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eBusiness in Fashion Industry: Interoperability Standardisation Meets Industry Supply Chain

Piero DE SABBATA[1], Arianna BRUTTI[1] Mauro SCALIA[2], Karolina KRZYSTEK[3], José Ignacio AGUADO[4],Marco RICCHETTI[5], Martin BAKER[6]
[1]*ENEA, Bologna, Italy piero.desabbata|arianna.brutti@enea.it*
[2]*Euratex, Bruxelles, Belgium, mauro.scalia@euratex.org,*
[3]*CEN-CENELEC, Bruxelles, Belgium, kkrzystek@cencenelec.eu*
[4]*AENOR, Madrid, Spain, jaguado@aenor.es*
[5]*Hermes-Lab,Milano, Italy, marco.ricchetti@hermeslab.it*
[6]*TOR, Birmingham,UK, martin.baker@torisinfo.co.uk*

Abstract: This paper presents the eBusiness Reference Architecture resulting from the European initiative eBIZ-TCF and the following pre-standardisation initiative, CEN WS eBIZ – eBusiness in the Textile, Clothing and Footwear sectors, both funded by the European Commission DG Enterprise. The reference architecture implements a standard based interoperability approach to the problem of enterprise interoperability. The paper presents both the aspects related to the technical contents and objectives of the architecture as well as the assessment phase of its validity and suitability for the industry (implementation in real business, benefits, etc.). Upgrade and fostering of the Reference Architecture currently run under the format of Workshop of CEN – the European Committee for Standardisation.

1. Introduction

This paper presents the case of the eBIZ-TCF Reference Architecture, an initiative aiming to create a favourable environment for e-Business within the Textile Clothing and Footwear (TCF) supply chains through a standard based interoperability approach.

European manufacturing SMEs need to create flexible and reactive industrial networks to remain competitive on the market and to gain advantages from new business models and new connections established within the industry networks.

The case deals with the initial activities under the eBIZ-TCF project (www.ebiz-tcf.eu) as well as the current pre-standardisation initiative, CEN WS eBIZ – eBusiness in the Textile, Clothing and Footwear sectors. The second initiative is running under the format of a Workshop of CEN – the European Committee for Standardisation- and aims to achieve consensus on common B2B processes and data exchange formats.

The paper, after an introduction of the objectives and of the current status of art (paragraph 2), presents the chosen approach (paragraph 3), the results in terms of outcomes (paragraph 4) and the measured benefits through 17 pilots (paragraph 5). In the conclusions (paragraph 6) learnt lessons and next steps are presented.

2. Status of Art and Objectives

Collaboration between IT systems can be obtained through at least two different paths [1]: *Integration* (where the concepts are *tightly coupling, coordination, coherence and uniformization* of elements of the IT systems) and *Interoperability* (where the concepts relates to *loosely coupling, coexistence, autonomy and federated environment*).

The *Interoperability* approach aims to affect only the interfaces between the systems, so that they could remain independent systems, better able to operate within open communities. It can be achieved via *integrated, unified* or *federated* approaches, according to the role of common models and formats for data exchange (see [1] for details). The *integrated* approach to *Interoperability* can be implemented through the adoption of standard specifications for the systems' interfaces at different levels (*organisational, semantic and technical* levels whose elements define an *interoperability framework* [2]).

Industry has implemented a wide range of different solutions that could be categorised (according to [3]) in: *slack* (data exchanged through natural language or unstructured data files) or *unregulated interoperability* (*ad hoc* peer-to-peer solutions), *semantic interoperability* (use of semantic technologies) and *standard based interoperability* (common models through standards).

The *cost of the unregulated interoperability* solutions have been examined in [3]: despite their very low initial threshold their costs increase exponentially with the number of the participants and the dynamicity of their relationships.

On the other hand, the *standard based interoperability* is a prerequisite to get the full advantage of the *semantic interoperability* ([4]) that has not deployed its full potential in practical use (one of the problems being the needs for skills that are rare in IT industry).

