

A CONCEPTUAL MODEL FOR COMPARATIVE ANALYSIS OF STANDARDIZATION OF VERTICAL INDUSTRY LANGUAGES

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ABSTRACT

In today's global economy and E-commerce, there is increasing need to integrate application systems within and across organizations. Additionally, to lower the cost of application development and maintenance, increase reuse, and support outsourcing, the application development is moving towards component-based development and Web services. While great stride has been made in standardization to achieve interoperability and integration at hardware, operating system, data communication, messaging, and common syntax level, the common semantics required for application integration has not been developed. The standardization of common semantics depends on particular vertical industries such as insurance, banking, healthcare, and manufacturing. The standardization in each of the verticals has proceeded in ad-hoc and very unique ways. Additionally, they are at different stages of development. In some industries, multiple consortia or groups are developing standards, which significantly overlap with each other. Many vertical industries have developed standards that overlap with each other and with horizontal industry standards. The objective of this research is to develop a conceptual model for comparative analysis of standardization of vertical industry languages, which can be used to evaluate the current standardization practices and recommend ways to improve the standardization processes in the vertical industry domains. A pilot study in the insurance industry has been performed, where representatives of two members of the dominating industry standard, ACORD, were interviewed. The interviews are summarized and reported in this paper.

Keywords: standardization; application interoperability; web services; semantics; vertical industry language.

INTRODUCTION

As our ability to build information systems continues to grow, so does the need for integrating the systems we build. Legacy systems developed over time in different sections of an organization need to be integrated for decision support purposes. Business mergers and acquisitions force systems previously owned by different institutions to be merged. Systems operated by cooperating enterprises in a value chain need to cooperate with each other. The rapid growth of E-commerce and the increasing globalization of businesses further boosted the need for system cooperation and integration. Such need for application interoperability is becoming ubiquitous, within and across organizations, in almost every domain. Additionally, there is increasing pressure to reduce application development and maintenance cost, achieve quicker application development, increase use of off-the-shelf applications, components and services and support outsourcing. This is moving application development more towards component-based development and services oriented architecture based on web services (Vitharana et al. 2003; Jain et al. 2003).

Years of standardization efforts in Information and Communication Technology (ICT) have achieved tremendous success in realizing interoperability at hardware, operating system, data communication, messaging and common syntax levels. Additionally, World Wide Web has resulted in common presentation and user interaction mechanism. However, inter and intra organizational interoperability and integration of applications additionally requires common semantics. While the standardization at hardware, operating system, data communication, messaging, and common syntax levels has been pursued independent of industry domains, the standardization of common semantics necessarily depends on particular industry verticals such as banking, insurance, health care, and manufacturing, as evidenced by the various XML.org Focus Areas (www.xml.org/xml/focus_areas.shtml) working on XML standards for particular vertical industries. The development of standards in industry verticals has proceeded in ad-hoc and very unique ways. In some industries, multiple consortia or groups are developing standards, which overlap with each other, e.g., the standards developed at IFX Forum (Interactive Financial eXchange Forum, www.ifxforum.org) and FSTC (Financial Services Technology Consortium, www.fstc.org) for the financial services industry. In addition, many vertical industries have developed standards that overlap with each other and with horizontal industry standards, e.g., XBRL (eXtensible Business Reporting Language, www.xbrl.org), ebXML (electronic business XML, www.ebxml.org), and OFX (Open Financial Exchange, www.ofx.net). Consequently, the extents of standardization in different industries vary substantially.

The objective of this research is to develop a conceptual model for comparative analysis of standardization of vertical industry languages, which can be used to evaluate the current standardization practices and recommend ways to improve the standardization processes in the vertical industry language domains. A pilot study in the insurance industry has been performed, where representatives of two members of the dominating industry standard, ACORD, were interviewed.

The paper is organized as follows. Section 2 presents a conceptual framework for application interoperability and a concrete architecture. Actualization of this conceptual framework based on the emerging web services technology is presented. The status of standardization of the various layers in the architecture is reviewed. The deficiency in standardization of vertical industry languages is outlined. Section 3 proposes a conceptual model for comparative analysis of standardization of vertical industry languages. Section 4 reports a pilot study in the insurance industry. Section 5 concludes the paper and describes the plan for future research.

