

STANDARDIZATION OF XML-BASED E-BUSINESS FRAMEWORKS

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ABSTRACT

The purpose of e-business frameworks is to enhance the interoperability of communication. Are there dependencies between e-business frameworks and their standardization? How are vendors, users, and institutions involved in the standardization of e-business frameworks? To what extent are the different frameworks complements or substitutes? How does e-business framework standardization relate to economics of standardization? This paper answers these questions by presenting four propositions on e-business frameworks that use Extensible Markup Language (XML). We also claim that some economic findings and suggestions related to vendor driven standards on physical products are irrelevant, as the e-business framework specifications are end products of standardization and they are used by end-user companies instead of individuals.

Keywords: standardization, XML-based e-business frameworks, economics of standardization

INTRODUCTION

Companies produce their documents and perform their processes in different ways, using heterogeneous information systems. Heterogeneous systems cannot exchange information without considerable manual work. To operate across organizational boundaries, organizations must have shared understanding of the way of doing business. Standardization brings order into the uncertainty by reducing variety (David 1995).

Automated business transactions between two organizations require that their information systems are capable of communicating. The organizations must agree on what information to share, when and how. This can be achieved through interoperability of business documents, business processes, and messaging. An e-business framework is a standard for this purpose (Nurmilaakso and Kotinurmi 2003). A framework often combines other standards, specifications, and classifications and covers both the business and technical aspects of communication. The literature provides a number of studies on e-business frameworks (Hasselbring and Weigand 2001, Li 2000, Nurmilaakso and Kotinurmi 2003, Shim et al. 2000). Some of the e-business frameworks presented in the articles, such as the BizTalk Framework, have been later officially closed down by their creators, and many, such as the XML/EDI framework, have been inactive for a considerable time. We focus here on XML-based e-business frameworks supporting industrial procurement, production, or distribution.

In this paper, we first present some theories and studies in economics of standardization and then introduce three different e-business frameworks, XML Common Business Library (xCBL), RosettaNet and electronic business XML (ebXML), which in our opinion are the most prominent e-business frameworks presenting different standardization approaches. After this, we

categorize these three frameworks with six other widely cited frameworks. Based on this categorization we present four propositions related to the e-business frameworks and discuss how economics of standardization match our observations of the e-business frameworks. Finally, we present our conclusions and suggestions for further work.

ECONOMICS OF STANDARDIZATION

The economic gains from compatibility are the driving forces for standardization. They result from the avoidance of costly handling of information. With regard to standardization, economic theory has focused much on network externalities (Katz and Shapiro 1985), standard adoption (Farrell and Saloner 1985, Katz and Shapiro 1986), standardization by committees versus markets (Farrell and Saloner 1988), and path dependence resulted from lock-in by the history (Arthur 1989). These studies present a number of theoretical findings, especially for public policies.

- (1) If the costs of compatibility fall more heavily on some than others, the free-rider problem biases away from compatibility.
- (2) If the information is incomplete, an obsolete standard may prevail, although a better alternative is available.
- (3) Standardization by market is faster, but standardization by committee causes fewer errors. A hybrid system of committee and market outperforms both.

Liebowitz and Margolis (1994, 1995) argue that network externalities and path dependence suffer from empirical shortcomings. In addition, some network effects are simply manifestations of technological progress, and knowledge of some initial endowment alone can never tell much about the eventual path of economies over time. Therefore, theories relying on network externalities or path dependence provide little support for an occurrence of a market failure. Economic studies also deal with standardization from the viewpoint of corporate policy. Shapiro and Varian (1999) suggest that:

- (4) Adoption dynamics work to the advantage of large networks and against small networks.
- (5) Expectations are vital to obtaining the critical mass necessary to fuel growth.
- (6) Introducing new products faces a trade-off between performance and compatibility.
- (7) Introducing new products faces a trade-off between openness and control.

How well do the e-business frameworks and their standardization fit in with findings for public policies and suggestions for corporate policy?

E-BUSINESS FRAMEWORKS

E-business frameworks facilitate the interoperability of business processes, business documents and messaging. Not all frameworks define these on the same level, and only a few frameworks specify messaging.

Business processes specify activities to be carried out in a given order, for example, when a business document should be sent and how and when it should be answered. The frameworks define these using diagrams and/or textual descriptions.

