Abstract

It is sometimes assumed that the Internet provides a sufficient basis for conducting business electronically. However, for business relationships between companies more is required, since electronic forms of business are meant to automate large parts of the business processes involved. To enable the automation of business processes across company borders, a 'common language' and a common understanding regarding legal implications are required for information systems to automatically handle deliveries and purchases. Experiences with earlier forms of electronic business (Electronic Data Interchange/EDI) allow us to understand these requirements in great detail. Now, a new platform for conducting electronic business between companies is emerging (based on the XML standard) which promises to significantly lower the costs of automating business processes across company borders. In order to realize this potential, the basic XML platform needs to be extended to cover all functions addressed by EDI systems. How should this task be accomplished? Specifically, which types of organization should be involved with which parts of the standardization process? This paper addresses these questions by drawing on experiences from earlier EDI systems.

INTRODUCTION

Electronic Data Interchange (EDI) implies the connection of business applications across company borders (Swatman and Swatman 1992). The main issues to be dealt with are systems integration and legal issues. On the one hand, computerized information systems must be enabled to ‘talk’ to one another; on the other hand, the exchange of data between computerized information systems has legal implications since exchanged data may trigger certain actions such as shipment of products to customers which involve a change of ownership. Thus, the main challenge is that companies involved in the trade need to establish an institutional framework within which they can conduct business electronically, in other words, they need to agree upon the legal implications of the data exchange before actually being able to exchange business data. Of course, this agreement does not have to be bilateral. It can be a generalised agreement or even become part of commercial law. However, since until now this institutional framework is, at best, patchy, the question arises of how to create it. Based on the experiences of EDI, this paper tries to provide tentative answers to this question with regard to the second wave of B2B electronic commerce – Internet-based EDI.

THE BENEFITS AND REQUIREMENTS OF EDI

Internet-based e-commerce can be differentiated into three forms of data exchange, viz., human-to-human, human-to-machine, and machine-to-machine (Ricker et al. n.d.). Using email to conduct business is an example of human-to-human Internet-based commerce. The difference from 'traditional' forms of conducting business lies only in the means of communication (Internet rather than telephone etc.). Therefore, new institutional requirements of this form of Internet-based commerce regard only those issues which pertain to the form of communication, for example, the paper-based signature which is generally required to prevent one party to the exchange from repudiating the contents of a message. Electronic equivalents of signing a document (for example a digital signature) are then required if otherwise the level of trust between the involved parties does not support the business relationship.

Technical requirements that must be met to enable this form of e-commerce consist of an addressing standard (eg, TCP/IP), and a standard for displaying e-mail messages. Since the contents of the message will be read by a human rather than a machine, it is sufficient to agree upon a set of symbols to be displayed on a screen.

Author

Kai Reimers
(reimers@em.tsinghua.edu.cn) is Visiting Professor for IT Management and IT and Organization at the School of Economics and Management, Tsinghua University. He is sponsored by the German Academic Exchange Service (DAAD) on a long-term teaching assignment. His research focuses on the institutional requirements of developing inter-organizational systems and organizational change in the wake of implementing enterprise systems.

Standardizing the New E-Business Platform: Learning From the EDI Experience

KAI REIMERS
APPROACHES TOWARDS STANDARDIZING EDI

EDI has been used almost since the time computers began being applied to help administer business processes. One of the earliest industries to use EDI was the automotive industry since large car manufacturers have traditionally long-term relationships with their suppliers which facilitates the implementation of EDI; also, new forms of supply systems, which often depend upon computer support such as Just-in-Time, were pioneered in this industry.

Initially, car manufacturers would request their suppliers to use their internal data standards for the exchange of business documents. As more and more companies tried to impose their internal data standards on their business partners, more and more companies were confronted with the necessity of maintaining multiple standards. Thus, a push towards standardization of data formats used for exchanging business documents was initiated which was first confined to the boundaries of more or less well-defined industries or supply chains (Webster 1994). However, as the network of electronic exchanges of business documents increased in density, similar problems emerged at a higher level of aggregation. Firms that were members of several industries or supply chains (for example companies supplying refrigerating technology for household appliance manufacturers and car companies (for their air-conditioning systems)) started to have difficulties. As electronic data interchange was also seen as a means of promoting international trade, a standardization body of the UN became involved in this standardization effort which ultimately created the UN/EDIFACT standard (Electronic Data Interchange for Administration, Commerce and Transport) which was approved as an ISO (International Standards Organization) standard in 1987 (Graham et al. 1995).

