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Déploiement et intégration des standards de Systèmes d'Information Verticaux : une étude des antécédents et des bénéfices

Completed Research Paper

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Abstract

Drawing on institutional theory and the literature on inter-organizational systems (IOS), this paper develops a research model for assessing the use of vertical information systems (VIS) standards. Extending prior research on IOS use, we differentiated between two distinct dimensions characterizing organizations' use of VIS standards: the extent to which organizations adopt VIS standards across a wide range of business processes, and the extent of systems and business process integration. We examine how VIS standards deployment and integration differentially influence operational and strategic benefits that standards users obtain. We also examine how various institutional pressures (coercive, mimetic, and normative) influence the extent of deployment and integration of the VIS standards in different ways. The hypotheses are tested using survey data collected from organizations in Asia who have implemented RosettaNet standards.

Keywords: Technology Adoption; Standards; Inter-Organizational Systems; Institutional Theory.

Résumé

Complétant les recherches antérieures sur l'usage des systèmes d'information inter-organisationnels, nous examinons comment le déploiement et l'intégration des standards de Systèmes d'Information Verticaux (VIS) influence de manière différenciée les bénéfices opérationnels et stratégiques que les utilisateurs peuvent obtenir, et comment - en retour - différents types de pression institutionnelles influencent le degré de déploiement et d'intégration des standards de VIS. Les hypothèses sont testées en utilisant des donnes d'enquête collectées auprès d'organisations en Asie qui ont implanté les standards RosettaNet.

Introduction

Research has shown that the use of inter-organizational systems (IOS) can provide significant operational and strategic benefits to organizations (e.g. Chatfield and Bjorn-Andersen. 1997; Clark and Stoddard 1996). In an increasingly global economy, IOS are more important than ever as organizations strive to improve the effectiveness of their entire value chain with business partners in different countries. However, effective deployment of IOS across a global value chain requires a set of standards that ensures the interoperability and integration of both the hardware infrastructure and the software applications of partner organizations. Years of standardization efforts in information and communication technology (ICT) have achieved success in realizing interoperability at hardware, operating system, data communication, messaging and common syntax levels (Jain and Zhao 2003). However, inter-organizational interoperability and application integration also requires trading partners to agree on the types of data to be exchanged, the semantics of the data fields, and the business processes to be adopted. The industry-specific nature of such data and processes has meant that the development of these standards has largely been within industry verticals.

Such industry-specific open standards for inter-organizational communication and coordination developed by user-led consortia are termed vertical information systems (VIS) standards (Markus et al. 2006; Wigand et al. 2005). These standards address aspects of Business-to-Business (B2B) E-business such as product identification, data definition, business document layout, and business process activities. VIS standards are typically implemented in IOS, which facilitate inter-organizational business activities such as order and payment management, logistics, collaborative forecasting, new product development, and inventory management. Examples of such standards include RosettaNet for the IT industry, CIDX for the chemicals industry and MISMO for the mortgage industry.

There has been a recent surge in interest in studying VIS standards development and diffusion (e.g., Boh et al. 2007; Markus et al. 2006; Nelson et al. 2005; Zhao et al. 2007), but only a few studies have examined issues relating to adoption and use of VIS standards (Bala and Venkatesh 2007; Malhotra et al. 2007). In this paper, we draw on institutional theory and the extensive literature on the adoption of IOS (e.g., Subramani 2004) and electronic data interchange (EDI) (e.g., Chwelos et al. 2001) to investigate the antecedents and benefits relating to the use of VIS standards. We believe that this research contributes to the literature in the following ways.

First, while prior research has extensively studied organizations' decisions to adopt IOS, there has been less attention on the different ways that organizations are using IOS. Hence, in this study, we distinguish between the extent of deployment and the extent of integration as two distinct ways related to VIS standards implementation and use. In implementing an IOS, organizations have to decide the extent to which they wish to deploy the IOS for different business processes (Bala and Venkatesh 2007). The extent of VIS standards use thus refers to the range of business processes that the VIS standards enable. Organizations also have to decide on the extent to which they wish to invest resources in integrating the IOS with their existing legacy systems (Mukhopadhyay and Kekre 2002; Zhu and Kraemer 2005). We examine whether the extent of deployment and integration of VIS standards have differential effects in terms of operational benefits and strategic benefits. We also examine whether the interaction of the VIS deployment and integration generates strategic benefits for the organization.

Second, prior literature has established the important role that institutional pressures (coercive, mimetic and normative pressures) play in influencing the adoption of IOS (Teo et al. 2003). In a recent study, Liang et al. (2007) found that coercive, mimetic and normative pressures influence ERP systems assimilation through different mechanisms. This shows that while institutional theory predicts that institutional pressures influence IT adoption because it focuses organizations' attention on the creation of legitimacy, the three types of institutional pressures do not influence IT adoption in the same manner. We extend prior literature by further showing that coercive, mimetic and normative pressures have differential effects on the deployment and integration of VIS standards

The rest of the paper is organized as follows. We first develop our theoretical framework, which integrates institutional theory and the prior literature on IOS adoption. Next, we describe the construct operationalization and

data collection process. Further, we present the data analysis procedure and the results of the model testing. The paper finally concludes with a discussion of the findings and their theoretical and managerial implications.

