International Commerce and Information Review
Volume 1, Number 1, Nov, 2008: pp. 25~39

논문투고일자 : 2008. 10. 17.
게재확정일자 : 2008. 11. 10.

Technologies and Standards for the Coordinated Implementation of Global e-SCM

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ABSTRACT

Global e-SCM (electronic Supply Chain Management) has become an important business strategy in a rapidly changing global competition environment. It encompasses both domestic business and overseas business. Overseas business, including B2B and B2G, involves the complex trade procedures across countries. So, the standardization of electronic documents (messages) and business processes is one of critical factors for the successful implementation of global e-SCM.

Without standardized messages and streamlined business processes, the benefits of global e-SCM would not be guaranteed because of human intervention like re-keying business data, which may create errors, delay processes, cause additional data or procedures, etc.

Thus, this paper is to review the implementation challenges of Global e-SCM, to address the needs for electronic information flows through the standardization in electronic documents and business processes for fast and accurate trade transactions in the global supply chain activities, and to assert the importance of adoption of international standards.

Key Words : e-SCM, Standards, EDIFACT, EDI, ebXML, Web Services

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Ⅰ. Introduction

With the emergence of global economy, today's business environment is getting more competitive than ever in the past. Coping with the rapid change, globalization, and competition in the business environment, many enterprises have adopted supply chain management (SCM) to effectively integrate both external and internal resources, and accordingly to boost business competence and efficiency.

Recently, high-speed information links and improved transportation have eroded the barriers of time and space between countries. Integrated technologies, especially the Internet, have provided a real-time platform to exchange information and have allowed collaboration among supply chain partners.

With an emphasis on automated communication and improved processes, the amount of paperwork, filing, and record keeping needed has been dramatically decreased. Accordingly, the way of doing business has been changed.

First, offshoring is more adopted as an operational strategy. Manufacturing continues to move to better locations for enhancing competitiveness (Trent and Monczka, 2002 ; Zeng, 2003).

Second, international operations are a challenge to a company's supply chain system. Many companies are struggling to set up effective operations to manage international supply chains (Prasad and Sounderpandian, 2003 ; Sawhney and Sumukadas., 2005).

Third, strategic sourcing is increasing. Companies are rationalizing their supplier base and then integrating process and technology with the "chosen few" (Chi and Holsapple, 2005).

Fourth, business practices between trading partners are shifting. Companies are requesting smaller and more frequent shipments (Wegner, 2005).

For these reasons, web-enabled or Internet-based supply chain management (i.e., e-SCM) has become an increasingly important tool to businesses.

There have been many theoretical, technological and practical research on the e-SCM, but relatively few on global e-SCM, especially transactions and information flows in the global trading. Thus, this paper will focus on the needs for standardization in electronic documents and business process as one of core success factors for global e-SCM.

Ⅱ. Challenges for Implementing Global e-SCM

1. Two Business Domains of Global e-SCM

Trading partners, business process and systems in the global e-SCM are quite different from those of traditional 'domestic' e-SCM. They are part of international trading in an electronic format and are closely related to the issues of paperless trade, trade facilitation projects, global trade networks, free trade agreements (FTAs), etc.