Business document specifications define the structure and contents of business documents exchanged in a commonly understood fashion. For example, a “purchase order request” business document guides how products, dates, financial amounts and currencies are

presented. This is achieved by schemas provided by the e-business frameworks for validating the contents of business documents.

Messaging defines secure and reliable communication when exchanging business documents in business processes. Messaging specifies the envelope for the business document as well as the packaging, security, and transportation standards to be used.

CASE E-BUSINESS FRAMEWORKS

Since the emergence of the XML standard, many organizations have started defining XML-based standards for use in e-business. We present here three important XML-based e-business frameworks: xCBL, RosettaNet and ebXML in the order of their initiation. We chose these frameworks for the case study because they have been much in the limelight. In addition, the first impression is that they differ from each other with regard to standardization, as xCBL represents standardization by markets and ebXML by committees. RosettaNet is a hybrid, in which end-users are more important than vendors and institutions.

The xCBL standardization effort began in 1997 before the XML specification was officially released in 1998. RosettaNet was initiated in 1998 and it took process standardization as its focus. The ebXML project started in the late 1999 to provide complete infrastructure for e-business needs and to answer the need to standardize the use of XML in e-business.

xCBL

xCBL is one of the first e-business frameworks, having originated in 1997 at Veo Systems. xCBL was originally called Common Business Library (CBL) and developed in a research project to test the limits of XML for e-commerce. In January 1999, CommerceOne acquired Veo Systems and the CBL technology. This led to the creation of xCBL 2.0, the first publicly available version of xCBL. xCBL is fundamentally a collection of XML-based business document specifications for use in e-business. It provides cross-industry vocabularies, but does not define business processes or messaging in detail.

xCBL 2.0, released in January 2000, consisted of 12 different business document specifications in 5 different categories. These were mainly meant for use in business-to-business procurement scenarios. xCBL 2.0 was based on existing Electronic Data Interchange (EDI) standards, to ease the migration from EDI to xCBL and thus promote the adoption of xCBL.

xCBL 3.0, released in November 2000, represented a major broadening of scope by allowing users to build their own customized business documents from standard components. xCBL 3.0 also introduced several new business document specifications, as well as new categories.

xCBL 3.5, released in October 2001, contains all the business documents found in xCBL 3.0 as well as nine new ones. Organization for the Advancement of Structured Information Standards (OASIS) took this version as the starting point for defining business documents in Universal Business Language (UBL).

xCBL 4.0, released in March 2003, is the latest version of xCBL. It consists of 44 business documents in eight categories. These categories are Order Management, Preorder Management, Financial, Material Management, Message Management, Application Integration, Catalog, and Statistics and Forecasting areas.

CommerceOne has dominated the standardization of xCBL. Although the xCBL framework is an open standard, its standardization is not transparent. The differences between the xCBL

versions 2.0 and 3.0, as well as 3.5 and 4.0 indicate that backward compatibility has played a minor role in the standardization of the xCBL framework.

RosettaNet

RosettaNet is a consortium founded in February 1998 by 40 information technology companies. Currently, it has more than 500 member organizations representing Information Technology (IT), Electronic Components (EC), Semiconductor Manufacturing (SM), and Telecommunications (TC) industries.

The corner stone of RosettaNet are the specifications for Partner Interface Processes (PIPs). PIPs specify the public processes between organizations and associated business documents. RosettaNet has published more than 100 different PIPs, which are sorted into the following categories on the basis of their characteristics: Partner Profile Management, Product Information, Order Management, Inventory Management, Marketing and Support, Service and Support, and Manufacturing.

In addition to PIPs, RosettaNet includes two dictionaries, which provide a common set of properties for the PIPs. These dictionaries are RosettaNet Technical Dictionary and RosettaNet Business Dictionary. RosettaNet Implementation Framework (RNIF) is the messaging framework used to execute PIPs between organizations securely over the Internet. RosettaNet leverages existing standards in the partner and product identification codes used.

