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XML-based e-business frameworks and standardization[☆]

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Abstract

ICT (information and communication technology) has created new opportunities for doing business. E-business, which is a manifestation of this development, relies on efficient information sharing within and between companies. E-business requires interoperability of information systems and, therefore, standardization of information sharing. An e-business framework is a standard for information sharing within and between companies. Tens of e-business frameworks have been standardized so that they utilize XML (Extensible Markup Language). This paper analyzes the properties and standardization of 12 prominent XML-based e-business frameworks. The analysis focuses on the commonalities, differences and regularities between these e-business frameworks and their standardization.

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1. Introduction

ICT (information and communication technology) has affected the way companies do business with their customers, suppliers and other business partners. *E-commerce* is often defined as the buying and selling of

products using ICT. B2B (business-to-business) e-commerce takes place between companies, B2C (business-to-consumer) e-commerce between a company and a consumer, and B2G (business-to-government) e-commerce between a company and a government organization. *E-business* means that ICT is utilized to perform and automate *business interactions* within and between companies. These business interactions do not only focus on buying products from suppliers and selling them to customers, but they cover all kinds of collaboration with business partners, e.g. distributing order forecasting information. In fact, e-business contains B2B e-commerce. The purpose of e-business is to increase the added value and to improve the resource utilization and cost efficiency by getting the right products at the right time to the right place.

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It is far from simple to automate even simple business interactions with a small number of business partners, because they may differ in many ways. There can be differences in the meanings of terms and modes of operations that can result in errors. Different companies can have information systems, such as ERP (enterprise resource planning), SCM (supply chain management), CRM (customer relationship management) and PDM (product data management), which cannot share information without considerable efforts in the integration of the information systems. Otherwise, human intervention is necessary to move information from one system to another. Even different units within a company can face problems in information sharing.

Before business partners can collaborate, they must have a shared understanding of their ways of doing business. The business partners must understand what information they should share, when and how. When the business partners' information systems are capable of sharing information, the business interactions can be automated. An *e-business framework* is a standard for information sharing within and between companies that answers or gives means to answering at least one of the questions of what information to share, when and how [21]. The e-business framework facilitates a shared understanding between many companies and their units because it brings order into the uncertainty by reducing variety. *Standardization* means planned activities to develop an e-business framework. These activities are carried out according to the rules and by the members of the community that promotes the e-business framework.

EDI (Electronic Data Interchange) was established three decades ago. EDI standards, such as the American National Standards Institute's ASC (Accredited Standards Committee) X12 in North America and the United Nations EDIFACT (EDI for Administration, Commerce and Transportation) in the rest of the world, are still predominant in e-business. These standards are also called EDI-based e-business frameworks. Although EDI can have advantages over manual business interactions, its use has concentrated on large enterprises, whereas SMEs (small- and medium-sized enterprises) have hesitated in adopting EDI. However, SGML (Standard Generalized Markup Language) and HTML (Hypertext Markup Language)

have led to the development of XML (Extensible Markup Language). XML is expected to enable more efficient information sharing than EDI [9]. In all, tens of e-business frameworks have been standardized so that they utilize XML [21].

We focus on 12 XML-based e-business frameworks and their standardization in this paper. We identify seven key variables related to the properties and standardization of the e-business frameworks and the possible values for each variable. The values assigned to the variables create a basis for analyzing the commonalities, differences and regularities between the e-business frameworks and their standardization. This paper proceeds by first introducing XML and the e-business frameworks and reviewing the literature of standards and standardization. Next, we present our research approach, which is based on a cross-sectional study, and introduce the chosen XML-based e-business frameworks. We identify variables and values, which characterize the XML-based e-business frameworks and their standardization, and assign the values to the variables. Then, we explain five findings based on these assignments. Finally, we discuss the analysis and present conclusions.

2. Background

2.1. XML

XML was originally designed by W3C (World Wide Web Consortium) for use in electronic publishing, but is now in wide use as a data format for exchanging information between applications. The initial goal of W3C in 1996 was to enable generic SGML in the Internet by developing a dialect of SGML that would be easy to use and interoperable with HTML. In 1997, XML reached the status of W3C recommendation. A recommendation is a maturity level assigned by W3C to those specifications it considers stable.

XML is a meta-markup language for expressing structured documents, and it defines the syntax in which other specific markup languages can be written. However, the applications do not understand each other by only having information in an XML document, it only provides a way to access information.

W3C has also defined mechanisms for specifying elements, structures, and to some extent semantics of XML documents. DTD (Document Type Definition) has originated from SGML and it has been a part of XML since the first XML specification, but DTD has relatively limited expressive power. In 2001, W3C published a recommendation for XML Schema that improves DTD by having more advanced capabilities for expressing elements and structures, and it is defined in XML. There exists a multitude of schemas, i.e. DTD and XML Schema specifications of XML documents, for various purposes, and it is necessary to agree on what schemas to use in e-business.