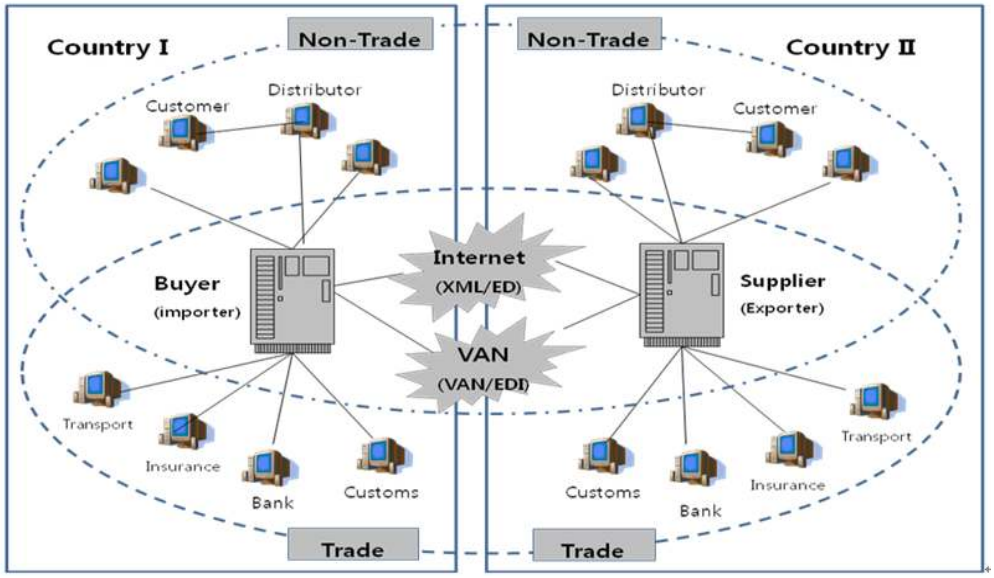
Some of these are related with the legal and technological issues which are beyond the individual companies, industries and countries. Sometimes, they need international cooperation and efforts among related countries and international organizations for the seamless trade procedures and information flow.

As seen in Figure 1, e-SCM can be divided into two business domains: 'Non-Trade' and 'Trade'. The 'Non-Trade' domain is relatively simple and linked with the general domestic transactions. Its business area is confined to domestic market and private B2B sector in each country.

On the other hand, the 'Trade' domain is relatively complex and include the foreign trade procedures, such as customs clearance, foreign exchange, insurance, physical distribution and payment. They, as shown in Figure 1, include private B2B sector (bank, insurance, etc.) like exporter (importer)-bank and public B2G sector (customs, port, etc.) like exporter (importer)-customs.

Its business area is extended into foreign country and public sector as well as private sector which usually require legal procedures and documents according to the international and domestic trade rules and regulations.

Since it involves many different trading partners, complicated business process and various systems in the supply chain activities, it is more difficult to implement global e-SCM than traditional 'domestic' e-SCM.



<Figure 1> Two Domains of Global e-SCM : Non-Trade & Trade

2. Implementation Issues of Global e-SCM

There are several issues to consider when implementing global e-SCM. First, a firm should examine its methods of business and be sure that they are in alignment with the information system. Trading partners should also be convinced that e-SCM is right for them, and that the benefits of e-SCM will reach their organizations (Pender, 2001). The benefits can only be accrued through the accuracy of the data and the consistent usage of the system. Without a true commitment from those involved, there is little chance for success.

Second, to optimize SCM performance, supply chain functions must operate in a tightly coordinated manner. However, the dynamics of an enterprise and the market require flexible responses and adaptations that have local and global effects on supply chain entities. To successfully realize such coordinated structures, modeling with simulation for integrating supply chain and exchanging communication data and information, as well as the use of knowledge of supply chain has become an extremely important approach.

Third, for the implementation of global e-SCM, some business and technical such as including business documents, business processes and messaging should be solved (Nurmilaakso et al., 2006). Business document issues include the definition of the structures and elements of business documents as well as the meanings of the terms used in these documents.

Business process issues include the definition of business partners' roles, in which order to exchange business documents as interactions and to handle the information of business documents as actions in the business processes. Messaging issues are involved in how business documents are securely exchanged, typically over the Internet : the structure, envelope, and elements in business documents, the security and transportation standards to be used, the runtime behavior, etc.

Fourth, there should be the true freedom of information throughout the supply chain. Many companies show little trust in sharing actual data with other companies (Scalet, 2001). Some organizations guard company information for fear that it will end up in a competitor's hands. However, without opening up to the supply chain, firms do not take a chance of exposing a core competency to the global competitive marketplace.

Fifth, firms should share information not only with their trading partners but also within their own organization. This requires the traditional silos and focus on functional areas to be revamped. The organizational structure must be changed to one that makes it easier to share information internally among functions, departments, and processes (Grossman, 2004).

Sixth, government and trade-related organizations should exercise all efforts to implement the global e-SCM. They include the improvement and simplification of trade procedures, the establishment of technical infrastructures, the standardization of electronic documents, the enactment of legal effects of electronic documents and electronic signatures, the cooperation with other countries and organizations for paperless trade.