However, it turned out that these standardization efforts did not result in as wide-spread ‘adoption’ of EDI as was originally hoped (some estimates put the total number of companies using EDI in the US at only 10,000, cf. Webber 1998). The main reason for this disappointing outcome can be seen in the neglect of the institutional requirements of implementing EDI. This point can be clarified by reference to the semiotic structure of human communication (Kubicek 1992). This is frequently divided into three levels: syntactic, semantic and pragmatic. Human communication rests upon symbolic representations of the world. The syntactic level contains rules for combining symbols into words and sentences, which are then, on the semantic level, attached to certain meanings. The pragmatic level refers to the intentions of humans when communicating with one another.

It is generally assumed that ‘language’ refers to the syntactic level. For example, it creates a set of words (that is, accepted combinations of phonemes or written symbols like alphabetic letters or characters) which, in turn, can be combined according to certain grammatical rules. The meaning of words and sentences, in contrast, is assumed to
be universal to humanity (since otherwise a text could not be meaningfully translated from one language into another).

As EDI is often considered to be a common business language, standardization efforts typically focus on the syntactic level. The UN/EDIFACT standard, for example, consists of a set of rules that need to be followed when designing a business document such as an invoice. It says which basic data elements exist (such as product numbers) and how they can be combined into larger units (quite similar to how sentences are constructed by drawing on a set of well-formed words which, in turn, consist of a limited set of symbols).

However, it quickly became apparent that defining the syntax of EDI documents was not sufficient; the meaning and purpose of these documents also had to be specified in order to enable automated document processing on both sides. While the meaning of certain ‘words’ and ‘sentences’ in an EDI message and the purpose of these messages would be clear to a human (once translated into human language or, alternatively, read by an EDI specialist familiar with the EDI coding language), they are not to a computer. For example, a certain material may be called a ‘motherboard’ in human language; however, the inventory management system of a manufacturer will use a certain code (XYZ) while the distribution system of the supplier may use still another code (ABC) for the same type of material. What is clear from this example is that the meaning of the ‘words’ in an EDI message also has to be standardized. This is typically done by maintaining huge so-called dictionaries or repositories, which define each possible instance of an EDI message such as product description, country name and currency. Then, both systems involved in an EDI transaction need to have access to the same dictionaries and to be able to relate these external dictionaries to internal dictionaries in order to ‘understand’ the meaning of the message. The need for creating and maintaining these dictionaries was quickly discovered and typically industry organizations have taken care of this task. However, even though computers could now understand the meaning of a message, they still needed to know its ‘purpose’. For example, the purpose of a purchase order is that the supplier delivers a certain type and amount of goods. Thus, the purpose is that the other party to an exchange performs a certain action, rather than purely receiving some information. Therefore, in addition to the meaning of a message, a computer also needs to ‘know’ how to act on it.

As these actions have legal implications (such as a transfer of ownership between companies), the legal consequences of sending and receiving EDI messages must be clarified in advance. For example: Is it necessary that the supplier responds to the purchase order with an order confirmation? If so, within what period of time, since otherwise the buyer might conclude that the supplier does not want to fulfill the order and turn to another supplier? Another example concerns the issue of messages that have been sent but not received, or only partially received. If a mailbox is used for receiving messages, how often does each party have to check its mailbox in order to enable a timely response? What needs to be done if only a part of a message has been received? Does the receiver have to notify the sender in this case? How can one ensure that the contents of the message have not been altered?

All these questions need to be settled in advance, since the process of EDI often does not involve human interaction which eliminates the possibility of allocating responsibility (computers cannot be held responsible for their actions). Or, to put it differently, the subject of responsibility shifts from properly handling business documents to properly operating an EDI system.

Since these issues require legally binding commitments of the involved parties, the general approach to resolving them has been to sign bilateral EDI contracts. Industry associations sometimes tried to support the establishment of these agreements by providing generalized EDI contracts.