Theoretical Framework

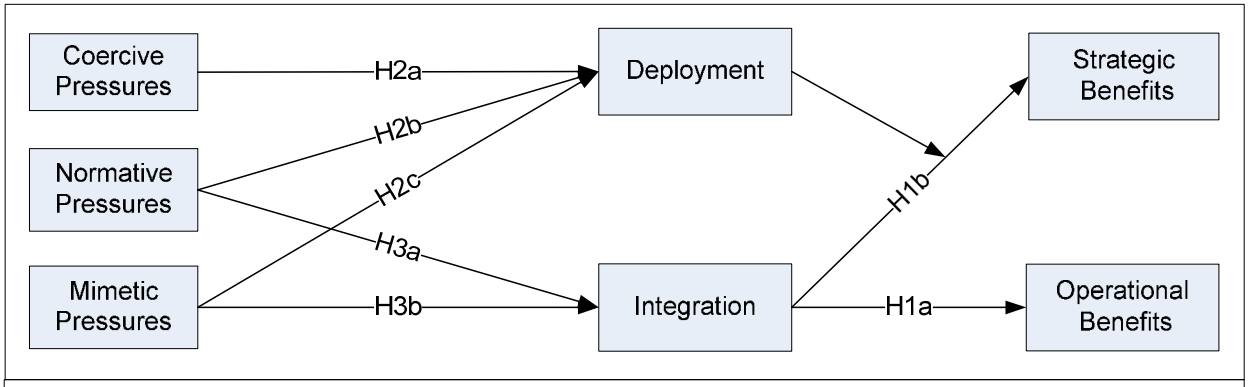

Figure 1. Research Model

Deployment and Integration of VIS Standards

Prior literature has pointed out the need to move beyond dichotomous "adoption versus nonadoption" (Zhu and Kraemer 2005, p. 61) conceptualization of IT innovation. Based on some exploratory case studies, Massetti and Zmud (1996) identified several dimensions of IOS usage, and two key dimensions are the breadth and depth of usage. Breadth of IOS usage refers to the extent to which the IOS has been used to exchange data with the trading partner for many different functions (Deployment). Bala and Venkatesh (2007), in a recent study, also identified the extent of deployment of VIS standards as a more nuanced way of defining the extent of IT assimilation. Depth of IOS usage refers to the "degree of technological sophistication of the connections between trading partners" (Massetti and Zmud 1996, page 340) (Integration). Prior research has also identified the extent of systems and business integration as a key factor influencing the value of IT use (Mukhopadhyay and Kekre 2002). While Massetti and Zmud (1996)'s work has provided insights into the different ways that IT used can be characterized, there has been limited research examining how these different types of use interact, and how they affect benefits from using IOS. Hence, in this study, we identify deployment and integration as two different dimensions that can be used to characterize different types of VIS standards users.

Extent of VIS Standards Deployment. VIS standards are defined for a broad range of business processes, covering a spectrum of activities and business exchanges between business partners. RosettaNet standards, for example, can be classified into seven major clusters: order, payment, manufacturing, logistics, design, forecast, and demand creation. CIDX standards can also be classified into clusters such as purchase, orders logistics, financials, and forecasting. Standards in each cluster support transactions for a particular class of business process. For example, VIS standards for order management support business processes such as quotation requests, quotation receipt acknowledgments, stock availability inquiries, order status inquiries, and purchase order update/change/cancellation notifications. Researchers have pointed out that organizations tend to start their IOS adoption process by automating a limited number of business processes (Swatman et al. 1994), typically for transactions that are used most frequently and least complex (e.g. order and payments management). The major goal of such narrow VIS standards deployment is typically to automate existing methods of doing business (Swatman et al. 1994) and to change the human mode to a programmed mechanical mode of coordination (Truman 2000). As organizations become more familiar with the VIS standards, organizations may then decide to expand the deployment of VIS standards. At this later stage, organizations typically deploy VIS standards related to more complex and collaborative business processes, such as exchange of sales forecast data or design specifications with trading partners. Hence, VIS standards deployment is defined as the number of standards sets, which support and enable relevant business processes in the value chain, deployed in organizations

Extent of Systems and Business Integration. VIS standards specify the business processes and data fields to be exchanged between trading partners. The standards are typically implemented in an IOS, which may or may not be integrated to the back-end system and internal business processes of an organization. Hence, although VIS standards have the potential to enable seamless interconnection among business partners, individual organizations make their

own choices about the extent of back-end systems integration they wish to invest in. Such back-end systems integration decisions can result in different levels of integration, ranging from one-sided automation, to manually assisted interchange, or even straight-through processing (Wigand et al. 2005). For example, in an un-integrated system, even when invoices and orders are exchanged electronically, users may still print out computer-generated orders or invoices and then enter the information manually into their back-end systems (Markus 2000). Thus, systems integration is defined as the extent to which the IOS has been integrated with the organization's internal application systems by implementing the VIS standards.

In addition to ensuring systems integration, organizations also need to change their work flow and business processes to ensure business integration (Markus 2000). Business integration is defined as the extent to which business processes have been re-engineered to enable the seamless flow of information and events between trading partners, which includes the removal of redundancy and inconsistency from the inter-organizational business processes, agreeing on which formats and protocols to use during the interaction, providing feedback about performance and quality, and coordinating teams.

Benefits of VIS Standards Deployment and Integration

Prior research has identified two types of benefits from IOS use: operational benefits and strategic benefits (Mukhopadhyay and Kekre 2002; Subramani 2004; Wigand et al. 2005). Operational benefits arise from lowered transaction and production costs through IOS use, e.g. quick response time, inventory cost saving, greater data accuracy, and reduced clerical work. In contrast, strategic benefits arise from opportunities for closer collaboration and cooperation with trading partners due to tighter linkages arising from IOS implementation. These opportunities include the development of new products and services, better relationship management through increased understanding of the trading partner, and new forms of inter-organizational collaboration (Subramani 2004; Wigand et al. 2005).