STANDARDS NEEDED TO ACHIEVE APPLICATION INTEROPERABILITY

It is obvious that standards are critical in achieving successful interoperability or integration of heterogeneous application systems, as the different parties need a lingua franca to communicate with each other. In the following sub-sections, we describe the various technical layers that need to be standardized for the purpose and an emerging approach, that is, web services.

A Conceptual Framework

In order to successfully cooperate with each other, multiple application systems must share common communication mechanism, common application-level messaging mechanism, common syntax, and common semantics. The common communication mechanism allows systems to communicate raw bits and bytes over a network. The common application-level messaging mechanism allows distributed applications to interact with each other on a higher abstraction level. The common syntax specifies the structure of the messages between applications. The common semantics provides a common definition of what is to be

communicated and is used to interpret the meaning of the communicated messages. The applications interacting with each other need to agree on the terminology used to describe concepts in the application domain. Some concepts common in multiple industries may be specified in some horizontal language, which covers multiple industries. Concepts unique for a particular industry need to be specified in a vertical industry language. Figure 1 outlines the technical layers that need to be standardized for applications to successfully and meaningfully cooperate with each other.

Common Semantics	Vertical Industry Language 1	Vertical Industry Language 2	...	Vertical Industry Language n
	Horizontal Language			
Common Syntax				
Common Messaging Mechanism				
Common Communication Mechanism				

Figure 1. A Conceptual Framework for Application Interoperability

An Infrastructure for Application Interoperability Based on Web Services Technologies

The conceptual framework for application interoperability can be implemented using different technologies. Indeed, different approaches have been implemented in the past, with EDI (Electronic Data Interchange) as a classical example. EDI allows distributed applications to communicate with each other via a (usually expensive) proprietary value-added network (VAN). The expensive adopters need to be added to the applications and they are hard to maintain. These difficulties have restricted the adoption of EDI to large organizations. Small to medium sized companies have often felt EDI prohibitively expensive to implement (Ramamurthy et al. 1999; Deitel et al. 2003).

Firmly supported and actively advocated by influential computer companies such as IBM, Microsoft, HP, and Sun, web services technology is emerging as an important trend in web-based application interaction and integration (Kreger 2003; Miller 2003; Williams 2003). Based upon open standards such as SOAP, WSDL, UDDI, and BPEL4WS, web services allow web-based applications to communicate through standardized XML messaging (Gottschalk et al. 2002). Contrast to the traditional EDI technology for application integration, which tightly couples the components via dedicated networks and proprietary messaging protocols, web services can be loosely coupled using open, text-based standards over the Internet, thus significantly reducing the costs of application integration. Web services technology provides a new computing model, which greatly eases application integration within and across enterprises and is getting increasing adoption (Gottschalk et al. 2002).

Figure 2 outlines an actualization of the conceptual framework for application interoperability described in the previous sub-section based on web services technology. Web services exchange messages over the Internet. Internet protocols, including the TCP/IP networking protocol and transport protocols such as HTTP and FTP, comprise the common communication mechanism. XML is the chosen syntax for marking up web service messages. A set of

standards, such as SOAP, WSDL, UDDI, and BPEL4WS, are being developed for passing messages between web services and describing, publishing, and assembling web services. At the same time, various XML-based languages encoding business semantics are being developed both horizontally and in particular vertical industries.

Common Semantics	Insurance (ACORD)	Human Resource (HR-XML)	...	Healthcare (HL7)
	Horizontal Language (ebXML)			
Common Syntax (XML)				
Common Messaging Mechanism (Web Services)	Service Composition (BPEL4WS)			
	Service Discovery (UDDI)			
	Service Description (WSDL)			
	XML Messaging (SOAP)			
Common Communication Mechanism (Internet)	Transport (HTTP, SMTP, FTP, BEEP)			
	Networking (TCP/IP)			

Figure 2. An Infrastructure for Application Interoperability Based on Web Services Technology