In many domains *standard based interoperability* has been achieved through the adoption of standards for eBusiness, it is the case of automotive industry (Odette) or for large scale retail (EANCOM). Nevertheless there are domains where, presently, only solutions based on *slack or unregulated* interoperability are in place: it is the case of sectors where the supply chains are fragmented, the SMEs (Small and Medium Enterprises) are predominant and, in parallel, the needs for sectorial specificity cannot be disregarded.

This is the case of the Footwear (FW) and Textile and Clothing (TC) industries where the European industry associations as well as other technological and standardisation actors have been promoting initiatives on interoperability, both from the technological and scientific point of view (European projects like Moda-ML, Shoenet, CecMadeShoe) and from the standardisation side (CEN WS TexSpin, TexWEAVE, FINEC and FINEC2).

The eBIZ-TCF project from DG Enterprise. In order to tackle this problem, in 2008 the European Commission (DG Enterprise and Industry) launched a first *standard based interoperability* initiative to "harmonise eBusiness in the European Textile Clothing and Footwear industry", the eBIZ-TCF project. It gave an occasion to re-collect all the outcomes of the previous initiatives, identify a common Reference Architecture (RA) and put it in action with a large scale experimentation involving more than 150 organisations within 20 European countries and whose results and cost-benefits analyses were collected and published. This activity evidenced the largest benefits can be achieved when a critical mass of adopters is in place.

The WS eBIZ initiative at CEN. Successively, two of the core organisations involved in eBIZ-TCF (Euratex and ENEA) put forward a proposal to the European Committee for Standardisation (CEN) to create a *CEN Workshop* to update the RA and foster the creation of a critical mass of adopters.

CEN is a recognised European Standardisation Organisation with the primary aim of developing harmonised requirements and testing methods for products and services in Europe in form of European Standards (EN). Standard development procedure entails close cooperation of all European Member States and takes on average 3 years.

Keeping that in mind, CEN decided that for new and rapidly changing technologies harmonisation should be done in a lighter and quicker process. Against this background a concept of *CEN Workshop* (CEN WS) was created which consist of giving a framework to the industry representatives and other stakeholders to participate in a completely open and transparent process of adoption of a harmonised deliverable.

CEN WS EBIZ is the result: it is financially supported by the European Commission which guarantees free-of-charge participation to all stakeholders and financing of a Project Team of six experts who work together, with regular consultation of all workshop participants towards upgrading the Reference Architecture.

CEN WS structure does not only guarantee neutrality and transparency of the results but also access to communication and dissemination tools which are expected to facilitate wide update of the Reference Architecture which will be available on-line free-of-charge.

3. Approach

The eBIZ Reference Architecture [9] is the major outcome of the eBIZ-TCF project; it provides an open and public framework to enable interoperation between suppliers, manufacturers and retailers. It was developed taking previous experiences and standards into account, with the aim to use them in a common framework and suggest how they can be implemented in actual TCF scenarios. Three aspects were considered:

- **business application layer**: it is about business scenarios (processes, activities and transactions), document models and document syntax/format;
- **middleware layer**: it concerns collaboration's configuration and aspects of security and reliability of data transport and related services;
- **communication layer**: it looks at communication type (synchronous or asynchronous), architecture (peer-to-peer, hub-based, etc.) and underlying protocols.

The result is an architecture composed of four different types of specifications:

- **business processes**, expressed through UML notation and ebXML ebBP documents;
- **data models**, provided as a set of document templates defined at logical level as well as at syntactic level (XML-based and pre-existing EDI syntaxes);
- **collaboration and communication protocols**, consisting of a set of recommendations based on existing standard for the middleware layer;
- **product classifications**, consisting of a partial overview of some existing national/international classification systems and some suggestions to allow their use.

