VIS standards deployment and integration : a study of antecedents and benefits

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**NANYANG
TECHNOLOGICAL
UNIVERSITY**

**VIS STANDARDS DEPLOYMENT AND INTEGRATION:
A STUDY OF ANTECEDENTS AND BENEFITS**

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NANYANG BUSINESS SCHOOL

2009

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SUMMARY

Extending prior research on inter-organization systems (IOS), I differentiate between two distinct dimensions characterizing organizations' use of vertical information systems (VIS) standards: (1) standards deployment – the extent to which organizations adopt VIS standards across a wide range of business processes, and (2) standards integration – the extent of systems and business process integration. I draw on institutional theory and the literature on inter-organizational learning to develop a research model assessing how other organizations influence standards deployment and integration by creating institutional pressures and learning opportunities. I also extend prior research by examining how the two dimensions differentially influence operational and strategic benefits. I made use of survey data collected from organizations in Asia that have implemented RosettaNet standards to test the research model. In addition, I also conducted case studies with five organizations to provide qualitative results to complement the quantitative findings. This dissertation thus extends the socio-political perspective on IOS adoption by examining how the learning perspective complements the institutional pressures perspective. I also contribute to the literature by generating insights into the trade-offs between standards deployment and integration as two dimensions of standards use.

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CHAPTER 1 INTRODUCTION

Inter-organizational systems (IOS) are telecommunication-based information systems shared by two or more organizations that are designed to support the sharing of data, link business processes, support supply chain management, and improve collaboration via electronic integration (Barrett and Konsynski 1982; Hart and Estrin 1991; Johnston and Vitale 1988). Prior research has shown that IOS can provide significant operational and strategic benefits to organizations (e.g. Chatfield and Bjorn-Andersen. 1997; Clark and Stoddard 1996). In today's global economy, IOS are more important than ever, particularly as organizations strive to improve the effectiveness of their entire supply chains with business partners in many countries. However, effective deployment of IOS across a global supply chain requires a set of standards that ensures 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 enabled interoperability at hardware, operating system, data communication, messaging, and common syntax levels (Jain and Zhao 2003). However, inter-organizational interoperability and application integration also require trading partners to agree on the types of data to be exchanged, the semantics of the data fields, and the inter-organizational business processes to be adopted.

EDI and VIS Standards

The Electronic Data Interchange (EDI) standards are the first generation of IOS standards that support the exchange of standardized electronic information between organizations. When organizations use EDI, transactions (e.g., orders) can

automatically be transferred into the systems of other organizations without manual data re-entry. Consequently, EDI can provide both operational and strategic advantages to its adopters (Clarke 1992; O'Callaghan et al. 1992). Despite the potential benefits, EDI is not widely accepted, especially among small and medium-sized enterprises, due to its proprietary nature and high implementation cost, and the lack of standardization of business processes across companies (Premkumar and Ramamurthy 1994). In order to improve the adoption of EDI and optimize business processes in the whole supply chain, several industries have come together to redefine EDI standards.

The industry-specific nature of such data and processes has meant that these standards have been largely developed 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. 2005b). These standards address aspects of Business-to-Business (B2B) E-business such as product identification, data definition, business document layout, and business process activities. Implemented in IOS, VIS standards 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, MISMO for the mortgage industry, and ACORD for the insurance industry.

Motivation and Research Question

There are specific characteristics of VIS standards that allow us to investigate IOS adoption and use with more theoretical depth and precision and thus contribute to prior research. First, VIS standards are typically set and promoted by a standards consortium - a cooperative association of organizations that develops and approves standards based on formal agreements through communication, political negotiation and coordination among participating firms (Boh et al. 2007). The consortium constitutes a community that engages organizations who are interested in implementing, or have already implemented the VIS standards. The presence of this community highlights the need to widen the socio-political perspective that has traditionally been used to consider the role that other organizations play in influencing an organization's decision to adopt the IOS.

Prior research using the socio-political perspective tends to focus on the institutional pressures organizations face from trading partners, competitors, and other firms in the industry in their IOS adoption decision. Social influence exerted by organizations, however, is not restricted to institutional pressures. The presence of a standards consortium community provides opportunities for all parties to build and retain a trusting climate and cooperative relationships. This encourages the use of softer influence tactics such as providing learning opportunities, rather than relying on more hard-line tactics such as pressuring organizations to adopt the IOS. Instead of exploiting dependence and exerting pressure, long-term benefits could accrue to all parties involved if a key supply chain master (such as Toyota) creates knowledge-sharing routines (Dyer and Singh 1998). These routines enable trading partners to obtain the necessary knowledge and capabilities to effectively use the technology. Since an organization's knowledge and technical capability significantly influences

their adoption decision (Chwelos et al. 2001; Iacovou et al. 1995), I propose that organizations can also influence the IOS adoption decisions of trading partners and consortia members by helping to improve their knowledge of implementing and using the IOS. I therefore extend the sociopolitical research on IOS adoption, by complementing the institutional perspective with a learning perspective, where providing learning opportunities for trading partners and other members of standards consortia constitute additional, alternative paths to successfully encouraging other organizations to implement and use IOS.

Another key characteristic of VIS standards is that their development is an ongoing process. VIS standards do not just cater to the most basic and frequently used set of transactions, such as order processing and payments, but they also facilitate more complex interactions between trading partners, such as collaborative design and sales forecasting (Rosettanet 2004). Organizations involved in standards setting and diffusion continually add to the existing standards repertoire to meet more of their needs. Such continual development and diffusion of standards occurs not only for less mature standards such as RosettaNet (which started in 1998), but also for more mature standards such as ACORD (which started in 1970). RosettaNet, for example, has published nearly 110 IOS specification sets over 8 years, whereas ACORD has published 1000 specification sets over 30 years.

The adoption decision facing organizations for VIS standards is therefore, no longer simply yes or no. Organizations have to determine the extent to which they will adopt VIS standards, in terms of the number of inter-organizational business processes that they wish to automate. Prior information systems (IS) literature has pointed out the need to move beyond a simple dichotomous “adoption versus nonadoption” (Zhu and Kraemer 2005, p. 61) conceptualization of IT innovation, and distinguished between

organizations that implement VIS standards for a limited number versus a complete set of inter-organizational business processes (Bala and Venkatesh 2007). Beyond VIS standards, I find many IT artifacts have similar characteristics. For example, an organization implementing an Enterprise Resource Planning (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. Likewise, an organization could only outsource its customer service first, and then decide whether it wants to outsource more complex business process such as billing or purchasing. Therefore, I hope this dissertation will provide significant insight into wider research fields.

Prior research has also identified the extent of integration as a key factor influencing the value of IOS use (Mukhopadhyay and Kekre 2002; Rai et al. 2006; Saraf et al. 2007). Effective integration of IOS with trading partners make the IOS investments firm specific and difficult to imitate, and thus creates more benefits (Yi et al. 2005; Zhu and Kraemer 2005). While prior research has highlighted these two dimensions as key for IOS use (Massetti and Zmud 1996), there has been limited research examining the antecedents and benefits derived from these two dimensions of IOS use simultaneously. I therefore identify deployment and integration as two distinct dimensions that characterize VIS standards use, and specifically examine the following research questions:

- 1) How do different external agencies (e.g., trading partners and standards consortia) influence the adoption behaviors (e.g., deployment and integration) of VIS standards users?
- 2) How do different adoption behaviors affect the benefits that standards users can obtain?

In order to answer these two research questions, I first identify how the institutional pressures and learning from trading partners and standards consortia members differentially influence organizations' decisions to deploy more standards, versus to invest in more systems and business integration. I also examine how these two dimensions of VIS standards use differentially influence operational and strategic benefits, providing insights into the trade-offs that are inherent in firms' decisions to engage in greater deployment or greater integration of VIS standards.

The rest of the dissertation is organized as follows. Chapter 2 describes a literature review of prior research of IOS/VIS adoption and benefits. Chapter 3 introduces the theoretical framework and presents related hypotheses. Chapter 4 introduces a quantitative analysis, which includes survey data collection process, the data analysis procedure and the results of the model testing. Chapter 5 introduces a qualitative analysis based on further case studies, which complement the results in Chapter 4. Finally, Chapter 6 discusses the findings, highlights significant implications and directions for future research and describes the contributions of this dissertation.

CHAPTER 2 LITERATURE REVIEW

To understand the antecedents and benefits of VIS standards use, I first extracted relevant studies in this area. As VIS standards adoption is related to the general IOS and EDI research (as noted in Chapter 1), this literature review also include the studies on IOS and EDI adoption and use. Keywords “VIS standards or IOS or EDI” and “Benefits or Adoption or Use” were used to search for papers (online database EBSCOhost, ABI and ScienceDirect Online) in major IS and management journals (such as MISQ, ISR, JMIS, AMJ, OS, MS, DATA BASE, Decision Sciences, Decision Support Systems, Information and Management, European Journal of Information Systems, Information Systems Journal, and Journal of Strategic Information Systems). I only focus on these top journals as they were most likely to provide influential and rigorous papers on the topic. Further I did backward search. I checked the reference of the papers that had been found based on the keyword search, and identified (based on topic) the papers that I needed to include in this dissertation. A total of 47 empirical papers were found.

Literature Review of VIS Standards/IOS Adoption

Prior adoption research focuses on three broad perspectives to examine what influence the adoption of VIS standards/IOS: (1) Economic perspective, (2) Sociopolitical perspective, and (3) Integrated framework.

Economic Perspective

In the economic stream, IT adoption is examined based on efficiency considerations. A group of researchers have applied theories from micro economics and transaction cost approach to theoretically model the adoption and diffusion of IOS and electronic

markets (Malone et al. 1987; Riggins et al. 1994; Wang and Seidmann 1995). For example, building on the main premise of transaction cost theory, Malone et al. (1987) indicated that an organization would adopt from alternative IT-enabled governance structures (electronic markets vs. electronic hierarchies) the one that best fit its economic efficiency rationales. Besides these economics theories, another two theories are identified in economic perspective: Innovation diffusion theory and network effect theory.

Innovation diffusion theory - Innovation diffusion theory presents that the adoption of innovations is related to the attributes of the innovations as perceived by potential adopters (Rogers 1995). For example, the degree to which an innovation is perceived as being better than the old technology has a direct impact on the likelihood of adoption. Thus, the superiority of the advantages or the benefits potential that the VIS standards offer will influence the adoption of the technology. Likewise, the use of VIS standards involves multiple partners/multiple transaction types, which may deal with a divergent variety of hardware, software, networking protocols, and business practices. Thus, related compatibility and complexity may dissuade firms from attempting wider technology adoption. Premkumar and Ramamurthy (1994) drew on this theory and examined the relationship between various innovation characteristics and adoption of IOS in organization. Likewise, O'Callaghan et al. (1992) found that the adoption of EDI is related to the perceived relative advantage of the technology and the level of compatibility with existing systems.

Network effect theory - Network effect theory posits that the benefits that adopters derive from a network technology are positively associated with the size of the network (Katz 1986). Network effects are both direct and indirect. An example of direct network effects is the positive impact of the number of VIS standards adopters

on the benefits that an individual adopter can achieve by enabling the sharing of information with a larger number of partners over the VIS standards. An example of indirect network effects is the increase in compatible software and hardware solutions as the standards diffuse. In the presence of positive network externalities, the value of an open-standard IOS increases with its size, and thus as a network grows in size, firms will have stronger incentives to adopt it (Zhu et al. 2006). In order to create positive network externalities, IOS initiators need to subsidize some adopters' costs to join the network (Riggins et al. 1994; Wang and Seidmann 1995)

Sociopolitical Perspective

The adoption of an IOS is significantly different from the adoption of an innovative internal technology. IOS is unlike other types of information technology innovations in that it cannot be adopted and used unilaterally. The adoption of IOS requires the cooperation of the firm's trading partners. Therefore, various aspects of inter-organizational relationships can have a significant influence on the adoption decision making. For example, firms that are motivated to begin using IOS should either find similarly motivated partners, or persuade or coerce their existing trading partners into adopting the technology. The sociopolitical research perspective focuses on two major aspects: sociopolitical structure, reflected by power and dependence relations, and sociopolitical process, reflected by dominant climate sentiments prevailing among members in the transaction channel (Reve and Stern 1979)

The sociopolitical structure aspect examines the balance of power and dependence relations among trading partners, and how this, in turn, influences the control inter-organizational linkages and actual transactions. In the context of IOS, there is some

evidence to indicate that power and dependence have significant influence on IOS adoption decision (Hart and Saunders 1998; Premkumar and Ramamurthy 1995; Webster 1995).

On the other hand, the sociopolitical process aspect of the theory suggests that a trusting climate and cooperative relation could help to create long-term benefits. A favorable climate is expected to facilitate inter-organizational coordination through better information flow and result in more cooperation and better decision making. For example, Hart and Saunders (1998) found that trust is positively related to EDI use, but power has a strong negative association with EDI use. Ramamurthy et al. (1999) found that customers support can affect EDI adoption. These long-standing, supportive climates could create smooth, seamless coordination of the various business and operational transactions.

In fact, many of the sociopolitical processes require a number of actions involving reciprocal investments, educating and/or training partners, marketing the awareness of the innovation's benefits, dispelling suspicion and fears and building trust, offering various forms of motivation, and so forth. Thus, these actions could be more desirable paths to successfully implementing and using IOS than power and dependence. For example, Son et al. (2005) compared the effect of power and reciprocal investments on EDI use, and they found that the customer's reciprocal investments in the form of EDI-related support are proven to be effective in increasing EDI volume and diversity. However, power exercised is found to be not effective. Thus, the reciprocal investments are found to be an even more effective strategy when suppliers desire to keep a more cooperative relationship with the customer.

