

Vertical Industry Information Technology Standards and Standardization¹

Overview and Introduction

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Standardized business documents, data definitions, item description and identification, and business processes have been seen as key to effective interorganizational commerce since the 1980s, when electronic data interchange (EDI) became the technology of choice for business-to-business coordination. *Vertical* information systems (VIS) standards are designed to promote communication and coordination among the organizations comprising a particular industry sector. Unfortunately, despite much promotion, EDI standards achieved only limited adoption; an estimated 2% of the world's businesses, including just 300,000 US companies have adopted EDI. Low penetration of electronic interconnection standards, particularly around business semantics, is believed to hinder electronic business and supply-chain integration.

Recently, the availability of open Internet protocols and technologies, particularly eXtensible Markup Language (XML), has given a boost to both the adoption of EDI and the development of vertical (that is, industry-specific) XML-based data and process standards. Vertical efforts to develop such standards have emerged in electronics (RosettaNet), mortgage (MISMO), chemicals (CIDX), insurance (ACORD), petroleum (PIDX), and several other industries. Many observers expect these developments to lower the cost of electronic connection and spur adoption, particularly among smaller firms. However, some analysts believe that there may be public goods problems associated with the development of industry wide standards. Larger companies with larger capital bases invest in the creation and maintenance of the standards, while smaller companies benefit from their adoption.

This special issue is predicated on the idea that VIS standards have important differences from IT products and services standards and therefore require their own theory and empirical research². As several authors note, for example, VIS standards development are more likely to involve users participating in voluntary consortia than generic standards. How such user participation influences the collective action dynamics within standards

¹ This is a pre-publication version. The published paper can be found in *Electronic Markets*, 15 (4) 285-288, and is available from the publisher at <http://journalsonline.tandf.co.uk/openurl.asp?genre=article&issn=1019-6781&volume=15&issue=4&spage=285>

² Some VIS standards research by the guest editors can be found at the website: Networks of Industry: Standards and Information Technology for Interorganizational Coordination (<http://ebusiness.tc.msu.edu/netindustry/index.html>).

consortia, as well as the technical choices that such consortia make, represents an area for new research.

The assumption that VIS standardization is different may not be correct, but the only way to test it is to undertake systematic investigations of VIS standards and compare findings to those for IT products and services standards. That said, it is challenging to draw clear boundaries between IS standards that pertain to particular vertical industries and those that apply more broadly. Difficulties may arise, for example, when considering functional areas that are found across industries, but also involve specialized companies, such as business financial reporting (see the paper by Cherry Chang and Sirkka Jarvenpaa, "Pace of Information Systems Standards Development and Implementation: The Case of XBRL" in this issue), human relations (e.g., HR-XML as referenced in the paper by Nelson, "Interorganizational System Standards Development in Vertical Industries"), and others.

As an example, financial services reporting is an industry in its own right, containing accounting and auditing companies, financial software vendors, and regulators as stakeholders. However, in addition, this industry provides the "infrastructure" for all other industries to work. This situation illustrates the challenge of determining the relevant "user" community for a VIS standard. All publicly held organizations are affected by the standards developed to support this area, even if we do necessarily expect them all to contribute to standards development. We could say that in this case these various financial reporting industry stakeholders (except for the software vendors) are the "users", working on a standard that will allow them to sell their accounting services to other firms. The distinction is somewhat analogous to differentiating mortgage originators from home buyers as standards users in the mortgage industry. We do not consider the home buyer as a "user" of the standard, nor would we expect any home buyer to be active in standards development. These distinctions are relevant when considering such factors that may influence strategic and cooperative behavior in standards development as the degree to which standards developers are users vs. vendors, as well as the extent to which they are direct competitors within the same stage in an industry, cooperating trading partners at adjacent stages in an industry, or relatively independent of each other.

The nine articles comprising this special issue address various issues and questions related to VIS standards. These contributions can be sorted into three groupings:

(1) Conceptual analyses emphasizing theoretical development for all VIS efforts:

- Kevin Zhao, Mu Xia, and Michael Shaw, "Vertical E-Business Standards and Standards Developing Organizations: A Conceptual Framework"
- Kai Reimers and Mingzhi Li, "Antecedents of a Transaction Cost Theory of Vertical IS Standards Processes."

