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# Supporting Enteprise Networks Set Up Combining ebXML, Semantic Tools and Sectorial Standards

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**Abstract:** The idea that undergoes the proposed paper is to present a collaborative framework, mainly based on the ebXML standard, able to implement the extended Smart Garment Organisation (xSGO*) and Interoperability* concepts in a useful set of tools and reference specifications. We assumed ebXML as a reference for the framework since ebXML represents, at this moment, one of the most important initiatives for the standardisation of collaborative eBusiness processes. The adoption of a standard framework, like ebXML, should reduce the efforts required to set up an electronic collaboration. Nevertheless ebXML lacks, for the moment, of practical implementations in real cases of clusters of enterprises (whilst cases based on Public Administration are known): with the proposed framework we would cover the gap between the ebXML specifications and the needs for a real implementation of the extended Smart Garment Organisation that is focused on a peculiar production chain like the Textile/Clothing sector.

## 1. Introduction

The scenario of global commerce relationships requires more and more new mechanisms and tools that, adopting and implementing international standards like ebXML, can ease the establishment and maintenance of new efficient business collaborations.

Starting from our previous experience supporting collaborations between companies, from the Moda-ML[1][2] FP5 project and the TexWeave[3] standardisation initiative of CEN/ISSS and from the concepts of eXtended Smart Garment Organization we create an ebXML-based framework that is composed of a set of resources and a set of tools to address specific problems that need to be solved before starting an industrial collaboration between two or more industrial partners.

The eBusiness Watch report on B2B witnesses the difficulty of the T/C sector [8] in the adoption of ICT in the sector to improve the collaboration between the partners: few installations, regarding only large companies and the relationships with large retail organisations rather than with suppliers and subcontractors.

To overcome these difficulties we adopt a standard-based approach: the main advantage in using the developed tools is the reduction of the efforts required to create a new version of standard documents for enterprise collaboration setup.

This paper describes, in the next section, the ebXML vision for the set-up of an e-business collaboration, how we intend to support such vision and in which steps the developed tools can be helpful. Section 3 will provide a general description of each component that constitutes the framework. Finally, the open issues and the conclusions that could by extracted from this experience will follow.

## 2. Setting-Up e-Business Collaboration: How to Support the ebXML Vision

Many efforts have been done to improve enterprise interaction [9]. Our aim was to define a framework that could, on one hand, support the enterprises to face several interoperability issues and, on the other hand, that can rely upon a wide and complete standardisation initiative, also in order to draw up the world of the standards with SME[11]. On this purpose ebXML represents one of the most complete standardisation initiative [10].

The starting point in the ebXML context is the creation of a common understood and of a shared XML document (called ebBP[5]) that describes the whole business process involving different partners, each of which with different roles in the production chain.

ebXML [4] does not specify explicitly the format of the exchanged documents: partners are free to decide what is the format of the documents they want to manage and transfer. But these documents must be explicitly indicated in the ebBP document with some reference information. In some cases the necessity of creation of new documents arises from the specific requests of the partners: in this case the people involved in the ebBP creation or implementation should analyse the requirements of the parties and create the new documents (or adapt the old ones).

It's clear that modelling such type of business collaboration in a complex scenario requires a great experience and a direct communication with the industries. It is also clear that the statement of a standard, or of a public description of a business process, cannot be made directly by one industry that, even if leader in a particular production sector, has not a complete vision of the whole production process.

Our purpose is then mainly to develop enabling tools that can be used both by ICT consultants and internal experts when setting up a business collaboration and that can be easily reused when creating a new collaboration.

The ebXML standard also requires the parties involved in the process to create and manage two different types of document. The first one, called Collaboration Protocol Profile (CPP)[6], defines the data about the party itself (like the role played in the collaboration, the required/expected documents, the communication channels implemented and the transport method available for each channel).

After the creation of the CPP, that is mainly based on the ebBP document, and that is in some sense proprietary of each partner since it describes only the capabilities/requirements of one party, the partners must find a common agreement to implement the collaboration, by the comparison of the different CPPs.

This agreement is written in the Collaboration Protocol Agreement (CPA)[6] and signed by the partners that want to adopt it during the collaboration.

Fig. 1 depicts the "path" to define and establish an ebusiness collaboration, the relationships among all the components of the framework, and interaction between them.

The idea is to start from the definition of an ebBP document. This first step is performed exploiting shared models of business scenarios and data structures. Both the collaborations and the data models can be designed considering the semantic model implemented in a set of OWL ontologies.