We argue that the deployment of VIS standards alone cannot lead to positive operational benefits for VIS standards adopters. Simply increasing VIS standards deployment without integration may fulfill only symbolic functions such as signaling commitment to a trading relationship, but do little to boost an organization's economic performance (Abrahamson 1991). Sometimes it can even lead to decreased efficiency, because of the additional manual work entailed in transferring and re-entering data from the IOS into back-end systems of an organization, and vice versa (Tuunainen 1998). Instead, operational benefits from VIS standards use can only be realized by companies that modify their internal business processes and integrate the IOS with internal systems using the VIS standards. Integration enables organizations to make effective use of the information provided by the IOS, thus enabling seamless flow of information along the entire value chain (Zhu and Kraemer 2005). These result in operational benefits. Hence:

> ***H1a:*** A higher extent of VIS standards integration is associated with greater operational benefits from implementing VIS standards.

In addition to operational benefits, organizations can also gain strategic benefits from using VIS standards. Strategic benefits refer to increased business opportunities arising from better relationship management with trading partners. We propose that in order to gain strategic benefits, organizations would not only need their IOS to be integrated with back-end systems and a smooth workflow process with business partners, but organizations would also require VIS standards deployment and integration across a wide range of business processes (Massetti and Zmud 1996). Using a wide range of VIS standards to automate inter-organizational transactions across many business processes provides organizations with cross-functional and broad transaction-based communication capabilities. The use of a narrow set of VIS standards covering the basic business processes such as ordering and payment may increase the efficiency of dealing with trading partners, especially for the most frequently used transactions. However, the extension of using VIS standards to automate a wider range of business processes, especially the business processes that are less transactional and more collaborative in nature, will enable organizations to create a more all-encompassing partnership with their trading partners. This provides organizations with a greater understanding of their trading partners and cements a closer relationship between the two parties. Hence, narrow deployment of VIS standards does not account for the complexities of inter-organizational relationship and the potential for competitive advantage, and represents IOS use for exploitation rather than exploration (Subramani 2004).

The deployment of VIS standards for a wide range of business processes, alone, however, will not allow organizations to reap the strategic benefits. We argue that systems and business integration across a wide range of

VIS business processes is critical, as it is through developing systems and business integration that ongoing, relationship-specific investments are made. The combination of wide deployment and integration builds long-term and close collaborations that enable organizations to understand their trading partners' internal processes and preferences, and develop insights and relationship-specific knowledge through cooperation with trading partners (Dyer and Singh 1998). Such knowledge and insights will enable organizations to solve unstructured and difficult problems that may arise from the cooperation, and finally create strategic benefits. The firm's competitors may face an unbridgeable barrier to achieve similar strategic position with the same trading partner. Hence, it is only when organizations deploy a wide array of VIS standards, and are able to successfully integrate the work flow and IOS with their back-end systems and business processes that they can reap the maximum strategic benefits to using VIS standards. We therefore hypothesize:

> ***H1b:*** A higher extent of VIS standards integration, coupled with the use of VIS standards for a wide range of business processes, is associated with greater strategic benefits from implementing VIS standards.

The Institutional Influences on VIS Standards Deployment and Integration

Types of Institutional Pressures. The external pressures faced by organizations have been found to be a key characteristic of the environmental context influencing IOS adoption. Institutional theory explains the influence of external pressures, and has been widely used in the study of the adoption and diffusion of organizational practices and technologies among organizations (e.g., DiMaggio and Powell 1983; Teo et al. 2003). Institutional theory takes the perspective that organizations sharing the same environment will employ similar practices (Kostova and Roth 2002), regardless of the technical value of the practice or innovation (Teo et al. 2003), so as to achieve greater legitimacy and status (DiMaggio and Powell 1983; Meyer and Rowan 1977). DiMaggio & Powell (1983) proposed three mechanisms through which such institutional isomorphism occurs: coercive, mimetic, and normative pressures. Coercive pressures are defined as formal and/or informal pressures exerted on organizations by other organizations upon which they are dependent. An example is the pressures from a key customer who provide for a dominant share of a suppliers' sales revenue. Normative pressures refer to pressures that stems from shared norms and values among members of a relational network. Mimetic pressures refer to pressures to imitate a peer that an organization perceives to be successful. When clear action is unavailable, and organizations are unsure as to how they should respond to uncertainty, organizations tend to face significant mimetic pressures to imitate a successful competitor.

The Institutional Influences on VIS Standards Deployment

Coercive Pressures. We expect coercive pressures to play a key role in affecting organizations' decision to deploy VIS standards. VIS standards are often sponsored by major agents in the industry (e.g. major buyers in the IT industry for RosettaNet such as Intel and Sony, major lenders in Mortgage industry for MISMO such as Countrywide Home Loans and Wells Fargo). These powerful agents have the resources and hence the power to shape the character of the standards consortium and align the objectives of the consortium with their interests (DiMaggio 1988; Townley 2002). These major agents are often the main advocates of the VIS standards, and play a key role in exerting coercive pressures on their trading partners to adopt the technology. Such coercive pressures enables VIS standards to achieve a critical mass of adopters (Boh et al. 2007). Often times, supplier firms are not even in the position to decide whether they should adopt the standards or not, due to the dominant position of buyers (Subramani 2004). For example, Webster (1995) presented a case study that showed how Ford Motor forced its suppliers to transfer order, shipment and forecast information through Fordnet. Suppliers were informed that trading by the system was a requirement of trading with Ford. We therefore propose:

> ***H2a:*** Coercive pressures are positively related to VIS standards deployment.