2. Case studies of specific VIS standardization efforts:

- Roman Beck and Tim Weitzel, “Some Economics of Vertical Standards: Integrating SMEs in EDI Supply Chains”
 - Jonathan Wareham and Arun Rai, “Standards Fragmentation in Electronic Markets: An Institutional Analysis of XML Infusion”
 - Martina Gerst and Raluca Bunduchi, “Shaping IT Standardization in the Automotive Industry – the Role of Power in Driving Portal Standardization”
 - Janis Gogan, "Punctuation and Path Dependency: Examining a Vertical IT Standard Setting Process"
 - Ellen Christiaanse and Juan Rodon, “A Multilevel Analysis of eHub Adoption and Consequences”
 - Cherry Chang and Sirkka Jarvenpaa, “Pace of Information Systems Standards Development and Implementation: The Case of XBRL”
3. Cross cutting comparative analysis, yielding a generalized description of the stages of VIS standards setting consortia and processes:
- Matthew Nelson, "Interorganizational System Standards Development in Vertical Industries"

Kevin Zhao, Mu Xia, and Michael Shaw, in "Vertical E-Business Standards and Standards Developing Organizations: A Conceptual Framework," review prior work on standards development organizations in order to build a conceptual framework to aid in the analysis of e-Business standards development. Their framework illustrates how the nature of the participants in the standards-making process (how many, from what sector in the industry, and with what bargaining power), the technical content of the standards being developed (mature technology vs. new innovation), and the institutional structure of the organization (what organizational structure, procedures, and openness) interact to influence the relative performance of the standards development organization. Performance is conceptualized in terms of speed, penetration rate and member satisfaction. Each of these factors in turn is shaped by the industry environment, including such factors as the IT intensity in the industry and the degree to which there are competitive standards development initiatives underway.

In "Antecedents of a Transaction Cost Theory of Vertical IS Standardisation Processes," Kai Reimers and Mingzhi Li provide the foundations for a transaction cost theory of information systems standards development, focusing on the development of interface standards in the context of a group of competing firms with common trading partners in a specific industry. They conceptualize the costs that organizations face in negotiating interorganizational electronic connections (either bilaterally, or through a generalized arrangement via an interface standards), and the benefits they accrue from the use of the interfaces. Their institutional view explicitly considers situations where there are multiple standards initiatives – which they call colliding standards efforts, which increase the costs of evaluating alternative arrangements for interorganizational connections. They further contrast their institutional view with what they call the physical view that has dominated standards research, whereby the positive externalities afforded organizations when a new organization adopts the standard (the new organization bears

the cost of connection, but existing adopters also benefit). Their contrast reveals that the costs of negotiating a generalized interface standard may lead to lower value than simple bilateral arrangements, resulting in the failure of standards efforts.

Roman Beck and Tim Weitzel, "Some Economics of Vertical Standards: Integrating SMEs in EDI Supply Chains," conducted an economic analysis of various approaches for electronic data interchange (EDI) by small and medium sized enterprises (SMEs) that retail office supplies in Germany. Internet standards are frequently claimed to reduce the costs of EDI, thus enabling more SMEs to adopt electronic ordering. Contrary to popular belief, Beck and Weitzel found that WebEDI was more costly than fax for SMEs, because WebEDI involved extra manual processing. They described how an ASP-hosted (Application Service Provider) solution involving emailed files extracted from an enterprise system helped promote widespread use of electronic ordering by SME office supplies retailers in three countries. Although technology developments may reduce such barriers to electronic interconnection in the future, Beck and Weitzel's analysis reminds us not to confuse claimed technology benefits with demonstrated economic value. It also demonstrates the importance of VIS standards for enabling widespread EDI use by SMEs, thereby helping to realize the full potential of electronic business.

In "Standardization in Vertical Industries: An Institutional Analysis of XML-Based Standards Infusion in Electricity Markets," Jonathan Wareham, Arun Rai, and Greg Pickering explained the barriers to effective use of XML-based standards by organizations involved in buying and selling electricity in Texas. Through the use of institutional theory, they traced the difficulties to factors such as principle-agent conflicts (e.g., conflict between developers of standards-compliant software and their clients), incentive misalignments (e.g., deregulation-generated competition among market regions extending into the standards domain), and path dependencies and technological legacies (e.g., the carryover of ambiguous EDI message formats from earlier software versions). This article reveals the strength of institutional analysis for explaining the evolution of the technical content of VIS standards.