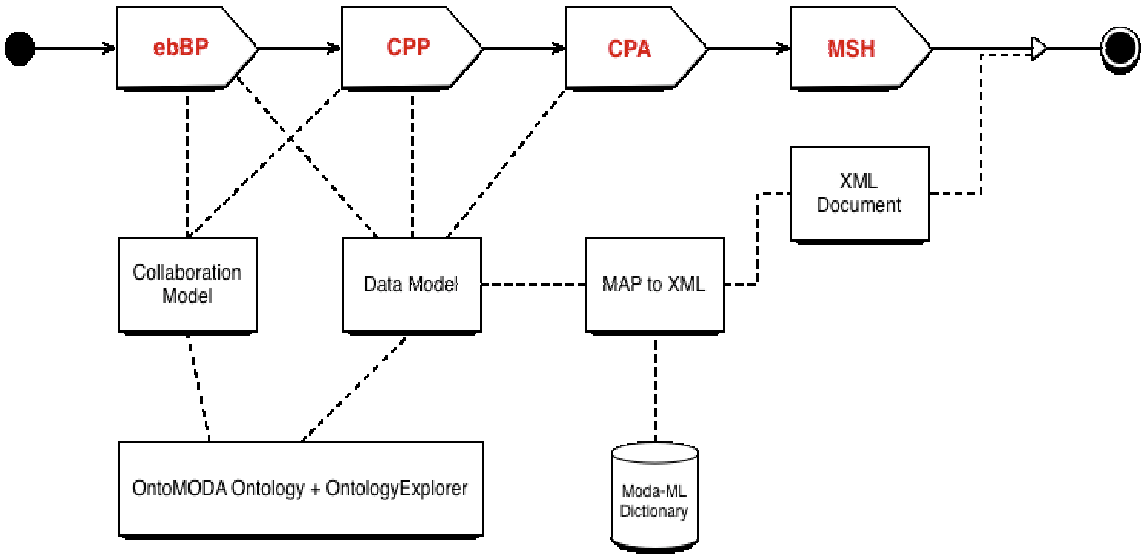


*Figure 1: A Graphical Representation of the Interaction Between Different Tools and Resources*

## 3. The Basic Components of the Framework

In the proposed framework, four components have been developed, under the LEAPFROG-IP project [7] to cover the different aspects of the definition of an electronic collaboration:

1. The OntoMODA ontology and the Ontology Explorer, to define data models
2. The CPP Editor and the CPA MatchMaker, to define business processes.

   All these tools, integrated together, support the set-up of a business collaboration.

### *3.1 OntoMODA Ontology and the Ontology Explorer*

The OntoMODA ontology and the Ontology Explorer can be used together to build a part of the ebBP document and, eventually, the electronic documents required during the transaction (for example an Order Document that contains all information about the provision of a fabric).

OntoMODA is a multilayered modular domain ontology oriented to the data modelling and e-business data exchange. Its primary purpose is to model a part of the Textile and Clothing sector knowledge through the semantic description of many aspects, like industrial processes and treatments, product description (like fabrics, yarns and fibres) and their characteristics and other information. It also is strictly related with the standardised TexWeave vocabulary for which represents the semantic view.

In fact to support in a helpful manner the data modelling phase, our aim has been to strongly interconnect the semantic model (the ontology) with a practical, formal and standardised set of data structures, as that defined in the TexWeave initiative.

This interconnection is implemented adopting the W3C reccomendation for semantic annotation [12] that allows to add the semantic information to XML Schema documents.

The figure shows the main parts of the architecture that we've implemented:

- OntoMODA, that is mainly composed of two sub-ontologies: Dynamic Ontology (DO), Static Ontology (SO).
- Annotated XML Schemas and Type Libraries: this is a library of XS type and a set of XS document annotated with the concepts defined in OntoMODA.
- ModaML Dictionary: this is a dictionary of business terms upon which it was based the TexWeave standardisation specifications.

The Static Ontology models the Textile/Clothing domain knowledge, defining, for example, concepts like "*fabric*" and specifying all its properties. It is connected with two

different types of connections to the Dynamic Ontology that, on the other hands, contains all the semantic descriptions of the representation mechanisms adopted to exchange the information modelled in the Static Ontology. Then, the Dynamic Ontology models the XML components (types, elements and attributes) used as interchange data format in e-business transactions. The Static Ontology itself is modular and therefore composed of several sub-ontologies, each of which addresses different modelling and meta-modelling aspects (i.e. ISO11179 standard, XML Schema meta modelling and real sector knowledge).