The layers up to common syntax have been standardized and are widely adopted. Internet protocols such as TCP/IP, HTTP, and FTP have become well-accepted standards. XML (Extensible Markup Language) is becoming a common standard syntax for describing data on the Internet and generating markup languages. XML originated from SGML (Standard Generalized Markup Language). The XML version 1.0 specification became a W3C (World Wide Web Consortium, the most influential standards body promoting web technologies) Recommendation (W3C's term for standard) in 1998 and was revised (in the second edition) in 2000. The XML version 1.1 specification is currently a candidate recommendation at W3C. SOAP (Simple Object Access Protocol) is currently supported by majority of the computer industry as the standard messaging protocol for web services. SOAP originated from a collaborative development of several companies, including IBM, Lotus, and Microsoft. W3C released SOAP 1.2 as a W3C Recommendation in June 2003. Microsoft and IBM collaborated to develop WSDL (Web Service Description Language) and submitted WSDL1.1, jointly with Ariba, to W3C in 2001. W3C released WSDL 1.2 working drafts in 2003. IBM, Microsoft, and Ariba led the UDDI (Universal Description, Discovery and Integration) project, which released the version 1.0 specification in 2000. OASIS (The Organization of the Advancement of Structured Information Standards), another key standards body promoting web services technologies, has approved UDDI version 2 as an OASIS Open Standard. BEA, IBM, and Microsoft developed BPEL4WS (Business Process Execution Language for Web Services),

which superseded two prior languages for web service composition: XLANG and XSFL. OASIS formed a technical committee in April 2003 to continue work on the process language based on BPEL4WS 1.0 specification.

While the standardization of the common syntax and the common mechanisms for web services can be considered in relatively healthy shape, the standardization of the common semantics is lagging far behind. Semantics alignment is considered a major challenge for application interoperability (Dodd et al., 2003; Hansen et al., 2002; McIlraith and Martin, 2003). The standardization of vertical industry languages has particularly proceeded in ad-hoc and unique ways in different industries. OASIS has formed Focus Areas through xml.org for several industries, including insurance, human resources, and printing & publishing, and is in the process of forming more Focus Areas, to facilitate the standardization of XML and related languages for vertical industries. However, the current extents of standardization vary substantially across industries. The standards being developed at multiple consortia or groups of a single industry sector or in different industries overlap with each other and with horizontal industry standards. Resources are unnecessarily wasted and effort duplicated. Research is needed to identify the critical factors that engender or inhibit successful standardization of vertical industry languages and gain insights in the reasons of the current situation. Unfortunately, our comprehensive literature search shows that there has been virtually no published research in standardization of vertical industry languages in the literature.

A CONCEPTUAL MODEL FOR COMPARATIVE ANALYSIS

We have developed a conceptual model for Comparative Analysis of Standardization of Vertical Industry Languages, based on analysis of information available from the web sites of various relevant standards bodies or organizations and a pilot study in the insurance industry, which we will describe in the next section. The model is outlined in Figure 3.

We have identified the following factors related to the business environment of a vertical industry that may influence the standard development process and the extent of standardization.