In "Shaping IT Standardization in The Automotive Industry – The Role of Power in Driving Portal Standardization," Martina Gerst and Raluca Bunduchi employ a social shaping perspective to analyze the role of organizational power in the failure of Covisint, the well-known electronic marketplace. Founded by major automobile assemblers, Covisint was originally intended to standardize IT-enabled "best practice" business processes involving the assemblers and their suppliers, benefiting both. But few suppliers were given the opportunity to participate in Covisint's development, and the assemblers found it too difficult technically and organizationally to adopt the process standards they developed. In reaction to perceptions that Covisint would not benefit them and might even harm them, suppliers created Supply-On, their own, and ultimately successful, electronic marketplace. This study highlights the importance of supply chain structure and relationship quality in the development and diffusion of VIS standards.

Janis Gogan, in "Punctuation and Path Dependency: Examining a Vertical IT Standard Setting Process," provides a longitudinal case study of the efforts to develop the eCheck

standard along with the Financial Services Markup Language (FSML). She illustrates how four key decisions early in the project - conceptualizing an eCheck as a digitally signed "writing," using a public-key infrastructure approach, employing two-factor token-based authentication, and developing a markup language to code the eCheckbook – placed the project on a trajectory that the team was unable to change, despite considerable shifts in the electronic payments landscape. Her case provides useful insights into the ways that standards development efforts can become path dependent and includes suggestions for avoiding this problem by incorporating boundary spanning roles and other flexibility measures into the process.

Ellen Christiaanse and Juan Rodon's paper, "A Multilevel Analysis of eHub Adoption and Consequences," emphasizes that the current proliferation of new IS standards based on open technologies is increasing the potential for interorganizational collaboration. Accordingly, they advocate research that raises the level of analysis to the constellations of organizations that are part of the industry network. The authors examine how the structural properties of the network affect the adoption decision and how the adoption in turn produces changes in the structure of the network. Then they argue for a multi-level analysis of the consequences of using IS standards and eHubs. Theoretical arguments are illustrated via a case study of the adoption and use of an IS standard and eHub in the chemical industry (Elemica). The authors address: (1) The structure of an industry network – centrality, structural equivalence and density -- as affecting the adoption decision. (2) The adoption of an eHub within an industry network may have a direct effect on the flow of network resources – information, assets and status-, and these effects, in turn, will produce changes in the structural properties of the network. (3) Their final argument is that the adoption and subsequent use of eHubs may create collective benefits for the industry that go beyond the organizational and dyadic levels. The authors contribute to the literature on interorganizational systems adoption by raising the level of analysis to that of the network level while exploring the embeddedness perspective in the research of eHub adoption and its consequences.

Cherry Chang and Sirkka Jarvenpaa, "Pace of Information Systems Standards Development and Implementation: The Case of XBRL," examine the development and implementation of eXtensible Business Reporting Language (XBRL) standards. XBRL is expected to evolve into the global data standard for financial reporting. The authors report on the early phases of XBRL implementation for external financial reporting in the US. They describe the issues around developing and gaining acceptance of this standard, and they contribute to the standardization literature by examining change dynamics. The authors note the possibility of using other alternative theoretical frameworks. Many architectural and process standards require consensus or agreement on issues that come with built-in tensions and collaborations among competitors in institutional fields characterized by their political and social fragmentation. The Greenwood and Hinings model is a robust starting point for examining change in an institutional field. It can be extended, for example, by examining the recursive nature of the effects over time. The authors report that while XBRL implementation has achieved major milestones, the progress has been at times pain-staking.

Matthew Nelson, in "Interorganizational System Standards Development in Vertical Industries," analyzed nine vertical standards consortia sampled from standards submitted to the XML.org registry. Based on formal questionnaires, interviews, analysis of web site, observation of meetings and other sources, Nelson compares the nine different consortia to extract a common set of elements that characterize such standards making groups. The result is a model of the standards development cycle that describes six common steps found across the nine consortia: 1) choreography and modularity where key cross-company processes are broken into manageable units for standardization efforts, 2) prioritization and scheduling of the standards-making efforts, 3) documentation and standardization – the core development work, 4) review and testing, 5) implementation and deployment of the standard, and finally, 6) compliance testing and certification.

The VIS settings and issues addressed here are quite diverse. We hope that this special issue provides a basis for systematic knowledge development about VIS standards and their differences (if any) from other types of standards. Lastly, we like to thank the many anonymous reviewers who provided excellent feedback over two rounds of review under considerable time pressure.