Normative Pressures. Institutional theory has largely conceptualized normative pressures as primarily stemming from professionalization, defined as "the collective struggle of members of an occupation to define the conditions and methods of their work, to control the production of the future member professionals, and to establish a cognitive base and legitimization for their occupational autonomy" (DiMaggio and Powell 1983, p. 152). Normative pressures influence technology deployment in several ways. First, deployment of technology by other members of a community sends a strong message to organizations that there is a convergence in expectations about the

technology's effectiveness and usefulness (Swanson and Ramiller 2004). This exerts a normative force over organizations to get onto the bandwagon. Secondly, as an organization builds relationships with other organizations in a community, they begin to establish various values and norms, which include beliefs about what actions members in the community view as appropriate (Son and Benbasat 2007). When organizations attend various events organized by VIS standards consortia, for example, they are constantly reminded of the need to adopt VIS standards, so that the entire industry is able to benefit from using the same standards. As an organization identifies more with the community, they feel greater normative pressure to deploy VIS standards, in order to help the community to reach the goal of full inter-operability throughout supply chain partners in the industry. Hence, we hypothesize:

H2b: Normative pressures are positively related to VIS standards deployment.

Mimetic Pressures. Technology adoption tends to follow a bandwagon pattern within an industry (Abrahamson and Rosenkopf 1993; Tolbert and Zucker 1983). When firms face with high levels of uncertainty and they are unsure as to how they should respond to it, they may be able to achieve legitimacy by following the collective actions of early adopters, or the "best practices" adopted by other similar firms (Son and Benbasat 2007). When organizations observe that other organizations are deploying VIS standards, they will similarly feel compelled to mimic other organizations, to "avoid being perceived as technologically less advanced and as less suitable trading partners than their competitors" (Teo et al. 2003, p. 22). Hence:

H2c: Mimetic pressures are positively related to the extent of VIS standards deployment.

The Institutional Influences on VIS Standards Integration

The decision to integrate the IOS to internal back-end systems and to change both the inter-organizational and internal business processes requires significantly greater commitment of resources than the decision to simply deploy an IOS to implement VIS standards. IOS integration requires the visible support and commitment of senior management, and the availability of appropriate resources and expertise. As highlighted by Kostova and Roth (2002), the key factor differentiating ceremonial from substantive adoption of an organizational practice is the extent to which there is internalization of the practice. Internalization refers to the extent to which an adopter views a practice as valuable for the firm and is committed to implementing the practice (Kostova 1999). In the case of a technology, the commitment is characterized by a strong belief in the acceptance of the technology's values, and a strong desire to exert considerable effort in implementing and assimilating the technology. Hence, we argue that unless a firm views VIS standards as valuable and is committed to the integration of VIS standards, it cannot achieve a high level of integration. On the other hand, the decision to simply spend minimal resources to deploy a small set of VIS standards in an IOS does not require a large amount of internalization of the value of using VIS standards.

Coercive Pressures. Although coercive pressures have very strong influences on VIS standards deployment, we do not expect coercive pressures to have any influence on the extent of integration. Firms who succumb to significant coercive pressures to adopt VIS standards will only engage in ceremonial adoption – where the standards are used to automate data exchange with suppliers. In such cases, firms adopt the VIS standards to show their commitment to the relationship with their customer, but they are unwilling to expend additional resources for integration. Buyer firms have little influence over supplier firms' integration decisions, as both systems and business integration deal with how firms are organizing their internal business processes and application systems. As the integration decision is internal to the organization, coercive pressures have no influence on the decision to invest in systems and business integration.

Normative Pressures. Standards consortia provide opportunities for firms to establish multiple inter-firm linkages and create a network where information about how VIS standards are used and how benefits are derived are shared amongst members (Lorenzoni and Lipparini 1999). Through various activities such as informal discussions and formal presentations that showcase success stories of VIS standards use, and through participating in technical working groups and committees, members are constantly reminded of the benefits of systems and business integration. This creates a normative force over organizations to similarly invest in systems and business integration, in order to also be viewed as part of the group of successful VIS standards adopters. The awareness that other organizations obtain benefits from using VIS standards through integration thus creates normative pressure on organizations to similarly invest in systems and business integration. Hence, we hypothesize:

H3a: Normative pressures are positively related to the extent of VIS standards integration.

Mimetic Pressures. As highlighted by Teo et al. (2003), there are two aspects of mimetic pressures: (1) the extent of technology adoption among competitors and (2) the perceived success of competitors that have adopted the technology. Hence, we argue that when organizations observe that their successful competitors gain benefits from using VIS standards through investing in systems and business integration, the inherent uncertainty in using VIS standards cause firms to succumb to mimicking the actions of their successful peers. This may be because mimicking successful others enable firms to reduce their search and experimentation costs, or to avoid the risks borne by first-movers, but more importantly, it enables them to gain greater legitimacy in the industry. Firms typically adopt the practice of benchmarking the business benefits they derive from IT usage against those derived by their peer organizations (Liang et al. 2007). When firms observe that their competitors are deriving significant benefits from using VIS standards, because they not only deploy the standards but also integrate the IOS with backend systems using VIS standards, firms are more likely to internalize the need to adopt similar competitor practices in order to derive the same set of benefits. Hence, we hypothesize:

H3b: Mimetic pressures are positively related to the extent of VIS standards integration.

Methodology

To test our hypotheses, we conducted an in-depth study of organizations that have adopted RosettaNet Partner Interface Processes (PIPs). Founded in 1998, RosettaNet (www.rosettanet.org) is a nonprofit consortium that aims to facilitate B2B e-business in the high-tech industry, e.g., electronic components, semiconductor manufacturing, and telecommunications. RosettaNet is an appropriate setting for this study because it is one of the few industry consortia that are dedicated to VIS standards. The study builds on the authors' three-year involvement with the RosettaNet consortium. In the preliminary stage, we conducted 1 to 1.5 hour face-to-face and telephone interviews with 20 key executives (seven RosettaNet regional directors, eight RosettaNet global staff and five IT or business managers of client companies who have implemented RosettaNet standards). These interviews helped us to obtain an understanding of RosettaNet operations, organizational issues with RosettaNet's standards implementation, and further ground our theoretical arguments and operationalize key constructs. We then generated the survey and reviewed the questionnaire with several RosettaNet executives and users to examine the face validity of the items. After finalizing the survey, we distributed the survey through the RosettaNet regional directors of China, Japan, Malaysia, Singapore, and Taiwan. We targeted organizations based in the Asia region because a large proportion of the high technology industries supply chain organizations are in Asia, and organizations in these countries are typically not involved in the standards setting process (Boh et al. 2007). This allows us to examine the standards adoption decisions of the organizations without the confounds of their participation in the standards development process. Since the target respondents include managers whose native languages are not English, the questionnaire was translated into Chinese and Japanese for respondents from China, Japan and Taiwan.