In addition to the XML Schema, W3C has defined other XML technologies for varying purposes. Of these, the most important in e-business is perhaps XSLT (Extensible Stylesheet Language Transformations) that received recommendation status in 1999. XSLT is a general-purpose language for transforming XML documents from one schema to another. However, when two schemas are different it may not be possible to transform all data but some information may be lost. Therefore, common agreement on the schemas to be used is needed.

2.2. E-business frameworks

As the late 1990s saw the emergence of many of standards for e-business, there are a number of papers discussing such standards. According to Hasselbring and Weigand [10], the standardization for the exchange and processing of documents can be at the lexical level of character sets, at the syntactical level of document structures, and at a deeper semantic level of dictionary and integrity constraints. Respectively, Nurmilaakso and Kotinurmi [21] have argued that the business partners have to know what information should be shared, when and how before they can do e-business. Therefore, a data format, such as EDI or XML, is useful in syntactic interpretation, but a standard for e-business is necessary in semantic interpretation. Shim et al. [29] have called these standards B2B e-commerce frameworks, Li [16] industrial standards for e-commerce, Medjahed et al. [19] B2B interaction standards and Nurmilaakso and Kotinurmi [21] e-business frameworks.

What are standards for e-business? This is not a simple question because the promoters of the stand-

ards for e-business characterize their standards in different ways, as the following four examples point out. xCBL (XML Business Library) [7] “is a set of XML building blocks and a document framework that allows the creation of robust, reusable, XML documents for e-commerce”. RosettaNet [27] is “a robust nonproprietary solution, encompassing data dictionaries, implementation framework, and XML-based business message schemas and process specifications, for e-business standardization”. ebXML (Electronic Business XML) [24] “is a modular suite of specifications that enables enterprises of any size and in any geographical location to conduct business over the Internet”. BPEL (Business Process Execution Language) [23] focuses on “specifying the common concepts for a business process execution language”. Medjahed et al. [19] have found that the B2B interaction standards deal with communication, content and business process layers. These layers provide protocols for exchanging messages between business partners, languages and models to describe and organize information, and are concerned with conversational interactions between business partners. Similarly, Nurmilaakso and Kotinurmi [21] have presented that an e-business framework is a standard for information sharing within and between companies that answers or gives means to answering the questions of what, when or how. These questions are related to business and technical issues of business documents, business processes and messaging.

- In *business document issues*, the e-business framework defines or gives means to defining the structures and elements of the business documents as well as the meanings of the terms used in these documents.
- In *business process issues*, the e-business framework defines or gives means to defining the business partners’ roles, in which order to exchange the business documents as interactions and to handle information of the business documents as actions in the business processes.
- In *messaging issues*, the e-business framework defines how business documents are securely exchanged, typically over the Internet. Messaging issues specify the envelope to package the business document and the structure and elements used in headers. The e-business framework also defines

the security and transportation standards to be used. In addition, messaging issues include the basic requirements of the runtime behavior, e.g. how to proceed if the acknowledgement of delivery does not arrive in time.

The purpose of the e-business frameworks is to support interoperability by making standard interfaces that offer scalability benefits. The business partners can change their business applications as long as they use the standard interfaces, which is important in the development and operation of information systems.

The e-business framework is based on XML, if it utilizes XML. The e-business framework can define the business documents or give means to defining the business processes by using schemas. In addition, it can use textual descriptions or graphical representations. XML is also used in messaging, in which the e-business framework specifies the headers with schemas.

There is a major difference between EDI- and XML-based e-business frameworks. The EDI-based e-business frameworks provide the business document specification that determines how to represent the business documents in EDI. These e-business frameworks do not deal with business processes or messaging.

2.3. Example

In order to illustrate what e-business frameworks are, we give an example business scenario, in which an e-business framework is used to solve a common business problem. The e-business framework used in the scenario represents what we believe is a “typical”

e-business framework, and therefore it is not able to capture all individual characteristics of different e-business frameworks, although an attempt to point out key differences in the example scenario has been made.

Our example concerns an OEM (original equipment manufacturer), which designs and sells products, and a contract manufacturer, which makes components to the OEM’s products. In order to guarantee optimal level of production, the OEM distributes forecasting information concerning the anticipated future demand of the products to the contract manufacturer, which is then better able to reserve capacity for the production. The inaccuracy of forecasts tends to amplify in a supply chain, a phenomenon known as the bullwhip effect. The bullwhip effect can cause severe problems in the supply chain, such as increased costs and poor customer service [15].

There is a lot of information that needs to be transferred securely between the OEM’s forecasting system and the contract manufacturer’s order planning systems, as the OEM periodically sends new forecasts, and updates old forecasts with more accurate information. The forecasting scenario between the OEM and the contract manufacturer is presented in Fig. 1.

According to Lee et al. [15], one way to reduce the bullwhip effect is to improve information sharing in the supply chain. This can be achieved by integrating the information systems participating in the above scenario, a task where the e-business frameworks can assist in many ways.