Integrated Framework

Technology–Organization–Environment (TOE) framework. The above literature review has indicated that many factors could influence IOS adoption. To gain a comprehensive view on what factors may shape the IOS adoption, the TOE framework has been used by many researchers (e.g., Chau and Tam 1997; Iacovou et al. 1995; Zhu and Kraemer 2005). TOE framework was developed by Tornatzky and Fleischer (1990). This comprehensive framework identifies three aspects of a firm's context that influence the adoption of technologies: technological context, organizational context, and environmental context. The technological context refers to the perceived attributes of technology that can influence the adoption process. Perceived benefits and some innovation characteristics are often included as important technological factors (Chau and Tam 1997; Iacovou et al. 1995). The organizational context reflects the specific characteristics of an organization that constrain or facilitate the adoption and implementation of the technology. Many organizational characteristics such as firm size and organizational readiness have been examined. Environmental context is the arena in which a firm conducts its business, and the external influence on adoption that may come from its industry, competitors, trading partners, and government. Institutional pressures have been highlighted and widely used as environmental factors in the study of the adoption and diffusion of organizational technologies among organizations (Abrahamson 1991; Teo et al. 2003).

Other integrated frameworks. Besides the TOE framework, a few studies also developed other integrated model. For example, Bala and Venkatesh (2007) drew on three theoretical perspectives (i.e., the relational view of the firm, institutional theory,

and organizational inertia theory) to explain the adoption of VIS standards in organizations. Son and Benbasat (2007) identified two groups of salient factors rooted in efficiency- and legitimacy-oriented perspectives, and assessed empirically their effects on organizational buyers' adoption and use of IOS.

Literature Review of VIS Standards/IOS Benefits

Early research on VIS standards/IOS benefits was primarily exploratory and focused on evaluating the benefits of IOS. For example, Mukhopadhyay et al. (1995) estimated the dollar benefits of improved information exchanges between Chrysler and its suppliers that result from using EDI. They found that the total benefits of EDI per vehicle amount to over \$100. Recent literature indicated that organizations experience both operational and strategy benefits from IOS (Mukhopadhyay and Kekre 2002; Subramani 2004). Further, IOS studies started to explain why some IOS adopters can obtain benefits and how to obtain benefits from appropriate IOS use. Three prominent views have emerged regarding the source of VIS standards/IOS benefits.

Industry Structure View

The first stream of research on IOS benefits draws primarily from the industry competitive analysis or value-chain framework of Porter and Millar (1985), which suggested that supernormal returns are primarily a function of a firm's membership in an industry with favorable structural characteristics (e.g., relative bargaining power, barriers to entry, etc). For example, Johnston and Vitale (1988) argued that

organizations can increase bargaining power by using IOS and finally increase competitive advantage. Likewise, Clemons and Row (1993) analyzed consumer packaged goods industry and found that some retailers resist IOS due to the impact on bargaining power, these retailers perceive that their bargaining power will be eroded under the new IOS coordination structure, and fear that it will preclude their sharing in the economic benefits. Finally, although IOS use could create greater benefits, the fact that IOS are shared by separate trading partners means that benefits from IOS are both unequal and interdependent. In particular, certain firms, often buyers, act as champions or initiators of the system by strongly encouraging or forcing their partners, often suppliers, to adopt the technology. Because buyers can use their superior bargaining power to appropriate benefits from streamlining inter-firm processes, benefits from the IOS are distributed unevenly and skewed in favor of the buyers (Riggins and Mukhopadhyay 1994)

Resource-based View (RBV)

The RBV provides a theoretical basis for linking IOS use and value. Rooted in the strategic management literature, the RBV posits that firms create value by combining heterogeneous resources that are economically valuable, difficult to imitate, or imperfectly mobile across firms (Barney 1991). In the IS literature, the RBV has been used to analyze IT capabilities (Mata 1995) and to explain how IT value is created. That is, IT value depends on the extent to which IT is used in the key activities in the firm's value chain. The greater the use, the more likely the firm is to develop unique capabilities from its core IT infrastructure (Zhu and Kraemer 2005). For example, some researchers argue that integration possesses the value-creating characteristics of resources (e.g., firm specific, difficult to imitate). Consequently, IOS integration

could create more benefits (Mukhopadhyay and Kekre 2002; Yi et al. 2005; Zhu and Kraemer 2005). Likewise, based on RBV, Chatfield and Bjorn-Andersen (1997) investigate Japan airlines (JAL), and they found that IOS not only contributed to JAL's improved competitiveness but also enabled it more fully to leverage its strategic value chain as an engine of growth and a new source of competitive advantage.

Relational View

Although the above two perspectives have contributed greatly to our understanding of how firms achieve supernormal returns, they overlook the important fact the (dis)advantages of an individual firm are often linked to the (dis)advantages of the network of relationship in which the firm is embedded (Dyer and Singh 1998). Proponents of the RBV have emphasized that competitive advantage result from those resources and capabilities that are owned and controlled by a single firm. Consequently, the search for competitive advantage has focused on those resources within the firm. However, a firm's critical resources may extend beyond firm boundaries and be embedded in inter-firm routines and processes. Dyer and Singh (1998) offer a relational view of competitive advantage that focuses on dyad/network routines and processes as an important unit of analysis for understanding competitive advantage. This view includes four elements: relation-specific asset, knowledge-sharing routine, complementary resources and capabilities, and effective governance.

A group of researchers integrated some of these elements and explain how IOS use creates benefits. For example, Subramani (2004) differentiated two patterns of supply chain management systems use by suppliers (exploitation and exploration), and he

argued that different patterns of use make different relationship-specific investments in business processes and domain knowledge. These, in turn, enable suppliers to both create value and retain a portion of the value created by the use of these systems in inter-firm relationships. Saraf et al. (2007) proposed that IOS integration leads to better knowledge sharing and process coupling with business partners, which is significantly associated with business performance. Malhotra et al. (2007) conceptualized the use of VIS standards as a boundary-spanning mechanism that helps overcome boundaries that impede knowledge transfer between enterprises in supply chains. VIS standards enable partners to gain insight into their broader environments, enriching each partner's perspective (enhanced bridging), and finally create collective gain.

This dissertation focuses on examining the influence of third party organizations, such as trading partners and other standards consortium members, on organization's adoption decisions for VIS standards. As the social-political perspective focuses on how the social and political environment of an organization influences an organization's decisions, it is the appropriate perspective to focus on when examining the different types of influence that third parties exert. In this thesis, I propose that in addition to institutional pressures, organizations are also influenced by other organizations through learning opportunities provided by trading partners and other standards consortium members.

Regarding the benefits of VIS standards, my dissertation examines that how different internal adoption behaviors (i.e., deployment and integration) affect the benefits that standards users can obtain. As I draw upon the fundamental argument that these different internal adoption behaviors represent the related capabilities owned by the organization, I draw upon the resource based view as the theoretical perspective to

apply to examine this question. The following section further presents the rational explanation.

First, prior research in sociopolitical perspective has examined the influence from both sociopolitical structure, reflected by power and dependence relations (Premkumar and Ramamurthy 1995; Webster 1995) and sociopolitical process, reflected by dominant climate such as trust (Hart and Saunders 1998), and compare the different influences of these two aspects (Son et al. 2005). Although prior literature highlights the influence of dominant customers or government, it ignores the influence of standards consortia. A standards consortium brings together a community of members in different roles, including customers, suppliers, logistics providers, solution providers, financial institutions, industry associations, and government agencies. Through various activities, technical working groups and committees, a standards consortium provides the venue for representatives of various organizations to exchange knowledge and create some norms in a specific community (Rosenkopf et al. 2001). Thus, organizations may follow the norms and rules in this community and learn from other members of the community, and all these activities will facilitate the adoption of VIS standards. Therefore, it is necessary to examine how standards consortia affect VIS standards adoption and compare the influence of standards consortia with the influence of trading partners.

In addition, there has not been any study that has applied the learning perspective to understand firms' VIS standards or IOS adoption decisions based on my literature review. The features of VIS standards are not fixed, but rather continue to develop and evolve over time with newer and improved versions (Swanson 1994). As users continue to identify various enhancements and extensions to meet new needs in business, IT innovations such as VIS standards become increasingly elaborate with

additional business functions and features. In order to adjust and benefit from ongoing changes of VIS standards, organizations need to continue to learn about, use, and decide whether they wish to extend the use of the full range of features built into VIS standards after the initial adoption and implementation of the system. Furthermore, organizations also need to possess the necessary expertise to use and integrate the VIS standards into their operations.

Prior literature has shown the importance of inter-organizational learning on increasing a firm's competitive advantage (Dyer and Singh 1998). In the VIS context, there is potential for companies to learn, not only from their own experience, but also from their trading partners and from the community involved in the standards consortia that develop and diffuse the VIS standards. Organizations that successfully create strong ties with their trading partners through a variety of institutionalized routines are able to tap into a knowledge network, which enables them to understand potential benefits of VIS standards as well as learn how to coordinate and integrate with their trading partners (Dyer and Nobeoka 2000; Lorenzoni and Lipparini 1999). In addition, organizations also can learn from other members of standards consortia by participating in some activities. In order to fill the above research gap, I examine and compare how institutional pressures and learning from trading partners and standards consortia affect organizations' decisions in using VIS standards.

Secondly, this dissertation draws on RBV to examine the benefits of VIS standards. Prior research based on the same view mainly suggests that IOS integration is valuable, firm specific, and difficult to imitate, and thus could create more benefits (Yi et al. 2005; Zhu and Kraemer 2005). However, integration may not be the only antecedent influencing the benefits in the context of VIS standards. Based on some exploratory case studies, Massetti and Zmud (1996) identified several dimensions of

IOS usage, and two key dimensions are the diversity and depth of usage (Massetti and Zmud 1996). Diversity 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 IOS use can be characterized, there has been limited research examining how these different dimensions of IOS use affect benefits simultaneously. Hence, in this dissertation, I identify deployment and integration as two different dimensions that can be used to characterize different types of VIS standards users, and examine how they differentially influence operational and strategic benefits that standards users obtain.

CHAPTER 3 THEORETICAL FRAMEWORK

I first introduce the conceptualization of the two core constructs of deployment of VIS standards and integration of VIS standards, before presenting the arguments for the hypotheses.

Deployment and Integration of VIS Standards

Kostova and Roth (2002) highlight that subsidiaries of multi-national corporations (MNCs) that are required to adopt organizational practices may engage in symbolic or ceremonial adoption of mandated organizational practices, in order to maintain legitimacy within the MNC and in the subsidiary's host country (Meyer & Rowan 1977). Kostova and Roth suggested a framework comprising two dimensions to portray the various responses typically exhibited by subsidiaries. The first dimension represents the actual implementation of the organizational practice and the second dimension represents the internalized belief in the value of the practice. The framework highlights that the key factor differentiating ceremonial from substantive adoption of a practice is the extent to which there is internalization of the practice. Internalization is the extent to which an adopter views a practice as valuable for the firm and is committed to its implementation (Kostova 1999; Kostova and Roth 2002).

I believe that the framework proposed by Kostova (2002) is highly relevant to the IOS adoption context, as organizations are frequently coerced into adopting IOS by a dominant trading partner (Bala and Venkatesh 2007). There are also other significant parallels. Implementation of organizational practices is similar to the extent of deployment of the VIS standards (Bala and Venkatesh 2007). Internalization in the case of VIS standards refers to a strong belief in value of the technology, and a strong desire to exert effort in implementing the technology. Organizations who believe in

the value of the technology will be willing to invest in the integration of the VIS standards with their back-end systems, and to streamline business processes to enable the seamless flow of information between trading partners. Hence, in this dissertation, I 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 noted 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 most frequent and least complex (e.g., order and payments management). The goal of such narrow VIS standards deployment is 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, they may expand the deployment of VIS standards. At this stage, organizations typically deploy VIS standards for 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, 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, to straight-through processing (Wigand et al. 2005b). For example, in an un-integrated system, though 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; Rai et al. 2006). Business integration is defined as the extent to which business processes have been streamlined 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 the protocols to use during the interaction, providing feedback about performance and quality, and the use of coordinating teams.

It is important to differentiate between deployment and integration as two distinct

dimensions of VIS standards use, as I hypothesize that both the antecedents and outcomes of these two dimensions differ. The next section first presents hypotheses about how VIS standards deployment and integration affects the benefits organizations obtain. Then I present the hypotheses about how the institutional perspective and learning perspective complement one another to explain how other organizations influence a firm's VIS standards deployment and integration decisions.

Figure 3-1 provides an overview of the proposed research model.

External Influence on VIS Standards Adoption

The adoption of IOS is unlike the adoption of other internal technologies, as an IOS cannot be adopted and used unilaterally, but requires the cooperation of the firm's trading partners. Recognizing this, researchers have used a sociopolitical perspective to examine how firms' IOS adoption decisions are influenced by other organizations. Prior research using this perspective tends to focus on examining the balance of power and dependence relations among trading partners, and how this, in turn, influences the establishment of inter-organizational linkages and trading partners' IOS

adoption decisions (Hart and Saunders 1998; Premkumar and Ramamurthy 1995; Webster 1995). Drawing on institutional theory, key studies on IOS have found external pressures faced by organizations to be a key factor influencing IOS adoption (Liang et al. 2007; Teo et al. 2003). The key idea of institutional theory is that organizations sharing the same environment will employ similar practices and thus become isomorphic with one another (Kostova and Roth 2002). The institutional theory takes the perspective that organizations adopt practices and innovations, 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 institutional isomorphism may occur: through the effects of coercive, mimetic, and normative pressure. Coercive pressure is defined as formal and/or informal pressure exerted on organizations by other organizations upon which they are dependent. Mimetic pressure refers to pressure to imitate a peer that an organization perceives to be successful. Normative pressure refers to pressure that stems from shared norms and values among members of a relational network.