The collaboration of countries and organizations could be a critical bottleneck in standardizing the electronic documents and processes. Thus, countries should establish an international organization to carry out the standardization tasks (Shim, 2006 ; Shim, 2007).

Fortunately, each country has been trying to streamline the trade procedures and realizes the importance of the paperless trade according to the guidelines and recommendations of international trade-related organizations, such as International Chamber of Commerce (ICC), United Nations (UN), World Trade Organization (WTO), World Customs Organization (WCO), etc.

Ⅲ. Technologies and Standards for Global e-SCM

1. EDI

For many decades, electronic data interchange (EDI) has been used for intermediaries between transaction parties in a supply chain. EDI can be described as the electronic transfer of business documents in a

standard format. It allows data to be electronically and reliably transferred between different firms and different applications.

EDI was motivated by the need for standard transmission between trading partners. Trading partnerships using EDI are well defined and generally stable. This stability means that EDI is used for automated replenishment and efficient supply chains (Crook and Kumar, 1998).

Traditional EDI requires message standards, translation software and a third party network, i.e., value-added network (VAN) which is providing a secure, point-to-point network and 'store and retrieve' of messages.

Message standards for data interchange have played a critical role for the successful EDI implementation. Without standardized messages and business process, the benefits of global e-SCM would not be guaranteed because of human intervention like re-keying business data.

Message standards are closely related to the specific business processes or requirements of each company, industry and country. Once the format of electronic documents is standardized differently from their own, it needs a lot of money and efforts to change or upgrade their business process and data systems. Therefore, there can be great conflicts among related parties during the standardization process.

They initially evolved from early proprietary agreements between pairs of trading partners to industry-wide standards. Later, they evolved into comprehensive and flexible nation-wide standards like ANSI X12 and international standards like UN/EDIFACT. They include data standard, transaction templates, and limited product and service representations.

Generally, a standard is understood as a document approved by an accepted body which contains rules, guidelines or features for generic and repeated use in products, processes or services (Mykkänen and Tuomainen, 2008).

As international VAN/EDI standard, United Nations rules for electronic data interchange for administration, commerce and transport (UN/EDIFACT) was created in 1987 by United Nations Economic Commission for Europe (UN/ECE). It has been maintained by United Nations Center for Trade Facilitation and Electronic Business (UN/CEFACT).

According to message implementation guidelines (MIGs), standard messages for VAN/EDI have been developed and used. Most of countries in the world are adopting UN/EDIFACT rather than ANSI X.12 which is a U.S. national standard.

With these well-defined data and transaction standards, EDI software has been able to provide transaction services that make it possible to execute viable commercial transactions between trading partners. It reduced cost, delays, and errors inherent in the manual exchange of transaction documents.

In this VAN/EDI environment, each user has an individual mailbox at VAN's host computer to receive messages usually on a batch-processing basis. Message security is high, and a helpdesk service is usually available.

In return, however, subscriptions to these services are quite high typically including an entry fee, a monthly rate and charges per kilo character sent, which is cost-prohibitive for small and medium sized firms (SMEs).

Moreover, EDI does not scale easily to include new participants. It is not designed to operate in efficient electronic markets where buyers search for products, prices, and related information from all sellers in a dynamic broader market.

2. XML

Today, the public Internet is replacing the costly VAN providers. Some of the larger VANs now offer Internet services in addition to traditional connectivity methods. This change is being driven by two technologies: extensible markup language (XML) and virtual private networks (VPNs) (Wang and Zhang, 2005).

XML is a markup language used to design web pages. Unlike hypertext markup language (HTML), XML is able to use tags that carry specific meanings. This feature allows data to be displayed in a variety of formats as well as to be sent in real-time across the Internet.

Much like the VAN translation service in the past, XML allows intermediaries to send data to and from different applications. Some industry groups are adopting XML as the language for communicating EDI transaction information via the Internet. In spite of this advantage, however, security is the great problem in using the public Internet to communicate confidential data.