- E-business frameworks define the exact details of the business documents for exchanging forecast-

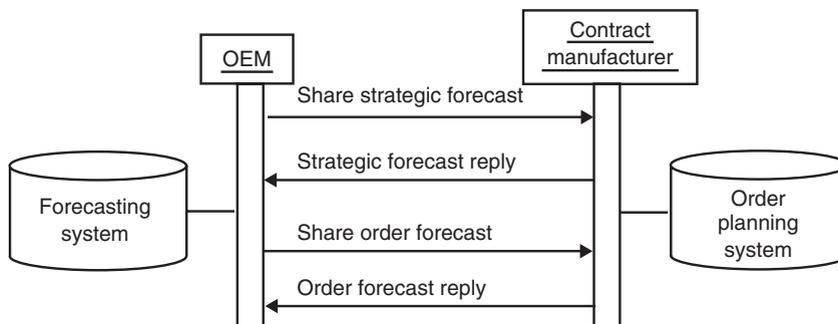


Fig. 1. A forecasting business process.

ing information. There is typically a schema that defines the structure and allowable contents for the forecasting information, and a dictionary to assist in establishing common semantics of the forecasting information between the OEM and the contract manufacturer. An excerpt of a forecasting business document from an e-business framework is provided in Fig. 2. However, some e-business frameworks can be generic so that they do not define any particular business documents, but only offer tools for designing new business documents.

- E-business frameworks define the business process for exchanging forecasting information, e.g. after the OEM has sent a strategic forecast sharing business document, the contract manufacturer must reply to it by a sending strategic forecasting reply business document to the OEM. Typically, the business processes are defined in the form of UML (Universal Modeling Language) diagrams and textual descriptions. However, some e-business frameworks can be generic in this aspect, and not define any particular business

processes, but only offer tools for designing new business processes.

- E-business frameworks define the messaging mechanism that is required to actually exchange the forecasting business documents, as specified in the forecasting business process. The messaging mechanism covers how to package and secure the business documents, what transport protocols, such as HTTP (Hypertext Transport Protocol), are used and how to guarantee security and ensure that the transport was successful.

By standardizing the forecasting business documents, the forecasting business process, and the messaging mechanism, the e-business frameworks can shorten the time to agree on integration details and also enable integration with other business partners with small additional work. In addition, without standards the integration is very tight so that any change in the systems would reflect on the integration. When using standards, internal changes do not matter as long as the use of the standard stays the same.

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  </ProductForecast>
</PartnerProductForecast>

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Fig. 2. Excerpt of a “Notify of Strategic Forecast” business document.

3. Literature review

The literature provides papers on standards or standardization in the fields of computer science, economics, industrial engineering, and information systems. Although standardization is essential to ensure interoperability within and between companies, it is hard to find articles describing technical standards for e-business [20].

There exist a number of studies on e-business frameworks. Four studies [16,19,21,29] compare e-business frameworks with regard to various properties of the e-business frameworks. Each study has some unique properties in the comparison, and the compared e-business frameworks vary. eCo or the business document specification used in eCo, xCBL, are compared in all four studies. BizTalk Framework, RosettaNet and cXML (Commerce XML) [2] are compared in three of the studies. OAGIS (Open Applications Group Integration Specification) [22] and ebXML receive attention in two of the studies. These studies stress the e-business frameworks, not their standardization. Standardization is never really linked with the properties of e-business frameworks. Closest to this is Li [16], who classifies standardization organizations as a basis of e-business framework selection for the analysis. However, standardization is not reflected in the analysis.

A few papers discuss standardization in general. Their conclusion is that the user's role has been less important in standardization than the vendor's role. Jakobs et al. [13] point out that companies with different cultural backgrounds are likely to have very heterogeneous needs and requirements, as they represent their own interests instead of those of "general" users. Jakobs [12] presents that standardization takes place in markets and committees. Moreover, users appear to be adopting technology assuming that it represents the "real" standard because it is the most widely adopted. Many users are less motivated than vendors to go to any length to influence standardization because tailor-made solutions hold the promise of faster solutions to the user's current problems.

In addition, there are papers on the adoption and impacts of EDI-based e-business frameworks. These papers point out that SMEs are unwilling to adopt EDI unless they are forced to do so. Iacovou et al. [11] have found that small companies tend to lack the

needed high organizational readiness and perceived benefits for EDI. Small companies are also reluctant to integrate EDI into their operations because it is too costly. Sriram et al. [30] have discovered that customer-initiated, long-time and larger EDI users recognize both strategic and operational benefits in greater proportions than voluntary, recent and smaller EDI users. However, there are no differences between EDI users in different industries. According to Stefansson [31], SMEs rely on telephone and fax because of three common reasons. Firstly, the investment is not in the EDI communication alone but also in an information system that can support it. Secondly, the customers do not use EDI communication. Thirdly, the volume of business interactions is too small to justify investing in EDI.