The focus on institutional pressure in prior IOS research ignores the possible role that learning can play in helping organizations to learn about whether and how they can effectively adopt, implement and use IOS to gain the benefits. I propose that trading partners and other members of the standards consortia are significant sources of knowledge that can help organizations to better understand the VIS standards and implement them.

Learning from Trading Partners (e.g., buyers, suppliers). An organization's customers and suppliers are a key source of knowledge for an organization, especially for improving coordination and collaboration between trading partners. Dyer and

Nobeoka (2000), for example, provided evidence that suppliers of Toyota learned more quickly after participating in the knowledge-sharing processes organized by Toyota. Von Hippel (1998) also found that ideas and information from customers and suppliers influenced the ability of organizations to understand the technology they adopt, and the way they interpret the technology and its value.

Learning from Other Members of the VIS Standards Consortia. A standards consortium brings together a community of members and provides important opportunities for members to learn from one another. Robey et al. (2000) argued that novice members can learn by observing and listening to more experienced participants in a community of practice. By means of both formal and informal activities, members of the community come together and these frequent communications allow them to transfer knowledge about the VIS standards implementation and use to other members in the community.

Hence, in this dissertation, in addition to exerting pressures on organizations to conform to norms and requirements, I highlight that trading partners and other members of the community also play a key role in providing knowledge and learning opportunities to help organizations to increase their knowledge about VIS standards, and consequently influence VIS standards deployment and integration.

Influence of Coercive Pressures from Trading Partners

Coercive pressures are defined as formal and/or informal pressures exerted on organizations by other organizations upon which they are dependent. I expect coercive pressures to play a key role in affecting organizations' decision to deploy VIS standards, as VIS standards are often sponsored by major players in the industry

(e.g., major buyers in the IT industry such as Intel and Sony for RosettaNet, major lenders in the Mortgage industry such as Countrywide Home Loans and Wells Fargo for MISMO). These powerful stakeholders have the resources and the power to shape standards consortia's character and objectives to align with their interests (DiMaggio 1988; Townley 2002). They are often the main advocates of the VIS standards, and exert coercive pressures on their trading partners to adopt the technology (Boh et al. 2007). Supplier firms are often not in the position to decide whether they should adopt the standards or not, due to the dominant position of buyers (Subramani 2004).

Coercive pressures, however, can only influence organizations' decisions to deploy VIS standards. Buyer firms have little influence over supplier firms' integration decisions, as both systems and business integration deal with how firms organize their internal business processes and application systems. IOS integration requires the support and commitment of senior management, and the availability of appropriate resources and expertise. The decision to invest in systems and business integration thus requires an internalization of the benefits of using the standards (Kostova and Roth 2002) and the willingness to commit resources for the integration effort. Therefore, managers may succumb to coercive pressures to deploy VIS standards, but may not expend effort for systems and business integration. They will engage in ceremonial adoption to show their commitment to their customer. I therefore propose:

H1: Coercive pressures are positively related to VIS standards deployment.

Influence of Normative and Mimetic Pressures from Standards Consortia Member

Other than coercive pressures from trading partners, organizations also experience normative and mimetic pressures from other organizations in the standards consortia,

which include both members of organizations' business and professional network, as well as their competitors. Normative pressures stem from shared norms and values among members of a relational network (Powell and DiMaggio 1991). Normative pressures influence IOS 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 (Swanson and Ramiller 2004). This exerts a normative force over organizations to get onto the bandwagon. Second, as an organization builds relationships with other organizations in a community, they begin to establish values and norms, which include beliefs about what actions members in the community view as appropriate (Son and Benbasat 2007). When organizations attend events organized by VIS standards consortia, for example, they are constantly reminded of the need to adopt VIS standards, so that the entire industry can benefit from using the same standards. Organizations thus feel normative pressures to deploy VIS standards, in order to help their community reach the goal of full inter-operability throughout their supply chain. Hence, I hypothesize:

H2a: Normative pressures are positively related to VIS standards deployment.

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 about how they should respond to uncertainty, there is significant pressure to imitate a successful competitor. Technology adoption tends to follow a bandwagon pattern within an industry (Abrahamson and Rosenkopf 1993; Tolbert and Zucker 1983). When firms face high levels of uncertainty and 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). Thus, I hypothesize:

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

As highlighted by Teo et al. (2003), there are two aspects of normative and mimetic pressures: (1) the extent of technology adoption amongst and (2) the perceived success of organizations in one’s relational network and competitors that have adopted the technology. Standards consortia provide opportunities for firms to establish multiple inter-firm linkages and share information about how VIS standards are used and how benefits are derived (Lorenzoni and Lipparini 1999). When organizations observe that other successful organizations 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 (Pavlou et al. 2007). When firms observe that other organizations 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 practices in order to derive the same set

of benefits. Hence, I hypothesize:

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

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

Influence of Learning from Trading Partners and Standards Consortia Members

To differentiate between the effects of learning from trading partners, versus learning from other members of the standards consortia, I draw on the theory of weak ties versus strong ties. Prior literature shows that weak ties and strong ties are beneficial for knowledge sharing in different ways. Granovetter (1973) theorized that weak ties - those typified as distant and by infrequent interaction - were more likely to be sources of novel information, because weak ties tend to be connected to diversified information sources that provide non-redundant information (Granovetter 1973). Subsequent research show that weak ties can be helpful for the diffusion of ideas (Rogers 1995) and the search for publicly available information (Uzzi and Lancaster 2003) and non-complex knowledge (Hansen 1999). Strong ties, on the other hand, are characterized by high level of trust, which results in greater willingness by parties to divulge private, idiosyncratic information about a firm (Uzzi and Lancaster 2003). Prior literature suggests that strong ties are more advantageous for sharing complex information (Hansen 1999) and information that is tacit and proprietary in nature (Uzzi 1997). Further, studies have shown that strong ties are associated with the expenditure of effort to ensure that a knowledge seeker sufficiently understands and can put into use newly acquired knowledge (Hansen 1999).

I propose that learning from other members of standards consortia is akin to learning from an organization's weak ties, whereas learning from one's trading partners is similar to learning from an organization's strong ties. Participating in a standards

consortium provides an organization with opportunities to build weak ties – or distant relationships where interactions take place infrequently, but the extensive reach of the consortia globally and across the entire value chain implies that organizations can access diverse information through these weak ties. Trading partners with whom organizations are implementing IOS, on the other hand, represent strong tie relationships, as there are significant amounts of relationship-specific investments made toward sustaining the relationship (Subramani 2004).

Learning from Standards Consortium Members. Standards consortia provide opportunities for firms to establish multiple inter-firm linkages and create a knowledge sharing network, thus offering access to specialized knowledge distributed among many organizations (Lorenzoni and Lipparini 1999). One of the key advantages provided by learning from a large community of organizations is the diversity of knowledge. The diversity of knowledge is particularly high in standards consortia due to the extensive reach of the consortia globally and across the value chain. Standards consortia involve members in diverse industry roles (e.g., customers, suppliers, solution providers, and logistics providers) that span the entire value chain. Many standards consortia also have offices all over the world. For example, RosettaNet is headquartered in the United States and has offices in ten countries in Asia and Europe. Such global reach presents organizations with access to knowledge from a wide variety of international sources.

The information that organizations in a standards consortium provide to other members is that which the firm is ready to reveal in the public domain (Uzzi and Lancaster 2003). Such information typically includes explanations of VIS standards, successful implementation cases and analysis of benefits obtained from using VIS standards. As highlighted by Hansen (1999), weak ties are advantageous for searching

and accessing such simpler forms of knowledge. Learning from standards consortium members, therefore, provides an efficient way to help organizations understand what the VIS standards are about, and what the VIS standards can do, thus diminishing the uncertainties they face about the technology (Ravichandran 2005). For example, showcasing an organization's system, and organizing site visits are effective ways of increasing the 'visibility' (Moore and Benbasat 1991a) of how the technology is adopted by other firms. Such information encourages adoption by shaping organizations' perceptions of the goals, opportunities and benefits of the implementation of VIS standards. Thus, standards consortia play a key role in convincing potential adopters of the benefits of VIS standards adoption, and persuading them to deploy VIS standards. I therefore propose:

H4a: Learning from other members of the standards consortium is positively related to VIS standards deployment.

Learning from Trading Partners. While learning from other members of the standards consortia provides opportunities for organizations to access a diverse array of knowledge resources, I expect such learning opportunities to have limited impact on helping an organization to improve its readiness and capabilities to engage in systems and business integration of the VIS standards. Weak ties impede the transfer of complex knowledge, which tends to require a strong tie between the two parties (Hansen 1999). The task of integrating the back-end systems to the IOS, and changing the internal business processes is a complex endeavor. Given the complexity of knowledge required for improving the organization's integration capabilities, I suggest that only close and frequent interactions with trusted partners will enable an organization to enhance such capabilities.

Alavi and Leidner (2001) also indicated that tacit and complex knowledge is best transferred through collaboration, shared experience, and rich interpersonal interactions over time, e.g. through collaborations that enable partner firms to observe and import others' practices (Powell et al. 1996). Interactions with close trading partners often include face-to-face meetings and in-depth conversations. With repeated interactions through formal sessions and informal conversations, firm representatives develop ties that increase the level of trust, fine-grained information exchange, and joint problem-solving efforts (Uzzi 1997). This enables organizations to learn how they can better utilize VIS standards and increase the level of systems and business process integration with their internal systems. For example, Wigand et al (2005a) described how a mortgage services firm worked with a leading lender, and how the two firms learned from each other to reengineer their joint business process, thus enabling a high level of integration between the firms and rapid processing of re-financing cases.

Although trading partners also encourage the deployment of VIS standards, learning from trading partners mainly influences integration of VIS standards. I argue that learning from trading partners have limited influence on the deployment of VIS standards because unlike other members of the standards consortium who may be viewed to be more similar to the organization, powerful trading partners are often viewed to have more resources at their disposal. Hence, any evidence that they may provide about the benefits they obtained from implementing RosettaNet standards may not be convincing, as such benefits may be interpreted to arise from the greater amount of resources available to the trading partner. Moreover, if powerful customers use learning opportunities to persuade suppliers to deploy VIS standards, there is a "natural and relatively indiscriminating" resistance to the imposition of "externally

mandated patterns" from the powerful customers (Westney 1993). Consequently, such a resistance dampens the effect of learning on deployment. I thus propose:

H4b: Learning from trading partners is positively related to VIS standards integration.

Benefits of VIS Standards Deployment and Integration

In addition to having a different set of socio-political antecedents, I also hypothesize that the deployment and integration of VIS standards will bring about different benefits. 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. 2005b). Operational benefits include lower transaction and production costs from quicker 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. 2005b).

First, I argue that operational benefits from VIS standards use can only be realized by companies that modify their internal business processes and invest in systems and business integration. Systems and business integration can reduce inefficiencies in operations and business processes. For example, with system integration of the VIS standards with internal ERP system, the information received from and transmitted to trading partners will be automatically transferred into the internal systems for

processing without manual intervention. Likewise, if organizations can remove redundant and inconsistent inter-organizational business processes and set up coordinating teams, they can make more accurate and timely decisions of forecast, manufacturing, and logistics. Therefore, 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 such as lower transaction and production costs, reduced processing time, and improved data accuracy (Mukhopadhyay and Kekre 2002; Subramani 2004). I therefore hypothesize:

H5a: 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 a higher extent of VIS standards integration. First, establishing systems and business integration requires organizations to work closely with their trading partners, creating joint learning opportunities and enhancing the level of interaction between the two parties (Dyer and Singh 1998; Patnayakuni et al. 2006). The organizations develop a detailed understanding of their trading partner's practices (Subramani 2004), which provide them with the knowledge and expertise to solve unstructured and difficult problems that may arise. In addition, investing in systems and business integration also enables organizations to create relation-specific assets. For example, organizations may customize their business processes to cater to the specific requirements of trading partners (Subramani 2004). These relationship specific investments give organizations an advantage over competitors (Subramani and Venkatraman 2003), as they signal the organization's commitment to the trading

partner, and enable the organization to provide superior services relative to their competitors. I therefore hypothesize:

H5b: A higher extent of VIS standards integration is associated with greater strategic benefits from implementing VIS standards.

As operational benefits are derived from efficiency improvement, I argue that the deployment of VIS standards alone cannot lead to positive operational benefits for VIS standards users. Prior literature has suggested the so called “pro-innovation bias” in diffusion of innovation studies (Fichman 2004). The pro-innovation bias refers to the presumption that innovations will be unambiguously positive to adopting organizations (Kimberly 1981). Studies of IOS adoption tend to show positive associations between IOS adoption and benefits, and negative outcomes are overlooked. However, ceremonial adoption of technologies results in non-efficient technological adoption that may fulfill only symbolic functions such as signaling commitment to a trading relationship, but do little to boost or even impede an organization’s operational performance (Abrahamson 1991). Thus, I argue that simply increasing VIS standards deployment without integration leads 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).

Furthermore, some organizations have used E-business for many years and they have adopted different types of E-business standards such as American National Standards Institute (ANSI) transaction sets and international standards of EDI for Administration, Commerce, and Transport (EDIFACT). Many proprietary standards do not directly conform to VIS standards. As a result, an organization may find itself

electronically exchanging numerous information of the same value-chain flows based on different standards, but it is unable to integrate these flows in an consistent electronic manner internally or externally (Clarke 1992), which finally causes the decrease of efficiency. I therefore hypothesize:

H5c: A higher extent of VIS standards deployment is associated with less operational benefits from implementing VIS standards.

Since deployment of VIS standards alone cannot result in operational benefits, one may intuitively expect that organizations are unlikely to engage in a wide extent of deployment without integration, as it appears irrational to do so. I argue, however, that such actions are possible, as wide deployment of VIS standards serves a different purpose than gaining operational benefits.