The objective was to provide automatic development and validation tools with formal descriptions of the specifications to be implemented by the applications. All these artifacts were intended as application-independent supports for ICT developers to easily achieve interoperability between different implementations [7]. In particular:

- the business processes are expressed by two standardized formalisms, ebXML ebBP [5] and UML, that provide an unambiguous representation of the process models from the machine and human point of view; each process was detailed in activities, each of them with pre and post conditions and composed by a number of transactions;
- the data models implementing the transactions of the TCF **upstream** areas are supported through WEB references to documentation (XML Schemas, User guides) published and maintained by the owners of the related IPRs (Shoenet and Moda-ML);
- the data models implementing the transactions of the **downstream** area are represented through syntax independent data models and XML implementation guides (Use Profiles) developed on purpose; pre-existing EDI (WWS Profil) specifications as well as XML Schemas (OASIS UBL 2.0 [6]) are referenced.

In this third case, due to the lack of an established sectorial specification, Use Profiles specify how to use UBL language in the context of TCF industry [8]. As UBL is a generic eBusiness language, they reduce the ambiguity arising from different uses and interpretations of the data dictionary. They suggest a common way to use UBL for the TCF industry through a restriction of generic UBL documents.

With the same objective of easily achieving real interoperability the use of global unique coding for product and party identification (GS1 GTIN and GLN) was assumed as

mandatory in the relationships with retail organisations. On the other side, in manufacturers networks, this was not possible because more flexible and expressive coding is required.

4. Results

4.1 The Reference Architecture

Taking into account requirements and practices, the supply chains were categorised as:

- **manufacturing networks** (**upstream**), characterized by specialized collaborations, small number of actors, strong partnership and cluster of enterprises; here the priority is to obtain maximum performance and flexibility and to quickly react to market trends; sectors specific solutions are required by different production processes;
- **production to retail** (**downstream**), characterized by large number of participants with high turnover; here the priority is to have simple and scalable solutions.

Thus, the resulting eBIZ-TCF architecture was sub-divided into three main areas:

- the common downstream supply chain networks;
- the upstream supply chain networks for the textile/clothing sector;
- the upstream supply chain networks for the footwear sector.

Table 1 witnesses the effort to tailor specifications for real business of each area.

Table 1. Upstream and Downstream Processes

Areas and Processes	Documents #
Footwear upstream business process: • Component supply	17
Textile Clothing upstream business processes: • Fabric subcontracted darning • Fabric subcontracted manufacturing • Fabric supply • Knitwear subcontracted manufact. • Yarn subcontracted manuf. • Yarn supply • On line stock service • Garment accessory supply	70
Downstream business processes: • Cyclic replenishment program – CRP • Vendor managed inventory – VMI • Replenishment on customer demand • Classical pre-order	18

4.2 Online Resources

In order to support the implementers in the adoption of eBIZ-TCF Reference Architecture, several artifacts (and tools based on them) were produced and published online:

- human-friendly documentation: textual description and UML diagrams of business processes and documents, implementation guidelines, ...
- machine-readable documentation: ebBP representation of the business processes, XML Schema and Schematron for the business documents and their Use Profiles, ...
- validation tool: based on XML Schema and Schematron, it checks the conformance of XML instances to the specification of eBIZ-TCF data models.

All these artifacts are semi-automatically generated starting from a common and shared repository where all information are collected: this allows to reduce maintenance efforts, ensures the coherence between different types of artifacts and reduces errors.

5. Business Benefits

A crucial eBIZ-TCF project activity was the assessment of the Reference Architecture towards industry needs, based on a number of real life pilots. A huge efforts was addressed to this objective [10]: seventeen pilots were set up (13 selected through a public call), involving more than 150 companies, most of them SMEs. The network of pilots extends on 20 countries (18 EU member states plus Serbia and Turkey).

In each pilot a facilitator coordinated a network of firms: 13 companies acted as facilitators; 47 were industrial producers or suppliers, 82 retail companies and 22 ICT providers (6 of them acting as facilitators).

Pilots were monitored during and after the project implementation; within each pilot participating firm had to adapt their **pre-existing systems** to support eBIZ-TCF specifications in order to collaborate with the other participants.

Use in real business environment. All the pilots but one reached the stage of actual use in day by day business (the failure was due to internal problems not related to the RA). In a few cases some document was not fully operational as its use was not envisaged by companies. In two cases the use was limited to experimentation, in two other cases the eBIZ compliant system was running in parallel with legacy systems.