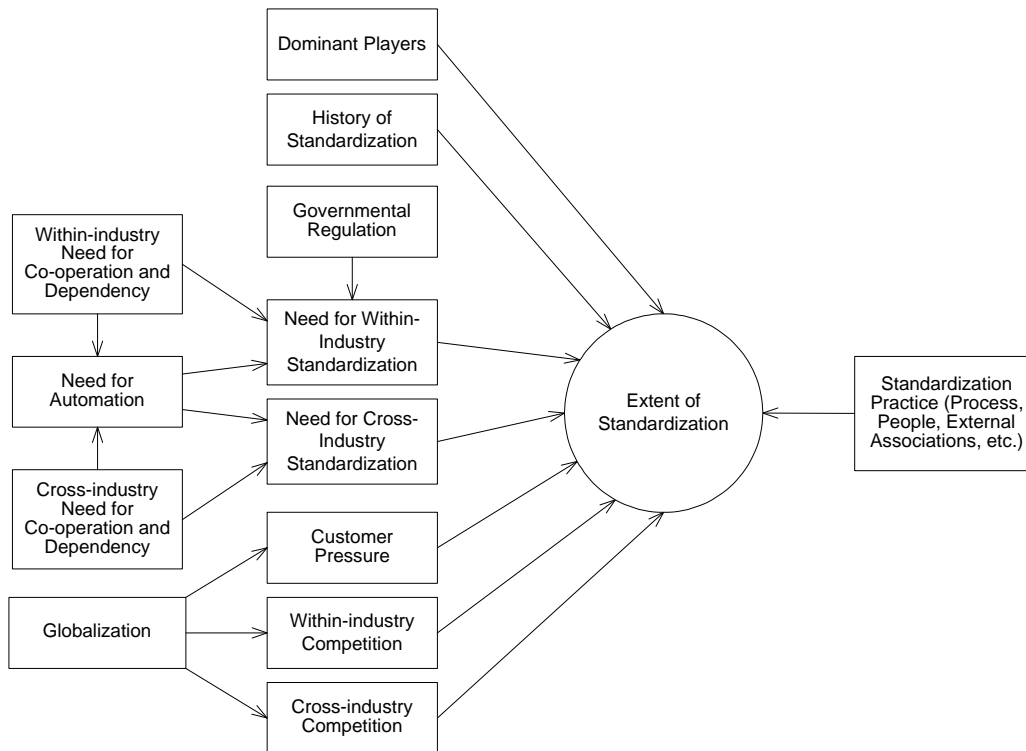


Figure 3. A Conceptual Model for Comparative Analysis of Standardization of Vertical Industry Languages

- *Within-industry competition (price pressures)*: The nature of competition among competitors within the industry can impact the standardization effort. If the competition within the industry is based mainly on price, the standardization may benefit all the companies in reducing the cost and may be easier to achieve. However, if the competition is based on either some proprietary technology or unique way of doing business, which creates customer lock-in and raises entry barriers, standardization may be difficult to achieve (Mata et al., 1995), because in this case companies are less likely to give up their proprietary processes in the fear of losing customers.
- *Cross-industry competition (price pressures)*: The nature of competition among competitors across industries may also impact standardization. The boundaries between some industries are becoming blurred. For example, insurance companies and financial services companies are getting into each other's businesses, similarly banks and financial services industry are getting into each other's spaces. Here again if the competition is based on taking advantage of existing relationships with the customer to offer expanded set of services and to offer one stop service, companies will be less motivated to support standardization in the fear of losing customers. On the other hand, if the competition is based on economies of scale and lower cost of serving the customer, the standardization is more likely to happen.
- *Within-industry need for co-operation and dependency*: The need for co-operation and dependency among partners in a value chain within the industry plays an important role in standardization. For example, insurance companies need to co-operate with agents and re-insurance companies to conduct their business operations. Similarly, manufacturing companies need to co-operate and need co-operation of various layers of suppliers in the

supply chain. In this case, standardization is likely to benefit the company and the business partners by reducing the cost of integration and the cost of doing business. This is especially true if the companies do not have exclusive relationships with business partners, e.g., exclusive supplier of an item to a company or an exclusive agent of an insurance company.

- Cross-industry need for co-operation and dependency: The need for co-operation and dependency among partners in a value chain across industries impacts the standardization. For example, insurance company's need to co-operate with hospitals, auto repairers and financial services companies such as banks increases the motivation for standardization. In this case, standardization can support much higher level of automation at lower cost, flow through processing and significantly reduced delays. The cross industry business partners are more likely to implement automated flow through processing, e.g., electronic receipt of invoices and payment, if same systems can be used with multiple business partners.
- Need for automation: The need for automation of workflow with business partners within and across the industry to improve efficiency and reduce cost is a powerful motivation for standardization. This need tends to be correlated with both the need for within-industry co-operation and dependency and cross-industry co-operation and dependency.
- Dominant players: The existence of a dominant player in the industry may impact standardization efforts. The dominant payer may attempt to establish de-facto standards of its choice and may seek to strengthen its position. In such a case if other companies decide to go along with the de-facto standards, then the standardization can happen easily. On the other hand dominant player may frustrate the standardization effort by not supporting the proposals of standardization body, e.g., in 1970's and early eighties the efforts of CODASYL in standardizing database languages were opposed by IBM (a dominant player at that time). This ultimately resulted in failure of CODASYL database standards.
- History of standardization: The history of standardization in the vertical industry and the existence of an established standardization body play a very important role in determining the level of standardization. A well-established and respected standardization body provides an easy forum for discussion on the increased level of standardization within the industry. It also facilitates communication between major players, as there exists an established history of companies working together.
- Globalization: The trend of globalization of the industry may also impact standardization effort. Globalization and global competition can add another dimension to the standardization. The international trade relationships and national pride and interests can further complicate the establishment of global standards. For example, the establishment of global cellular standards has been complicated by global competition and national interest. On the other hand multinational corporations doing business in many countries like to see global standards to simplify and ease the management of their operations.
- Governmental regulation: The extent of governmental regulation of the industry has significant impact on standardization. Highly regulated industry has extensive and expensive government reporting requirements. In this case the government agencies and companies alike have interest in standardizing the reporting formats to significantly reduce the cost of reporting by using off-the-shelf products or services.