THE ‘SECOND WAVE’ OF E-COMMERCE: XML

As the ‘first wave’ of business-to-business (B2B) e-commerce, typically called the EDI-approach, has delivered only partially satisfying results (as evaluated from the perspective of the original enthusiastic predictions), it is now hoped that the Internet will remove those bottlenecks that have limited the growth of EDI. Specifically, a fairly new data description standard, eXtensible Markup Language (XML), is being promoted as a new platform for B2B e-commerce and sometimes as a replacement for EDI systems (Webber 1998). ¹

XML is also called a ‘tagging’ language, which illustrates the way this method describes data. Specifically, each data entry (a ‘word’) is preceded by a ‘start tag’ and followed by an ‘end tag’. The tags describe the function of the word in between. For example, a tag ‘ProductName’ may be used to indicate that the function of the word ‘computer monitor’ is to give the name of a product. This language can also be used to describe traditional (standardized or non-standardized) EDI documents. To achieve this, additional information is required specifying which ‘functions’ can be used in a document and how they can be combined. This additional information, called a Document Type Definition (DTD), is also described in XML language and can thus be transmitted together with the contents data.

There are basically three reasons why proponents of XML-based technologies believe that XML-based B2B e-commerce will overcome the barriers characteristic of EDI system implementation:

1. The language is flexible (‘extensible’) in that new requirements can be easily incorporated in a message by adding ‘tags’ and changing the Document
Type Definition. Thus, companies are not limited to the range of possibilities defined in the EDI document standards (Webber 1998).

2. The message contents can be easily read and understood by humans using standard browsers (which support XML language) in addition to the attached computer applications. Thus, supply chain participants that do not have computerized systems to handle EDI messages can still receive, understand, and act upon XML-based EDI messages (typically small and mid-sized firms) (Ricker et al. n.d.).

3. Whereas EDI technologies require highly specialized knowledge of the EDI methodology in order to implement B2B e-commerce, XML-based technologies can rely on more generic IT skills for implementation. It is expected that this knowledge will be cheaper, reducing the costs of implementing B2B e-commerce (Ricker et al. n.d.).

However, given the semiotic model of human and computerized communication described above, it is far from clear whether these expectations can be met. First, the flexibility of changing exchanged messages on the syntactic level is of limited use if a machine rather than a human needs to act on this information. Adding a new function in a business document requires that the receiving computer ‘knows’ both how to interpret this function and how to act upon it. For example, a purchase order might add a function ‘variety’ to describe small differences in a certain product type (e.g., different colours for the same size, form) sweater. This will be intelligible to a human but not to a computer that has not been instructed to cope with this function. Moreover, the instances of ‘variety’ (e.g., red, green) need to be coded in a way intelligible to the computer. Thus, this type of flexibility will only apply to e-commerce systems involving, on at least one end, a human or a continuous automated adaptation of these systems to changing syntactic and semantic standards.

Second, the ability to display XML-coded EDI messages to humans by employing a standard browser goes back to the use of a natural language, typically English. In contrast, EDIFACT-based EDI messages use non-natural codes for expressing the contents of a message (which allows for more efficient automated processing but makes it more difficult for humans to understand these messages). However, by virtue of the same fact, XML-based standardized EDI messages are limited to senders and receivers using the same natural language. To overcome this limit, translators are necessary wiping out any original benefit of using XML technologies (based on the fact that no additional converters are needed, that is, in addition to standard browsers).

Finally, whether or not XML expertise will be cheaper than EDIFACT and X.12 expertise cannot be answered theoretically but remains to be established empirically. A recent survey of 327 US firms has shown that 51% of those respondents using some form of B2B e-commerce report that implementation costs have not been lowered by using XML technologies (Anonymous 2000).

So are there any advantages of XML-based e-commerce over traditional EDI? The answer is twofold:

1. The possibility of expressing EDI messages in a format legible to human readers certainly helps small companies to continue doing business with large companies if they require EDI capability, even if they have to use the English language as this is already the new ‘lingua franca’ in the business world.

2. Along with XML comes a new approach of addressing EDI, specifically with regard to the pragmatic level of interaction.

APPROACHES TOWARDS LEVERAGING XML FOR EDI

Two approaches which build on the momentum created by XML can be distinguished, the ‘technical’ and the ‘organizational’ approach. The most prominent initiative adopting a technical approach is ebXML, an 18-month long project by two non-profit organizations dedicated to the development of data standards. Recognizing that doing business electronically requires some form of agreement on the structure and contents of exchanged messages as well as the precise manner of exchanging these documents, in other words, an agreement on the pragmatics of exchanging documents electronically, ebXML tries to automate the process of reaching such an agreement. In order to do that, companies have to formally describe their EDI requirements and register these requirements with a central repository. When a company wishes to do business with another company, it will retrieve this information in order to check whether it can support the EDI requirements of its potential business partner or not. It is envisaged that in those cases where the company is not yet able to comply with the EDI requirements of its potential business partner, it can download a piece of software which automatically provides it with the required ability to conduct business with the respective business partner. Based on these requirements it will then send a document to the targeted business partner specifying the terms of an EDI agreement which need to be acknowledged by the business partner. Once this is achieved, the exchange of business documents proper can begin.