Prior literature has indicated that implementation of the IOS strengthens the business relationship between customers and suppliers, and in turn leads to customers rewarding those suppliers who adopt the technology (Mukhopadhyay and Kekre 2002). Subramani (2004) also suggested that IOS adoption can be look upon as relationship-specific investments, which represents an important source of advantage. For example, relationship-specific assets present barriers to imitation, emulation, and substitution by competitors. In order to keep the business of customers, some organizations engage in ceremonial adoption to use a narrow set of VIS standards covering the basic business processes such as ordering and payment. However, 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).

It is those companies who are willing to invest heavily in a large array of standards that really signal their commitment to their customers and therefore reap the strategic benefits of the investment through better ties and relationship with the customer. 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. 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.

Therefore, 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. I therefore hypothesize:

H5d: A higher extent of VIS standards deployment is associated with greater strategic benefits from implementing VIS standards.

CHAPTER 4 QUANTITATIVE ANALYSIS

Field Context and Data Collection

To test the hypotheses, I 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 author's three-year involvement with the RosettaNet consortium. In the preliminary stage, I 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 me to obtain an understanding of RosettaNet operations, organizational issues with RosettaNet's standards implementation, and further ground my theoretical arguments and operationalize key constructs. I 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, I distributed the survey through the RosettaNet regional directors of China, Japan, Malaysia, Singapore, and Taiwan. I 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 me 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 me 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. I 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 I called. The completed surveys were returned to me 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, I asked the RosettaNet regional directors to distribute the questionnaire again. Finally, I obtained 62 responses and 60 questionnaires were usable for data analysis, showing an effective response rate of 27 percent. Because VIS standards are a new emerging technology (e.g., RosettaNet was founded in 1998), the target population of RosettaNet adopters was not large. Given that I am targeting RosettaNet adopters in the Asia region, which effectively halved the potential target population. Thus, the 62 responses I obtained could be representative of the target population I am studying. I 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 ($p > .05$).

Scale Development

I identified the appropriate measures for the 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 4-1 (Measures are shown in Appendix 1).

As prior studies on IOS and VIS standards have not measured learning from other organizations, measures for these constructs were not readily available in the literature. In order to generate the measures for this construct, I coded the transcripts of the preliminary interviews to identify the strategies adopted by RosettaNet to encourage the adoption of the standards, and the inter-organizational routines adopted and participated in by various supplier organizations and supply chain masters. I then compared the items derived from the interviews to the list of strategies and routines obtained by a comprehensive search of the literature in marketing, strategy and technology adoption. The RosettaNet directors were then consulted about the comprehensiveness of the items identified through this process.

Consistent with the theoretical rationale that extent of adoption by competitors is not necessarily correlated with the perceived success of adoption by competitors (Teo et al. 2003), the mimetic pressures construct was operationalized as a formative construct formed from two sub-constructs: the extent of adoption by competitors and the perceived success of adoption by competitors. Similarly, I also defined learning from trading partners and learning from other standards consortium members as

formative constructs because the participation of organizations in different learning activities reflected the extent to which organizations learned from other organizations. However, participation in one activity did not mean that organizations would necessarily participate in other activities. For example, organizations that often attended routine meetings with customers may not always get help in business process reengineering from customers. Business integration and systems integration, which are both measured with reflective indicators, together formed a second order formative construct representing VIS standards integration. For all other constructs, reflective indicators were used.

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, I included controls for an organization's IT experience and capability as a proxy for organizational readiness. I did not include perceived benefits as a control, as the construct is more applicable for non-adopters. I measured the actual perceived benefits from using VIS standards as the outcome variable. In addition to the extent of deployment and integration, Massetti and Zmud (1996) also identified two other dimensions of IOS use: (1) volume, which refers to transaction volume through IOS, compared to the overall inter-organizational transactions; and (2) breadth, which refers to the number of business partners connected using IOS. I control for the breadth dimension by including a measure for the number of business partners connected using RosettaNet standards. I was unable to control for volume, however, as the volume of transactions would differ for different types of business

processes; hence this variable was not relevant in this research context where a wide range of inter-organizational business processes is examined.¹

Table 4-1 Construct Definitions and Scale Development

Research construct	Definition	Origin of item scales	Cronbach Alpha
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)	0.882
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)	0.918
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.	Conceptualization based on field interviews	N.A.
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)	0.792
Coercive pressures	The perceived extent of formal and informal pressures from dominant customers.	Teo et al. (2003)	0.837
Normative pressures	The perceived extent to which organizations are influenced by the views of other members of the standards consortia	Teo et al. (2003) Liang et al. (2007)	0.774
Mimetic pressures	The perceived extent to which competitors have adopted VIS standards and have benefited from using the standards. (formative measures)	Teo et al. (2003)	N.A.
Learning from trading partners	The extent to which organizations participate in and learn from the activities organized by the trading partners. (formative measures)	Conceptualization based on field interviews	N.A.
Learning	The extent to which organizations participate in	Conceptualization	N.A.

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

Research construct	Definition	Origin of item scales	Cronbach Alpha
from standards consortia	and learn from the activities organized by the standards consortium. (formative measures)	based on field interviews	
Firm size	Sales revenue and no. of employees	Zhu and Kraemer (2005)	0.928
Experience	Experience in VIS standards and experience in EDI		0.874
IT capability	Number of PCs per employee and IT professionals		0.812
Connection	The number of trading partners that are connected with RosettaNet standards		N.A.
Cost	Organization's investment in systems implementing VIS standards		N.A.

Data Analysis and Result

Instrument Validation

I used PLS Graph (Version 3.0 build 1126) for data analysis since my research model contains both reflective and formative constructs, and I have a relatively small sample size. PLS has an advantage over other structural equation modeling (SEM) methodologies as it does not require distributions 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 my 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) , I conducted the following tests to validate the instrument.

Convergent Validity and Reliability. To assess factorial validity, I 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. I 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. Reliability of the survey instrument's items was also quantitatively validated by calculating Cronbach alphas for each construct. The standardized alphas ranged from 0.774 to 0.928 and are itemized in Table 4-1 above.

Discriminant Validity. I then proceeded to examine the discriminant validity by calculating the AVE and comparing it to the correlations among constructs. Table 4-2 provides this information with the square root of AVE given in the diagonals. The 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 the 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 (Appendix 3), supporting adequate convergent and discriminant validity.

Further, to ensure adequate discriminant validity to address this comment, I used the sorting method proposed by Stephenson (1953). This procedure requires independent experts to sort the measurement items into separate categories, based on the similarities and differences among items. A number of MIS researchers have used similar sorting procedure to establish discriminant and convergent validity of constructs (e.g. Moore and Benbasat 1991b; Segars and Grover 1998). If an item is consistently placed within a particular category, then it is considered to demonstrate convergent validity with the related construct, and discriminant validity with the others. I created an item list that included all measurement items in a random order. Another two experts (An assistant professor and a PhD student in IS) were asked to sort the items into categories (e.g., coercive pressures, learning from trading partners, operational benefits, etc). Two experts' sorting results and my real measurement matched exactly.

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

Table 4-2: Correlations among Major Constructs

Construct	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Operational Benefits	3.70 (0.74)	.79												
2. Strategic Benefits	3.20 (0.81)	.46**	.86											
3. Deployment	7.18 (6.87)	.21	.65**	N.A.										
4. Systems Integration	3.89 (0.69)	.64**	.72**	.17	.84									
5. Business Integration	3.52 (0.63)	.63**	.76**	.19	.74**	.81								
6. Coercive Pressures	3.77 (0.77)	.10	.30*	.44**	.13	.10	.82							
7. Mimetic Pressures	3.09 (0.62)	.32*	.30*	.41**	.10	.21	.41**	N.A.						
8. Normative Pressures	3.08 (0.72)	.15	.21	.26	.03	.02	.17	.30*	.85					
9. Learning from Trading Partners	2.99 (1.12)	.19	.66**	.58**	.35*	.70**	.36*	.31*	.16	N.A.				
10. Learning from Consortia	3.20 (1.02)	-.03	.54**	.68**	.56**	.20*	.26*	.18	-.01	.60**	N.A.			
11. Size	3.78 (1.31)	.51*	.27	.29*	.55**	.37**	.22	.38*	.19	.18	.12	.96		
12. IT capability	3.30 (1.12)	.42*	.40*	.36**	.54**	.45**	.35*	.43**	.29	.39	.27	.74**	.79	
13. Experience	6.32 (3.96)	.35	.38	.57**	.33*	.40**	.29*	.37*	.03	.41*	.47**	.64**	.57**	.91
14. Number of Connections	13.06 (15.43)	.05	.10	.15	.16	.14	.01	.26*	.34*	.09	.13	.43**	.32*	.32*

Common Method Bias Assessment. I used two approaches to assess whether there is any common method bias in the 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, I 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 my analysis indicated that common method bias, if any, was not substantial because the smallest correlation coefficient among the manifest variables is less than 0.10 ($r = 0.01$, 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 4-1 shows the path coefficients and explained variances for the research model based on the PLS analysis.

** $p < 0.01$; * $p < 0.05$; + $p < 0.1$

Antecedents of VIS Standards Deployment and Integration. The results show that coercive pressures have a significant influence on deployment (path coefficient = 0.160, $p < 0.01$), but not on integration (path coefficient = -0.080, $p > 0.1$), thus

providing support for H1. Normative pressures have a marginally significant influence on deployment (path coefficient = 0.134, $p < 0.1$) and integration (path coefficient = 0.184, $p < 0.1$). This provides partial support for H2a and H3a. Mimetic pressures have a marginally significant influence on deployment (path coefficient = 0.157, $p < 0.1$) and a significant influence on integration (path coefficient = 0.330, $p < 0.01$), showing partial support for H2b and support for H3b. The hypotheses for the learning constructs were all supported, as the results show that learning from standards consortia has a significant influence on deployment (H4a, path coefficient = 0.492, $p < 0.01$), and learning from trading partners has a significant influence on integration (H4b, path coefficient = 0.384, $p < 0.01$). Overall, the variables accounted for 64% of the variance in the extent of standards deployment and 62% of the variance in the extent of systems and business integration.

Benefits of VIS Standards Deployment and Integration. Integration positively influenced operational benefits (path coefficient = 0.731, $p < 0.01$) and strategic benefits (path coefficient = 0.421, $p < 0.01$), providing support for H5a and H5b. As hypothesized by H5c and H5d, the PLS analysis indicates that standards deployment negatively influenced operational benefits (path coefficient = -0.356, $p < 0.01$) and positively influenced strategic benefits (path coefficient = 0.457, $p < 0.01$). 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. None of the control variables were significant, except that firm size positively influenced operational benefits (path coefficient = 0.327, $p < 0.01$).

Power. Following Liang et al. (2007), I used Cohen's (1988) power table for multiple regression analysis to calculate power values for the PLS model. As Chin (1998) explained that PLS is performed by iterative regression analysis, thus power analysis on multiple regression should be also applicable for PLS. PLS estimates a structural model block by block, so I calculated power values separately. Each block consists of a DV and its IVs. My research model has four endogenous variables (strategic benefits, operation benefits, integration, and deployment), which are looked as DV in each block. So I will have four major blocks and four power analyses. The power values ranged from .87 to .99 (Given $\alpha=0.01$).

CHAPTER 5 QUALITATIVE ANALYSIS

A multiple-case study approach was used to complement the quantitative analysis. While the quantitative analysis tested the hypothesis presented in the conceptual model, the objective of the case study approach was to provide more in-depth explanations from organizations on why and how they deployed and integrated the VIS standards, and the extent of benefits they experienced. I adopted a positivist perspective. The unit of analysis was the organization. The organizations represented different types of RosettaNet standards users.

Case Site Selection and Data Collection

According to the guidelines of multiple-case study research and exemplars (e.g., Bala and Venkatesh 2007; Lapointe and Rivard 2005), the selection of the research sites should be done so as to allow substantial variations in the core theoretical constructs. Given that my key theory is about different adoption behaviors and benefits, I needed to identify organizations that differed on their use of VIS standards and could provide variability across constructs of interest at the time of data collection. By combining two dimensions (Deployment and Integration) into a two-by-two quadrant, I first created the following classification of four key types of VIS standards users (Figure 5-1).

(1) ***Ceremonial users*** have deployed VIS standards for only a narrow range of business processes, and have not integrated the IOS to their back-end systems or changed their business processes to streamline the related work flow. Institutional theory suggests that ceremonial adoption is likely to happen in situations where organizations have high uncertainty about a technology and feel strong pressures from the external environment to adopt the technology (Meyer and Rowan 1977; Westphal et al. 1997). Potential adopters who face a large amount of institutional pressure, but are unwilling or unable to spend resources to integrate the IOS to their back-end systems are ceremonial users. Examples of such companies would be some small and medium businesses (SMBs) who have succumbed to external pressures from customers to adopt VIS standards, but who make use of manual processes to enter orders and invoices into the IOS (Webster 1995).

(2) ***Efficient users*** have deployed VIS standards for only a narrow range of business processes (typically, the most frequently-encountered transactions, such as order processing), but they have invested in changing their back-end systems and internal business processes so that transactions can flow straight through from end-to-end.

Such companies are expected to reap the significant benefits from implementing the VIS standards.

(3) ***Signaling users*** have deployed VIS standards for a wide range of business processes, but have not invested in integrating the IOS with their internal systems and changing work flow. Such users are expected to be rare, as it is unusual to waste resources on implementing a wide range of VIS standards with none of them really working effectively. Some organizations may become signaling users because they want to signal a commitment to sustain a trading relationship with trading partners, and achieve greater legitimacy, or they perceive potential benefits of using VIS standards, but do not have sufficient resources and capabilities to achieve a higher level of integration.