- Customer pressure: Customer pressure for standardization can play a significant role in standardization. This is especially true in an industry where you have one or more customers that are dominant like government in the case of defense industry or big three in the case of auto industry. In this case, the dominant customers can force all their business partners to follow certain standards. For example, big three auto companies asked all the suppliers to follow EDI standards or follow ISO quality standards. Even in the industry with no dominant customers, if significant cost reduction or simplification of operation can be achieved customers can collectively push for standardization e.g. the open system movement within the computer industry.

The trend of globalization of economy influences a number of factors, including (within-industry and cross-industry) competition and customer pressure which in turn influences the extent of standardization. In addition, the history of standardization and dominant players also influences extent of standardization in a vertical industry. Within industry and cross industry dependency and need for co-operation can influence the need for automation and need for within and across industry standardization respectively. The need for automation can be a major driving force in determining the need for across and within industry standardization, which in turn can influence the extent of standardization of a vertical industry domain. Government regulation can also influence the need for within-industry standardization.

Besides the above factors related to the business environment of the industry, the standardization practice per se, including the adopted process, the people sitting in the committees, and associations with other SDOs (standards developing organizations), also influence the extent of the output. While these factors are more likely common in any standardization effort and have been studied in the literature (e.g., Jakobs et al., 1999; Jakobs et al., 2001; Jakobs, 2003; Bach, 1995; Oksala et al. 1996; Rada, 1998; Updegrave, 1995), it is interesting to see whether the findings of previous research in other domains hold in standardization of vertical industry languages.

A PILOT STUDY

Based on the above conceptual model we have performed a pilot study to analyze the state of standardization in the insurance industry. Established in early 1970, ACORD has become the dominating global XML standards developer of the insurance industry. ACORD has a large body of members, including over 70% of the top 10 and 60% of the top 25 life and annuity carriers, over 75% of the top 50 property and casualty carriers, and 70% of the top 10 reinsurers, as well as the Top 5 reinsurance brokers representing 80% of the top 20's gross revenue (<http://www.acord.org/about/ourmembers.aspx>). These members are categorized into Insurance Carriers, Reinsurers, Distributors, Solution Providers, Associations, and User Groups.

In order to get inside into the state of standardization efforts within insurance industry, we interviewed representatives of two member companies of ACORD. Both interviewees joined ACORD in recent years and are currently serving in an observer role. They plan to participate in some of the sub-committees and working groups in near future. Since these interviewees joined ACORD relatively recently (less than two years), they provided good insight into the motivation for their companies to join ACORD. One of the member company interviewed is a service-oriented solution provider for the insurance industry. It participates in ACORD to enable the company to provide products and services that are certified by ACORD as ACORD-compliant and to reach a larger client base. The other company interviewed is a large insurance carrier. Its motivation to join ACORD is described as to increase flexibility, reduce cost, and save time in internal project development by using the standard as a starting point. It may consider adopting

off-the-shelf ACORD-compliant software in the future. Based on the above interviews, analysis of business environment (one of the author has experience in insurance industry) and extensive study of the history and current status of ACORD and standardization within insurance industry, we have analyzed the state of standardization in this vertical industry using the conceptual model described in previous section.

Evaluation of factors related to the business environment:

- Within-industry competition (price pressures): The competition is increasing within the insurance industry.
- Cross-industry competition (price pressures): The competition across industries is also increasing. For example, insurance companies and financial services companies are getting into each other's businesses.
- Within-industry need for co-operation and dependency: The need for co-operation and dependency among partners is increasing. For example, insurance companies need to co-operate with agents and re-insurance companies to efficiently conduct their business operations.
- Cross-industry need for co-operation and dependency: The need for co-operation and dependency among partners in a value chain across industries is increasing. For example, insurance companies need to co-operate with financial services companies such as banks, hospitals, and auto repairers to reduce their operation cost and compensate for increasing cost of health care and auto repair.
- Need for automation: The need for automation of business workflow with business partners within and across the industry is increasing. Information increasingly needs to be electronically communicated among insurance companies, agents, reinsurance companies, financial services companies, and customers. This has become important as there is increasing price pressures and increased expectation of service by the customers.
- Dominant players: The existence of a dominant player in this industry is diminishing.
- History of standardization: ACORD has a long history of serving the insurance industry. ACORD started with developing forms in the 70s, moved into EDI technology in the 80s, communication standards in the 90s, and XML in the late 90s.
- Globalization: There is increasing trend of globalization in this industry, which had relatively low level of globalization.
- Governmental regulation: The industry has significant regulations and reporting requirements. Many regulations vary from state to state in USA and by country globally.
- Customer pressure: There is no significant customer pressure for standardization. However, there is increasing expectation of fast and 24X7 service by customers.