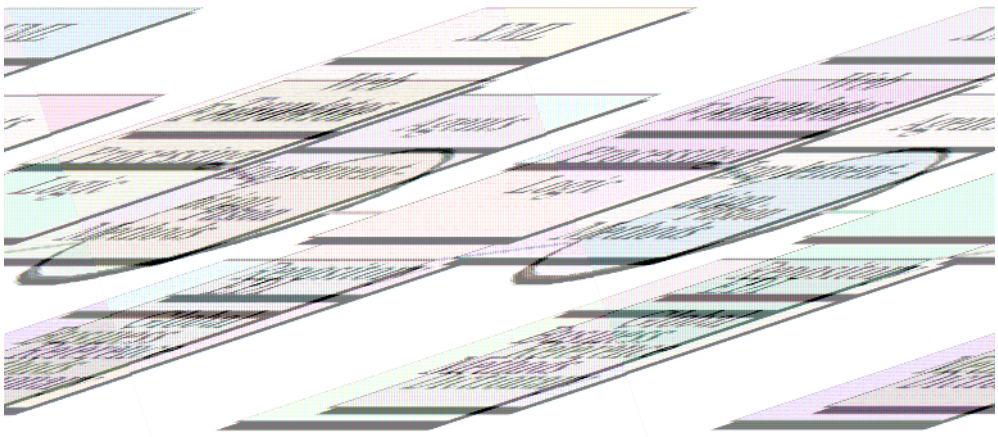
VPNs use the public Internet to send data, but create a secure connection using authentication methods in combination with encryption. When used in conjunction with XML, VPNs allow data to be securely sent between different, realizing the XML/EDI.

XML/EDI is the fusion of technologies of XML and EDI, the structure of which is shown in Figure 2. It allows organizations to exchange data on a transaction-by-transaction basis. An XML file, together with XML schema, provides a definition and semantics of the documents for business transactions. As XML documents and XML schema are text-based, they can be transmitted through hypertext transfer protocol (HTTP).

Since implementing XML data transmission is cost-efficient, small and mid-sized companies that previously could not afford EDI-based solutions will get benefits from the timely and cost-efficient information exchange with trading partners (Chou et al., 2004).

However, both an international standard like ebXML and industry standards like Rosettanet in electronic industry are used for XML/EDI. At present, standard messages for XML and ebXML have been developed and used with XML DTD (document type definition) and XML Schema for XML, and ebXML core components, respectively. This situation may hamper the development or introduction of new applications and the wide use of XML/EDI in the world.

Fortunately, BCF (business collaboration framework) in the ebXML Messaging Service (ebMS) would be expanded to handle all standards. Along with ebXML, BCF was chosen as a policy to develop a framework that can apply to all standards of electronic transactions including ebXML, EDI, web services, etc.



Source : Requoted in Hsieh and Lin(2004)

<Figure 2> XML/EDI : the Fusion of Technologies

3. ebXML

The proliferation of XML-based business interchanges has served as the catalyst for defining a new global paradigm known as electronic business using extensible markup language (ebXML).

It is a modular suite of specifications that enables enterprises of any sizes and in any global regions to conduct business over the Internet in more straightforward and efficient ways than in the past (Hofreiter et al., 2002).

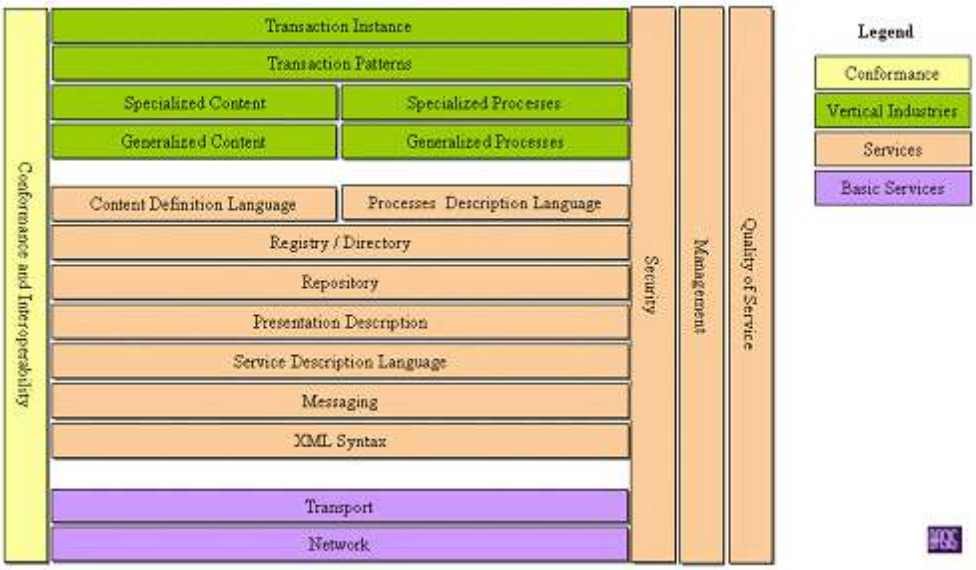
Using ebXML, companies now have a standard method to exchange business messages, conduct trading relationships, communicate data in common terms and define and register business processes.