The different parts of RosettaNet have been developed somewhat separately, and they are still evolving. The increasing amount of RosettaNet implementations in production, however, indicates a certain overall maturity of the standard. Soon after RosettaNet was founded, it published at a quick pace almost one hundred different PIPs. Currently the standardization process focuses on implementations. RosettaNet has two kinds of programs for the advancement of the RosettaNet framework. Milestone programs, such as The Global Billing Milestone Program, focus on reaching an implementation goal within the related PIP specifications. Milestone programs require approval from RosettaNet, and commitment from the members to provide resources to the program and to implement its results. Foundational programs, such as the "PIP specification format", encompass the development and evolution of all RosettaNet specifications, e.g. introducing new XML-technologies such as XML Schemas to define RosettaNet business documents and making the process descriptions computer-readable. The RosettaNet members can vote on standards developed in the programs and they can become open standards available for everyone only after they have been approved. In this respect, the current standardization process resembles the process proposed in Jakobs (2002), where feedback is provided to the process and the standards are validated by implementations before the specifications are released as open standards.

RosettaNet marks each PIP with maturity level information such as "in production" or "waiting validation". Most of the published PIPs before the Milestone programs have not yet reached the highest maturity level of "in production", which means that the PIP has been used in production by the members. RosettaNet has published several versions of the Business Dictionary and Technical Dictionary, as the dictionaries may require updating when introducing new PIPs. RNIF 2.0 is the second and latest version of RosettaNet Implementation Framework. It was published in July 2001 and replaced RNIF 1.1, which was the first public version of RNIF.

Overall, RosettaNet is rather pragmatic with regard to what it standardizes and how. It leaves many things, such as trading partner discovery, not standardized, and it has been relatively slow in the adoption of new implementation technologies such as XML Schemas. The existing

implementations make the process of introducing big changes slow. However, RosettaNet has promised future support for new technologies and emerging cross-industry standards.

ebXML

The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and OASIS sponsored the ebXML project started in November 1999 as an 18-month project. The mission of ebXML is to provide an open XML-based infrastructure enabling the global use of electronic business information in an interoperable, secure and consistent manner by all parties. ebXML is targeted for every sector of the business community, from international conglomerates to small and medium sized enterprises. The first specifications were released in the end of the original project in May 2001. During the original project, many standard developing organizations (SDO) announced plans to support certain parts of the standard.

ebXML has defined a set of specifications designed to meet the common business requirements and conditions for e-business. The ebXML Business Process Specification Schema (BPSS) is an XML-based specification language that can be used to formally define the public business processes that allow business partners to collaborate. The ebXML Registry provides a set of services that enable sharing of information between interested parties. The two specifications describing the use of registries are Registry Information Model and Registry Service Specifications. Collaboration Protocol Profiles and Agreement (CPPA) are used to encode a company's e-business capabilities and technical agreements. The ebXML messaging services (ebMS) provide a general-purpose messaging mechanism to allow reliability, persistence and security. The ebXML Core Components (CC) provide the way business information is encoded in the business documents exchanged. Core Components was the only group that failed to publish any approved specification in the original project.

After the original 18-month project, further development of the ebXML framework continued in committees coordinated by UN/CEFACT and OASIS. The OASIS technical process develops further the specifications for ebMS, Registries and Repositories, CPPA as well as Implementation, Interoperability and Conformance work. UN/CEFACT developed further the CC and the BPSS specifications. One reason for adopting a temporal consortium form of several different consortia may be due to difficulties experienced in agreeing on the standards. The editorial board of XML.com, a popular XML-related website, nominated ebXML as a runner-up for "The Most Spectacular Incidence of Committee/Project In-fighting in 2001".

The OASIS working groups have since published new versions of every specification they are developing further. The first specification for the Core Components from UN/CEFACT was published in August 2003. In August and September 2003, UN/CEFACT and OASIS separately announced completion of the second phase of ebXML technical standards work on defining the specifications further. UN/CEFACT will no longer participate in ebXML development. OASIS will develop ebXML standards further, but details on the developed specifications were not clear when writing this in November 2003. In September 2003 the OASIS ebXML Business Process Technical Committee was formed to proceed standardization based on the BPSS version 1.01. In October 2003, UN/CEFACT published BPSS version 1.1. This is a good example on the confusion with the current situation.