The economics of standards emphasizes network effects [14] and path dependences [3], although there is a disagreement on the existence and relevance of network effects and path dependences [17,18]. Network effect means a change in the value that an adopter derives from technology when the number of other adopters of the same technology changes. Path dependence means that history matters, because the dynamic selection favors one technology from many technologies by interacting with economic forces and historical events. However, network effects and path dependences may lead to problems in the standardization of technologies. On one hand, an inferior standard may be chosen or an old standard may predominate, although a new superior standard is introduced. On the other hand, there may exist no or too many standards. Farrell and Saloner [8] conclude that markets are faster but committees cause fewer errors in standardization. Even when the value of speed is taken into account, committees are still more efficient than markets. However, hybrids of the committee and market are more efficient than committees. Shapiro and Varian [28] present that positive feedback works for large networks and against small networks, expectations management is crucial to build positive feedback, and formal setting is now being used to develop more standards than ever before. In addition, introducing new products faces one trade-off between performance and compatibility and another between openness and control, although it is important to retain limited control over technology even when establishing an open standard.

In all, the literature does not contain many papers in which both multiple standards and their standardization have been systematically analyzed in an e-business context. Choi et al. [5] are an example of looking at the standardization of ebXML in detail. This is no surprise. Understanding the standards and their standardization requires continuous follow-up because changes happen fast as the technologies and organizations evolve. This has not discouraged us from analyzing XML-based e-business frameworks and their standardization. The e-business framework is not a black box, e.g. it may have properties to describe business processes in e-business. The e-business framework is not prepared in a black box, e.g. software vendors may be involved in its standardization. In addition, the properties and standardization may be dependent on each other and some variables related to them are more non-technical than others.

4. Analysis

4.1. Research approach

We have analyzed XML-based e-business frameworks to identify key variables related to their properties and standardization, the relationships between the variables, and to explain why these relationships exist. This analysis is based on 12 e-business frameworks: BPEL, BPML (Business Process Modeling Language) [4], CIDX (Chemical Industry Data Exchange) [6], cXML, ebXML, OAGIS, papiNet [26], PIDX (Petroleum Industry Data Exchange) [1], RosettaNet, UBL (Universal Business Language) [25], xCBL and XPD (XML Process Definition Language) [32].

In addition to EDI-based e-business frameworks, we are aware of other XML-based e-business frameworks, such as FIXML (Financial Information Exchange Markup Language) and swiftML (Society for Worldwide Interbank Financial Telecommunication Markup Language) for banking and financial services. Of the tens of XML-based e-business frameworks, we have selected e-business frameworks that are suitable for industrial procurement, design, production or distribution, and were active in 2004. Our sample of XML-based e-business frameworks con-

tains both pioneers, such as OAGIS and xCBL, and newcomers, such as BPEL and UBL, as well as those that have been in the limelight, such as ebXML and RosettaNet. Although it is difficult to say anything definite about the real adoption of the chosen e-business frameworks, they can be regarded as successes rather than failures. Each one of them, except UBL, is supported by one or more commercial system products of software vendors, such as BEA, Fujitsu, IBM, Microsoft, Oracle, SAP, Tibco and webMethods.

Our analysis is primarily based on the specifications of the e-business frameworks, but we have also used other information, e.g. on members, organization, IPRs (intellectual property rights) and news, available on the web pages of the e-business frameworks. We have analyzed the literature to identify key variables and their possible values, and to assign these values to the variables. We have also presented our analysis and results in “the Workshop on Standard Making: A Critical Research Frontier for Information Systems” whose participants were researchers of ICT standards and standardization, including e-business frameworks. The feedback has given us the opportunity to improve our analysis, especially with regard to standardization.

First, we have identified three variables related to the properties of the e-business frameworks and four variables related to their standardization, and possible values for these variables. The XML-based e-business frameworks have been summarized on the basis of these variables and values. We have used this summary to find commonalities, differences and regularities between these e-business frameworks and their standardization. Finally, we have explained these findings and compared them to those presented in the literature.

4.2. Chosen e-business frameworks

In order to introduce the chosen e-business frameworks, we present a brief history for each e-business framework. The presentation order for the e-business frameworks is based on their age, starting from the oldest XML-based e-business framework. The following information is based on the situation in the end of the year 2004.

- In 1997, Veo Systems developed CBL (Common Business Library) that was used as a part of

another e-business framework called eCo. In 1999, CommerceOne acquired Veo Systems and created *xCBL*, the first public version of CBL. CBL was an XML-based e-business framework developed and modeled after ASC X12. *xCBL* defines 44 business documents, to some extent following ebXML CCTS (Core Components Technical Specification) and illustrates the exchange of these business documents in business processes.

- In 1995, OAG (Open Applications Group) and its members, such as PeopleSoft and SAP, started to define *OAGIS* in an own data format. The first XML-based version of *OAGIS* was released in 1998. Currently, OAG has over 40 members, such as IBM and webMethods. *OAGIS* specifies 190 business documents and describes 61 business scenarios where business documents are exchanged in business processes. In addition, OAG has released instructions guiding how to use RosettaNet RNIF (RosettaNet Implementation Framework) in messaging and ebXML BPSS (Business Process Specification Schema) in business processes with *OAGIS*.
- *RosettaNet* was formed in 1998 by 40 major high-technology industry companies, such as Intel, Microsoft and SAP. Since then, many other major high-technology industry companies, such as Nokia, have joined RosettaNet, and today RosettaNet has over 500 members. Originally, RosettaNet focused on the electronic component and consumer electronics industries, but it has since then been extended to the semiconductor manufacturing, telecommunications, and logistics industries. RosettaNet has published several specifications to facilitate e-business in the high-technology industries. The most important part of RosettaNet is the business process specifications called PIPs (Partner Interface Processes). Currently, RosettaNet covers over a hundred PIPs and associated business documents. RosettaNet also provides a messaging specification called RNIF.
- In 1999, Ariba released *cXML*, which is an XML-based e-business framework although it was developed and modeled after ASC X12. *cXML* defines 34 business documents and illustrates their exchange in business processes.
- In 1999, the United Nations CEFAC (Centre for Trade Facilitation and Electronic Business) and