Several workshops and meetings were launched to explain the objective of the survey to potential respondents, and to encourage their participation. The RosettaNet regional directors in each country helped us to approach their member organizations, identifying the key RosettaNet champion in each enterprise. Surveys were emailed to these champions, and they were requested to obtain the relevant information for each section of the survey from the manager most likely to provide accurate responses for a line of questioning. For instance, IT managers answered the questions related to RosettaNet PIPs implementation, whereas the business managers answered the questions related to the operational and strategic benefits, etc. We randomly called several organizations to double check on the process that was adopted to answer the survey, and found that this process was adopted for all the respondents we called. The completed surveys were returned to us either by the RosettaNet regional directors or by the RosettaNet champion in each organization directly. Of the 221 questionnaires distributed, 37 questionnaires were returned after the first round survey. After three months, we asked the RosettaNet regional directors to distribute the questionnaire again. Finally, we obtained 62 responses and 60 questionnaires were usable for data analysis, showing an effective response rate of 27 percent. Because VIS standards is a new emerging technology (e.g. RosettaNet was founded in 1998), the target population of RosettaNet adopters was not large. Given that we are targeting RosettaNet adopters in the Asia region, which effectively halved the potential target population, we believe that the 62 responses we obtained was sufficiently representative of the target population we are studying. We assessed non-response bias using t-tests to compare the responding and non-responding companies' industry, revenue, and number of employees and found no significant differences.

Scale Development

We identified the appropriate measures for our constructs by identifying existing scales from the literature, with some minor modifications made to make them more suitable to the context of VIS standards. The definition of the constructs and the source of the items are shown in Table 1 (Measures are shown in Appendix A).

Prior research has shown that organizational readiness and perceived benefits are two key factors influencing IOS adoption, in addition to institutional pressures (Iacovou et al. 1995). Hence, we included controls for an organization's IT experience and capability as a proxy for organizational readiness. We did not include perceived benefits as a control, as the construct is more applicable for non-adopters. Since we measured the actual perceived benefits from using VIS standards as the outcome variable, we were not able to measure the perceived benefits prior to VIS standards use as an antecedent, because we did not have the opportunity to collect longitudinal survey data.

Table 1. Construct Definitions and Scale Development

Research construct	Definition	Origin of item scales
Strategic benefits	The outcomes that result when firms take advantage of opportunities arising from relationships with their trading partners, including the development of new products and services, a richer understanding of the partner, and the ability to sense and respond to changes in the relationship.	Subramani (2004), Zhu and Kraemer (2005)
Operational benefits	The benefits arising from efficiency improvements, such as reduction in cycle time, inventory cost and operating costs, as well as increases in productivity and information accuracy.	Subramani (2004), Zhu and Kraemer (2005)
VIS standards deployment	The number of standards sets (Number of RosettaNet PIPs) deployed by each firm, which represents the number of business processes automated through the use of VIS standards.	
VIS standards integration	Second Order Formative Construct made up of the following reflective constructs: 1. Systems integration: The extent to which the IOS is integrated with back-end application systems by implementing VIS standards. 2. Business integration: The extent of business integration, which refers to the extent to which business processes have been re-engineered to enable the seamless flow of information and events between trading partners.	Markus (2000), Yi et al. (2005)
Coercive pressures	The perceived extent of formal and informal pressures from dominant customers.	Teo et al. (2003)
Normative pressures	The perceived extent to which organizations are influenced by the views of other members of the standard consortia.	Teo et al. (2003)
Mimetic pressures	The perceived extent to which competitors have adopted VIS standards and have benefited from using the standards.	Teo et al. (2003) (formative measures)
Control variables:		
Firm size	Sales revenue and no. of employees	Zhu and Kraemer (2005)
Experience	Experience in VIS standards and experience in EDI	
IT capability	Number of PCs per employee and IT professionals	

Data analyses and Results

We used PLS Graph (Version 3.0 build 1126) for data analysis since our research model contains both reflective and formative constructs, and we have a relatively small sample size. PLS has an advantage over other structural equation modeling (SEM) methodologies as it does not require distributions to be normal or known (Chin 1998; Chin et al. 2003). In addition, PLS has less stringent sample size requirement. Chin (1998) suggested that researchers use a rule of thumb of 10 cases per predictor, whereby the overall sample size is 10 times the largest of

two possibilities: (1) the block with the largest number of formative indicators (i.e., the largest so-called measurement equation) or (2) the dependent variable (DV) with the largest number of independent variables (IVs) impacting it (i.e., the largest so-called structural equation). Hence, a sample size of 60 is sufficient to test our research model. Unlike a covariance-based SEM method such as LISREL, PLS employs a component-based approach for estimation purposes (Chin 1998; Chin et al. 2003). In general, PLS is better suited for explaining complex relationships as it avoids two serious problems: inadmissible solutions and factor indeterminacy (Fornell and Bookstein 1982).

Following Straub (1989) and Boudreau et al. (2001) , we conducted the following tests to validate the instrument.

