accordance with its procurement plans. There are two types of procurement procedure :

- **Closed** procedure, in which the TO issues a Request For Interest (RFI), addressed to pre-selected potential bidders asking for a company's general information and area of interest, or a Request For Proposal (RFP), submitted to pre-selected suppliers as well, but requiring a brief, general description of the respondent's proposal. After having received and evaluated the RFIs or the RFPs, the TO issues the Call For Tender (CFT).
- **Open** procedure, no RFI or RFP is issued but a CFT is addressed to all interested BOs.

PHASE 1			
relevant to compliance with european & international law			
Conceptualisation a project is originated	Preparation a project is discussed with others and agreed;documentation is prepared	Pre-Tender a procurement is formalised;interest obtained from the outside world	Tender invitations to tender are issued, received, evaluated;the tender is awarded
PHASE 1/2		PHASE 2	
Post Tender Detailed contract negotiations carried out	Contract Performance contract is performed in consultation with the procurer		Contract Payments involves ordering, invoicing, payment under the contract

Figure 1: Legal Issues

Since this last case is of more general interest, the E-NTRY project is focused on the case of open Tenders. Thus the issuing of a CFT is the start of the actual Tendering process. The BOs receive the CFT, prepare and submit the corresponding Bids. After receiving the bids, the TO evaluates the bids and publishes the results with regard to the rejected and the selected suppliers. The Contract Negotiation process starts and ends when the contract is signed by the TO and by the successful BO(s).

After the contract is signed, the activities of the 2nd phase of the Procurement Process start concerning the system purchasing, installation and after sales support.

As stated earlier the E-NTRY project focusses on the 1st phase of the Procurement Process.

2. Project Objectives

A general description of the Tendering and Bidding processes is given below:

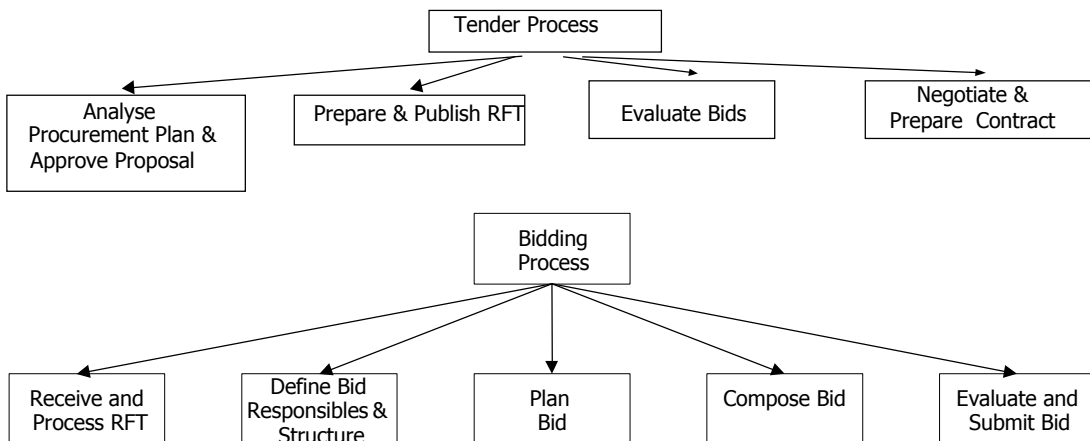


Figure 2: Tendering and Bidding Processes

They are very complex and costly processes, involving many actors from different departments within the respective organisations with substantial data exchange. The expectations of the E-NTRY Industrial partners focus on the reduction of the overall lead-time of the entire procurement process, with significant reductions in the time and the costs concerning the tendering and the bidding processes.

From an analysis of the actual Procurement process, the E-NTRY industrial partners have detected several inefficiencies that will be addressed by the E-NTRY tool, in particular:

- poor quality of the produced documents (the CFT is often inconsistent and incomplete, the Bids do not comply with the format and information content required in the CFT);
- little or no reuse of information related to past cases;
- limited transparency of the procurement process (the evaluation criteria used by the TO are often not clear, and the results are not made public);
- limited support for information flows and co-ordination of activities within the organisations during the Tender and the Bid Creation processes.