(4) ***Strategic users*** deploy VIS standards for a wide range of business processes, and they invest in both systems and business process integration to implement the VIS standards. This group of users optimizes the use of VIS standards, and they are able to benefit from the synergies created by the cross-functional linkages across the entire value chain activities, rather than benefiting only from integrating a single class of business processes. Examples of such strategic users would be the large lenders described in Markus et al. (2006)'s case who have adopted MISMO standards not only for external communication, but they have also used MISMO standards internally to create a technical and organizational infrastructure enabling a leaner end-to-end mortgage process.

Based on the above classification, survey data, and cluster analysis (Appendix 4), I chose one strategic user, one ceremonial user, one signaling user, and one efficient user. In total, four firms were chosen. These choices followed theoretical replication strategies to improve the external validity of my study (Yin 1994). Theoretical

replication refers to a multiple-case selection strategy in which the cases vary in terms of expected outcomes.

I collected data using semi-structured interviews. The key informants were middle managers, such as IT managers and supply chain managers, who were knowledgeable about their organization's adoption and use of RosettaNet. A total of nine individuals were interviewed from the four firms. I started with a set of initial questions about the company's background and the interviewee's role in the company and experience in E-business. I then moved to questions about the adoption of and benefits from VIS standards. The interview protocol is provided in Appendix 2. Most interviews were audio taped. If the interviewee did not want to be taped, notes were taken and then transcribed.

Data Analysis and Result

In this section, I discuss the qualitative findings and provide further interpretations of the conceptual model to supplement the quantitative findings. Data were analyzed in two stages: within-case analysis and cross-case analysis (Yin 1994). A within-case analysis was performed first to allow the unique patterns of each case to emerge and to provide researchers with an understanding of each case. Second, a cross-case analysis was conducted to understand the variations across cases and to find alternative or novel explanations for findings from the within-case analysis.

Within-Case Analysis

This section presents a narrative of the VIS standards adoption, implementation, and use process, and the benefits experienced in each case. Not only does this analysis

allow the identification of diverse adoption behaviors, but the motivators, initial conditions, and consequences can also be distinguished. What results is an in-depth understanding of the antecedents to and benefits from the VIS standards adoption throughout the whole process. Table 5-1 summarizes relevant information from all case sites.

Table 5-1: Summary of Case Sites

Pseudonym	Nature of Business	Size of Organization	No. of PIPs	Extent of Integration
Strategic User (S1)	Semiconductor Manufacturing	No. of employees: 43000 Revenues: EUR 7.9 billion	15	4.3
Efficient User (E1)	Semiconductor Manufacturing	No. of employees: 500 Revenues: USD 50 million	8	4.1
Ceremonial User (C1)	Semiconductor Manufacturing	No. of employees: 128,000 Revenues: USD 16 billion	5	2.4
Signaling User (S2)	Logistics	No. of employees: 300 Revenues: USD 24 million	7 (12*)	3.1

* S2 is implementing another 5 PIPs recently

S1 (Strategic user) is a strategic user because S1 has wide deployment and high integration. S1 deployed PIPs in different industry clusters, and integrated VIS standards with its internal ERP system and other E-business systems. Therefore, it is able to benefit from the synergies created by the cross-functional linkages across the entire value chain activities.

Company Background – S1 was spilt from the semiconductor operations of its parent company in 1999. S1 offers semiconductors and system solutions for automotive, industrial electronics, chip card, and security companies as well as applications in communications. With a global presence, S1 has its global HQ and IT

center in Germany, and its regional HQ in Singapore. The company has more than 43000 employees and has achieved more than EUR 7.9 billion in revenues last year.

Antecedents to Adoption – Before using RosettaNet standards, S1 used a variety of traditional EDI standards, such as ASC X12 and EDIFACT. In 2004, S1 first started using RosettaNet standards because there was a demand from customers. S1's adoption was also influenced by its motivation to stay up-to-date, so it had the terminology to link with trading partners. In the past, S1 had been on a different E-business platform that was not RosettaNet enabled. S1 tried to make all the standards available to its customers. S1 also received a grant from the Singapore government to support its implementation.

Adoption and Implementation – Before the RosettaNet implementation, all involved partners (customers, suppliers, solution providers) discussed the contract of the organization, the B2B contract, and the agreement. They then exchanged the PIPs, their connectivity profiles, and all the specifications. They also discussed the business process and had to understand where the information came from when they used PIPs. Even now, S1 still uses a solution provider because it has not done the RosettaNet implementation in-house. S1 asked an offshore outsourcing partner to do the RosettaNet implementation rather than doing the mapping and taking care of some operations by itself. S1 started the RosettaNet standards implementation from two PIPs in the order cluster. After one year, S1 felt that RosettaNet standards were working well and there were benefits. As customers demanded more RosettaNet implementations, S1 moved on to adopt more RosettaNet PIPs. S1 has now implemented 15 PIPs in order, payment, and manufacturing clusters.

Benefits – After using RosettaNet standards, S1 thought that the main benefit was that all the transactions using RosettaNet standards were free as long as organizations had an Internet connection. Therefore, S1 did not have to pay for the value-added network (VAN) charges. S1 has also reduced manual data entry and the number of customer logistic managers, and created better relationships with its customers. S1 believes that it has created more opportunities to do business with trading partners once the company had the RosettaNet link.

E1 (Efficient user) is an efficient user because it deployed VIS standards for the most frequently-encountered transactions, such as order processing, payments, and logistics, and invested heavily in integrating VIS standards with its back-end systems and internal business processes so that its internal staff can use a single system for all information exchange needs.

Company Background – E1 is a total industrial solution provider for manufacturers of static control, micro-contamination control, and other specialized tools and materials required in the semiconductors, disk drives, electronics, and other precision technology sectors. E1 has an international network that spans at least nine countries and 21 locations around the world. About 60% of its revenue (USD 50 million in last year) comes from manufacturing and specialized packaging materials, while the remaining 40% of its revenue is from trading. E1 has about 500 employees that include 300 who are in manufacturing.

Antecedents to Adoption – E1 started B2B E-business in the early 1990s. However, even before that, E1 had been getting requests from customers to use E-business. At first, E1's implementation of EDI was not integrated with its backend system. Next,

the firm was transacting with several customers via ARIBA (like an e-catalog system) that was developed by a third party service provider and catered to different customers/suppliers. In 2001, E1 was introduced to RosettaNet standards. But E1 had no choice of whether to implement or not due to the customers' pressures, the only choice was how to implement it, such as make use of service providers' infrastructure or do it in-house.

Adoption and Implementation – In 2002, E1 made a decision to do the implementation in-house. E1 received a grant from the Infocomm Development Authority (IDA) of Singapore to defray part of the cost. The firm successfully put in place the infrastructure and linked the system implementing RosettaNet standards to its ERP system. E1's IT team learned from the solution provider and customers in the initial PIPs implementation. After that, E1 gained in-house experiences in implementing the RosettaNet interface and implemented the subsequent RosettaNet PIPs. E1 took five months to complete the first RosettaNet project and six weeks to complete the second project. Since then, E1 usually has taken about three months to implement well-defined PIPs and projects. E1 started the RosettaNet standards implementation from one PIP in the order cluster, and now E1 has implemented eight PIPs in order, payment, and logistics clusters.

Prior to implementing RosettaNet, E1 had many proprietary EDI connections with its business partners, which were not integrated with its ERP system. As a result, users had to log on to many different systems to download orders, which created much inefficiency. Hence, when implementing RosettaNet, the management decided to make the necessary investments to integrate RosettaNet with its internal ERP system. While this took a lot of work and resources, E1 has realized significant benefits from

the integration, as can be seen in its recent E-customs project. Part of the reason that the seamless integration with the ERP system can be achieved is that E1 uses an ERP system developed in-house. Moreover, the people involved with the ERP system development (in the mid 1990s) are still in E1, and this has enabled E1 to retain significant knowledge about its ERP system. This has greatly facilitated the task of integrating RosettaNet PIPs with the ERP system. A manager highlighted, *“The ERP is developed from scratch in-house by the very team that is sitting here!”*

Benefits – Having used RosettaNet, E1 saw the benefits of this standard. Use a recent E-customs project as an example. After E1 integrated the new system with its internal ERP system, it got the following benefits:

- The total transaction processing time decreased by 75% from 32 minutes to eight minutes.
- Transaction errors decreased from 5% to 2%.
- The estimated value of the benefit from the project currently stands at about \$71,650.

There are also some savings from the maintenance cost of the old E-custom system. Besides these operational benefits, E1 also foresees some strategic benefits:

- Based on E1’s experience, prior RosettaNet implementations with customers have provided a 10% to 15% increase in sales with those customers on average. This is because the commitment exhibited by E1 to automate the linkage with the customer places E1 in a different category of suppliers where their relationship is more long-term in nature. Customers are more willing to do business with suppliers who exhibit a greater commitment to the relationship.

- The E-customs project provides strategic advantages to E1, as it puts in place the infrastructure for E1 to improve its customer service by offering additional customs declaration services to customers. E1 plans to expand the use of RosettaNet standards to its customers, enable the automatic transmission of data to its customers, act as a broker, and extend the customs declarations service for its customers. E1 has significant potential to increase its business, as 40% of E1's revenue comes from trading. One of E1's managers noted, *"Eventually, we can become a broker for other companies. They can make use of our infrastructure to communicate with customs. There is no additional cost for us once we have this infrastructure in place."*
- E1 also plans to expand the use of the E-customs project to its subsidiaries and related companies in countries like Malaysia and Philippines so that it can automate customs declarations for a larger pool of transactions.

C1 (Ceremonial user) is a ceremonial user because C1 is a very small company and was forced to use RosettaNet by its customers. C1 deploys only a few basic PIPs. C1 has only four IT staff members and does not have the capability and experience to create very high integration.

Company Background – C1 is a small manufacturing company and engages in the production and sales of stamped and plated integrated circuits in Singapore. C1 has around 300 employees and achieved more than USD 24 million in revenues last year. C1 has a DOS-based ERP system that is quite old and does not have any EDI functions. C1 uses other E-business systems to be able to respond to its customers.

Antecedents to Adoption – C1's RosettaNet standards implementation was customer initiated. Customers required C1 to support them by using RosettaNet standards. On one hand, C1 wanted to create a good working relationship with these customers so that C1 could obtain more orders from them. On the other hand, C1 had very little choice due to the pressures from the customers. Fortunately, C1 received a grant from IDA to justify the implementation cost.

Adoption and Implementation – Since its IT team is very small, C1 focuses on its own company's activities and does not have much time to participate in RosettaNet activities. In order to implement RosettaNet PIPs, C1 worked with customers to find out what software can be purchased or even obtained from its trading partners. C1 worked with a solution provider to implement RosettaNet standards. In the implementation process, C1's customers have been helpful. One manager of C1 said, *"If our customer just gives requirement, and doesn't want to cover details, I think that will be quite difficult to us."* During the implementation, C1 even formed a project team, including customers, IT vendors, and other technical partners. It implemented the system in six months, and the process was quite smooth. So far, C1 has implemented five PIPs in order, payment, and logistics clusters. It does not plan to expand the implementation because there is no further request from customers.

Benefits – By using RosettaNet standards, C1 can receive the information of the customer's inventory level on a daily basis and help to maintain the optimal inventory level. Without having the inventory information from the customer, there might be either over- or under-stock, which could influence the customer's production plan. When C1 first implemented RosettaNet standards, orders from customers increased in the first two years.

S2 (Signaling user) is a signaling user because S2 deployed more PIPs than the ceremonial user but did not create very high integration. S2 is a big company and has its own E-business system that is not integrated with RosettaNet standards. S2 deployed RosettaNet standards because of the demand from customers.

Company Background – It is a big logistics provider and provides express, freight, and other logistics services in many industries. S2 has its global HQ in the Netherlands, its IT center in the UK, and its regional HQ in Singapore. The company has more than 128,000 employees and achieved more than USD 16 billion in revenues last year. S2 has its own E-business system, which is called customer interface technology (CIT). S2 uses this system to cooperate with customers and receive orders. Customers can easily create an order online using any Internet browser.

Antecedents to Adoption – Before using RosettaNet standards, S2 received most documents (e.g., notification, order) from customers by email. S2 was pushed to adopt the standards by a key customer. This customer has been a strong supporter of RosettaNet standards, a council member of the RosettaNet consortium, and one of the key users of RosettaNet standards PIPs. S2 did not learn too much from the RosettaNet consortium because S2 thought RosettaNet events were not quite relevant.

Adoption and Implementation – In S2, RosettaNet standards are only integrated into the warehouse management system (WMS), which primarily aims to control the movement and storage of materials within a warehouse and process the associated transactions. Although S2 is using the WMS and RosettaNet standards in Asia, this system is not a part of S2's corporate system because S2 provides logistics services in multiple industries that have different products and requirements for automation. Since RosettaNet standards were first initiated by high-technology companies and

have focused on the products, document layout, and business processes in high-technology industries, these standards cannot be used easily in other industries. S2 has implemented seven PIPs in the logistics cluster, and it is implementing five additional PIPs recently. Although S2 has learned a lot from its customers, the knowledge is very specific. Therefore, the knowledge gained from these customers is not so useful for other situations and can only help S2 to better understand the customers' industry and environment.

Benefits – The use of RosettaNet standards have reduced transaction errors and paperwork to some extent, but it did not reduce headcount. S2 thought that the use of RosettaNet standards could lock in the customer and create a better relationship between S2 and the customer. However, this customer insisted that all vendors, not only the logistic providers but also the technical, engineering, and service partners, must adopt RosettaNet standards. The firms that did not adopt the standards could not qualify to do business. Therefore, the use of RosettaNet standards did not lock in this customer who did not feel obligated to S2. In fact, all major logistics providers (e.g., DHL, UPS) have adopted RosettaNet standards; thus, S2 does not have any advantage.

