Chapter 19

Modularized Interoperability in Supply-Chains: A Co-adoption study of RosettaNet's XML-based Inter-organizational Systems

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Abstract: The factors that influence an organization's decision to begin using a certain type of technology have come under much study. Several theoretical models, commonly referred to as technology diffusion models, have been developed to better understand the role of these factors in the adoption, diffusion and infusion of certain types of technology. The benefits of this line of research are pervasive and the opportunities are clear. Managers gain insight as to why a technological innovation may diffuse quickly, or may stagnate. Researchers gain insight into factors causing greater assimilation depths or wider adoption breadths. Managers may find the opportunity to influence or predict these factors. Researchers may detect common influential factors across several technology types and generalize their models to a broader scope. This paper introduces an innovation diffusion model regarding a recent technological innovation known as XML-based interorganizational systems. A theoretical framework is proposed to assess the influential factors leading toward adoption and internal diffusion of the target technology. The factors under study include compatibility, relative advantage, environment and three control variables (seller versus buyer, technology conversion type, and location in supply chain). A case study utilizing RosettaNet's Partner Interface Process is presented, the results are compared to the theoretical model, and the findings stated. Overall the findings indicate substantial improvements in all financial and operational measures (ROI, transaction cost, payback, cycle time and through-put). Further, significant indirect benefits include: information ubiquity, improved employee morale, improved time allocation towards value-added activities, and significant product cost savings on the part of the buyer organization. Overall, *environmental* factors and the lack of *compatibility* with the old processes jointly resulted in the organizations' adoption of RosettaNet-based solutions. The *relative advantage* construct was

determined to be the key factor that would sustain interest in the target technology likely leading towards greater internal diffusion. The paper concludes with several managerial implications and recommendations for future research.

Key words: Innovation diffusion, IT Adoption, Supply Chain Interoperability, Interorganizational systems, and XML

1. INTRODUCTION

The factors that influence an organization's decision to begin using a certain type of technology have come under much study. Several theoretical models, referred to as technology diffusion models, have been developed to better understand the role of these factors in the adoption, diffusion and infusion of technology innovations. The benefits of this line of research are pervasive and the opportunities are clear.

- Managers can gain insight as to why a technological innovation may diffuse quickly, or may stagnate (Fichman and Kemerer 1999, Cho and Kim 2002).
- Researchers can gain insight into factors causing greater assimilation depths or wider adoption breadths (Cho and Kim 2002, Fichman and Kemerer 1999, Fichman 2001, Hart and Saunders 1998).
- Managers may find the opportunity to influence or predict these factors (Davis, et al 1989, Lucas and Spitler 1999, Rai and Bajwa 1997).
- Researchers may detect common influential factors across several technology types and generalize their models to a broader scope (Fichman 1992, Cooper and Zmud 1990)

This paper introduces an innovation diffusion model regarding a recent technological innovation of XML-based interorganizational systems (IOS). A theoretical framework is proposed to assess the influential factors leading toward adoption and internal diffusion of the target technology. The factors under study include compatibility, relative advantage, environmental and three control variables (seller versus buyer, technology conversion type, and location in supply chain). A case study utilizing RosettaNet's Partner Interface Processes (known as PIP^{TM}s) is presented, the results are compared to the theoretical model, and the findings stated. Several managerial implications are summarized and recommendations for future research are presented.

The contributions from this research are significant. For instance, this is one of the first known studies to model adoption and internal diffusion of XML-based technologies in an interorganizational setting. Second, this study assesses how the content and influence of these factors change between sellers versus buyers and between participants along a supply chain. Third, an emphasis is placed on measurement variables that are quantitatively measured and objectively based. The relative advantage construct, for instance, includes the direct financial impact from the target technology's implementation (ROI, transaction costs, and payback), as well as the operational performance impact (cycle time and through-put). Fourth, the significant indirect benefits that qualitatively accrued to the participating organizations' are discussed at length. These include information ubiquity, improved employee morale, improved time allocation towards value-added activities, and significant product cost savings on the part of the buyer organization. Fifth, this paper suggests several managerial implications and recommendations.

For nomenclature purposes, the terms 'target technology', 'technology innovation' and modularized XML-based IOS are used interchangeably through out the paper. For purposes of this study, these terms are intended to connote similar meanings. Also, the term *co-adoption* is intended to imply the mutual adoption of the same technology innovation between two different organizations. This is similar to the notion of *electronic dyads* as defined by Choudhury, "electronic dyads are bilateral IOSs, where a buyer (seller) establishes individual logical link(s) with a selected seller (buyer)…. each line[between a buyer and a seller] represents an electronic dyad." (Choudhury 1997, page 3).