The idea with the ebXML specifications has been that software industry can make their products conform to the specifications, and there are products to support the specifications. The specifications are quite general in nature, as they have been designed to support many different technologies. Since the publication of the specifications, only ebMS has gathered notable industry support and industrial implementations. The standardization process has been open, so

the specifications are open for public commenting. The standardization process has not required implementations of the developed specifications.

Summary

The xCBL framework represents standardization by market, the ebXML framework by committee. RosettaNet is a hybrid, in which end-users are more important than vendors and institutions. The organizational form and involvement are not the only differences. xCBL is developed by making large changes, while RosettaNet progresses through incremental changes. ebXML standardization has been the most open process, and after the initial development process the individual specifications have gone through incremental changes. Of the three frameworks studied in detail, xCBL seems to lack major end-user companies promoting the usage. The framework seems to have adapted the strategy of co-operating with other frameworks such as UBL.

RosettaNet seems to be the most successful of the three frameworks. The current standardization process emphasizing implementations seems to be working well. Those who wish to benefit from the improvement of the specification, have to be willing to pay to bring the improvement about. This commitment seems to work and is something that might be usable for other e-business standardization efforts as well.

The ebXML framework is ahead of its time in some respects. The market is probably not ready for the registries and automated negotiations yet, as even a single integration between partners is still hard to achieve. In addition, the adoption of the specifications seems currently hard. Trying to cover all the needs of every industry can lead to complexity and overly general specifications. The existing ebXML specifications seem indeed quite general and do not thus significantly reduce uncertainty. So far, the major support for standards has been received from government agencies. ebXML has gathered support from industry consortiums and vendors, but the actual implementations seem few, apart from ebMS. The current situation where UN/CEFACT and OASIS approve the specifications individually can also cause confusion.

ANALYSIS OF STANDARDIZATION

In addition to xCBL, RosettaNet and ebXML, our analysis covers Chemical Industry Data eXchange (CIDX), commerce XML (cXML), Open Applications Group Integration Specification (OAGIS), papiNet used in pulp and paper industry, Petroleum Industry Data eXchange (PIDX), and UBL. These XML-based e-business frameworks are still active in 2003, and important vendors, e.g. Microsoft, or end-users, e.g. DaimlerChrysler, are involved in their development, or use at least one of these frameworks. In addition, vendors such as webMethods, Microsoft, Fujitsu, BEA and IBM provide support for all or at least some of these e-business frameworks in their products. UBL is still an evolving e-business framework and not supported by products.

Classification of e-business frameworks

As Farrell and Saloner (1998), and Jakobs (2002) note, committees and markets are alternatives for defining standards. The committee or institutional approach works through SDOs, such as American National Standards Institute's ASC X12 and United Nations EDIFACT in Electronic Data Interchange (EDI) standardization. The market or business-driven approach allows companies to do the standardization work independently. In the hybrid approach, companies form a consortium to set the standard. There are many industry consortiums, such as RosettaNet and papiNet, defining e-business frameworks. In table 1 of e-business framework categorization, the main drivers of the e-business framework are distinguished.

The literature on standardization economics concentrates on situations where equipment manufacturers or institutions drive standardization. In these cases, the end-users of the standardized products are individuals. This is not the case with e-business frameworks, as the end-users of standards are companies. These companies can represent standard-supporting product vendors and consultants, or they can be end-users of the standards. Industry associations can represent the end-users. Companies such as IBM and Fujitsu can represent both the end-user and the vendor in a framework. This vendor and end-user distinction is worth making, as these participants in the standardization have different expectations for the framework. The involvement column in table 1 represents this aspect of the e-business framework.

The different e-business frameworks can have differences in how they specify business processes, business documents and messaging. Not all frameworks specify all these, and some e-business frameworks are much more detailed than other.

As it seems that not all e-business frameworks target all industries (cross industry), the distinction is made here as well. Some frameworks concentrate on just one or a few specific industries (single/multi). Sometimes this distinction of the target industry is called horizontal and vertical.