Cross-Case Analysis

Cases within each category (i.e., strategic user, efficient user, ceremonial user, and signaling user) were first compared to each other to discover similarities and variations within each category. This step allowed me to develop a general pattern of findings for each of the major categories of constructs in this study. Results of the cross-case analysis are presented below for the antecedents and their relationship to the adoption, and the relationship between the adoption and benefits.

Antecedents of VIS Standards Adoption

The qualitative results across cases showed how institutional pressures and learning facilitated the adoption.

Coercive Pressures - Out of the four organizations I examined, all organizations noted that they implemented the standards because they were told to do so by customers. In most cases, customers simply told the organizations, *“If you don’t implement the standards, you don’t get our orders”*. A manager of S1 explained that:

“If you want the business, you have to adopt the standards they specify. That is the biggest factor for all the suppliers... for small companies, these big customers sometimes form 70-80% of revenue.”

As noted by E1, the only choice that the organizations had was the extent of their investment in back-end integration. Survey findings support that coercive pressures can influence the extent of deployment, but not the extent of systems and business integration (H1a).

Normative Pressures - The quantitative results show that normative pressures have a partially significant influence on both deployment and integration (H2a and H3a). All four organizations noted normative pressures. For example, a manager of S1 remembered when VIS standards were first introduced to the firm:

“Since then, we have noticed that some big high-tech companies, even like Nokia, Intel, were moving to RosettaNet standards. In Asia, I think that a lot of government bodies are supporting RosettaNet consortium, which encourages the use of RosettaNet standards, so we jumped onto the bandwagon as well.”

Interestingly, normative pressures only have a partial influence in this study, while prior studies have found a significant influence (Teo et al. 2003). One possible interpretation is the lack of benefits from some VIS standards adoption. 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. The quantitative data show that there is a substantial group of ceremonial users, who have gained only moderate operational benefits and low strategic benefits. Due to the close community of RosettaNet, organizations are aware of benefits of RosettaNet standards implementation. Ceremonial users serve to dampen the effect of normative pressures on VIS standards deployment, as organizations note that adopting VIS standards does not automatically mean that they would gain significant benefits. The comments from a manager of C1 support this interpretation:

“I had a feeling that in 2003 or 2004, a lot of people talked about RosettaNet standards in the industry. In these few years, it has kind of quietened down Before we rolled out RosettaNet standards, we thought that the standards would help companies be able to exchange documents more easily. Until now, it is not really happening.”

Another interpretation is that since VIS standards are new emerging technologies, there are no mature values or norms in the community yet, which could also dampen the effect of normative pressures. For example, a manager of S2 said:

“If an industry has a standard and everybody is using it, then it is certainly something that we will adopt. I see the value in RosettaNet standards if all the industries use it. Then it becomes a standard protocol. But even across the high-

tech players, we don't always come across the need to have RosettaNet standards (not all customers ask for it). We do shipments for some big companies like Intel and IBM, but we are not always forced to use RosettaNet. So it really depends on the customers themselves. Until now, personally, I don't see the penetration of RosettaNet standards across industries."

Mimetic Pressures - The quantitative results show that mimetic pressures have a partially significant influence on deployment and a significant influence on integration (H2b and H3b). Three organizations provided diverse comments about mimetic pressures. Two organizations (S1 and S2) agreed that they felt mimetic pressures to adopt the standards. For example, one manager of S2 indicated that:

"I think they (our competitors) are in the same situation as us. Like DHL, they are very proactive. They participated in the RosettaNet consortium. I think they are a council member. Maybe FedEx (participated in RosettaNet consortium) as well. So we also participated in the consortium and tried to be active."

A manager of S1 also pointed out that mimetic pressures influence the organization's decision making:

"If your competitors have the capability to use RosettaNet standards and you don't have it, then you must make this technology available to your customers."

However, another organization (C1) thought that the influence of mimetic pressures was limited and used a wait and see attitude, which explains the partially significant influence on deployment. A manager of C1 said:

“When RosettaNet standards started to catch on and we started hearing about RosettaNet standards adopted by our competitors, it was 3-4 years ago. And we started to look at it and say ‘Should we become a RosettaNet member?’ Honestly, during these 3-4 years, nothing much was developed. Yes, RosettaNet standards are there, and we hear a lot about it, but it didn’t take off like many people thought it would. So we never did participate for one reason or another. I don’t think there is any big loss in hindsight.”

Learning from Standards Consortia - Quantitative data show that learning from standards consortia has a significant influence on deployment (H4a). All four organizations mentioned that they could see the benefits and values of adopting VIS standards, and even get government grant information by participating in some conferences and workshops. Furthermore, some companies joined the milestone programs that were initiated by standards consortia; they then learned more from other members of the standards consortia during program activities. For example, a manager of E1 highlighted that his organization learned from and contributed to the standards consortium when E1 joined a pilot program:

“Some elements required for trade declaration were missing for the PIP 3B18 technical specs. Since we were the pilot implementers of 3B18, we had to conduct technical specification revision of the PIPs themselves.... We had some conference calls with RosettaNet global consortium, worked with their solution team and partners, and provided our feedback to them. We learned a lot through this process, and we feel that we have made a major contribution to RosettaNet too.”

Learning from Trading Partners - Quantitative data show that learning from trading partners has a significant influence on integration (H4b). In addition to exerting pressure, organizations also play a key role in helping trading partners to implement and integrate VIS standards. All four organizations highlighted the importance of help from trading partners. Some of them (S1 and S2) directly learned from customers, while others (E1 and C1) got help from customers when they worked with solution providers.

The qualitative findings suggest that learning from trading partners has multiple functions that facilitate integration. First, learning from trading partners can help organizations to clarify the standards implementation specification. When organizations implement and use IOS, they may use very different things in certain fields. Without a clear specification, suppliers could provide data that do not match customers' needs. Some important identifiers could be missing, which are necessary for mapping data into the backend system. Thus, trading partners must mutually understand specifications in order to achieve high integration. A manager of S1 explained the reason and provided an example:

“And then we will exchange the PIPs specifications with our customers. They (the customers) will give us the specification, and we also exchange our connectivity profiles. We also discuss about the implementation specification. We like to know ‘what does it mean to them if we use RosettaNet standards in this particular field’. So we’ll have to understand the PIPs specifications in the context of different customers’ business processes, even though we are using the same PIP across customers.”

“Like PIPs for orders. There are so many different versions. For instance, for some segments like address, some customers would use a code, while others

prefer to enter the full address. From company to company, the implementation may be different, so this is where the challenge is.”

Second, learning from trading partners can help organizations to understand the internal business process of trading partners. In order to create high business integration, organizations need to understand both their own and trading partners' business processes. A manager of S2 indicated that:

“Customers have different business processes, which we then have to understand and manage. The technical details of PIPs messages are easy; our IT (staff) can do it. We don't need to get involve. The challenge is in figuring out what the message does for us, what the message means to us? That is the challenge because we have to understand where this message comes from, when it comes in, what the timeline is, and how to respond. It is in the customer's interest to help us to understand the standards better before we can setup the system properly. They are very responsible, helpful and proactive.”

Third, integrating IOS that implement VIS standards with back-end systems often requires major modifications or development of new applications, thereby adding significant technical challenges for organizations. It will be very difficult for suppliers if customers just ask suppliers to adopt the PIPs but do not discuss implementation and use details. Customers can directly help or cooperate with solution providers to provide support. A manager of S1 explained how S1 helped its suppliers:

“Normally, suppliers will engage with solution providers. The solution providers will work with us. And then we will help them. On the other hand, the solution providers will make it (the implementation) as easy as possible to suppliers.”

Although all interviewees agreed that learning from trading partners is helpful, a manager of S2 also suggested that the knowledge of implementing the standards for one customer might not be translatable to implementations for other customers:

“You will learn. The question is whether the knowledge from them is useful for other situations because you learn about the process of a specific customer. When you go down to that level to get much more details, it helps you to understand that kind of industry and environment better. Some of those threats are common to other players in the same industry. Yes, you do learn a little bit more. Down to the low level, (the knowledge) becomes very specific, so that is not translatable to another customer”

Benefits of VIS Standards Adoption

The qualitative cross-case analysis also provided support and further insights on the relationship between the VIS standards adoption and operational and strategic benefits.

Operational Benefits and Integration - Consistent with the quantitative findings, the qualitative data support that operational benefits are positively related to standards integration (H5a). All four organizations mentioned that VIS standards integration reduced manual data entry, paperwork, and errors. For example, when E1 was implementing RosettaNet standards, the management decided to make the necessary investments to integrate the standards with its internal ERP system. While this took a

lot of work and resources, E1 has realized significant benefits from the integration. A manager of E1 compared the new system based on RosettaNet standards with the old EDI-based system:

“The biggest incentive is to allow the customs declaration process to integrate into our ERP. Our ERP has comprehensive and integrated information. Resource and utilization information is already in the ERP. Using the prior Tradenet system [used for customs declarations in the past], we need to manually re-key information from our ERP system to Tradenet system. That wastes a lot of time and create many errors.”

Strategic Benefits and Integration - The qualitative data also support that strategic benefits are positively related to standards integration (H5b). When organizations create high integration, they not only generate better relationships with trading partners but also build up related IT and business capabilities. Furthermore, they can create more business opportunities based on the increased capability. Only S1 and E1 confirmed that they got more strategic benefits. For example, E1’s IT team learned from a solution provider in the initial PIPs implementation and integration. After that, they gained the in-house capability to implement and integrate RosettaNet interface and implemented subsequent RosettaNet PIPs by themselves. In a recent E-customs project, E1 explored more business opportunities that went beyond the connection with the Singapore government:

“PIP 3B18 [RosettaNet PIPs for Customs Declaration] opens a new door of opportunity externally and internally. We now can consider handling trade

declarations for our subsidiaries and related business. We may even expand to handle trade declarations overseas (e.g., Trade declaration in Malaysia)”

Operational Benefits and Deployment - Interestingly, the quantitative analysis indicates that operational benefits are negatively influenced by a wider extent of deployment (H5c) when integration is controlled. After deploying some VIS standards sets, E1 and S2 noticed this problem of wide deployment without integration. In contrast, C1 did not have wide deployment, and S1 created very high integration; therefore, they did not have this problem. Based on the qualitative data, I present multiple explanations about the negative effect of high deployment. First, if organizations deploy more standards sets without integration, they must operate and manage all the systems individually and separately. As a result, users have to log on to many different systems to download orders, which creates much manual intervention and inefficiency. As noted by a manager of E1 about the separate systems:

“It came to a point where it was just too much. Users were spending all their time downloading purchase orders from so many different systems.”

Second, many organizations use different types of E-business systems. Although they think that VIS standards have technical advantages, these organizations have no intention or ability to create a consistent standards platform. Thus, the more standards sets they deploy, the more complex combinations they create. For example, organizations may have VIS standards, EDI, and web-based systems at the same time,

which makes it difficult to communicate among these systems. S2 provides logistics services in multiple industries; one manager said:

“We don’t go into a large amount of RosettaNet implementations for high-tech (industries) because we provide [logistics] services in many different industries. Across industries, the level of [B2B] automation is all different. Although we are using (RosettaNet) here in Asia, it is actually not part of our corporate system because RosettaNet is unable to cater to the needs of our centralized system. So in Asia, we develop our own warehouse management system. We customize the processes, so that the system can manage, operate, and deal with what we are working on here in Asia. And we build the RosettaNet interface using that system. So RosettaNet has never fully penetrated our company. It is only at this local level, and it is only because the customer wants it.”

Strategic Benefits and Deployment - The quantitative analysis indicates that strategic benefits are positively influenced by a wider extent of deployment (H5d). All four organizations mentioned that they tried to establish better relationships with customers by deploying more RosettaNet PIPs. The wide extent of deployment indicates high relationship-specific investments that represent an important advantage (Subramani 2004). For example, C1 is a supplier of S1, and C1 obtains more business by deploying more standards sets and keeping S1 happy. A manager of C1 said:

“Our customers usually require us to support them. Or rather we want to create a good working relationship with our customers to get more orders from them.... When we first implemented RosettaNet standards, we saw that for the first one to two years, orders did increase”

A manager of S1 confirmed that the company gave more business to the suppliers that used RosettaNet standards:

“...because it is more convenient. The (connection through RosettaNet) is already there, so we (the business department) will buy more from this supplier. Once you have the link, you can have more business with trading partners. At least this is one of the hopes of using the standards”.

Organizations can also obtain more strategic benefits by cooperating more comprehensively and deeply in wide business processes. For example, E1 expanded the use of VIS standards to many business processes of ordering, manufacturing, and logistics. The wide use of VIS standards provided strategic advantages to E1, as it put in place the infrastructure to offer additional services (e.g., customs declaration) to customers and other companies in countries like Malaysia and Philippines. Therefore, E1 has significant potential to increase its business, as 40% of its revenue comes from trading. A manager of E1 said:

“Eventually, we can become a broker for other companies. They can make use of our infrastructure to communicate with customers at no additional cost, since we have the infrastructure in place”.

Table 5-2 presents the major qualitative findings. The qualitative analysis has provided support for research hypotheses and some additional insight on quantitative findings. For example, the qualitative analysis provides a reasonable interpretation of the partial influences of mimetic and normative pressures. Furthermore, the qualitative analysis presents multiple functions of learning from trading partners. Finally, the cross-case analysis also shows real examples of how different adoption

behaviors influence operational and strategic benefits that standards users can get. In the next chapter, I will discuss the implication of my dissertation based on both quantitative and qualitative findings.