2. TECHNOLOGY INNOVATION REVIEW

Many claims have been made that business-to-business (B2B) e-commerce growth over the Internet is constrained by HTML's inherent limitations - minimal content structuring capability, application coupling with back-end systems, and limited options to customize electronic business documents. Development for eXtensible Markup Language (XML) started in 1996 and was formerly recommended by the World Wide Web Consortium (W3C) in 1998. By allowing programmers and system developers the flexibility to define (and invent) electronic business documents, field attributes, and data tags; XML provides an avenue to overcome many of HTML's obstacles and substantially improves the ability to conduct B2B e-commerce via the Internet (Varon 2001, Sliwa and King 2000, Berinato 2001, Jones 2000, and others).

The very benefits that XML offers, however, have introduced a host of new challenges. To fully leverage the B2B e-commerce benefits that XML offers (and the Internet for that matter), industry groups and supply chain partners must agree on common sets of electronic business documents, field definitions, data attributes and communication protocols. This has spawned a host of new horizontal and vertical industry organizations with the purpose to develop XML-based standards for their respective industries. Output from such organizations have included XBRL for Extensible Business Reporting Language, HR-XML for Human Resource based XML, MathML for XML use in advanced Mathematical equations, and many others. In fact, as of August 2001, *XML.org Registry* had 105 different registered submissions for XML-based standards spanning 25 vertical and 7 horizontal industries. Similarly, *XML in Industry* had 450 different submissions for XML based standards spanning 54 vertical and 9 horizontal industries.

An example of one such XML-based standards setting organization is RosettaNet. Founded in 1998, RosettaNet is a non-profit consortium formed to develop XML-based standards for the Information Technology, Electronic Components, Semiconductor Manufacturing and Solution Provider industries. Like RosettaNet, many of these newly formed XML standard setting organizations have not limited there standards to consistent field attributes and definitions, but rather they are expanding there standards to include business dictionaries, networking protocols, and technical dictionaries organized around shared business processes within and between partner organizations. RosettaNet, for example, has developed standards for more than 75 of these shared business processes ranging from '*request engineering change'* to '*cancel a purchase order'* to *'notify of authorization to build'*. The content of each is complete with messaging service standards, business dictionaries, technical dictionaries, and business process choreography. These XML-based shared business process standards form point to point connections, via the Internet, that enable execution of the relevant business processes within and between different organizations on a global basis. They are, in effect, XML-based interorganizational information systems. On an individual basis, the scope of each of these standards is extremely small (traditionally limited to a single business function). But, collectively, taken on a business process by business process and a industry by industry basis, these standard setting organizations are developing the foundation to facilitate and enable future B2B e-commerce growth over the Internet. Alternatively, from a supply-chain perspective, a different way of depicting this technological innovation is to refer it as enabling modularized interoperability between supply chain partners.

As previously alluded, the scope and purpose of these standards setting organizations are beginning to vary greatly. Some, for instance, limit their scope to setting standards for simple XML-based business document attributes and common data definitions in their representative industries. Others, like RosettaNet, are developing modularized XML-based shared business process standards that are tantamount to an XML-based IOS. The scope of this study is focused on the latter, and not the former.

The existence of this phenomenon raises many unanswered research questions. How can XML-based standards setting organizations promote the adoption and diffusion within and between their participating organizations? What are the significant factors influencing the adoption and diffusion of XML-based IOS standards in organizations? How do these influencing factors change between seller organizations versus buying organizations? How do these influencing factors change between roles in a supply chain setting?

3. A CO-ADOPTION MODEL OF XML-BASED IOS

Figure 1 depicts an innovation adoption and diffusion model of the target technology. The factors that influence the adoption and internal diffusion of this technological innovation can be classified into four constructs-compatibility, relative advantage, environmental and control variables.