Table 1. e-Business framework categorization				
Framework	Driver	Involvement	Content	Industry
CIDX	Consortium	User-intensive	Documents, Processes (messaging)	Single
cXML	Business	Vendor-intensive	Documents, Processes	Cross
ebXML	Institution	Neutral	Processes, Messaging (documents)	Cross
OAGIS	Consortium	Vendor-intensive	Documents, Processes (messaging)	Cross
papiNET	Consortium	User-intensive	Documents, Processes (messaging)	Single
PIDX	Consortium	User-intensive	Documents, Processes (messaging)	Single
RosettaNet	Consortium	User-intensive	Documents, Processes, Messaging	Multi
UBL	Consortium	Vendor-intensive	Documents, Processes	Cross
xCBL	Business	Vendor-intensive	Documents, Processes	Cross

() Provides only guidelines for how it is accomplished, not actual specifications

CIDX, papiNet and PIDX are consortiums that define e-business frameworks for their respective industry sectors. Industry associations and large companies represent the end-users in these frameworks. There are also some vendors represented, but their role in the standardization is smaller. The three frameworks all define the business documents and processes in detail and guide secure messaging by utilizing the RosettaNet or the ebXML frameworks.

cXML and xCBL are business-driven frameworks with a clear vendor focus. The e-marketplace software vendors CommerceOne and Ariba are the driving forces behind these frameworks. They both target their specifications for all industries and concentrate on defining the business documents. The guidelines for the processes are very general.

ebXML is an institutional framework, as UN/CEFACT and OASIS have been behind it. It intends to provide specifications for all industries. ebXML provides guidelines for defining inter-company processes and core components (CC) for business documents, but no definitions to take into use as such, e.g. a standard purchase order. ebXML also specifies registries and automated partner discovery and agreement specifications, and thus covers the widest area.

Large enterprise system vendors originally formed the OAG consortium behind the OAGIS framework. OAGIS has currently also end-user companies and industry associations as members, but the vendor companies still dominate it. OAGIS defines business documents intended for cross-industry usage and provides support for associated processes. OAGIS also gives guidelines on how to use the RosettaNet messaging specifications.

The RosettaNet consortium includes many vendors that provide software and services for the RosettaNet framework. However, the number and importance of end-user companies in the RosettaNet IT, EC, SM and TC industry boards makes the framework end-user oriented. RosettaNet defines processes, business documents and messaging in detail.

The goal of UBL is to provide common cross-industry business documents leveraging ebXML CC methodology to enable convergence of existing e-business frameworks. The OASIS organization is behind the UBL effort and its members are mostly vendor companies.

Propositions for e-business framework standardization

On the basis of our experience in studying and classifying these e-business frameworks, we have developed the following propositions.

Proposition 1: End-user companies prefer to participate in industry-specific frameworks, and cross-industry framework development relies on institution-driven or vendor-intensive standardization.

End-user companies seem to concentrate on just one framework. By participating in the standardization, end-user companies can affect the result and concentrate on issues important to their situation. As the main business partners represent the same industry, the end-users do not have to participate in lengthy cross-industry standardization. For institutions and vendors, the existence of a framework can be important, but they do not provide very specific requirements. Vendors such as webMethods, Microsoft, SAP, Fujitsu, BEA and IBM participate also in standardization organizations that target all industries.

Proposition 2: Industry-specific frameworks deal with business documents, business processes, and messaging in more detail than cross-industry frameworks.

The industry-specific frameworks cover all the aspects of business communication in detail. Cross-industry frameworks such as OAGIS, xCBL, cXML and UBL concentrate mostly on defining the business documents, they just assist in the processes, and only OAGIS defines secure messaging. The ebXML framework covers all the aspects and even provides help for partner discovery and agreements, but does all this on a very high level.

Proposition 3: Standard competition between the e-business frameworks is not very intensive, because the frameworks have differing main goals.

In many ways, the different frameworks are complementary, as certain parts, such as messaging can be acquired from another standard. All frameworks are somehow interrelated with at least one other framework and there have been many promises for future support. RosettaNet has announced potential support for ebXML messaging and BPSS in the future. OAGIS publicly supports the ebXML specifications BPSS and CPPA, and it is aligning its documents according to CC methodology, as do xCBL and UBL. CIDX and PIDX have a lot in common with RosettaNet. papiNet uses ebXML messaging with its own guidelines.