The architecture resulted suitable for **different application models**: 8 pilots used a **P2P** model while 9 were based on **Hub** communication model. Two of the pilots reported the support of both communication models.

Migration from legacy systems. A detailed analysis of the legacy data exchange systems before the adoption of eBIZ was carried out on 13 companies. Two were using almost exclusively email while in 3 companies email was predominant. In 2 companies phone/fax was were still dominant while in 2 cases legacy EDI systems covered around 100% of orders management. Thus 9 companies out of 13 were either new to EDI or poorly using it.

Rate of adoption. The actual rate of adoption of eBIZ was measured as % share of orders processed through eBIZ, out of the total numbers of orders received/sent by the company. The pilots showed a high variance around the average (from 100% to less than 1%). The high variance is mainly related to the former use of electronic document exchange: companies new to EDI tend to show a low current rate of adoption; companies already running extensively legacy EDI systems show very high current rates of adoption.

Increased efficiency and gains from the adoption of eBIZ by the companies were assessed looking at **orders processing time**. Eleven out of 13 companies provided reliable data on processing times before and after the adoption of eBIZ. Most of them reported huge time savings, in more than 1/3 of pilots the decrease in processing time was over 80%.

All companies upgrading from telephone/fax systems had remarkably huge savings in processing times, while companies upgrading from email centred systems reported mixed results, from a remarkable 25%-30% to very huge gains (80% a textile upstream pilot).
Although assessment answers from the pilots were based on sparse evidence and expectations, there was consensus for a substantial shortening of response time: as far as quick orders are concerned the response time halved. Companies working mainly on classical seasonal pre-orders report gains from 10% to 20%.

The evaluation of the advantage in terms of lower cost of software development and thus **lower implementation costs** for the companies was not trivial and evidence was anecdotal. In most cases the IT providers had no specific experience in developing EDI software or were not ready to provide reliable estimates (nevertheless their implementation was successful):

- one IT provider specialised in upstream networks reported a 30% drop in the cost of the service for customers in comparison to traditional EDI solutions;

- two IT providers whose core business was the development and sale of ERPs mentioned that the eBIZ module can be offered as a free upgrade;
- one IT provider specialised in downstream networks stated that the deployment of the eBIZ solution to a new network partner (store/supplier) can require from half to 1/3 of the analysis man-days of the traditional EDI solutions because of its standard and more flexible features. The IT provider reported a yearly rate of partners turnover for their customers around 15% (that require the deployment of new software)

The assessment of economic benefits in monetary terms for the Pilots was limited to the static gains relevant to the order processing time.

Dynamic advantages (new services, customer fidelisation, ..) are, in the long term, by far more important than static advantages, however the reliability of dynamic advantages calculations in a very limited span of time after the adoption is largely unreliable and could be based only on uncertain guesses.

The Pilots different characteristics trigger different potential advantages. Some Pilots were unable to provide reliable figure for the ex-ante/ex-post calculation as they never took into consideration the hidden costs of traditional order processing before. In this framework, calculation of sample statistics can be non representative and misleading.

Thus a case history approach based on detailed and real business information was thus adopted with Pilots' Case histories.

Case 1. A Medium-large clothing company, exchanging order documents with a medium size textile company. Both based in a "high labour cost" European Country and using a fax/email system for document exchange before eBIZ.

At the end the eBIZ compliant system covered around 30% of the overall customer orders and around 10% of the overall orders of the supplier. The gain in order processing time is calculated in 80% for the supplier and 50% for the customer. The potential gain, when all the orders will be processed through eBIZ, is estimated in 400 orders'manager man days, that is over 100.000 Euros of labour cost in just one year.