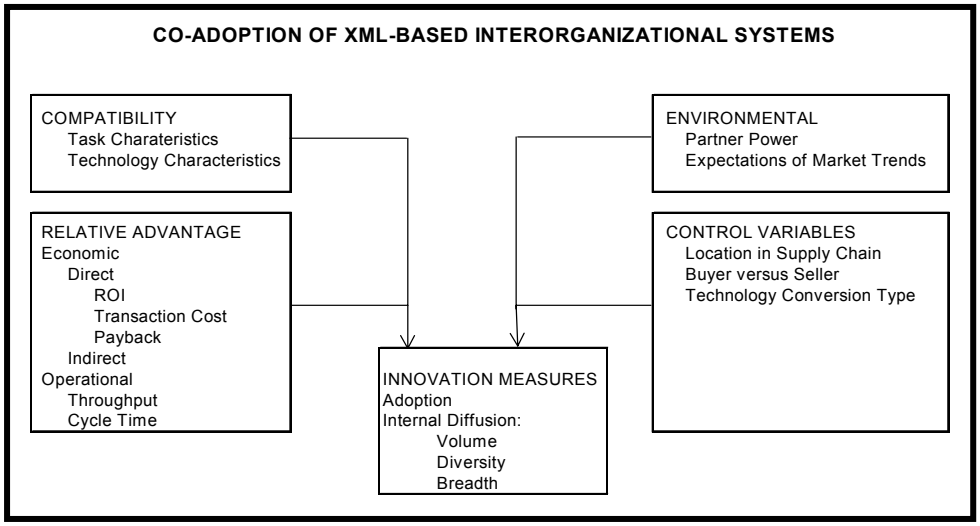

Figure 1. Co-Adoption of XML-based Interorganizational Systems

The utilization of these constructs was based on the interoperability needs between business partners in a supply chain setting. The *environmental* construct, for example, considers the influence of supply chain partner power and the expectations of technological market trends toward adoption and the level of internal diffusion of the target technology. The *compatibility* construct considers the *assumption gaps* between the *shared business process* task needs of supply chain partners versus the technology utilized to perform those tasks. The existence of large assumption gaps, or the lack thereof, could be assessed to determine its' influence on the innovation measures. Similarly, the measurement variables in the *relative advantage* construct can be computed (for both the supplier and buyer) to assess their influence on the innovation measures. These measurement variables not only include the traditional financial (transaction cost, ROI) and operational indicators (cycle time, throughput), but they also consider the indirect considerations inherent in supply chains (e.g. negotiation time, product costs, availability of substitutes). The *control variables* should prove to be extremely valuable in this model. By utilizing *control variables* as separate levels of analysis, we will be able to differentiate how these constructs change between roles in a supply chain, differentiate the influence of these constructs between buyers and suppliers and between the different types of technology utilized by partners. A complete description of construct definitions, measurement variables and references to prior innovation diffusion and IOS literature are provided below.

3.1 Compatibility

Technology compatibility is referred to as how the new technology is consistent with existing tasks, needs, prior experiences and processes of the adopters (Cho and Kim 2002, Cooper and Zmud 1992, Agarwal 1999). Cooper and Zmud (1992) provide a framework for assessing compatibility of a new technology by evaluating assumption gaps between the new technology characteristics versus the task characteristic needs of the organization. This framework should prove to be extremely useful for the current study for two primary reasons. First, the scope of the current study includes two distinct business processes – purchase order (PO) processing and shipments (and the corresponding debit charge-backs) from made-to-stock items. Similar technological innovations are applied to these distinct business processes that necessitate very different task characteristics. Second, the alternative technical innovations include XML-based standards (current study), web-based POs, electronic data interchange (EDI) and manual-based process solutions. In fact, if we extend the analysis to include a compatibility assessment in the old (prior to the technical innovation

implementation) and new environments, results in an extremely useful matrix depicting which solution is most appropriate based on the assumption gaps identified in the various technical solutions. For instance, assumption gaps for PO processing may include volume of order requests, number of partners, an Internet-presence, and back-end system processing. Assumption gaps for ship from stock and debit may include build complexity, testing complexity, and demand variability (make-to-order versus make-to-stock).