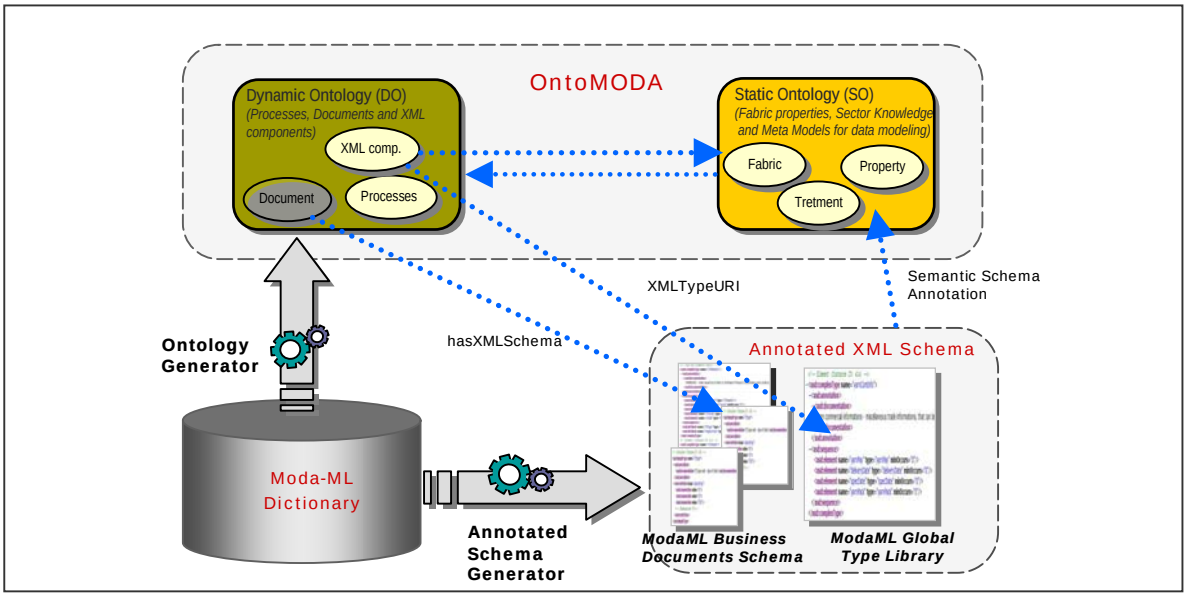


*Fig.2 - OntoMODA Overall Architecture with Annotated Schemas and Dictionary*

The Dynamic Ontology is generated automatically from the ModaML Dictionary (that can evolve in time - then it is dynamic) and it is split in three sub-ontologies concerning Business Documents (like Order, Invoice, etc…), Business Processes (i.e. Fabric production, Supplying etc…) and the XML Schema Components defined in the real XML Schema files. Here the main connections connect respectively

1. The semantic representations of the business documents with their XML root elements defined in XML Schema and
2. Each semantic representation of the XML components with their real representations in XML Schema files.

As said before the content of OntoMODA is split into its static and dynamic part. The first one mainly describes products, their properties and treatments. It contains a classification of the products and in particular describes the fabrics and their properties. Each fabric property is classified for a particular kind of application. Moreover, a set of relationships has been defined in order to interconnect the classes of the ontology and to model the properties of the instances.

OntoMODA is also a great knowledge source that could be used for documentation purpose. Thanks to the textual description of many concepts it can offer many interesting information useful for who needs to know product definition, industrial treatments, processes and fabric properties.

In order to search and read information through the OWL ontology we developed a web application named Ontology Explorer. The tool lets the user surf the entire OntoMODA, starting from the taxonomy and picking up from it the desired concepts to see more detailed information through apposite panels.

We integrate the ontology with the CPP Editor and the CPA Match Maker to allow an easy and rapid access to the description of the processes defined into OntoMODA. This was

done adding simple links that open in a separate window the OE with the ontology loaded on a particular business process.

There are many tools to edit and browse ontology. Protégé [13] is one of the most used one, but there are many others. On the other hand, our aim is to simplify the operation of ontology browsing.

The Ontology Explorer allows the user to navigate, in a simple way, ontologies (it is not strictly related to the OntoMODA ontology and it can show all the online ontologies written in OWL language) and to find concepts and information. Actually all the tools that manage ontologies are really hard to use and to understand: sectorial experts could not be so skilled in computer science or in ontology development to use these tools. Nevertheless, semantic annotation and description ease the comprehension of the information for modelling data and process defining a business collaboration. Then, a relevant problem in developing an ontology for a classical industrial sectors, like the Textile/Garment one, is to create tools to use it easily: the Ontology Explorer is a configurable web tool that is mainly oriented to the Domain Expert rather then to the Ontology Expert or developer.

Usually, domain experts have great knowledge about concepts that concern their expertise area, but their knowledge about ontology implementation is quite absent.