Case 2. A Small footwear company, exchanging order documents with a component supplier and selling to a chain of large surface specialised stores. Both based in a "low labour cost" European Country and using a fax/email system before eBIZ.

eBIZ compliant system covered just a small fraction of the overall orders for all the participants. As the legacy systems were very inefficient the gains in order processing time have been huge (over 90% of time is saved in order processing). Given the current low rate of adoption, the measured yearly gain is limited to around 10 orders'manager man days but the potential gain, with all the orders processed through eBIZ, is substantial, exceeding 380 order manager man days, that amount to over 40.000 Euros of labour cost in just one year.

In both cases early evidence from the pilot show errors in order processing dropping from a 10% average to around 1%. The average response time for an order halved.

The analysis of the pilot cases has evidenced two problems and one result:

- the mandatory adoption of product identification encountered some resistance from the firms, mainly for organisational (too many codes) or economic (cost) reasons
- lack of critical mass of adopters hampers the benefits for the adopters (in some cases it has been possible to see the follow up two years later: were the weight of connected partners was meaningful the system has been maintained and fostered, where only a couple of partners was involved there were no further developments)
- on the other side the RA demonstrated to be easily implemented, even when the firms were not usual to EDI technologies and approaches.

6. Current and Future Development

The current CEN WS eBIZ initiative aims at upgrading the Reference Architecture in order to consolidate it within 2013 and to boost eBusiness adoption in the TCF sector.

Firstly the work carried out by a team of experts consist of production of software artifacts to support new requirements with updated -but back-compatible- specifications.

New requirements emerged in the recent years are, for example:

- RFID devices in the intercompany logistics, brings in the concept of single item identification across the supply chain communications. The impact on the flows of information through different companies is analysed in order to extend the existing RA, for example by managing the new identification standards (like EPCGlobal);
- supply chain optimisation or co-designing of products and open innovation require a closer integration between final goods producers and their suppliers
- new European directives and experiences on e-invoicing towards the public administration should be considered as an opportunity also for the Business to Business invoicing becoming a leverage to foster eBusiness
- public consultations have evidenced some difficulty due to the variety of transmission protocols that are allowed.

Secondly, the project aims to achieve a definition of an interoperability testing procedure via a new testing and validation software tool (freely accessible) to validate conformance to the eBIZ-TCF Reference Architecture with supporting artifacts, both for single documents as well as sequences of documents.

7. Conclusions

As a result of the intensive validation activity of the eBIZ-TCF Reference Architecture, the following benefits were demonstrated and measured by the pilots:

- *Increase in efficiency*, by decreasing operating costs. These benefits, labelled as *static benefits*, were measured according to a "before and after" approach. They mainly improve the cost competitiveness of the company.
- *Increase in effectiveness*, by reducing lead time, response times and increase flexibility. These benefits, labelled as *dynamic benefits*, enable companies to provide better services to the customer. Due to their enabling nature, the actual positive outcome will only accrue to those companies that implement coherent market strategies. They improve mostly non-price competitiveness.
- *Reduction of software implementation costs*. The eBIZ Reference Architecture implementation has generally lower software development costs and lower deployment costs in comparison to EDI systems. They lower the threshold for eBusiness adoption.

Because benefits may vary on their extent and rapidity based on the fashion companies' specific conditions, the eBIZ experience allowed to learn some lessons:

- patterns for benefits in eBusiness adoption:
  - *Fashion companies new to electronic documents exchange*; the upgrade to e-Business, from tools like fax/ phone/ email, generates the widest leap in terms of improvement. Benefits are large and normally gained in the short term;
  - *Companies formerly using legacy proprietary electronic documents exchange systems* but new to an open standard system; benefits are lower in the short term and become relevant as the business network increases (new customers, new suppliers) or in the long term thanks to lower software maintenance and development costs.
- need for critical mass and governance: the standard based interoperability approach need a critical mass of adopters to make actual its benefits, at least at single network level consensus of a relevant share of the participants is needed; the consequence is the need for independent promoters and governing bodies, like standardisation bodies, to facilitate the creation of such critical mass.

From the operative point of view the running CEN WS eBIZ is expected to facilitate the adoption of the RA, to bring the results of the previous projects forward and to capitalise the benefits of the standardisation and interoperability in a fragmented business sector.

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