Factors related to the standardization practice:

- Process: ACORD operates an open process, in which any interested party can initiate a maintenance request or new standard proposal, participate in the working groups of their interest, and contribute to the development of the standard. High-level Steering Committees of ACORD is composed of senior persons from member companies. Subcommittees are formed to focus on different areas of insurance industry, such as Life & Annuity, Reinsurance, and Property & Casualty. Subcommittees can in turn form working groups for

detail work and resolution of technical issues. The average size of sub-committees is about 20-25. Subcommittees meet about once a month via teleconferencing and semi-annually face-to-face. The work of all the working groups under a Subcommittee are discussed, further developed, and voted for approval at the semi-annual Subcommittee meetings. The Steering Committee has the authority for final approval of all standards. While the standards development process is open, only ACORD Members and Associate Members have the voting rights (<http://www.acord.org/Standards/Process.aspx>).

The standardization process has been more cooperative than competitive (or political) and more open-minded than conflicting. Many requests for new proposals have been due to lack of understanding of the existing mechanisms in the current standard and can be resolved via education. There is no dominating party, but certain dominating people, who are experienced experts in the field and sometimes represent multiple organizations, in the process. Insurance companies do not have concern about losing their competitive edge due to standardization, but see standardization as an opportunity to reduce cost and improve service. Insurance companies strive for uniqueness in their interfaces to customers, while the internal raw data are mandated by the standard.

- **People:** Unlike in the standardization processes of other technologies, where users are extremely underrepresented, as reported in the literature (e.g., Jakobs et al. 2003), user participation in the ACORD standards development process has been reasonably high. Although ACORD works closely with W3C in developing XML specifications, requirements have largely come from users. Insurance companies and agencies guide the standardization process and are the driving forces. The trend of the insurance industry is that there will be more independent agents, who work with multiple insurance companies and appreciate a uniform, standardized interface to communicate with different insurance companies, although the particular insurance company we interviewed is maintaining contracted agents who exclusively work for it.
- **External associations:** Around 2000 to 2001, ACORD carried out a major change in its scope. Its coverage was extended via integration with other business areas, such as financial services and human resource, and alliances with other standards bodies, such as IFX (Interactive Financial eXchange Forum) and HR-XML. It also built relationships with WISE, a European standards body involved in reinsurance, and other international standards bodies, to move towards global reach. ACORD was used for external information exchange between insurance companies and agents before. Now it has a broader scope, and is used for external communication between insurance companies, reinsurance companies, agencies, and other financial services companies such as banks, as well as internal communications across departments within insurance companies.

Overall, ACORD is considered successful and is indeed in a much more advanced state than many other industries, such as healthcare, retail/wholesale, and government. The process has been a little bit slower than the members wished it to be, because of the large group of members and wide scope. It is expected to become faster in the future. The standards development process is ongoing, without an end in the near future.

CONCLUSIONS AND FUTURE RESEARCH PLAN

While standardization of vertical industry languages has not been adequately investigated in the literature, this research aims at developing a conceptual model for comparative analysis of standardization of vertical industry languages. Such a model is potentially useful in evaluating

the state of standardization in vertical industries and in suggesting ways to improve the current practice.

This research is still at an early stage. We are planning to further proceed in several directions. While a pilot study in the insurance industry has been performed this analysis is based on only two interviews. Based on the above pilot study we are revisiting the conceptual model and trying to find additional theoretical support for the model from the organization and strategy literature. We are planning to conduct more interviews and collect additional data through other means. Similarly, we plan to analyze other major vertical industries, interview and survey some key players in each of these industries. We plan to specifically focus on the semantics and XML standards for vertical industries. This study will allow us to get a feel of state of standardization in major vertical industries and help identify the critical factors that engender or inhibit successful standardization of vertical industry languages and gain more insights into the reasons for the current state.

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