3.2 Relative Advantage

Davis defines perceived usefulness (PU) as meaning, "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis 1989, page 985). In the current study, this definition is altered in two respects. First, usefulness is measured from an organizational perspective, as opposed to the individual 'user' level. This is consistent with several studies in the innovation diffusion line of research (Iacovou 1995, Agarwal 1997, Cho and Kim 2002 and others). Second, by considering financial performance (direct and indirect) improvements and operational performance enhancements enabled by the technological innovation, the 'subjectivity probability' component in Davis' definition is significantly reduced. Although most IT adoption and innovation diffusion studies include financial benefits and / or operational performance enhancements to be within the scope of PU (Iacovou 1995, Cho 2002, Davis 1989, and others), very few have actually used objective (unbiased) measures for PU (see Venkatesh and Davis 1996). This second notion is also consistent with research objectives of the present study. Since two of this studies' objectives are to introduce an XML-based technology diffusion model and empirically compare this model to case studies (currently omitting statistical corroboration of the model), affords a prime opportunity to quantify and report PU measures experienced by the participating organizations.

Thus, a revised definition of relative advantage for the present study (which is closer to the definition presented by Agarwal 1997) is; the extent to which a potential adopting organization views the innovation as offering financial and operational benefits over previous ways of performing the same tasks (page 562). The financial indicators to be used include ROI, transaction costs savings (before versus after), investment and payback. The operational performance indicators includes throughput (capability per unit of time) and cycle time.

3.3 Environmental factors

In general, the study of environmental factors has experienced mixed results in innovation diffusion and technology adoption literature. Except, that is, when it comes to the study of environmental factors' influence on the diffusion of IOS between organizations. Hart and Saunders studied the role of trust and power in the context of 'electronic partnerships', Iacovou studied the influence of external pressures in the context of EDI adoption and integration in small businesses, and Gebauer studied the changing role of adoption strategies in an IOS environment as a result of emerging technologies (e.g. Internet-based systems) (Hart and Saunders 1998, Iacovou 1995, Gebauer 2000). The influence of environmental factors clearly play a significant role in the context of IOS systems.

The two environmental factors under consideration include – *partner power* and *expectations of market trends*. The first, *partner power*, is defined as (for purposes of the present study) the percentage of sales that a given supplier is dependent on from their partner-customer. This use of the power variable is consistent with the industry under study (semi-conductor manufacturing), availability of substitute suppliers, low manufacturing capacity utilization rates and relatively low switching costs. This is consistent with Hart and Saunder's notion of supplier dependence in dyadic relationships (see page 90) and similar to Iacovou's findings regarding external pressure in EDI adoption. The second, *expectations of market trends*, is an infrequently used variable in study of innovation diffusion (Fichman 1993, Cho and Kim 2002). For the present study, the definition for this variable is consistent with Cho's, "Expectation for market trend is the degree of expectation that the target technology will be pervasively adopted in the industry in the future" (Cho and Kim 2002, page 130). This is the most subjectively based variable used in the present study. The reason for including this variable is rather complex to explain, but simple in nature. RosettaNet is a non-for profit XML-based standard setting organization funded from contributions by partner organizations. Thus, partner organizations have a serious and 'vested' interest in developing and setting the most appropriate standards that need to be utilized within their industry. Indeed, a particular technical solution that has been implemented that is found not to be a high expectation of future market trends would be a significant finding.

3.4 Control Variables (Levels of Analysis)

Three control variables used in this study and include *buyers versus sellers*, *location in supply chain*, and *technology conversion type*. Since the present study does not develop a statistical deterministic model, the control variables are used for levels of analysis to perform on the data collected from the field study. For instance, the financial indicators of the buyer organization (ROI, transaction cost savings, and payback) can be compared and contrasted to that of the seller organization. Investigation into significant differences could prompt a richer understanding of how this innovation impacts buyer organizations versus seller organizations. Similar levels of analysis can be conducted based on the organization's role in the semi-conductor supply chain and the type of technology they converted from (e.g. manual, EDI or web-based PO).

3.5 Innovation Measures

The innovation measures (dependent variables) included in this study focus on the notion of adoption and internal diffusion. For purposes of the present study, Cooper and Zmud's product definition of adoption will be utilized, "A decision is reached to invest resources necessary to accommodate the implementation effort." (Cooper and Zmud, page 124). Fichman defines internal diffusion as, "The extent of use of an innovation across people, projects, tasks, or organizational units" (Fichman 2001, page 454). In the area of IOS (and more specifically EDI) Massetti and Zmud provide three additional dimensions to internal diffusion that will be useful in the present study – volume, diversity and breadth (Massetti and Zmud 1996). *Volume* refers to the ratio of business documents transmitted via the technology innovation channel, over the total number of business documents exchanged (regardless of the technology). *Diversity* refers to the total number of RosettaNet PIP^{TM}s implemented. *Breadth* refers to the total number of trading partners with the organization that are utilizing the technology innovation channel. The use of these definitions is consistent with other EDI studies (Hart and Saunders 2002, Massetti and Zmud 1996).