Although carrying the acronym ‘XML’ in its name, this initiative’s scenario does not depend on using XML as a document/data description standard. The intended flexibility, which distinguishes this scenario from traditional EDI scenarios, stems from the automation of the process leading to an EDI agreement. The implicit assumption is that achieving these agreements is a major barrier to conducting business electronically and that automating the agreement process does not add to the costs of doing
business electronically. Otherwise, it cannot be assumed that those companies that are currently not implementing EDI systems due to cost considerations will do so based on the ebXML scenario.

The difficulty in agreeing on syntactic, semantic, and pragmatic standards stems from the fact that in most cases companies need to change their internal systems in order to comply with these standards. If companies could just ‘plug’ their systems into a sufficiently general EDI system, the only difficulty of agreeing upon these standards would consist of discovering a standard that can accommodate all requirements. If there are several such solutions, a decision could be made by choosing one randomly. This seems to be the underlying assumption of the ebXML initiative: to discover the structure common to all requirements and describe it in a generalized manner. If this assumption cannot be met in practice, the ebXML system will only help to discover the differences between EDI requirements but fail to overcome them. Overcoming these differences requires hard-nosed negotiation between trading partners implying a certain distribution of costs and benefits of conducting business electronically.

The second approach, dubbed the organizational approach, can be illustrated by the RosettaNet initiative. RosettaNet is a consortium of the IT, electronic component, and semiconductor companies created in 1998. Although there are some elements in the RosettaNet scenario similar to the ebXML scenario, specifically the idea of automatically configuring EDI systems of trade partners according to ad-hoc requirements, the main characteristic of this approach is the development of a detailed description of the interaction procedures between companies conducting business electronically, that is, of standards on the pragmatic level, in addition to syntactic and semiotic standards (which are also developed by RosettaNet). These specifications, called ‘Partner Interface Processes’ (PIPs), describe the expected actions by the recipient of a message, that is, they specify an agreement on the pragmatic level. For example, it is specified whether or not the reception of a message has to be acknowledged and if so, within what time period. Requirements regarding the way a message is sent are also specified (such as encrypting and digitally signing messages).4

Thus, any company which commits to RosettaNet standards will not only have to comply with certain syntactic and semantic standards, but also with pragmatic standards. For example, it may commit to acknowledging or refusing an order within 24 hours after receiving a purchase order. This illustrates that the main benefit of conducting business electronically does not stem from the increased speed of sending business documents (which could be achieved by fax as well), but by compressing the time it takes to act upon the received information. However, this generally requires: (1) automating so-called back-office systems, that is, all those systems that take care of a company’s administrative processes; and (2) enabling these systems to understand incoming messages in terms of contents and expected actions. Otherwise, the only benefit of conducting business electronically over traditional (telephone-, fax-based) forms consists of saving the costs of entering the data on the receiving end of the exchange (which may be considerable).

HOW TO PROCEED FROM HERE?

These two scenarios still have to prove their viability with RosettaNet having advanced considerably further along the implementation path than ebXML.5 Specifically, a fundamental question is whether these new initiatives can succeed in establishing multilateral agreements on all three levels. Since the difficulty of creating generalized agreements increases as one moves from the syntactic to the semantic to the pragmatic level, the traditional approach to EDI standardization has been to strive for a global syntax standard (UN/EDIFACT), industry-wide semantic standards (for example dictionaries of product codes), and bilateral agreements on the pragmatic level. The two initiatives described above maintain this approach with respect to syntactic and semantic standardization but aim at creating systems for multilateral agreements on the pragmatic level. Can this approach succeed?

First of all, earlier EDI efforts have often been hampered by established trade associations stepping in to orchestrate EDI standardization efforts. As trade associations are generally grouped around product characteristics (for example the semiconductor industry) rather than around trading relationships, this approach has sometimes reinforced adversarial relationships across the supply chain (for example between the textile and the apparel industries; cf. Monse and Reimers 1995). Forming industry groups around trading relationships, as is done in RosettaNet’s case, represents a considerable advantage over earlier EDI initiatives. However, an intricate issue still remains to be solved. The standards thus far released by RosettaNet clearly demonstrate the increasing difficulties of reaching agreements as one moves from the syntactic to the semantic to the pragmatic level. Whereas the standards on the syntactic and the semantic level are quite complete, the standards on the pragmatic level (the ‘Partner Interface Processes’) contain a large number of open issues. For example, response times to messages are often not specified and thus have to be specified in further bilateral negotiations.6

There are two scenarios for further development:

1. Industry groups facilitating the process of reaching agreements on the pragmatic level by providing contract templates. This is the approach adopted by earlier initiatives and thus represents no big advantage over traditional EDI initiatives.