Convergent Validity and Reliability. To assess factorial validity, we first examined the convergent validity of the scales. Convergent validity is shown when the t-values of the Outer Model Loadings are above 1.96 (Gefen and Straub 2005). The t-values of the loadings are, in essence, equivalent to t-values in least-squares regressions. Each measurement item is explained by the linear regression of its latent construct and its measurement error. The loadings are above 0.5 (in an acceptable range) and the t-values indicate that the loadings are significant. We also note that all of the reliability coefficients of the reflective constructs are above .80 and the average variance extracted (AVE) is above .50, indicating that the measurements are reliable and the latent construct account for at least 50 percent of the variance in the items.

Discriminant validity. We then proceeded to examine the discriminant validity by calculating the AVE and comparing it to the correlations among constructs. Table 2 provides this information with the square root of AVE given in the diagonals. Our results show that the square root of the AVE is greater than all of the inter-construct correlations, thus providing evidence of discriminant validity (Chin 1998). To further assess validity of our measurement instruments, a cross-loadings table was constructed (Gefen and Straub 2005). Each item loading in the table is much higher on its assigned construct than on other constructs, supporting adequate convergent and discriminant validity.

In sum, these results provide strong empirical support for the reliability, discriminant and convergent validity of the scales used in this study.

Table 2: Correlations among Major Constructs

Construct	Mean (SD)	1	2	3	4	5	6	7	8
1. Coercive Pressures	**3.77 (0.77)**	**.82**							
2. Mimetic Pressures	**3.09 (0.62)**	.409**	**.74**						
3. Normative Pressures	**3.08 (0.72)**	.167	.300*	**.85**					
4. Deployment	**7.18 (6.87)**	.442**	.409**	.26	**1**				
5. Systems Integration	**3.89 (0.69)**	.129	.103	.031	.169	**.84**			
6. Business Integration	**3.52 (0.63)**	.101	.205	.024	.195	.742**	**.81**		
7. Operational Benefits	**3.70 (0.74)**	.102	.318*	.152	.209	.640**	.633**	**.79**	
8. Strategic Benefits	**3.20 (0.81)**	.303*	.302*	.211	.654**	.720**	. 761**	.464**	**.86**

** p < .01; * p < .05; square root of AVEs are in bold.

Common Method Bias Assessment. We used two approaches to assess whether there is any common method bias in our data. Firstly, Harman's one-factor test was conducted (Podsakoff and Organ 1986). If a significant amount of common method bias exists in the data, then a factor analysis of all of the variables in the model will generate a single factor that accounts for most of the variance. Unrotated factor analysis using the eigenvalue-greater-than-one criterion revealed eleven factors, and the first factor explained only 34 percent of the variance in the data. Secondly, we examined common method bias using the marker-variable technique (Lindell and Whitney 2001; Malhotra et al. 2006). According to Lindell and Whitney (2001), "the smallest correlation among the manifest variables provides a reasonable proxy for common method variance" (p. 115). Malhotra et al. (2006) found that when the correlation coefficient is less than 0.10, common method variance effects are not substantial, and thus common method bias is not a serious threat. The results of our analysis indicated that common method bias, if any, was not substantial because the smallest correlation coefficient among the manifest variables is close to 0.10 (r = 0.101, n.s.). Based on these two methods, it seems reasonable to conclude that this present study is relatively robust against common

method bias.

Structural Model

Figure 2 shows the path coefficients and explained variances for the research model based on the PLS analysis. [1]

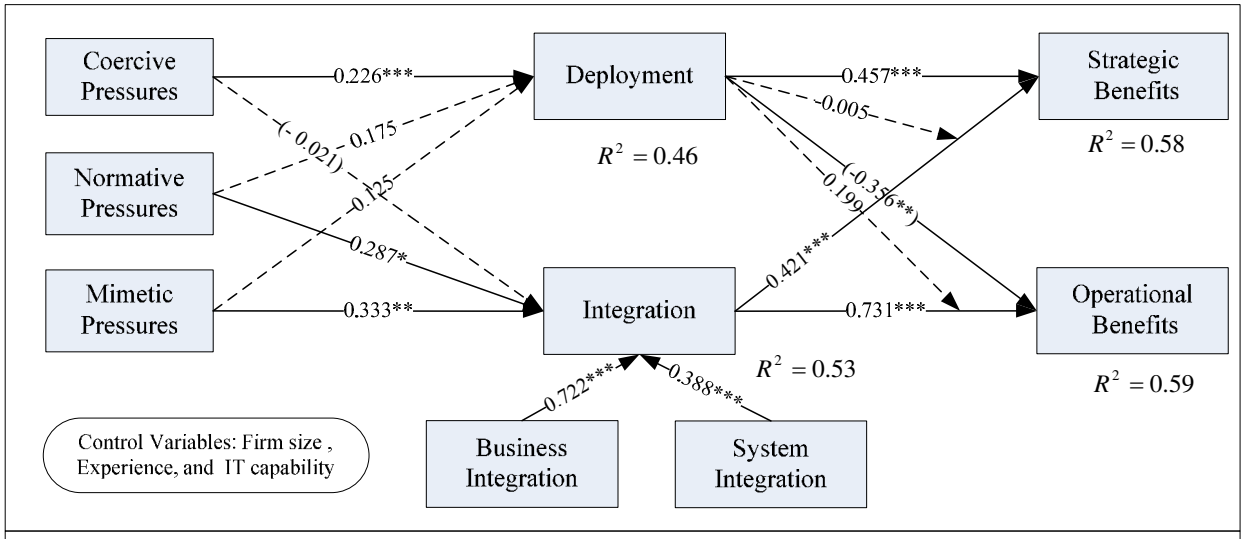

Figure 2. Results of PLS Analysis

*** p < .01; ** p < .05; * p < .1

Operational and Strategic Benefits of VIS Standards Deployment and Integration. As shown in Figure 2, the R^2 values of both dependent variables (operational and strategic benefits) are greater than 0.5, which indicates that the model explains a substantial amount of variance. The results show that operational benefits is significantly influenced by standards integration (path coefficient = 0.731, p<0.01), providing support for H1a. Interestingly, the PLS analysis indicated that operational benefits are negatively influenced by a wider extent of deployment (path coefficient = -0.356, p<0.01), when integration is controlled for.