For analysis and discussion purposes, *diversity* and *breadth* will be measured at the organizational level (as opposed to an individual business process level). The reason is two-fold. First, RosettaNet's technology is fairly recent and the participating organizations in this study have a limited number of actual PIP^{TM} implementations. Second, (as previously described) the intent of this study is empirical analysis (and not a statistical deterministic model). Thus, the use of these measures for analysis,

discussion and comparison purposes is better served by studying these innovation measures at the organizational level.

4. CO-ADOPTION OF ROSETTANET STANDARDS

4.1 RosettaNet Background

RosettaNet seeks to enable interoperability in a supply chain by developing modularized technical standards surrounding shared business processes between supply chain partners. RosettaNet's modularized partner interface processes include four components: messaging service standards, business dictionaries, technical dictionaries, and business process choreography. These modularized XML-based IOS enable the electronic sharing of business information and opens the lines of communication and opportunities for everyone involved in the supplying and buying in a supply chain. Businesses that offer the tools and services to help implement RosettaNet processes gain exposure and business relationships. Companies that adopt RosettaNet standards engage in dynamic, flexible trading-partner relationships, reduce costs and raise productivity. End users enjoy speed and uniformity in purchasing practices. RosettaNet seeks to drive adoption and implementation of common processes and standards within and between member companies. RosettaNet's approach is to bring business owners from member companies together to define and agree on common processes and to develop XML-based standards to support these processes. A sample of XML-based IOS partner interface process (PIP™) standards developed by include:

Order Management • quote & order entry • transportation & distribution • returns & finance management • product configuration	**Inventory Management** • collaborative forecasting • inventory allocation • inventory reporting • inventory replenishment • sales reporting
Marketing Information Management • lead/opportunity management • marketing campaign management • design win management • ship from stock & debit	**Manufacturing** • design transfer • manage manufacturing work order and WIP distribute manufacturing information

The field research examines the impact of a new XML-based B2B e-commerce system implementation between a manufacturer (seller) and a distributor (buyer) in the semi-conductor manufacturing industry. The scope includes the co-adoption of the *ship from stock and debit* interorganizational system between the two companies. The technical solution utilizing RosettaNet's Partner Interface Process (PIP™) is presented and the new system's benefits are described and quantified.

4.2 The Adoption Process

The former (old environment) *ship from stock and debit* system between the seller and buyer was a hybrid of manual and automated steps including the use of fax machines, phone calls, voice messages, and internal paper work moving back and forth between departments and companies. The purpose of the *ship from stock and debit* IOS is to enable the distributor to sell excess inventory (in stock at the distributor's site) at discounted prices and debit the manufacturer for a portion of the discounted price. This process also enabled the distributor to meet competitive market price situations, or to offer volume discounts to large customers. The hybrid of manual and automated steps to complete the business process created numerous problems in the current environment including manual keying errors, unintended lost discounts, unintended expired debit-requests, and a host of logistical problems. In fact (prior to adoption) the average debit-request rejection rate by the manufacturer was 40% to 60% and the average response time per credit-request was 2 to 5 days.

4.3 The XML-based IOS Solution

The new system (see Figure 2) was developed consistent with RosettaNet's PIP™ *Marketing Information Management* standards series. Specifically, the seller and buyer both agreed to co-adopt RosettaNet's PIP#5D1- *Ship from Stock and Debit* XML-based IOS. Key standards (features) of the new system include a centralized debit authorization database with ubiquitous web-access by all partners (supplier, distributor, and manufacturer representative). Electronic receipt, notification and communication of debit authorization requests. In addition, automated centralized approval-progression status of debit authorizations is provided with automatic tolerance checks and electronic notifications of *ready-to-expire* debit authorizations.

The new system has enabled significant benefits to both the seller and the buyer. For example, reduced manual processing such as faxing, writing e-mails, re-keying information, researching debit request information and inquiring on approval status. Also, the new system enforces a 24-hour *initial* response from the seller to the buyers' initial debit authorization request. The seller has the initial option to 'accept', 'reject', or indicate 'additional research necessary'. This has resulted in significant reductions in unintended lost discounts, unintended expired debit authorization requests, and manual re-keying errors. In addition, it circumvents a host of delays inherent in manual-based processes and exacerbated in a business to business relationship (personal vacations, verbal commitments, employee turnovers, and timing).