An example of a typical user of the Ontology Explorer (OE) could be a textile expert who consults a sectorial ontology (like OntoMODA) to understand which properties can be used to describe or to characterize a generic fabric.

The Ontology Explorer provides more and better functionalities than other tools dedicated to the same purpose. To enable these functionalities, the Ontology Explorer is designed to be intuitively to use (also for the inexpert user) and many visualization and navigation configuration alternatives are available to the user. It also implements dynamic components that respond to user input, thus enhancing interactivity.

### *3.2 The CP-NET Tool Set*

CP-NET (Collaboration Protocol – Networking Enterprises Technology) is a software application set to enable the enterprises, cooperating through a collaborative framework ebXML-based, to establish and to perform Business Collaborations.

To achieve a Business Collaboration it is necessary to provide, for each couple of enterprises, a common base upon which to start doing business. This base is basically a Business Agreement and it is built, following the ebXML standard model, by comparison and by match of two company Business Profiles. ebXML provides a XML standard to describe both Profiles and Agreements: ebXML Collaboration Protocol Profile and Agreement (ebCPPA).

CP-NET provides two web applications to handle the ebXML CPPA specification: the CPP editor and the CPA Match Maker.

The CPP editor allows the enterprises to create and modify their own CPPs (Collaboration Protocol Profile), required to set up the collaboration with other partners and reducing the number of errors, using a simple interface with the aid of a simple inline help. In fact actually the CPPs are created by hand, directly writing the XML, because no tool exists that allows to create it using a human friendly interface. The idea of the CPP editor is to cover this gap, allowing a non XML expert to write a correct CPP.

The CPA MatchMaker wants to simplify the agreement process required to start up the collaboration: it allows to create and to modify, from two CPP Profiles, the Collaboration Protocol Agreements (CPA) for a couple of enterprises. Currently the two CPPs are compared by hand, identifying both the possible problems and the agreements: the problems are solved in a direct contact, using the phone or the fax, by the partners. At the end of the process nowadays one of the partners must write down all the defined agreements in a XML structured document. This document is the final CPA.

This process is very long in time, because the agreement process is, normally, not in real time: when a possible conflict arises during the CPP comparison, the CPA writer must contact the other party and negotiate about the modifications.

The CPA tool simplifies this agreement process reducing the comparison time and highlighting directly the conflicts between the two CPPs. At the end of the agreement process it writes down directly the CPA in the XML format. This reduces the time required by the whole agreement process.

CP-NET framework supports the ebXML Business Process Specifications (ebBP standard), therefore, into the CPP Profiles and into the CPA Agreements the enterprises can describe their characteristics related to one or more Business Processes.

*3.3 CP-NET Requirements*

The CP-NET tools, CPP-Editor and CPA-MatchMaker, provide:

- A support to upload and store the ebXML CPP and CPA documents, checking and validating them against the proper XML schema;
- A set of Data Access Object to read/write from/to generic DBMS (particularly MySQL and Microsoft Access), remote ebXML ebBP documents, local ebXML CPP and CPA documents;
- Web interfaces, both web applications and web services, that guide users through a logic step sequence to view/change information;
- A software architecture under MVC (Model View Controller) paradigm;

A general vision of the initial objective is showed in the diagram depicted in fig. 3. CP-NET provides an infrastructure to access/edit XML files (particularly ebXML CPP and CPA files) under the MVC (Model View Controller) paradigm. The application is developed in Java language and includes a library set to implement further characteristics not expected by the framework.

To make the application accessible from the web, the tools run on Apache Tomcat Web Server with the support of the Apache Struts framework to develop web applications and Apache Axis to publish web services.

The software architecture is structured in different layers. We can separate them in two main groups:

1) Client/Web

- Client Layer: users can access to CP-NET tools through a web browser or their own web service client implementation.
- Web Layer: two ways are provided to access to CP-NET interface, through web applications or web services calls. Both ways are linked with the same Business Delegate layer and the information is arranged in java bean structures.

2) Core Application

- Business Delegate Layer: all the external accesses must go cross this border that is the general interface to CP-NET core application. This layer provides a set of methods that are called from Web Layer. Each method of Business Delegate is called by Servlets of web applications and published as a single web service too;
- Business Logic Layer: this layer contains all the methods to perform the main tasks that characterize CP-NET tools: to receive get/set commands from web layer, to retrieve/insert information from/to XML files and database, to prepare java bean structures, to reply to method calls, to handle errors and exceptions. To access to resources (XML files and database) the business logic use Data Access Business Objects (next layer);
- Data Access Business Object (DAO) Layer: CP-NET tools need to access to two types of resources: XML files (ebXML CPP, CPA and ebBP documents) and database

(MySQL or Microsoft Access). The created DAO classes provide all the methods to get/set information from/to resources.