Thus E-NTRY system supports:

- mechanisms for distributing and receiving (parts) of the Tendering Documents and for submitting the Bidding Documents in an electronic secure way;
- mechanisms for the exchange of information and standard templates between personnel of the Tendering or of the BO;
- mechanisms for analysis of information concerning similar past CFT or Bid preparations and reuse of the documents produced
- a workflow tool supporting the co-ordination and synchronisation of the activities that takes place within a tendering (or bidding) organisation but also supporting the information flows across the tendering and the BOs during the procurement process;
- the negotiation phase, to make transparent the bid-opening phase and to facilitate the convergence to mutually acceptable solutions between the TO and the winning BO.

3. System description

The E-NTRY software system consists of the following software tools:

— **Repositories:** containing

- the models that are relevant for the configuration of the tools (encompassing a Process Model, which defines tasks, activities, rules, constraints and best practices in the tendering, bidding and negotiation processes, a Product Model which defines the procured products, a Costing and Planning Model, which defines product costing and production planning rules, a Pricing Model, which defines product pricing rules and a Bid Evaluation Model which defines bid evaluation rules);
- the historical documents of the past cases;
- the documents and the messages produced during a particular Procurement process (the text of the CFT, the submitted bids, the request for clarifications sent by the Bos to the TO...).

All this information is stored into three Repositories (Tender, Bidder and Web Site Repositories), depending on their use and confidentiality.

— **Tendering Tool:** offers to a TO **Decision Support** functionality to, e.g.: create, plan and control a “CFT” project; browse and search in the Repository for similar tenders; re-use parts of past “CFT” documents; (semi-)automatically generate a new one; define in details the bid evaluation criteria; publish a CFT and invite bidders; pre-screen and evaluate received bids;

— **Bidding Tool:** offers to a BO **Decision Support** functionality to, e.g.: create, plan and control a “Bid” project; browse and search in the Repository for similar bids; re-use parts of past “Bid” documents; (semi-) automatically generate a new one; estimate the costs and execution plans; evaluate risks; define an optimal bidding price; check, vet and quality assure documents produced; self-assess the bid created by using the evaluation criteria defined by the tendering company.

- **On-line Negotiation Tool:** supports the TO in using *bid evaluation* functionality and the BOs in using *cost/price estimation* and *bid self-assessment* functionality. It allows a tendering company to open on line received bids, through screen sharing mechanisms, and to close a bid on-line, by publishing the final outcome on the Web.
- **Active Workflow Tool:** includes three main components: *Tendering Workflow*, *Bidding Workflow* and *Inter-Organisation Workflow*. The first two components support information flows, co-ordinates and synchronises all activities, which take places **within** a tendering (or bidding) organisation. The Inter-Organisation Workflow supports the information flows, co-ordination, synchronisation group-**across** the TO and the BOs.

4. Technical solutions

E-NTRY targets standard and low-cost platforms in order to limit the training phase of users: Windows 98 as the base operating system, Word 98 for the document preparation, Explorer 3.1 for browsing the information on the net and for e-mail exchanges.

The E-NTRY tools make extensive use of some key technologies, whose exact use is explained in more details in the following:

- **XML** (eXtensible Markup Language) as the main representation format for information and documents; this choice enables interoperability across the E-NTRY components and of the E-NTRY tools with other systems; it also makes possible development of mechanisms for the analysis and processing of documents;
- **Java** technologies that allow development of portable and downloadable components, as well as server-side applications connected to information repositories;
- **SSL** to support secure transactions and authentication over the Internet.

4.1 Information and Document Management

The large amount of data that flows within and among the involved organisations during the procurement process mainly consists of documents containing information of different nature, such as legal texts, personnel profiles, contractual rules as well as images, drawings, photographs and so on. In order to catalogue, retry, combine, exchange and publish semi-structured information it is necessary to organise it within some kind of framework: XML is the ideal solution for giving both a physical and a logical structure to the documents.

The use of XML tags allows for a clear description of the information, that can be queried, extracted, reused, manipulated and published as desired. Futhermore, it is possible to describe, using style sheets, the rendering of the information within a document, thus different users can see different parts (potentially with different formats) of the same document: this is useful in order to improve the user-friendliness of the applications and, when combined with an adequate authentication mechanism, to manage sensitive data in order to show them only to authorised people.