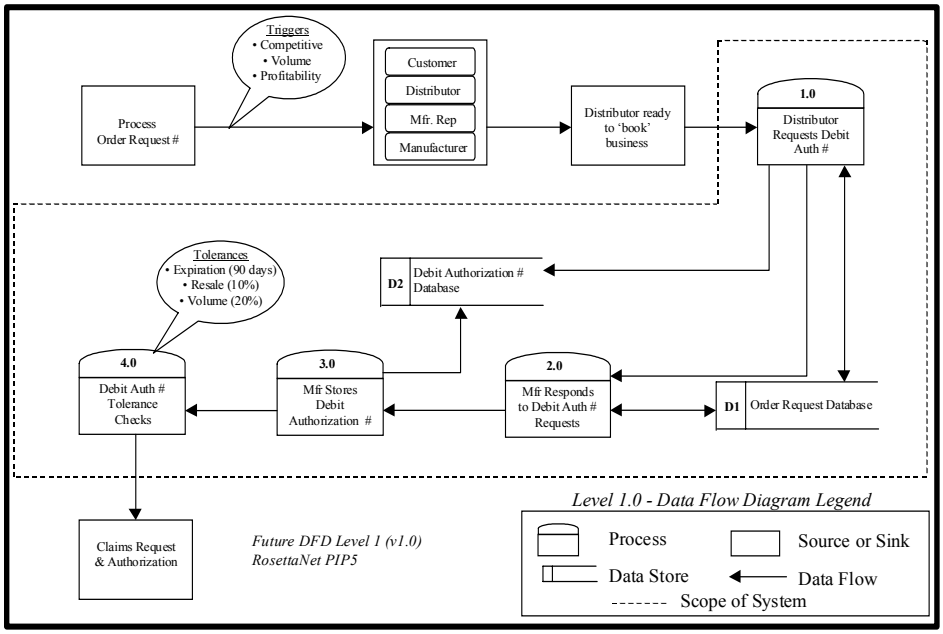

Figure 2. Level 1 Data Flow Diagram of the Ship from Stock & Debit XML-based IOS

5. COMPARISON OF CASE STUDY VERSUS THE THEORETICAL MODEL

The following is a comparison of the Co-Adoption of XML-based IOS model to the RosettaNet ship from stock and debit IOS system. See Table 1 for a Summary of Findings.

5.1 Compatibility

From a compatibility perspective, both organizations would rank *low compatibility* with respect to the old environment and *high compatibility* with respect to the new environment. The reasons are straightforward. The inherent 'tasks needs' of this ship from stock and debit business process include; high transaction volumes, time sensitivity (due to the product's price volatility), and high collaboration between organizations. Both organizations were previously using a hybrid of manual and semi-automated processes (e-mails, fax machines, phone calls, etc.) in the old environment. Clearly, the underlying assumptions of the technological innovation are much more congruent with the task needs of this business process.

5.2 Relative Advantage

Overall, the quantified benefits of the new system are substantial (see *Table 1*). The seller experienced a 45-minute reduction in handling time. The buyer experienced a 82% reduction in size of the 're-work' queue. Overall, the seller gained a 650% increase in transaction capability per hour and the buyer gained a 67% increase in transaction capability per hour. From a financial performance perspective, the new system has reduced ongoing transaction costs by 87% for the seller and by 40% for the buyer. The ROI for the IT investment is 52% for the seller (with a payback in 1.9 years) and 55% for the buyer (with a payback in 1.8 years).

The indirect benefits have been substantial as well. Both organizations benefited from improvements in: information ubiquity, improved employee morale (due to decreased frustration with the manual process), improved time allocation on value-added activities, and overall convenience. Due to the nature of the system and the large re-work queue reductions, the buyer in this instance has also gained significant indirect financial benefits in product cost savings. Although the buyer was unwilling to quantify these savings for purposes of this study, the savings are significantly larger than the direct financial savings. As a result, the overall relative advantage of the technological innovation is considered *moderate* for the seller, and *high* for the buyer.

5.3 Environmental

With respect to partner power, neither organization is highly dependent on the other. When considering the dollar value of ship from stock and debit

transactions (the sales value of transactions could not be ascertained due to company confidentiality), the value of transactions between the two organizations with respect to the annual sales is .1% for the seller and .01% for the buyer. Thus, using the partner power notion, the buyer has slightly more power over the seller. Although slight as this may be, combining this fact with the significant indirect financial benefits afforded to the buyer as a result of this technological innovation, provides reason why the buyer was very motivated for this system's implementation.