2. Industry groups acquiring the ability to legally bind members to generalized agreements, including the
ability to sanction non-compliance with these agreements.

In the latter case, any member of a certain industry group could conduct business electronically with any other member without prior negotiation and agreement. Thus, industry groups would transform themselves from supporting bodies to legal entities able to co-ordinate their members’ behaviour (just as companies are legal units able to co-ordinate their employees’ behaviour). This seems a rather futuristic scenario since industry groups would become powerful actors able to define and enforce rules governing the behaviour of companies rather than just guiding it. They would represent a new governance structure which, in turn, would have to be recognized by national and international systems of business law. Thus, the legal framework would have to be extended and adapted quite substantially, posing a major challenge for policy makers. However, if we are to see a truly new form of how business is conducted enabled by the Internet, we should be prepared to also provide the institutional form for realizing this potential. History shows that all new forms of economic organizations had to be reflected in the institutional framework of a society (witness the creation of the institutional form of the public stock and the limited liability company at the turn of the nineteenth century). The economic prospects of a nation are shaped to a significant degree by the ability of governments and societies to create the institutions required for realizing new forms of business (North 1990).

CONCLUSIONS

In this paper, we have discussed implications of past experiences with electronic data interchange for the ‘second wave’ of B2B e-commerce based on the Internet infrastructure and, specifically, the recently created XML standard(s). We have shown that the main difficulties of implementing B2B e-commerce systems stem from ‘higher’ level standards, that is, agreements that need to be made on the semantic and pragmatic levels in addition to the syntactic level, which is addressed by the XML standard. Thus, it cannot be expected that application of the XML standard itself will significantly reduce the barriers to widespread implementation of EDI-like B2B e-commerce. However, in the wake of the emergence of the XML standard, new approaches towards B2B e-commerce have been initiated. These specifically address issues on the pragmatic level of B2B e-commerce. Two approaches have been compared and discussed. We have argued that new forms of industrial governance are required in order to handle these issues if multilateral rather than bilateral agreements are to be achieved. However, it seems unlikely that these new forms are viable under current institutional arrangements.

Notes
1. XML is a simplified version of an even more general data description method called SGML (Standard Generalized Markup Language); cf. Webber 1998. An earlier attempt at overcoming barriers to EDI implementation has been proposed by the Australian-based ICARIS (Intelligent Commercial And Research Information System) project, which was started as a study into the reasons for the disappointing uptake of EDI and later came up with its own solution. The proposed solution consists of a directory for identifying and labelling data elements which make up the contents of a message, called the ‘Business Data Registry’, and a service to make this directory available (called BEACON for ‘Business Engineering Architecture Construction Object Nexus’). This project had originally co-operated with a similar ISO initiative but later broke off. It is run on a commercial basis which is why some commentators feel reluctant to recommend including it in other XML initiatives (for example for ‘tagging’ purposes; see description in the main text). Information about this initiative is available at http://icaris.org.

2. These are OASIS (Organization for the Advancement of Structured Information Standards), originally a group of small software companies and large user companies founded in 1993, and UN/CEDIFACT (United Nations Center for Trade Facilitation and Electronic Business), founded in 1996 to continue the UN’s activities in the field of B2B e-commerce.

3. This process is described in detail in ‘ebXML Technical Architecture Specification v1.0.4’, released by the ebXML Technical Architecture Team on 16 February 2001. However, the proposed specification, which details the interaction required to achieve such an agreement, emphasizes that legal implications are not included in this process (see ‘ebXML Collaboration-Protocol Profile and Agreement Specification 0.93’, p 9).


5. At the end of 2000, RosettaNet claims that 39 companies are using PIPs for conducting business (‘in production’); the ebXML was officially concluded on 11 May 2001, by publishing its approved specifications but has not yet moved beyond an initial ‘proof-of-concept demonstration’ (Computerworld, ‘First ebXML Specification Approved’, 14 May 2001).

6. See, for example, the PIP specification for ‘Manage Purchase Order’, Release 1.4, 19 December 2000.

References