ebXML has some values : (i) provides the only globally developed open XML-based standard built on a rich heritage of electronic business experience, (ii) creates a Single Global Electronic Market Enables all parties irrespective of size to engage in Internet-based electronic business, (iii) provides for plug and play shrink-wrapped solutions, (iv) enables parties to complement and extend current EC/EDI investment expand electronic business to new and existing trading partners, (v) facilitates convergence of current and emerging XML efforts (www.ebxml.org).

ebXML was started in 1999, first made in 2001 and then revised in 2005 as a joint initiative of the Organization for the Advancement of Structured Information Standards (OASIS) and the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT). It is currently known as ISO 15000.

OASIS is a not-for-profit, international consortium founded in 1993 hat drives the development, convergence, and adoption of e-business standards. It has more than 3,500 participants representing over 600 organizations and individual members in 100 countries (www.oasis-open.org).

OASIS members themselves set the technical agenda, using a lightweight, open process expressly designed to promote industry consensus and unite disparate efforts. The consortium produces more Web services standards than any other organization along with standards for security, e-business, and standardization efforts in the public sector and for application-specific markets (See Figure 3 for OASIS).



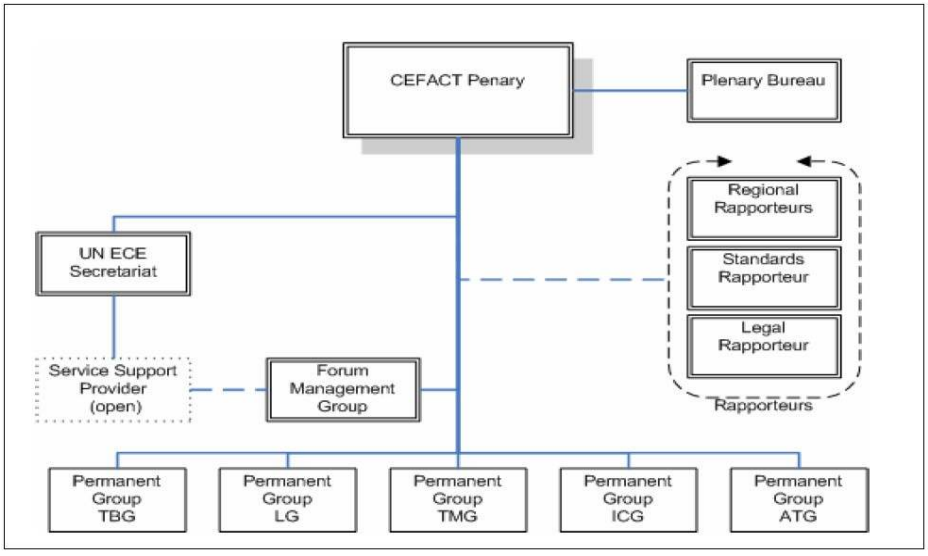
Source : OASIS(www.oasis.org)

<Figure 3> Standardization Categories of OASIS

UN/CEFACT is a subsidiary body of the UN/ECE Committee on Trade. It has a mission to improve the ability of business, trade and administrative organizations, from developed, developing and transitional economies, to exchange products and relevant services effectively and so contribute to the growth of global commerce (www.unece.org/cefact).