Table 5-2: Summary of Major Qualitative Findings

	Major Qualitative Findings
Coercive pressures	All organizations noted that they implemented the standards because they were told to do so by customers. The only choice that the organizations had was the extent of their investment in back-end integration. Survey findings support that coercive pressures can influence the extent of deployment, but not the extent of systems and business integration.
Mimetic pressures	Mimetic pressures feature in interviewees' comments about what influenced their decision to adopt RosettaNet. Organizations considered the possibility of losing their customers to competitors with the RosettaNet capability.
Normative pressures	Normative pressures appeared to be less of a push factor for the interviewees, mainly because most felt that the technology was not mature enough to constitute an industry wide standard to make them jump onto the bandwagon just to follow others in the industry.
Learning	While learning from other standards consortium members was important to gain an understanding about the RosettaNet standards, interviewees also highlighted that it was really learning from their trading partners that facilitated both systems and business integration.
Operational benefits	Qualitative results show that simply deploying VIS standards without integrating the standards can have negative effects on achieving operational benefits. Several interviewees highlighted problems with deploying more standards sets without integration and noted the inefficiencies with operating and managing all the systems individually and separately. When users have to log on to many different systems to download orders, it creates much manual intervention and inefficiency.
Strategic benefits	Interestingly, I found that although deployment did not significantly influence operational benefits, it had a significant positive influence on strategic benefits. I hypothesized that organizations were reaping the benefits of relationship-specific investments. The interviewees, similarly, mentioned the benefits of "keeping their customers happy".

CHAPTER 6 DISCUSSION AND CONCLUSION

This dissertation conceptualizes two dimensions of VIS standards use – extent of deployment and extent of integration. I examine how institutional pressures and learning from other organizations influence the extent of VIS standards deployment and extent of integration, on one hand, and how these two dimensions relate to operational and strategic benefits, on the other.

The analyses show that coercive pressure significantly influenced standards deployment, but did not have any significant influence on standards integration. This shows that coercive pressure can only make organizations adopt and deploy the VIS standards, but will not influence organizations' decisions to invest in integration. In view of the results about the benefits from deployment and integration, it shows that organizations that respond to coercive pressure to deploy the VIS standards without integration will not enjoy operational or strategic benefits.

Both normative pressures and mimetic pressures only marginally influenced standards deployment. These finding should be interpreted in light of the results on the benefits from deployment and integration. 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 (Swanson and Ramiller 2004). There is a substantial group of VIS standards adopters who only adopt the standards ceremonially, and are not able to gain benefits from using VIS standards. This group of organizations may thus serve to dampen the effect of normative and mimetic pressures on VIS standards deployment, as organizations are aware that adopting the VIS standards does not automatically mean that they would gain the benefits from adoption.

In contrast, learning from other standards consortium members is positively and significantly associated with the extent of standards deployment while learning from trading partners was shown to be positively and significantly related to systems and business integration. This highlights the need for researchers and organizations to become more cognizant of the importance of helping organizations reduce the knowledge gap in IT assimilation (Swanson and Ramiller 2004). It may be more effective for the standards consortium and trading partners to help organizations learn about the benefits of VIS standards adoption, and how the benefits can be achieved through the VIS standards implementation process, rather than to use pressure tactics that work on the basis of imitation, isomorphism or coercion.

In addition, mimetic pressures were shown to significantly influence integration, whereas normative pressures were shown to have only marginal influence on integration. This may be because organizations place significant emphasis on following their competitors that have shown that they have obtained benefits from integration. Hence, the imitation effect is much stronger with respect to competitors compared to other standards consortium members.

In terms of the outcomes of deployment and integration, the analyses show that only users who integrate the VIS standards to their backend systems and who change the business processes as part of the integration and implementation effort reap operational benefits from using VIS standards. A wide extent of deployment alone is even negatively associated with operational benefits. This highlights that the investment in integration is critical for organizations to reap the operational benefits; ceremonial users who adopt VIS standards only for symbolic reasons to signal their commitment to their trading partners, without investing in integration do not get any operational benefits from using VIS standards. In contrast, I found that deploying

standards set widely can bring about strategic benefits for organizations. This shows that VIS standards provide the opportunities for organizations to invest in generating relationship specific assets, learn more about their trading partners and signal their commitment to the relationship.

Implications for Research

My dissertation contributes to the literature in three distinct ways. First, while deployment and integration have individually received attention in prior IOS literature (Bala and Venkatesh 2007; Rai et al. 2006; Yi et al. 2005; Zhu and Kraemer 2005), they have not yet been examined together. Deployment and integration represent different dimensions of VIS standards use, and each dimension emphasizes its own set of considerations and impacts. It is necessary to examine the effect of deployment and integration at the same time, as they are both important dimensions of organizations' VIS standards adoption decision. My dissertation therefore, examines the trade-offs involved in organizations' decisions relating to each dimension, both in terms of their antecedents and their outcomes. By examining the antecedents and outcomes on both dimensions of deployment and integration simultaneously, we are able to understand and interpret the results regarding the differential effects of the antecedents based on the benefits provided by deployment versus integration and vice versa.

Second, I extend prior research on the socio-political perspective, which tends to focus on the effects of institutional pressures on organizations' IOS adoption decisions. I show that third party organizations, such as trading partners and other standards consortium members have a wide ranging influence on different aspects of an organization's VIS adoption decisions. In addition to institutional pressures,

organizations are also influenced by other organizations through learning opportunities provided by trading partners and other standards consortium members. I found that learning from trading partners increases the level of systems and business integration, whereas learning from other standards consortium increases the level of standards deployment. Some studies, in fact, appear to implicitly subsume the arguments relating to the learning perspective in the arguments for normative pressure. For example, Teo et al. (2003) noted that “a focal organization with direct or indirect ties to other organizations that have adopted an innovation is able to learn about that innovation and its associated benefits and costs, and is likely to be persuaded to behave similarly” (p. 24). Liang et al. (2007) also noted that “by developing *guanxi* with managers of other organizations..., top management creates an interorganizational network within which greater resources, knowledge, and management expertise can be accessed” (p. 66). I thus provide greater theoretical clarity by teasing out the impact of learning from trading partners and other members of the community, vis-à-vis normative and other forms of institutional pressures, which essentially states that organizations can be pressured into adopting technologies to increase legitimacy and status within the group. My dissertation also shows that both learning from other organizations and institutional pressures (in its different forms) differ in their influence on standards deployment versus standards integration.

Finally, by examining the operational and strategic benefits arising from VIS standards deployment and integration, I broaden the view of why and how organizations generate benefits from using IOS. The results show that only integration brings about operational benefits. A wide extent of deployment, on its own, can be even negatively related to operational benefits. On the other hand, both integration and wide deployment are positively and significantly associated with strategic

benefits. My dissertation show the value of examining the differential benefits arising from different dimensions of VIS standards use, as this broadens our perspective of how different aspects of technology adoption decisions may result in positive or negative benefits for the firm.

Implications for Practice

My dissertation has several practical implications. First, the empirical results show that simply deploying VIS standards without investing in integration generate limited operational and strategic benefits. Hence, when implementing VIS standards, organizations need to make the necessary investments to integrate standards with their internal system and business process. Further, firms 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. For example, E1 has a very focused and well-defined project scope that can decrease project risk. And it is in line with E1's overall long-term B2B strategy and initiative, where each small and focused project builds E1's long term capability. Each project success also provides confidence to both the top management and system users to continually invest in upgrading and expanding the implementation of RosettaNet. Thus, my dissertation highlights how implementing VIS standards in a step-by-step approach (e.g., Start small, build a series of focused but successful projects) allows an organization to use their prior experience to update their perceptions and increase their technical capabilities for further standards deployment and integration.

Second, this dissertation highlights that exerting coercive pressures on organizations will only influence organizations' deployment decisions, but does not influence their integration decisions. In view of the results about the benefits from deployment and

integration, the results show that organizations that respond to coercive pressures to deploy a few VIS standards without integration will not be able to enjoy operational or strategic benefits. 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 significant 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. By educating suppliers about how the VIS standards can help them instead of simply coercing them into adopting the standards, supply chain master increase suppliers' commitment to implement VIS standards, which raise the amount of resources they are willing to spend on the deployment and integration. For example, when S1 asked suppliers to use E-business, it gave different options:

"They (suppliers) can go through this portal. It is a cheap solution for them and requires less maintenance. We provide them with alternatives. We do not say that they must buy all the middleware. In that sense, they can reduce their capital cost."

And sometimes S1 also considers the benefits in the view of suppliers. For example, RosettaNet consortium initiated a new program for small firms, but S1 had a different opinion to push the program among its suppliers.

“We looked at it (as an alternative to the existing portal solution), but we think it doesn’t really benefit the small companies because it is just using the PDF. You open the document, edit it, save it, and send it back. Eventually, it is still not integrated to their backend system.”

In addition, the results also show that the community’s influence on encouraging standards adoption should not be limited through normative and mimetic pressures. Instead, standards consortia should provide more learning opportunities and help organizations to understand the value of VIS standards.

Limitations and Future Research

My dissertation should be interpreted in view of the following limitations. First, the survey sample consists predominantly of the RosettaNet consortium members. There are other organizations that have implemented RosettaNet who are not RosettaNet members. In fact, such organizations are even more likely to be ceremonial users than organizations in my research sample, as these organizations have not even bothered to become a RosettaNet consortium member. Based on my theory, I would expect such individuals to obtain even less operational and strategic benefits from using RosettaNet PIPs. The cluster analysis results (Appendix 4) show that even the ceremonial users in the pool of respondents had a reasonably high level of integration (2.99), operational benefits (3.19) and strategic benefits (2.53). Hence, it is likely that non-RosettaNet members will score even lower in terms of the level of integration and benefits obtained. Nevertheless, I am able to establish that my research model appropriately explains standards deployment and integration for the sample, which

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

Second, I have acknowledged the limitation of the small sample size in my study. Because VIS standards are a new emerging technology, the target population of RosettaNet adopters was not large. Given that I was targeting RosettaNet adopters in the Asia region, it effectively halved the potential target population. Thus, the 62 responses I obtained should be representative of the target population I am studying. Other VIS standards studies have also had the same problem of sample size. For example, a recent ISR paper that collected data from the RosettaNet champions at each enterprise (Malhotra et al., 2007) received responses from 13 enterprises.

Third, as this study is conducted using cross-sectional survey data, the usual caveats relating to the limits to the ability to draw definitive conclusions about causality apply. Nevertheless, the research framework proposes that various environmental factors (institutional pressures and learning) 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 mitigates 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.

Fourth, this dissertation focuses on organization-level analysis. However, VIS standards may provide benefits not only to individual organizations, but to the entire supply chain. Alternatively, while the benefits may be focused on one or two organizations in the supply chain, prior research has not examined whether the supply chain, considered as a whole, gains more benefits from using VIS standards. Hence, future research should consider the use of IOS and the adoption of VIS standards, not only from the point of view of individual organizations, but also from the point of view of the entire supply chain. One way to approach this would be to examine a network of organizations within a supply chain.

Finally, this dissertation shows that learning from trading partners increases the level of systems and business integration, whereas learning from standards consortia increases the level of standards deployment. This highlights the importance of examining the role of inter-organizational learning in IOS and VIS standards adoption. There is, however, potential for further study to expand in greater detail the role that inter-organizational learning plays. For example, given that VIS standards adoption is an ongoing process, learning from trading partners and standards consortia may have different effects in different stages of this process. Besides these two types of learning, organizations also can learn from their experience. Thus, future study can explore how different types of learning work in different stages of the whole VIS standards adoption and implementation process, and what the different consequences are.

Conclusion

Extending prior research on IOS use, this dissertation differentiates 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. I examine how various external agencies (Trading partners vs. Standards consortia) influence the extent of deployment and integration of the VIS standards in different ways, drawing on Institutional theory and the literature on inter-organizational learning. I also examine how VIS standards deployment and integration differentially influence operational and strategic benefits that standards users obtain. The hypotheses are tested using survey data collected from organizations in Asia who have implemented RosettaNet standards. In addition, I also conduct a qualitative analysis to complement the quantitative findings and further interpret the theory model. My dissertation thus extends the socio-political perspective on IOS adoption, by examining how the learning perspective complements the institutional pressures perspective. I also contribute to the literature by generating insights into the trade-offs for standards deployment and integration as two dimensions of standards use – both in terms of their antecedents as well as their outcomes.