OASIS (Organization for the Advancement of Structured Information Standards) formed *ebXML* to define a set of specifications for e-business. The first specifications were released in 2001 and the further development of individual specifications continued in working groups of CEFAC and OASIS. *ebXML* does not define certain business processes, but BPSS gives an XML-based language to specify business processes. Since 2001 there has not been a new approved version of BPSS and the working group defining this specification has changed from CEFAC to OASIS. *ebXML* does not specify certain business documents but CCTS released in 2003 gives “components” to specify business documents. In addition, OASIS further develops specifications for messaging, registries for storing and looking at business processes and business documents, as well as automated business partner discovery and agreements. For messaging, *ebXML* provides MSG (Messaging Services). In 2004, the specifications for messaging, registries and automatic business partner discovery and agreements were approved as International Standards Organization (ISO) standards. Currently, there are a number of full members, such as Fujitsu and Sun Microsystems, contributing to the development of individual specifications.

- *CIDX* was originally formed in 1985 to promote the use of ASC X12 within the chemical industry, but it focused on developing an EDI-based e-business framework for the chemical industry. In 2000, BASF, Dow Chemical and DuPont started to develop an XML-based version of *CIDX*, which was given to *CIDX* to maintain and further develop. Today, *CIDX* has about 50 members and provides specifications that define 60 business documents and related business processes. *CIDX* also contains a messaging specification, which is a modified version of RNIF.
- In 1986, API (American Petroleum Institute) formed *PIDX* to develop an EDI-based e-business framework for the petroleum industry. Since 2001 an XML-based version of *PIDX* has been available. Currently, *PIDX* has about 20 members, such as ChevronTexaco, Shell and Total. *PIDX* has published specifications that define 17 business documents and related business processes. In

addition, PIDX includes a messaging specification, which is a modified version of RNIF.

- In 2000, 23 members of CEPI (Confederation of European Paper Industries) and GCA (Graphic Communications Association), which had developed an EDI-based e-business framework for the printing industry in North America, formed *papiNet* to develop an XML-based e-business framework for paper and publishing industries. Since then *papiNet* has been extended to the pulp and wood product industries. *papiNet* has over 40 members, such as International Paper, StoraEnso and Time. *papiNet* provides specifications that define 36 business documents and related business processes. In addition, *papiNet* covers a messaging specification, which is a modified version of MSG.
- In 2001, BPMI (Business Process Management Initiative) released *BPML*, which is an XML-based language to specify business processes. Currently, BPMI has over 50 members, such as PeopleSoft and webMethods.
- In 2002, WfMC (Workflow Management Coalition) published *XPDL*, which is an XML-based language to specify business processes. Today, WfMC has about 50 members, such as Fujitsu and Oracle.
- In 2002, BEA, IBM and Microsoft started to develop *BPEL*. These companies together with SAP and Siebel introduced *BPEL*, which is an XML-based language that can be used to formally describe any business process. Since 2003 *BPEL* has been developed under OASIS and it has 15 full members.
- OASIS started to develop *UBL* in 2001, taking *xCBL* and *CCTS* as the starting point. In 2004, OASIS released *UBL*, which defines eight business documents and illustrates their exchange in business processes. *UBL* has six full members, such as Oracle and Sun Microsystems.

4.3. Properties

For the properties of the XML-based e-business frameworks, we have identified three technical key variables, as presented by Medjahed et al. [19] as well as Nurmilaakso and Kotinurmi [21]. The variables have three values, including no value, which are assigned to the variables as shown in Table 1.

Table 1
Properties of XML-based e-business frameworks

Framework	Business documents	Business processes	Messaging
BPEL		Generic	
BPML		Generic	
CIDX	Specific	Specific	RNIF
cXML	Specific	Specific	
ebXML	Generic	Generic	MSG
OAGIS	Specific	Specific	RNIF
papiNet	Specific	Specific	MSG
PIDX	Specific	Specific	RNIF
RosettaNet	Specific	Specific	RNIF
UBL	Specific	Specific	
xCBL	Specific	Specific	
XPDL		Generic	

- *Business documents—what information should the business partners share?* If the e-business framework follows the *specific* document approach, it defines the particular business documents to be represented in XML. If the e-business framework is based on the *generic* document approach, it provides means to define the business documents.
- *Business processes—when should the business partners share information?* If the e-business framework is based on the *specific* process approach, it defines the particular business processes. If the e-business framework follows the *generic* process approach, it provides means to define the business processes to be represented in XML.
- *Messaging—how should the business partners share information?* If the e-business framework covers messaging, either *ebXML MSG* or *RosettaNet RNIF* is used.