UN/CEFACT facilitates the development of e-business standards that can cross all international boundaries and help lower transaction costs, simplify data flow and reduce bureaucracy. Work outputs of UN/CEFACT activities include ebXML, UN/CEFACT's modeling methodology (UMM) and UN/EDIFACT. A cornerstone of the "UN/CEFACT approach" is the core component technical specification (CCTS).

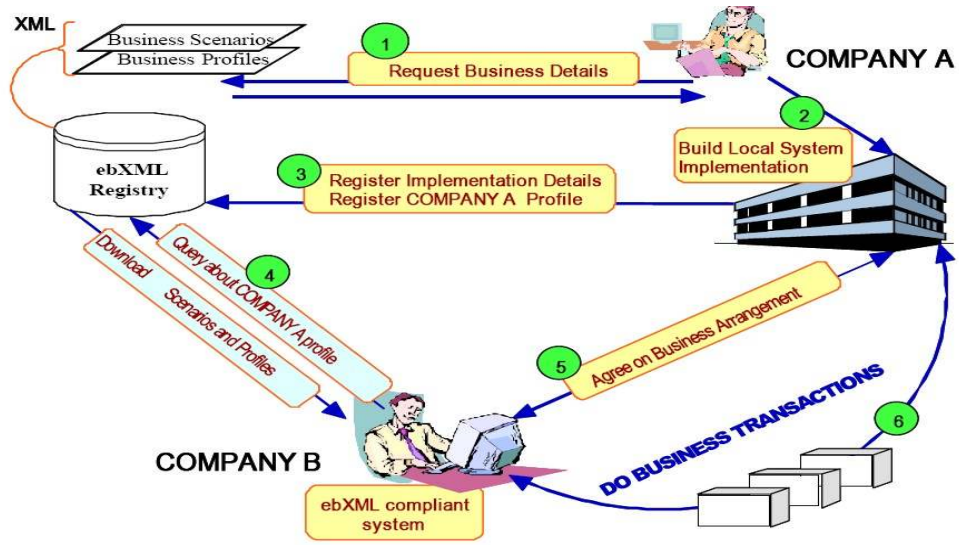
UN/CEFACT is inclusive, in that it welcomes participation from UN member states, intergovernmental agencies, sectoral and industry associations recognized by the United Nations Economic and Social Council (ECOSOC) as well as the private sector, from which much of UN/CEFACT's technical expertise comes (See Figure 4 for UN/CEFACT).



Source: UN/CEFACT (www.unece/cefact.org)

<Figure 4> Organization of UN/CEFACT

The original ebXML project envisioned and delivered five layers of substantive data specification, including XML standards for : business processes, core data components, collaboration protocol agreements, messaging and registries and repositories.



Source: ebXML (www.ebxml.org)

<Figure 5> A Higher Level Overview of Interaction of Two Companies Conducting e-Business using ebXML

ebXML represents a set of modular business collaboration-oriented specifications, defined as a set of layered extensions to the base simple object access protocol (SOAP) and SOAP messages with attachments (SOAPAttach) specifications.

Business collaboration requires a solid and consistent conceptual foundation, encompassing both issues in inter-enterprise business collaboration (based on mutually accepted trading partner agreements), and a technical infrastructure that (i) enables businesses to find each other and (ii) provides for the reliable and secure exchange of business messages between partners (Bechini et al., 2008).

As well as the plain web services technology, ebXML provides technical interoperability through a vendor-neutral protocol. Moreover, ebXML uses collaboration protocol agreements (CPAs) to declare bindings to business collaboration specifications. ebXML requires collaborating partners to mutually agree upon the formats and semantics of business documents. However, it is not mandatory to exploit only XML-encoded messages in an ebXML-based system: theoretically, EDI messages could be used as well.

In an inter-enterprise business collaboration scenario, both business partners would use the ebXML messaging service (ebMS) to transport business documents in a secure, reliable, and recoverable way. Obviously, in case one of the business partners cannot manage ebMS messages (for instance, in the case of legacy systems), the communication is handled via enterprise service bus (ESB).