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APPENDIX 1. ITEM MEASURES

Research construct	Measures
Strategic benefits	<p>To what extent do you agree that these results follow from the use of RosettaNet PIPs:</p> <p>SB1. We learn a lot about this customer (e.g., buying patterns)</p> <p>SB2. We learn a lot about the markets for our products</p> <p>SB3. We develop new business opportunities with this customer</p> <p>SB4. Purchases from my firm are increasing from this customer</p>
Operation benefits	<p>To what extent do you agree that these results follow from the use of RosettaNet PIPs:</p> <p>OB1. Sales cycle time is reduced</p> <p>OB2. Inventory cost is reduced</p> <p>OB3. Productivity is improved through automation</p> <p>OB4. Greater return on investment in our supply chain is achieved</p> <p>OB5. Operations costs is reduced</p> <p>OB6. We get timely and accurate information for decision making</p> <p>OB7. Clerical efficiency is improved through reduced paperwork</p>
VIS standards deployment	<p>How many PIPs have you implemented in each of the RosettaNet Clusters (i.e., Order, Payment, Logistics, Demand Creation, Manufacture, Design, and Forecast)?</p>
VIS standards integration	<p>To what extent do you agree with the following statements:</p> <p>BI1. Redundant activities have been removed from the inter-organizational business processes that cross my firm and the customer.</p> <p>BI2. The gaps and conflicts between business processes of my firm and the customer have been solved</p> <p>BI3. Our internal business processes facilitate our communication and cooperation</p> <p>BI4. Feedback about the problems relating to inter-organizational business processes across my firm and the customer are handled in a timely manner</p> <p>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</p> <p>SI1. Data from the customer must be re-keyed, as they are used and reused by different employees within my firm (Reversed)</p> <p>SI2. Electronic data flows smoothly from RosettaNet system into our</p>

	internal ERP system
	SI3. Our internal systems can easily transmit and process data from the customer.
Coercive pressures	<p>With regard to my main customers that have adopted RosettaNet PIPs,</p> <p>CP1. My firm's well-being depends on their purchases.</p> <p>CP2. My firm MUST maintain good relationships with them.</p> <p>CP3. They are the largest customers in the industry</p> <p>CP4. These customers have great influence on our firm's decision of whether or not to adopt RosettaNet PIPs</p>
Mimetic pressures	<p>With regard to my main competitors that have adopted RosettaNet PIPs</p> <p>MP1. They have benefited greatly.</p> <p>MP2. They are perceived favorably by others in the same industry.</p> <p>MP3. They are perceived favorably by their customers.</p> <p>MP4. RosettaNet PIPs are widely adopted by our firm's competitors</p>
Normative pressures	<p>To what extent do you agree with the following statements:</p> <p>NP1. My perceptions of RosettaNet PIPs' usefulness are influenced by the views of other RosettaNet Members</p> <p>NP2. Participating in RosettaNet consortium generates some pressure on our organization to adopt RosettaNet PIPs</p>
Learning from trading partners	<p>To what extent does your organization participate in the following activities:</p> <p>PC1. Routine meetings with customers on issues of RosettaNet PIPs use</p> <p>PC2. Engage help on private business process reengineering (BPR) from customers</p> <p>To what extent does your organization learn from the following activities:</p> <p>LC1. Routine meetings with customers on issues of RosettaNet PIPs use</p> <p>LC2. Engage help on private business process reengineering (BPR) from customers</p>
Learning from standard consortia	<p>To what extent does your organization participate in the following activities organized by the RosettaNet consortium:</p> <p>PR1. Conferences /Workshops / Seminars / Forums, etc</p> <p>PR2. Personal communication with other members of RosettaNet</p>

consortium --- e.g. sharing experience or asking advice of RosettaNet PIPs?

To what extent does your organization learn from the following activities organized by the RosettaNet consortium: (1 = very low; 5 = very high)

LR1. Conferences /Workshops / Seminars / Forums, etc

LR2. Personal communication with other members of RosettaNet consortium --- e.g. sharing experience or asking advice of RosettaNet PIPs?

Firm Size How much is your sales revenue? (Less than US\$1 mill. -- US\$1 mill. to US\$10 mill. -- US\$10 mill. to US\$100 mill. -- US\$100 mill. to US\$ 1 billion -- More than US\$1 billion)

How many employees do you have? (Less than 50 -- 50 to 99 -- 100 to 999 -- 1,000 to 5,000 -- More than 5000)

IT capability What is the ratio of number of PCs per employee? (Below 1/10 -- 1/10 – 1/5 -- 1/5 – ½ -- 1/2 – 1 -- Above 1)

How many IT professionals do you have? (Below 10 -- 10-50 -- 50 – 100 -- 100 – 500 -- Above 500)

Experience How many years of experience does your organization have with automated communication systems (e.g., EDI)? ____ Years

How many years of experience does your organization have with RosettaNet PIPs?

____ Years

Cost What is your organization's investment in systems implementing RosettaNet PIPs?

Below US\$5 K -- US\$5 K to US\$20 K -- US\$20 K to US\$100 K -- US\$100K to US\$1M -- Above US\$1 M

APPENDIX 2. INTERVIEW PROTOCOL

- When was the RosettaNet PIPs implemented?
- Why did you implement RosettaNet PIPs (Benefit-driven, customers' pressure, or other reasons)?
- What were your expected benefits before you implemented RosettaNet PIPs?
- What were the actual benefits after you implemented RosettaNet PIPs?
- How did you implement the RosettaNet PIPs? How did you learn from your implementation experience?
- Do you consider implementing another PIP? Why?
- How did you decide about which PIP or PIPs to implement?
- Why did you [or did you not] implement subsequent PIPs which are related to the PIPs that you already implemented?
- How were the factors influencing the implementation of the latest PIP different from the previous PIP you implemented?
- Do you feel pressures to implement new PIPs now? What is your response?
- What did you learn from your trading partners and other members of standards consortium about PIPs? Is the learning helpful?

APPENDIX 3. ITEM LOADINGS AND CROSS LOADINGS

	Coercive pressures	Mimetic pressures	Normative pressures	Integration	Learning from trading partners	Learning from consortia	Operational benefits	Strategic benefits
CP1	.830	.443	.349	.360	.423	.175	.22	.367
CP2	.824	.189	0	.253	.196	.235	-.022	.211
CP3	.803	.347	.088	.233	.234	.341	.127	.214
CP4	.840	.364	.033	.244	.307	.12	-.035	.161
MP1	.232	.674	.249	.322	.1	-.01	.207	.254
MP2	.396	.890	.194	.488	.277	.086	.271	.238
MP3	.352	.700	.191	.326	.216	.013	.177	.187
MP4	.244	.703	.337	.264	.154	.193	.229	.279
NP1	.102	.184	.698	.172	-.044	-.047	.086	.164
NP2	.173	.310	.995	.266	.175	-.003	.155	.214
BI1	.256	.589	.358	.836	.403	.322	.605	.552
BI2	.373	.461	.144	.812	.527	.347	.531	.548
BI3	.184	.324	.154	.734	.310	.103	.567	.529
BI4	.16	.406	.157	.805	.603	.339	.527	.665
BI5	.115	.252	.137	.649	.613	.253	.299	.537
SI1	.392	.318	.087	.802	.573	.276	.546	.516
SI2	.258	.166	.162	.636	.167	-.001	.620	.280
SI3	.242	.282	.396	.579	.13	.026	.520	.195
PC1	.286	.257	.213	.624	.914	.593	.236	.730
LC1	.18	.313	.271	.481	.693	.563	.199	.688

PC2	.268	.428	.15	.497	.791	.635	.22	.564
LC2	.404	.523	.266	.471	.763	.652	.116	.658
PR1	.045	.251	.05	.446	.479	.582	.307	.401
LR1	-.116	.231	.172	.288	.122	.695	.369	.129
PR2	.261	.236	.059	.295	.419	.897	.056	.493
LR2	.350	.165	-.103	.318	.132	.686	.129	.119
OP1	.107	.157	.19	.432	.027	-.144	.737	.253
OP2	.232	.287	.23	.555	.155	-.075	.822	.477
OP3	-.037	.265	-.025	.526	.192	.106	.795	.330
OP4	-.013	.238	.231	.387	-.155	-.21	.801	.25
OP5	.056	.221	.032	.567	.014	-.109	.899	.313
OP6	.162	.347	.024	.586	.431	-.032	.728	.470
OP7	.048	.248	.202	.782	.255	.19	.749	.405
SB1	.269	.197	.157	.680	.724	.606	.366	.898
SB2	.21	.182	.217	.518	.609	.483	.335	.870
SB3	.241	.437	.169	.678	.562	.353	.556	.893
SB4	.350	.207	.232	.330	.237	.386	.316	.760

APPENDIX 4. CLUSTER ANALYSIS OTHER ANALYSES

Subsequent cluster analysis and sub-group comparisons were conducted to further support survey result and case site selection. In order to determine the clusters, I follow the literature and conducted the three steps: (1) the identification of variables for grouping, (2) the algorithm to be used for placing similar objects into clusters, and (3) the number of clusters to be generated (Premkumar et al. 2005).

In my study, the research model drove the selection of variables: deployment and integration. The second decision involves choosing between two broad categories of clustering algorithms - hierarchical and nonhierarchical or k-means cluster. Researchers recommend combining the two procedures by using the hierarchical method to establish the number of clusters and cluster centroids, and then using centroids as seeds in the nonhierarchical method (Punj and Stewart 1983). I used a similar two-step approach in this study. To choose the number of clusters, I used the proposed two-by-two framework to set the number of cluster to four. The program (SPSS) then determines the cluster membership for each organization automatically. I then use this cluster membership list to select my case sites.

Using Two-Step cluster analysis, I found four clusters of VIS standards users. These four clusters of users map onto the ceremonial users, efficient users, signaling users and strategic users hypothesized in the theory section. Table A-1 shows the profile of the four groups of VIS standards users, the mean operational and strategic benefits obtained from RosettaNet implementation, and the average number of trading partners that are connected with RosettaNet standards.

Table A-1: VIS Users Cluster Distribution

	Narrow deployment	Wide deployment
Low integration	No. of ceremonial users : 15 Mean PIPs deployment: 3.93 Mean integration: 2.99 Operational benefits: 3.19 Strategic benefits: 2.53 No. of Connections: 4	No. of signaling users : 6 Mean PIPs deployment: 7.50 Mean integration: 3.26 Operational benefits: 3.27 Strategic benefits: 2.95 No. of Connections: 31.8
High integration	No. of efficient users : 26 Mean PIPs deployment: 4.42 Mean integration: 3.91 Operational benefits: 3.92 Strategic benefits: 3.25 No. of Connections: 11.4	No. of strategic users : 9 Mean PIPs deployment: 20.78 Mean integration: 4.33 Operational benefits: 4.19 Strategic benefits: 4.27 No. of Connections: 44

* Four companies were excluded in this analysis because they did not provide completed information

Using Pairwise T test, I had some interesting findings about the differences between the four subgroups for their ratings of operational benefits and strategic benefits from using RosettaNet standards (Table A-2) that further supported my hypotheses. For example, although the cluster analysis results show that the strategic users – with high deployment and high integration had the highest level of strategic benefits, the level of operational benefits obtained was not significantly higher than the efficient users. This is in line with the negative influence of deployment on operational benefits (H5c), controlling for the extent of integration. Likewise, although ceremonial users and efficient users deployed similar number of standards sets, efficient users had much higher integration. Consequently, the level of operational benefits and strategic benefits obtained by efficient users was significantly higher than the ceremonial users, which supported both H5a and H5b.

Table A-2: Pairwise T test of Operational and Strategic Benefits

Comparison	Operational Benefits		Strategic Benefits	
	Mean difference (I - J)	P value	Mean difference (I-J)	P value
I = Strategic Users J = Efficient Users	0.267	0.657	1.018	0.000*
I = Strategic Users J = Ceremonial Users	0.996	0.001*	1.744	0.000*
I = Strategic Users J = Signaling Users	0.929	0.024*	1.319	0.001*
I = Efficient Users J = Ceremonial Users	0.729	0.002*	0.726	0.002*
I = Efficient Users J = Signaling Users	0.661	0.041*	0.301	0.675
I = Ceremonial Users J = Signaling Users	-0.067	0.995	-0.425	0.451

I also indicate the number of connections in Table A-1, which represents the number of external trading partners with whom an organization has established RosettaNet connections with. The number of connections is an important tactical consideration because it indicates how successful a firm has been in establishing electronic linkages to interact with customers, suppliers, logistics, financial institutions, and government agencies (Massetti and Zmud 1996). The more receptive an organization is to establishing such electronic relationships, the more likely that organization is to be successful in adapting and competing within the emerging electronic marketplace (Jelassi and Figon 1994). On average, strategic users connected more trading partners than efficient users (44 vs. 11.4), and efficient users connected more trading partners than ceremonial users (11.4 vs. 4).

Further, I explored the types of standards set that different users deployed. Based on the complexity of the E-business process, RosettaNet consortium defined three levels of business process and developed PIPs catering to the business processes.

Transactions (Least complex) – The business processes in this level focus on ordinary transactions. The information is used to initiate E-business activities in the supply chain. Information flow and content is pre-determined. Most PIPs in order and payment clusters belong to this level.

Visibility (Medium complex) – The business processes in this level improve the visibility of supply chain and the optimization of the supply network. The information shows supply-chain activity for trading partners to monitor, analyze and refine E-business. Information flow and content is pre-determined. Most PIPs in logistics and demand creation clusters belong to this level.

Collaboration (Most complex) – The business processes in this level (e.g., forecasted inventory management) have the most uncertainties and thus have the highest complexity. The exact flow and content of the information exchange is dynamic (not pre-determined). Most PIPs in design, forecast and manufacture clusters belong to this level.

Based on this classification, I summarized the different types of standards set (i.e., PIPs) deployed by different standards users in Table A-3.

Table A-3: Types of Standards Deployment

Interestingly, I found that most PIPs deployed by ceremonial users were “Transactions” related (over 80%). Efficient users deployed more “Visibility” and “Collaboration” PIPs (over 30%) than ceremonial users. And strategic users deployed the most “Visibility” and “Collaboration” PIPs (over 50%). Firstly, it is not a surprise that both efficient users and ceremonial users deployed more “Transactions” PIPs because these PIPs are relatively easy to implement and use, and the organizations can use them to automate the ordinary transactions immediately.

Furthermore, I found that the types of standards set that different users deployed may also influence the benefits they obtained. For example, efficient users deployed more “Visibility” PIPs, which enabled them to collect and analyze distributed supply chain events, such as delayed shipment; to generate specific recommendations, such as expedited shipment; and to reach predefined supply chain business goals, such as on-time delivery. Such visibility can considerably improve the efficiency of supply chain execution and planning. Thus, efficient users get more benefits than ceremonial users. Beyond enabling visibility, “Collaboration” PIPs provide intensive cooperation scenarios among a few trading partners, which exhibit collaboration and real-time interactions at a much higher degree than other PIPs. For example, customer involvement in product design, forecast, manufacture and dynamic logistics planning are several business processes that require intense real-time collaboration and interactions across the whole value chain. Once organizations successfully implement these PIPs and related IOS, they will obtain significant relationship-specific domain knowledge and capabilities that competitors cannot have. And consequently, they will get the maximum operational and strategic benefits.