4.4. Standardization

Jakobs [12] and Shapiro and Varian [28] offer a starting point to identify non-technical key variables. The four variables characterize standardization of the XML-based e-business frameworks. We have identified two to three alternative values for these variables. Table 2 presents the values assigned to the variables.

- *Industry—what kind of use is the e-business framework directed to?* If the standardization aims to cover all industries, the e-business framework is *cross-industry*. Respectively, the e-business frame-

Table 2
Standardization of XML-based e-business frameworks

Framework	Industry	Drivers	Organization	Openness
BPEL	Cross	Vendors	Formal	Semi
BPML	Cross	Vendors	Formal	Semi
CIDX	Specific	Users	Formal	Semi
cXML	Cross	Vendors	Informal	Semi
ebXML	Cross	Vendors	Formal	Semi
OAGIS	Cross	Vendors	Formal	Semi
papiNet	Specific	Users	Formal	Semi
PIDX	Specific	Users	Formal	Semi
RosettaNet	Specific	Users	Formal	Semi
UBL	Cross	Vendors	Formal	Semi
xCBL	Cross	Vendors	Informal	Semi
XPDL	Cross	Vendors	Formal	Semi

work is industry-specific if its standardization focuses on one or a few industries. The specifications of the e-business frameworks express whether the e-business framework is industry-specific or not.

- *Drivers—what kinds of members drive the standardization?* Software vendor and consulting companies, other companies, and non-profit organizations are members in the standardization of e-business frameworks. In some cases, there is a difference between full members, which have to pay for their membership and may have greater power in the standardization, and other members. In other cases, all members are full members, but they may not have to pay for their membership. If the majority of the full members are software vendor and consulting companies, the *vendors* drive the standardization of the e-business framework. Respectively, the *users* drive this standardization, if the majority of the full members are other companies. Otherwise, the standardization is *neutral*.
- *Organization—how is the standardization organized?* Formal standardization is based on a standardization organization. This is a non-profit organization, in which a board and rules guide its members, which prepare the standardization work. Informal standardization allows companies that want to be involved as members in the standardization to do their work without an additional organization. It is also possible to make a difference between a formal and an informal organization because either the standardization organization

or the companies have IPRs of the e-business framework.

- *Openness—to what extent is the e-business framework open?* At one extreme, the e-business framework is fully *open* if it is subject to no IPRs. At the other extreme, the standardization organization or companies use patents, trademarks or copyrights to exercise *control* over their e-business framework. The e-business framework can also be *semi-open* if the standardization organization or companies have copyrights to the e-business framework but they as licensors grant perpetual, non-exclusive, royalty-free rights to publish, use and implement the e-business framework without warranty of any kind. As conditions of the membership or license, the members and licensees must agree not to use the e-business framework in any misleading manner and not to assert any IPRs against the licensors or any others to publish, use or implement the e-business framework.

4.5. Commonalities

When a variable has the same value for more than three-fourths of e-business frameworks, a commonality is found. The first commonality rests on the variable Openness and the second on Organization, as shown in Table 2.

The standardization of e-business frameworks is mostly organized formally. Excluding cXML and xCBL, the standardization of XML-based e-business frameworks is organized formally. Therefore, standardization seems to take place more in formal settings than in informal settings [28]. For example, BizTalk Framework driven by Microsoft has been closed down, and BPEL driven first by BEA, IBM, Microsoft, SAP and Siebel has later been standardized under OASIS. Formal organizations can be regarded as committees and informal organizations as markets. Since most e-business frameworks are standardized through committees, this indicates to some extent that the committees have advantages over the markets, as Farrell and Saloner [8] have found.

E-business frameworks are limitedly open. Although XML-based e-business frameworks follow copyright licensing, their openness is essential. In

order to guarantee openness, standardization organizations and companies use copyrights to have limited control [28]. This may resemble copyleft licensing, but the licensees do not have to publish the source code for their system products that utilize the e-business framework. In addition, the licensees may have no rights to modify the e-business framework. If this source code had to be published, the e-business framework might not be attractive commercially. In addition, if the members or licensees could modify the e-business framework and set IPRs unilaterally, they could extend the e-business frameworks in proprietary directions.

4.6. Differences

Since there are variables that have the same value for at most three-fourths of e-business frameworks, there are also differences. We have found differences by studying mainly the variables Business documents, Business processes and Messaging presented in Table 1 and to some extent the variable Industry, as shown in Table 2.