XML documents have predefined structures specified by DTDs (Data Type Definition documents). Any XML document can be “validated” against a DTD document to ensure that the structure of the information content follows the rules described in the DTD. The use of DTD’s provides a level of quality checking so for example, a bid proposal will not be accepted by the TO if it is not validated against the rules established in the corresponding DTD. Similarly, the preparation of a Tender document can be done following a predefined well-accepted structure defined by a DTD: this prevents document authors from omitting some important parts and, consequently, the document quality is significantly improved and the need of clarifications is decreased.

The use of a common format for all the documents enables interoperability among all the different tools: the XML tags being used as convenient data wrappers during the transfer of information among systems or application: XML is the format for structuring the information with the E-NTRY **Repositories**. The Process, Product, Costing and Pricing models are described using XML; the historical case bases consist of:

- **Typical procedures, legislation, contractual rules** common to all the CFTs (i.e.: the list of documents and certifications required to the bidders) and all the Bids, respectively: they are structured as XML documents, using hypertext links;
- **Templates** for documents are DTD files, possibly one for each type of tender plus XSL style-sheets for their rendering.
- For each **past tender/bid**: a description of the Tender/Bid Creation process, the profiles of the people involved, the CFT/ Bid and all the other documentation supplied to the bidders/tenderer, the document describing the evaluation criteria for the bids, information about the participating bidders (area of interest, contact person..), the received bids and the result of the evaluations. All such documents are stored in an XML format, together with the corresponding DTDs and style sheets (if any).

The Tendering and the Bidding Tools are mainly web applications that help the user in preparing documents, calculate costs and prices using the models and the past documents. The Tender tool creates a document containing the evaluation that are automatically used by a Java Applet, downloadable by a bid organisation from the web in order to make a self-assessment of its own proposed bid.

4.2 User Interfaces

The TO hosts a Web-server in which are published the CFTs and the results of the evaluation of the received bids; the server also contains HTML forms and Java applets that can be used by the bidder organisation to perform a preliminary evaluation of their own bids and then to submit the bids.

Analogously, people from the TO or the BOs can access and browse information stored in the local repository by web-pages that send requests from the client browser to Java Servlets running on the local server. Obviously the information forming the Tender Case Base and the Bidder Case Bases are physically stored on different servers that can be accessed only by personnel of the respective organisations. The servlets reside on the machine where the information is store: using JDBC connections they can efficiently perform queries, receive the results in XML format, send them back to the client browsers possibly in an HTML format that results applying style sheets rules to the XML.

4.3 Active Workflow Tool

The Workflow Tool allows to open a **groupware session** inside which users, depending on their role, can perform different activities: an *administrator* can provide the responsible of a phase/group of tasks with information (the documents and authorisations that have to be provided, the expected deadlines and so on), and set deadlines, alerts etc.; the responsible and the collaborators can read/write messages, add/retrieve documents etc.

The key technologies used are again essentially XML and Java.

The Tender (Bidder) Project Creation Tool produces **XML files** describing tasks, responsibilities, documents to be produced for every task and relative authorisations. A **Java Servlet application** reads this documents and produces HTML pages presenting the process structure to the administrator's browser. The actors involved in the Tendering (Bidding) process exchange documents by HTML forms/Java Applets that support e-mailing (JavaMail is used to implement an e-mail architecture where the message contents

are **XML** documents). Some other Java servlet can monitor the status of the deadlines and of the documentation sending other e-mails to alerts the responsible of missed deadlines. The Inter-Organisation workflow module supports bidders **request for clarifications**, tender **replies** (clarifications and amendments) to all bidders interested in a CFT, bid electronic **submission**, **on-line negotiation** between TO and winning bidder organisation. The adopted technical solutions are: the use of forms supplied by web-pages to compose e-mails using JavaMail classes and a server-side Java Application that implements a **mailing list**; the user **mail-boxes** can be accessed via web-pages, since access permissions to mail folders and security of e-mail transmissions are ensured by using JavaMail classes.

4.4 On-line Negotiation management

The definition of the **negotiation modalities** and of the **legal agreements** are described by the TO, by re-using and completing XML documents that are published as web pages on the Tender site. The received bids are accessed on-line by using **Net-Meeting**: a selected person from the TO can access the Repository where bids are stored and open and visualise them; all the connected bidders can see (parts) of the results.

Then, using the **Bid Evaluation Tool**, all the bids are evaluated and receive a score: information about the results (contained in XML documents) is published on web pages in HTML format. **XSL style-sheets** stored in the Tender part of the Repository describe what information the other bidders are allowed to see.