The *expectation of market trend* was *extremely high* with the seller and the buyer. Both organizations never questioned or expressed concerns regarding the benefits of utilizing XML-based IOS systems. In addition, the fact that several major organizations in the semi-conductor industry formed RosettaNet to establish XML-based IOS, was an important point in establishing the expectation of market trend.

5.4 Control Variables (Levels of Analysis)

Since the present study includes only one instance (and two organizations) of the target technology, utilizing control variables for *levels of analysis* has limited benefits. Indeed a recommendation for future study would be to extend this type of analysis to multiple instances of the target technology. Despite this, however, a few conclusions can be reached. For instance, the seller's role in the supply chain was that of a manufacture. The buyer's role was that of a distributor. If one considers the underlying business process (ship from stock and debit) and the inherent limitations of the *technology conversion type* (manual based processes in the old environment), one could begin to generalize that co-adoption of an XML-based interorganizational system under this set of circumstances would have a high likelihood of providing greater indirect financial benefits to a buyer / distributor, rather than a seller / manufacturer.

5.5 Innovation Measures

In terms of the case study (based on the empirical results, but without statistical corroboration), the *lack of compatibility with the old technology* and *expectations of market trends* are what lead to the decision to adopt RosettaNet – based solutions. Or, more specifically, the *lack of compatibility* between the business needs of the organizations and the old technology, is what drove the organizations to *inquire* about new *technological innovation (XML-based IOS) options.* The *environmental*

factor (*expectations of market trends*) *directed* the organizations to select RosettaNet –based solutions. The *relative advantages* (direct financial and operational benefits) are sustaining the organizations continuos interest in XML-based IOS solutions and will likely lead to greater internal diffusion (volume, diversity and breadth).

Table 1 – Summary of Findings

	MANUFACTURE	DISTRIBUTOR
CONTROL VARIABLES		
Location in Supply Chain	COMPONENT MFR	DISTRIBUTOR
Buyer versus Seller	SELLER	BUYER
Technology Conversion Type	MANUAL	MANUAL
COMPATIBILITY	HIGH	HIGH
Task Charateristics	High volume, High collaboration needs, Time sensitive data	
Technology Characteristics	High compatibility with new XML-based IOS	
RELATIVE ADVANTAGE	MODERATE	HIGH
ROI	52%	55%
Transaction Cost	-87%	-40%
Payback	1.9 years	1.8 years
Indirect:		
- *Information Ubiquity*	X	X
- *Real-time request tracking*	X	X
- *Improved Salesman time allocation*	X	
- *Convenience*	X	X
- *Improved Employee Morale*	X	X
- *Product Cost Savings*		X
Throughput	650%	67%
Cycle Time	-91%	-40%
ENVIRONMENTAL		
Partner Power	LOW (0.1%)	LOW (0.01%)
Expectations of Market Trends	HIGH	HIGH

6. MANAGERIAL IMPLICATIONS

Several key managerial implications and recommendations can be provided. First, addressing the research question: *How can standards setting organizations promote the adoption and diffusion within and between their participating organizations?* XML-based IOS standard setting organizations, like a RosettaNet, should consider assessing the 'assumption gaps' between the tasks needs of organizations versus the capabilities of their old technology. As was the situation with both the supplier and buyer in the case study, their tasks needs demanded high volume, time sensitive, and high interorganizational collaboration business processes. Yet, their old technology was a hybrid mixture of manual processes and antiquated technology (faxes, phone calls, and e-mails). Large assumption gaps existed. Similar 'generic' assumption gaps could be identified in a simple

two-by-two matrix, with business processes (e.g. P.O. processing, engineering collaboration, work-order processing) along one axis and antiquated technologies (manual, EDI, web-PO) along the other axis. This could easily identify if and where assumption gaps exist and assist in identifying where the XML-based interorganizational systems could provide solutions.

In addition, they should consider tracking and cautiously promoting the direct financial benefits and operational performance improvements of XML-based IOS implementations. Obviously not all XML-based IOS implementations should expect the significant ROI, transaction cost savings, and payback experienced by the organizations involved in the case study. However, over time and with a greater volume of implementations, averages can be developed. 'Best in Class' expectations can be formed. Similar to the proceeding recommendation, utilization of a 'generic' and simple two-by-two recording matrix with business processes along one axis and of types technologies to convert from (manual, EDI, web-PO) along the other axis.