Competition between e-business frameworks is more intensive in business documents and less intensive in messaging than in business processes. On one hand, e-business frameworks compete when they are substitutes, and cooperate, when they are complements. On the other hand, competition is more intensive when the number of substitutes is larger. However, competition and cooperation are not black and white, but there are various shades of grey. In business documents and business processes, e-business frameworks following the same approach are substitutes, whereas those that take different approaches are complements. BPEL, BPML, XPDL and ebXML BPSS follow the generic process approach. These e-business frameworks are substitutes to each other and complements to others. For example, OAGIS and RosettaNet have announced support for BPSS. Since ebXML CCTS takes the generic document approach, it is a complement to other e-business frameworks. For example, UBL is aligning its business documents according to CCTS, and so is xCBL. In particular business documents and particular business processes, cXML, OAGIS, UBL and xCBL are the strongest substitutes, whereas CIDX, papiNet, PIDX and RosettaNet are

the weakest substitutes to each other. The former e-business frameworks are also strong substitutes to the latter e-business frameworks in business documents, but weak substitutes in business processes. This results from differences between industries in the meaning of terms and modes of operations. Although these e-business frameworks overlap, this overlap is only partial. For example, both xCBL and UBL provide a purchase order document, but only xCBL describes a product catalog document. In addition, the cross-industry e-business frameworks explain in which order to exchange particular business documents in a particular business process, whereas the industry-specific e-business frameworks also describe the purpose of this business process and the business partners' roles. For substitutes and complements, messaging differs from the business documents and business processes slightly. ebXML MSG and RosettaNet RNIF are substitutes to each other. They establish the current basis for messaging. Although papiNet utilizes MSG and CIDX, OAGIS and PIDX utilize RNIF, ebXML and RosettaNet are complements to these e-business frameworks.

The different e-business frameworks compete for the support of potential adopters. Considering the use of XML, the e-business frameworks that support the specific document approach, the generic process approach or messaging is of special interest. A major source of competition between these e-business frameworks has been the business documents. Aligning the business documents of different e-business frameworks is no trivial task. Vendors, and especially users cannot easily support business documents or even business processes from different e-business frameworks simultaneously. Complete transformations between different e-business frameworks are sometimes impossible because of missing information. Messaging is clearly a minor source of competition because the requirements for it do not vary much. This competition is mostly between the underlying technologies. These facts also explain why the competition between the e-business frameworks is not very intensive, although the e-business frameworks are to some extent substitutes to each other. As Varian and Shapiro [28] have presented, not every new ICT must endure a standards war.

4.7. Regularities

A regularity is found when two or more variables have the same values for more than one-fourth and at most three-fourths of e-business frameworks. The first regularity is based on the variables Business documents, Business processes and Messaging presented in Table 1 and Industry in Table 2, whereas the variables Industry and Drivers, as shown in Table 2, create a basis for the second regularity.

Industry-specific e-business frameworks are more comprehensive than cross-industry e-business frameworks. The industry-specific e-business frameworks define particular business documents and particular business processes as well as cover messaging. Excluding OAGIS, the cross-industry e-business frameworks are less comprehensive. Although cXML, xCBL and UBL provide particular business documents and particular business processes, they ignore messaging. BPEL, BPML and XPDL enable generic business processes. ebXML deals with messaging but focuses on generic business documents and generic business processes. Generally, the industry-specific e-business frameworks have an exact dictionary for particular business documents and descriptions for particular business processes. In comparison, the cross-industry e-business frameworks produce less detailed specifications for more generic use.

Users prefer to drive the standardization of industry-specific e-business frameworks, whereas vendors favor the standardization of cross-industry e-business frameworks. A user does not want to participate in lengthy standardization for all industries if its main business partners represent the same or closely related industry. When a user participates in standardization, it usually concentrates on only one e-business framework, probably because the adoption of the e-business framework is costly. For example, StoraEnso is involved in papiNet and Nokia in RosettaNet. By participating, the users can affect the results and concentrate on the problems that are important in their situation. For vendors, the existence of an e-business framework can be important, but they do not have specific requirements. Obviously, they aim to support e-business frameworks that have as many users as possible, because supporting an e-business framework requires investments in the system product development. In addition, the vendors

may participate in the standardization of two or more e-business frameworks. For example, IBM and Sun Microsystems are involved in BPEL, OAGIS and RosettaNet.

In the context of XML-based e-business frameworks, there is a trade-off between performance and compatibility [28]. However, this trade-off is more important in business interactions between different users than between different e-business frameworks or their different versions. Shapiro and Varian [28] have argued that large networks have advantages over small networks in adoption. If an e-business framework has more adopters than another e-business framework, the former has an advantage over the latter. This could mean that although many e-business frameworks coexist in the short run, only one e-business framework survives in the long run. A generic e-business framework can be expected to have more potential users than a specific e-business framework. However, not only the expectations of a number of potential adopters are vital. The value of the e-business framework depends on the number of users as well as on the number of business interactions between the users. An e-business framework used more intensively by a small number of companies can be much more valuable than another e-business framework used less intensively by a large number of companies. Although users tend to play a minor role in standardization in general [12], their participation seems to be very important in the standardization of XML-based e-business frameworks. Our findings indicate that users are interested in the deeper use, whereas vendors stress the wider use. There are different preferences not only between vendors and users but also among users, as Jakobs et al. [13] have noted. For example, a transport company collaborates with business partners from a large number of industries, whereas a manufacturing company has business partners from a small number of industries. Therefore, the existence of only one e-business framework is not necessarily the best outcome.