Strategic benefits are significantly influenced by both integration (path coefficient = 0.421, p<0.01) and deployment (path coefficient = 0.457, p<0.01). However, the interaction of deployment and integration does not significantly influence strategic benefits (path coefficient = -0.005, p>0.10)[2]. Hence, H1b is not supported.

Antecedents of VIS Standards Deployment and Integration. Our results show that coercive pressures have a significant influence on deployment (path coefficient = 0.226, p<0.01), whereas normative pressures (path coefficient = 0.175, p>0.10) and mimetic pressures (path coefficient = 0.125, p>0.10) have no significant influence on deployment. This provides support for H2a and shows the lack of support for H2b and H2c.

We also find that normative pressures (path coefficient = 0.287, p<0.1) marginally influences integration, providing marginal support for H3a, and mimetic pressures (path coefficient = 0.333, p<0.05) significantly influences integration, providing support for H3b. Meanwhile, we also find that coercive pressures does not have a significant influence (path coefficient = -0.021) on integration, supporting our argument that coercive pressures have no positive influence on the decision to invest in systems and business integration.

[1] We conducted sensitivity analysis by including the respondent's country as a dummy variable in the analysis. The results remain unchanged.

[2] Chin et al. (2003)'s approach, where indicators are standardized and all possible products from the indicators of both constructs are used as the indicators of the interaction term, was used to test H1b.

Discussion

This study conceptualizes two dimensions of VIS standards use, and thus provides an understanding of the differential effects of the extent of deployment and extent of integration on operational and strategic benefits.

Operational benefits are not obtained by deployment of VIS standards alone, but require integration of the VIS standards to backend systems and changes to business processes. Hence, standards users who adopt VIS standards for symbolic purposes without investing in systems or business integration are unlikely to obtain significant operational benefits from the deployment of VIS standards. Interestingly, we find that a wider extent of deployment even has significant negative influence on operational benefits after controlling for integration. Manual interventions to transfer data from IOS systems to internal application systems are extremely counter-productive. The inefficiencies increase substantially if manual interventions are required to make up for the lack of systems and business integration across a large number of business processes. When firms deploy more standards sets without integration, they actually increase manual interventions and instead of obtaining operational benefits, they may end up having to spend more time to deal with more errors arising from the manual interventions and transferring of data from their IOS to their backend systems. Thus, firms seeking to obtain operational benefits are best advised to start with a narrower set of VIS standards and to ensure that these are well integrated with internal systems and processes, before moving on to deploying additional standards.

Greater strategic benefits are obtained through VIS standards deployment and integration. The integration across a wide range of business processes enable organizations to learn more about their business partners, to deepen ties, and create new business opportunities with those partners. Although our results show that both integration and deployment have significant influences on strategic benefits, we find that the moderating effect of deployment is not significant. This may be because wide standards deployment influences strategic benefits in another way. Subramani (2004) suggested that IOS adoption can be look upon as relationship-specific investments, which represent an important source of advantage. For example, relationship-specific asset presents barriers to imitation, emulation, and substitution by competitors. Thus, wide standards deployment enhances a supplier's ability to retain an equitable proportion of the value generated by IT use - value that the focal firm could otherwise appropriate by the switching to alternative suppliers (Dyer and Singh 1998; Subramani 2004). Thus, wide deployment could create strategic benefits by keeping customers happy, which focuses on value-retention, rather than value-creation through high integration.

Standards deployment is influenced only by coercive pressures. Interestingly, deployment is not affected by normative pressures, nor by mimetic pressures. This finding should be interpreted in view of our results on the lack of benefits from deployment without integration. As noted by Swanson and Ramiller (2004), mindless implementations of IT innovations due to the fashionableness of the innovation will be dampened when organizations begin to realize and observe that the benefits of adoption cannot be rapidly and easily achieved. Our data shows that there is a substantial group of VIS standards users, who have gained only moderate operational benefits,. This group of organizations may thus serve to dampen the effect of normative and mimetic pressures on VIS standards deployment, as organizations note that adopting the VIS standards does not automatically mean that they would gain significant benefits from adoption.

Standards integration is influenced only by normative pressures and mimetic pressures. This suggests that organizations which focus on communities' norms and values, and competitors' successful adoption of VIS standards understand that significant benefits are obtained via integration. These organizations are therefore willing to commit resources needed for IOS integration and process streamlining. Standards integration is not affected by coercive pressures, because customers who exert coercive pressures on suppliers are primarily concerned with suppliers' deployment of VIS standards for the customer's convenience. The customer is less concerned about suppliers' level of internal integration.

Limitations and Future Research

Our findings should be interpreted in view of the following limitations. First, our sample consists of members of the RosettaNet consortium. There are other organizations that have implemented RosettaNet who are not RosettaNet members. In fact, such organizations are even more likely to have less internalization of VIS standards than organizations in our sample, as these organizations have not even bothered to become a RosettaNet consortium member. Based on our theory, we would expect such individuals to obtain even less operational and strategic benefits from using RosettaNet PIPs. Hence, it is likely that there are non-RosettaNet members that will score even lower in terms of the level of integration, and benefits obtained. Nevertheless, we are able to establish that our

research model appropriately explains standards deployment and integration for our sample, which exhibits lower variance and range in integration and benefits than that of a sample involving non-RosettaNet members. Hence, we effectively tested the theory for a group of first-movers who have adopted RosettaNet, and we expect that the results should hold true or become even stronger if we include non-RosettaNet members.