Also, standards setting organizations should develop of a framework for consistent identification and quantification of indirect benefits enabled by XML-based IOS implementations. As was the situation in this case study, and as is often the case in IT implementations, the indirect benefits are far greater than the direct benefits. An indirect benefits framework would, at a minimum, need to include four dimensions: (1) current (old) technology, (2) business process, (3) location in supply chain, (4) buyer versus seller. Although some companies (as was the situation in this case study) may be reluctant to quantify the indirect benefits, ranges should be approximated. Once again, over time and with a greater volume of implementations, averages can be developed. 'Best in Class' expectations can be formed.

Second, addressing the research question: *What are the significant factors influencing the adoption and diffusion of XML-based IOS standards in organizations?* The *lack of compatibility* between the business needs of the organizations and the old technology, is what drove the organizations to *inquire* about new *technological innovation options*. The *environmental factor* (*expectations of market trends*) *directed* the organizations to select RosettaNet –based solutions. The *relative advantages* (direct financial and operational benefits) are sustaining the organizations continuos interest in XML-based IOS solutions and will likely lead to greater internal diffusion (volume, diversity and breadth).

Third, addressing the research question: *How do these influencing factors change between seller organizations versus buying organizations?* Both organizations experienced low compatibility in the old environment and high

compatibility in the new environment. The seller organization earned higher direct financial and operational performance benefits from the XML-based IOS implementation. The buyer organization earned significantly greater indirect financial benefits as a result of product cost savings enabled through the XML-based IOS implementation. The seller organization has slightly greater 'partner power' influence over the buyer organization.

Fourth, addressing the research question*: How do these influencing factors change between roles in a supply chain setting?* The buyer (distributor) organization earned significantly greater indirect financial benefits as a result of product cost savings enabled through the XML-based IOS implementation. This same result could be anticipated by other buyer organizations under the following circumstances: (1) The relevant business process is similar to a 'ship from stock and debit' process and (2) Both organizations are converting from manual-based business processes to XML-based IOS technology and (3) The seller organization is a manufacturer and the buyer organization is a distributor.

7. CONCLUSIONS

The factors that lead to the adoption and internal diffusion of a recent technological innovation occurring in industry were examined. We labeled this technology innovation phenomenon as XML-based interorganizational systems. A theoretical model was introduced to measure the diffusion of this technology and the factors included compatibility, relative advantage, and environmental. A study was presented describing one instance of this technology innovation implementation based on the use of RosettaNet's modularized XML-based IOS technical standards. The findings were compared to the theoretical model and conclusions with managerial implications presented.

There are several limitations to this study in its' current form. First, it is based on one instance of this particular technology. Indeed, to make this model generalizable, several more instances need research and consolidated with the present study. Second, both participating organizations migrated from manual-based processes to the target technology. A richer and generalizable study would include organizations migrating from a variety of different technology types in the old environment (e.g. EDI, proprietary solutions, or web-based PO). Third, in the analysis of measurement variables and the assessment of constructs, this study heavily emphasized the use of quantifiable – objective variables. Future research in this area should include those factors, but also include subjectively based measurement

variables. This would allow, for example, the organization's anticipated implementations of the target technology in the next year, two years, etc. This would also allow for better framing (and comparisons to prior literature) around the indirect benefits from this technology.

Despite these limitations, however, several insights were gained. An acknowledgement, and perhaps a framing, was captured surrounding a recent technological innovation (XML-based interorganizational systems). This technological innovation is a significant enabler to enhancing modularized interoperability in supply chains. In addition, it was concluded that the combination of *lack of compatibility with the old processes* and *environmental factors*, jointly resulted each of these organization's adoption of RosettaNet-based solutions. Further, the *relative advantage* construct was determined to be the key factor that would sustain interest in this technology innovation likely leading towards greater internal diffusion. As indicated in the *managerial implications* section, this lends insight into future adoption strategies by RosettaNet and other XML-based industry setting organizations. Furthermore, the implementation of this technology innovation created substantial financial and operational improvements to the participating organizations. The ROI, transaction cost savings, payback, decreased cycle time and increased through-put capability, for both the seller and buyer, were substantially improved and quantified.

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