- X-Lab libraries Layer: the DAO classes of previous layer are specific for CP-NET tools to access to ebXML standards and to CP-NET database. To access to CPP, CPA and ebBP files, the DAO classes extend the XLabDOM class that provides constructors, methods and functionalities for generic XML files. To access to CP-NET database, the DAO classes extend the Xdatabase class that provides constructors, method and functionalities for generic databases. XLabDOM and XDatabase are classes of org.xlab package, developed to reuse and sharing commons procedures into ENEA XML-Laboratory.
- Java libraries Layer: other standard java libraries are included to implement previous layer (for example: Xerces, Xalan, JDOM, …) to access to resources.

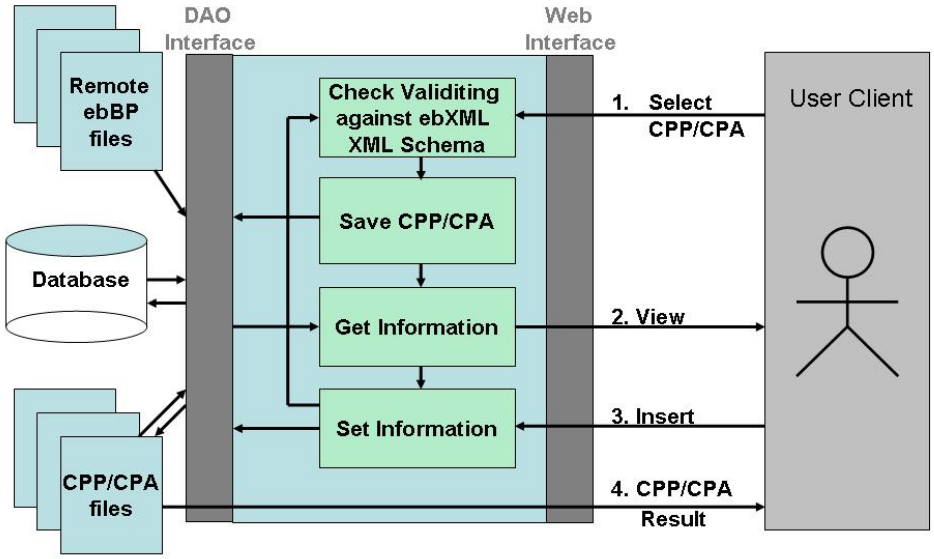


*Figure 3: General Vision*

## 4. Conclusions

The proposed framework has been developed under the LEAPFROG-IP project, in order to define new tools to improve e-business interoperability between the enterprises of the Textile/Clothing sector. The framework will improve the ability of the enterprises to set-up business collaboration, thanks to a complete set of tools that allows the modelling of some relevant aspects related with the definition of a business agreement (from the definition of the data format to exchange information to the definition of the business processes). The benefits of this architecture could be perceived in the next year, when the adoption of ICT tools for data modelling and agreement building will allow the enterprises to formalize the e-business collaborations and then to automize the exchange of business documents. The adoption of the developed framework will also bring to the definition of enterprise profiles that can be used by the enterprises to find and better understand possible collaborations among new and heterogeneous partners. The definition of such profiles represents the premises to populate shared registry of enterprise profiles; CP-NET tools can moreover ease the adoption of standardised documents, like UBL.

One of the next steps in our work will regard the strong integration of such types of tools with applications specific for the exchange of business data (in the ebXML language, a Message Service Handler – MSH), that we are now developing.

The introduction of the semantic vision of the different concepts will ease the usability of the framework itself, allowing a simple access and comprehension also for non ICT skilled users. A learnt lesson during these activities regards the complexity of existing business documents: this complexity makes the adoption of e-business data formats really hard ("customisation" of standard documents is one of the main issues for the enterprises [14]). The testing phase we are now starting includes the exploiting of the ontology to build new, interoperable data format, and the creation of shared business models (ebBP) that will be provided to the enterprise to allow then to design their own profile, following the CPPA specification. These tests will involve both enterprises and domain experts (in the context of the LEAPFROG-IP project) to evaluate the business collaboration design process and to evaluate how to make this operation easy enough for SME.

It is worth to note that our effort does not want to create a brand new interoperability framework, but aim to reinforce and support the adoption of shared standardisation specifications with which it is strongly interconnected. These standards, ebXML and TEXWeave, lack of practical implementations, especially in domains like the Textile/Clothing one, and are consequently not easy to be adopted by the enterprises.

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