5. Discussion

The research on XML-based e-business frameworks and their standardization is challenging. In

many cases, such as in gathering adoption data, the promoters of the e-business framework are the only available sources of information. The reliability of such data can be questioned, as the promoter of the e-business framework is hardly impartial, and may have incentives to show a large number of adopters for the e-business framework. On the other hand, the promoter is not necessarily aware of all the adopters.

Another factor that makes this research challenging is the considerable speed of change. Old e-business frameworks may disappear and new emerge. For example, BizTalk Framework was officially closed down in 2002 and eCo has been inactive for years, whereas the first full version of UBL was published in 2004. Moreover, new versions of some e-business frameworks emerge nearly on a monthly basis. Therefore, many of the studies on e-business frameworks are already outdated. There are also unification plans. For example, CIDX and PIDX have had some plans to align their specifications so that they are interoperable, which is not the case today. In addition, the future of some cross-industry e-business frameworks, such as BPML, cXML, xCBL and XPDL, seems to be more uncertain because their standardization is less active than other chosen e-business frameworks.

The variables identified for our analysis are incontestable, but the identification and assignment of their values cannot be completely unambiguous. This was not a serious problem with the properties presented in Table 1 because we followed to a large extent the classification of Nurmilaakso and Kotinurmi [21]. According to Nurmilaakso and Kotinurmi, a business document specification is based on an XML document or document modeling approach and a business process specification on a detailed, rough or generic process approach, whereas messaging is based on ebXML MSG, RosettaNet RNIF or Web Services. We made no difference between the detailed and rough process approaches because they define certain business processes only at a different level of accuracy. We also ignored Web Services, which are a collection of XML technologies, i.e. SOAP (Simple Object Access Protocol), UDDI (Universal Description, Discovery and Integration) and WSDL (Web

Services Definition Language), rather than a messaging specification. These two modifications have not affected our results. In standardization, we made a number of changes according to the feedback given in “the Workshop on Standard Making: A Critical Research Frontier for Information Systems”. For the variable Industry in Table 2, we first suggested that CIDX and PIDX are single-industry-specific, papiNet and RosettaNet multiple-industry-specific and other e-business frameworks cross-industry. Since the differences between single-industry-specific and multiple-industry-specific e-business frameworks were not straightforward, we have regarded them as industry-specific e-business frameworks. For the variable Organization in Table 2, we originally followed Farrell and Saloner [8] who have noted that standardization takes place through committees, markets or their hybrids. We have regarded committees and hybrids as formal organizations and markets as informal ones because the differences between committees and hybrids are difficult to recognize. These two changes have had no effects on our results, but they have simplified our analysis. With regard to the variable Openness in Table 2, the situation was different. Two extreme values, i.e. control and open, proved to be insufficient, and so we have taken into account a middle value, i.e. semi-open, which reflects limited openness. Considering the variable Drivers in Table 2, we realize that this variable is quite dynamic because new members join and old members withdraw from the standardization of e-business frameworks.

Despite the challenges in observing XML-based e-business frameworks, there seems to be some common trends in their properties. The messaging is stabilizing. The e-business frameworks use either the messaging specification of RosettaNet or ebXML. There are some plans in RosettaNet to support also ebXML in messaging. There is much more variety in the business documents, and the speed of change is still considerable. A notable change is the use of XML Schema instead of DTD in the business document specifications. The speed of change seems fastest, however, in the business processes. The business process specifications, such as BPEL, evolve fast and are gradually beginning to gather increasing attention in the industry.

For further research, an interesting question is why some e-business frameworks have a larger number of adopters and more impacts on adopters than others, or even why some e-business frameworks have survived and others have ceased to exist. Longitudinal studies could provide valuable information on the success and failure of e-business frameworks and their standardization.

6. Conclusions

An e-business framework is a standard that answers or gives means to answering at least one of the questions of what information should be shared, when and how within and between companies. The purpose of e-business frameworks is to enable efficient business interactions between business partners. Although the literature contains a number of papers on standards or standardization, there seem to be very few papers studying both e-business frameworks and their standardization systematically. We have focused on 12 XML-based e-business frameworks, analyzing them with respect to seven variables.

Our analysis indicates two commonalities. Most XML-based e-business frameworks are standardized in formal organizations that can be regarded as committees. All e-business frameworks are limitedly open so that they cannot be modified or extended in proprietary directions. These findings match well with those presented in the literature. Since there are differences between e-business frameworks, they do not compete in all respects but often cooperate with each other. The most intense competition between e-business frameworks occurs in the business document specifications and the least intensive in the messaging specifications. In addition, we have found two regularities. Cross-industry e-business frameworks are less comprehensive than industry-specific e-business frameworks. Vendors tend to drive the standardization of cross-industry e-business frameworks and users the standardization of industry-specific e-business frameworks. Therefore, vendors seem to emphasize a wider use and users a deeper use. These findings differ to some extent from those in the literature. Firstly, the value of the e-business framework is dependent not only on the number of users but

also on the number of business interactions between these users. Secondly, the users have an important role in the standardization of e-business frameworks, although the vendors have traditionally dominated the standardization.

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