4.5 Security Issues

Within E-NTRY we are mainly concerned with some security issues:

- **Confidentiality** of the data stored in the repository, that must only be accessed by authorised users coming from the organisation that owns and manages such data.
- **Authentication** of the users of the tools.
- **Secure** exchange of messages on the Internet.
- **Non-repudiability** of the CFTs and off the bids published on the web server.

Users are authenticated using an HTTP authentication mechanism, that requires the user ID and password for the authentication of users within an organisation, or certificates when a user from an organisation connects to the Web Site and requires some service. To ensure the confidentiality of such data HTTP must be combined with the SSL protocol, resulting in the HTTPS protocol, implemented for each connections among the Web and the remote applications or the browsers used by the clients. For secure access to data in the repository, E-NTRY will exploit the access restriction mechanism supplied by the data servers used to implement the Repository, also modifying, if necessary, the granularity of the access restriction policy in order to define permissions for sub-parts of the XML documents.

Messaging within E-NTRY is implemented by an e-mail service used by the workflow tools; we selected http and simple sockets (used by Java applications) as the transports and XML for the format of the exchanged messages to ensure openness, simplicity and internationalisation.

An XML document can be digitally signed by including the signature within the document, as the content of a special tag. The signature is calculated as follows: first the hash value of the canonical form of the document is calculated, then it is encrypted using a private-public key mechanism. For the cryptographic operations, we use the Java Security classes for the algorithm implementations and the `keytool` utility to produce the key pairs.

5. Business Benefits and Innovation

E-NTRY is highly innovative, not only because it exploits the most advanced Information and Communication Technologies, but also because it advances current state-of-the-art in Internet-based procurement from many different viewpoints: it is much more than just a Web database because:

- encompasses the *complete* tender-based *procurement process* in Industry. A number of research projects are ongoing at EU and International levels in the domain of procurement but they address only few tasks in the whole procurement process (mostly information exchange).
- supports not just information flows, but *co-ordination* and *synchronisation* across *all actors* in the *procurement chain*.
- *actively supports all key decisions* which take place along procurement processes, exploiting XML representation of tendering/bidding documents and Java-based bids evaluation applets self-configuring based upon the content of the Repository
- supports *complex negotiation* processes *across the entire procurement chain*. There are Web Sites which manages auction-type bids but they simply allow placement of offers in an on-line auction, and mostly cover simple and standard products. E-NTRY will go beyond, as it provides decision support to both tenderers and bidders during the complex negotiation processes, which take place in industrial procurement chains.

6. Conclusions

Tendering and bidding are becoming common procurement practices in many private and public sectors, used for a wide range of complex and expensive products (e.g. civil works, aircraft, ships, production facilities, industrial equipment, electronic and telecommunication devices, etc.) and related services. Key issues in tender-based procurement are: open competition (any organisation meeting a well defined set of requirements should be informed about the bid and able to bid); transparency (complete and clear information should be equally shared between the TO and all the BOs); fairness (evaluation criteria should be made explicit, rigorously applied, and contract negotiation and awarding should be transparently performed). One of the major obstacles to full-scale adoption of more open, transparent and fair procurement processes is the difficulty, complexity, costs and time needed to strictly adhere to working practices meeting the above goals.

It is a specific objective of E-NTRY to create a *generic* tool, meeting the requirements of a wide range of Industry sectors: pilot Users are tendering (OTE) and bidding (INTRACOM) companies from the *Telecommunication* Industry, but requirements and solutions will be generalised by E-NTRY IT partners to other sectors, such as *Maritime* (BMT), *Construction* (TEAM) and *Public Administration* (SUN). E-NTRY incorporates a set of generic functionality. Based upon the content of the Models (Process and Product descriptions, Costing and Pricing rules..) included in the Repository, E-NTRY will be able to self-configure its functionality, thus ensuring a degree of generality and of flexibility far beyond the current state-of-the-art.

The main objectives of the E-NTRY project are:

- Reduce the time and cost of tendering and bidding through, mainly, re-use of past experience and support to decision;
- Increase the quality of the tender documentation, in terms of clarity, completeness and ease of understanding and streamline all information flows;
- Increase the quality of the bid documentation, therefore increasing the reliability, clarity and completeness of bids and, consequently, **increasing bidders' chances of success**.
- Increase the openness, transparency and fairness of the procurement process.