The different e-business frameworks compete for company usage with each other. A typical source of competition among standards is the way the business documents are described. Fensel et al. (2001) point out that e.g. aligning xCBL and cXML document structures is no trivial task. The same kinds of problems are probable with also other frameworks. This means that companies cannot easily support different business document specifications simultaneously. Messaging standardization is clearly not a major competition factor for e-business frameworks, because the requirements for it do not seem to vary. The competition there is mostly between the underlying technologies used to encrypt or package the exchanged business documents.

Proposition 4: E-business frameworks differ from general IT protocols or traditional product standardization.

As the end-users are companies with bargaining power, the situation is different from traditional standardization. Jakobs et al. (1998) point out that companies with different cultural backgrounds are likely to provide very heterogeneous needs and requirements, as they represent their own organization instead of end-users in general. The different requirements of end-user companies make it unlikely that a single e-business framework would gain control. The EDI standards are very fragmented and the same seems to hold true also for XML-based e-business frameworks.

Economic findings and suggestions

The e-business framework standardization practices support the following claims related to the economic findings:

- (1) The free-rider problem does not necessarily lead to non-standardization. Since large enterprises benefit much from the e-business frameworks, they are willing to pay the costs of standardization.
- (2) Incomplete information can slow down the adoption of a better standard, as e.g. companies do not abandon their investments in EDI until uncertainty over XML is dispelled. In addition, the large number of e-business frameworks causes problems because adoption of a framework is not costless. Which framework to support, if any?

- (3) Most of the studied e-business frameworks seem to be driven by consortiums. This indicates that consortiums outperform business and institution driven organizations in the standardization of the e-business frameworks. The BizTalk framework driven by the vendor Microsoft has closed down and ebXML is not doing very well.
- (4) The adoption of an e-business framework depends on its value, which is affected both by the size and by the density of the network. A framework that is very intensively used by a small number of companies may be more valuable and, therefore, more interesting than another framework that is used less intensively by a large number of companies. The large number of industry-specific frameworks against the small number of cross-industry frameworks provides indirect support for this.
- (5) The pre-announcement strategies used by the frameworks indicate that expectations are vital. For example papiNet, RosettaNet, and xCBL have published information on current implementations of the framework. Positive history strengthens positive expectations. The frameworks also announce future support to other emerging standards to boost the expectations for future interoperability.
- (6) There can be a trade-off between performance and compatibility when introducing a new version of an e-business framework. For example, RosettaNet has proceeded through incremental changes not significantly endangering backward compatibility with the existing implementations. This is a challenge for conformance work between the different e-business frameworks.
- (7) Openness plays a key role in e-business frameworks. Except for PIDX, the frameworks follow an intellectual property right (IPR) policy that a standardization organization has a copyright to its framework that is an open standard. The standardization organization as a licensor has and can grant a perpetual, non-exclusive, royalty-free, worldwide right to use, publish, copy and distribute the framework as well as to implement and use the business documents, business processes and messaging included in the framework for the purpose of computer programs. This requires that the contributors agree not to assert any IPR against the standardization organization or any other to implement and use the framework. This also applies to licensees as conditions of the license.

In all, our findings of e-business frameworks do not seem to support all the existing economic findings and suggestions on standardization, e.g. (1), (4) and (7), although for many, it is too early to say anything definite.

CONCLUSIONS AND FURTHER RESEARCH

In e-business standardization, the end-users of the standards are companies. Some economic findings and suggestions related to vendor-driven standards on physical products are irrelevant to this situation, as the end-users of the standards affect choices. The purpose of the e-business frameworks is to lower the transaction costs and to enable better communication between the end-user companies. Standards specifications in the e-business domain are not goods to be sold, but are freely available for use.

The different frameworks do not compete in all respects, but very often complement each other. So far, it seems that the industry-specific frameworks such as RosettaNet, which have a clear focus, are more successful. The current situation with many e-business frameworks and

technological standards increases the uncertainty over the e-business frameworks and can slow down the adoption of the frameworks in industry.

The limited data available on e-business frameworks poses challenges to methodology in doing this kind of research. The reliability of the conclusions made here could be improved by collecting information on the usage of different e-business frameworks, the numbers of partners and connections. Our future work includes collecting usage information and identifying the success factors of the e-business frameworks. We aim to conduct comparative case studies to analyze how well different XML-based e-business frameworks do support, e.g. order management and engineering change management.

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