Business level failures are completely taken into account with the business process specification schema (BPSS). For example, if a party fails to respond within a pre-defined time period, then the BPSS reverts to the previously known secure state.

ebMS is just concerned about message transport: an additional standard is needed in order to define the semantics of a business document (i.e., the message payload). As there are several horizontal and vertical content standards in existence, a novel initiative, called universal business language (UBL), is trying to achieve a universal XML business language over ebXML.

The message-exchange agreement between two business partners is described by means of a CPA. Any successive change on the interface of a business service identified in the CPA will consequently invalidate the CPA, thus requiring a new formal agreement document to be built.

Of course, this kind of modifications does not affect the technical message exchange function. Hence, the sender can still be sure that the message gets delivered, even if the recipient will be likely to experience potential problems with the new message content semantics.

The foundation layer of the ebXML stack, i.e., the XML Schema and the SOAP standards, constitute a stateless, one-way message exchange paradigm, providing a basic messaging framework for higher abstract layers.

4. Web Services (WS)

With the prevailing e-Business environment, web services (WS) and service-oriented architectures (SOA) suggested by the World Wide Web Consortium (W3) use simple object access protocol (SOAP), web services definition language (WSDL), and XML specifications as the basic means for Internet connections.

WS uses open standards and have been submitted to the W3C. WS can involve either simple data passing or two or more services coordinating some activities. The goal of WS is to provide a universal set of communications protocols to enable computer systems and business processes to seek each other out over the Internet and have meaningful interactions without human intervention.

SOAP-WS architecture is the most common and marketed form of web service in the industry. In global e-SCM scenarios, the specific strengths of ebXML and WS can be combined in that ebXML is used for managing enterprise-spanning business transaction services in the context of collaborative business, while WS find their place in intra-enterprise integration of back-end systems.

WS focuses mainly on data type standards, schema expression languages, and common communication methods. While universal description, discovery and integration registry (UDDI) attempts to meet the needs

in the middle layers (categorization, schemas, and transaction templates), it does not provide sufficient support. In order to meet all the requirements for a successful architecture, UDDI needs to be combined with other frameworks, such as ebXML technical architecture specification, RosettaNet, universal business language (UBL), or the semantic web (Albrecht et al., 2005).

The most important vendors of WS architectures support SOAP, WSDL, UDDI as the primary standards to develop simple WS, and ebXML as the standard for complex WS.

Actually, both standards implement the principles behind the next generation of e-business architectures, representing the logical evolution from object-oriented architecture (OOA) to systems of services, built according to SOA.

The fundamental layer of WS, however, does not consider business process semantics as ebXML does. Not surprisingly, an ESB can be considered as a SOA approach to integration, even though, as we want to emphasize in this section, interoperability, rather than integration, is the most innovative principle of SOA.

SOA promotes significant decoupling and dynamic binding of components: all software components are structured as services, i.e., they encapsulate behavior and expose it to other collaborating components on the network by means of standard messaging facilities. In the SOA approach, applications are built by discovering and orchestrating network-available services, or by just-in-time integration of applications (Bechini et al., 2008).

Ⅳ. Conclusion

Global e-SCM encompasses many B2B and B2G trading partners in domestic and across countries, complicated business processes, various systems. Therefore, it is more difficult to implement 'global' e-SCM than traditional ‘domestic’ e-SCM.

For the successful implementation of global e-SCM, standardized messages and streamlined business processes are critical. Without them, human intervention like re-keying business data, which may create errors, delay processes, cause additional data or procedures, etc., are needed.

This paper *is to discuss the implementation challenges of Global e-SCM, to review the relevant technologies (EDI, XML, ebXML, Web Services, etc.) and to assert the importance of adoption of international standards.*

With the Internet-based network economy as well as prevailing e-Business environment, there are many advantages in adopting ebXML as international message standard for implementing global e-SCM

successfully. It can be applied without any pre-agreed models. It supports new business models that allow open and flexible global transactions across the countries.

Unlike other EDI-based or XML-based B2B standards, ebXML not only defines XML messages between transaction parties, but also provides methods of modeling business processes inside a corporation.

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