Second, as our study is conducted using cross-sectional survey data, the usual caveats relating to the limits to our ability to draw definitive conclusions about causality apply. Nevertheless, our framework proposes that various environmental factors (institutional pressures) influence different aspects of use (deployment and integration), which in turn influences the benefits derived from use (operational and strategic benefits). This logical sequence of factors mitigate the possibility of reverse causalities amongst the constructs. Nevertheless, the research provides limited insights about how organizations would move from a ceremonial user to become an efficient user, and what affects organizations to change their decisions after the initial adoption decision. Hence, future research should examine VIS standards adoption and use in a longitudinal study to examine the dynamics of how organizations expand, continue or stop the use of VIS standards.

Implications for Research and Practice

This study contributes to the literature in two ways. First, it highlights that the use of IOS or VIS standards can be characterized by two distinct dimensions – the extent of deployment and integration, and these two dimensions have differential influences on the amount of operational and strategic benefits organizations obtain from using VIS standards. Specifically, we find that integration positively influences operational benefits, while deployment alone, without integration, does not result in operational benefits and is even negatively associated with the amount of operational benefits obtained. The results also show that both integration and deployment have significant influences on strategic benefits, but the interaction between integration and deployment does not have any significant influences. These two dimensions of use not only characterize IOS or VIS standards use, but is also applicable to the use of other IS innovations such as ERP systems. For example, an organization implementing an ERP system would have to decide whether they wanted to only implement the accounting module, or to extend the ERP implementation to other modules like manufacturing, logistics and customer management, and the extent to which they wish to integrate the ERP modules with existing IT systems. These different deployment and integration decisions are expected to have differential effects on the benefits that organizations derive from using such IS innovations.

Secondly, we extend prior research applying institutional theory to technology adoption, to show that various types of pressures influence the deployment and integration of IOS in different ways. Specifically, we show that coercive pressures have significant influence on deployment, whereas mimetic pressures and normative have significant influences on integration. This adds a more nuanced conceptualization of how institutional pressures influence IT adoption and use.

Our study also has several implications for practitioners. First, our study shows that simply deploying VIS standards without investing in integration generate limited operational benefits. Second, our study highlights that exerting coercive pressures on organizations will only influence organizations' deployment decisions, but does not influence their integration decisions. These results have implications for both the supply chain master and its supplier. From the supplier's perspective, the results indicate that if the organization deploys VIS standards without a good understanding of the standards and without investing in integration, in response to customer's coercive pressures, they are unlikely to gain any operational benefits from adoption, beyond signaling their commitment to the customer. From the supply chain master's perspective, these results show that coercing their suppliers to adopt VIS standards will only result in benefits for the supply chain master, at the expense of the supplier. To generate a win-win situation where suppliers also benefit from adopting the standards, the supply chain master should consider helping their suppliers to better understand the VIS standards implementation process and helping them to increase the level of integration with backend systems. In addition, our results also show that the community's influence on encouraging standards adoption may be limited through normative pressures. Instead, standards consortia should consider helping organizations to understand that value from VIS standards is obtained through integration.

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Appendix A. Item Measures

Research construct	Measures
Strategic benefits	To what extent do you agree that these results follow from the use of RosettaNet PIPs: SB1. We learn a lot about the customer (e.g. buying patterns) SB2. We learn a lot about the markets for our products SB3. We develop new business opportunities with the customer SB4. Purchases from my firm are increasing from the customer
Operational benefits	To what extent do you agree that these results follow from the use of RosettaNet PIPs: OB1. Sales cycle time is reduced OB2. Inventory cost is reduced OB3. Productivity is improved through automation OB4. Greater return on investment in our supply chain is achieved OB5. Operations costs is reduced OB6. We get timely and accurate information for decision making OB7. Clerical efficiency is improved through reduced paperwork
VIS standards deployment	How many PIPs have you implemented in each of the RosettaNet Clusters (i.e. Order, Payment, Logistics, Demand Creation, Manufacture, Design, and Forecast)?
VIS standards integration	To what extent do you agree with the following statements: Business integration BI1. Redundant activities have been removed from the inter-organizational business processes that cross my firm and the customer. BI2. The gaps and conflicts between business processes of my firm and the customer have been solved BI3. Our internal business processes facilitate our communication and cooperation BI4. Feedback about the problems relating to inter-organizational business processes across my firm and the customer are handled in a timely manner BI5. An inter-functional team from our business unit, together with the teams from the customer, has meetings to figure out how to work better together Systems Integration SI1. Data from the customer must be re-keyed, as they are used and reused by different employees within my firm (Reversed) SI2. Electronic data flows smoothly from RosettaNet system into our internal ERP system SI3. Our internal systems can easily transmit and process data from the customer.
Coercive Pressures	With regard to my main customers that have adopted RosettaNet PIPs, CP1. My firm's well-being depends on their purchases. CP2. My firm MUST maintain good relationships with them. CP3. They are the largest customers in the industry CP4. These customers have great influence on our firm's decision of whether or not to adopt RosettaNet PIPs
Mimetic Pressures	With regard to my main competitors that have adopted RosettaNet PIPs MP1. They have benefited greatly. MP2. They are perceived favorably by others in the same industry. MP3. They are perceived favorably by their customers. MP4. RosettaNet PIPs are widely adopted by our firm's competitors
Normative Pressures	To what extent do you agree with the following statements: NP1. My perceptions of RosettaNet PIPs' usefulness are influenced by the views of other RosettaNet Members NP2. Participating in RosettaNet consortium generates some pressures on our organization to adopt RosettaNet PIPs