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Abstract

This study addresses a gap in IOS (interorganizational system) adoption literature by proposing an integrative model of RFID (radio frequency identification) adoption and early integration, that combines multiple theoretical perspectives suggesting different rationales for adoption. The study suggests possible roles for technological, interorganizational pressure, organizational readiness and external environmental factors in the adoption of RFID and proposes the perceived radicalness of technology as a moderator of relationships in the model. Using multiple lenses of strategic choice theories (diffusion of innovation, organizational innovativeness) and institutional theory as the basis and reflecting data from semi-structured interviews and news reports, the study develops an integrative conceptual RFID adoption model and presents testable hypotheses at the construct and rationale levels. The model incorporates different rationales for adoption and integration of interorganizational systems(IOS) namely the strategic choice perspective where adoption is voluntary with a view to improve organizational efficiency and performance and the institutional perspective where adoption is more a result of conforming to pressures from organizations within an organization's field of operation. Two technological factors (perceived benefit and perceived costs), three organizational readiness factors (top management support, financial readiness, IS infrastructure and capabilities) and three external environmental factors (perceived standards convergence, perceived consumer privacy and perceived stakeholder privacy) have been suggested as adoption and integration drivers from a strategic choice perspective while the three Inter-organizational pressure factors (coercive, mimetic and normative pressures) have been proposed as predictors of adoption intent and expected integration from the institutional perspective. The study allows for a comparison of the relative influence of each rationale on the adoption and post adoption integration decisions by a firm. Perceived radicalness of the technology has been operationalized as a continuous construct and suggested as a moderator of relationships between the drivers and adoption/integration of RFID. Analysis of data collected from the interviews and news reports lends support to the model and provides insight into relative importance of the constructs.

Key words: Adoption, Integration, RFID, interorganizational systems, radical innovations

Word Count: 7283

I. INTRODUCTION

Even with extensive writings on adoption and diffusion of innovation (Rogers, 1983) the adoption of new and emerging technologies with unique characteristics is still not well understood. Adoption of special technologies with adopter interdependencies (Katz & Shapiro 1986; Markus 1987), technologies that impose heavy knowledge burdens on adopters (Attewell 1992; Cohen & Levinthal 1990), and adoption of EDI (Chwelos, Benbasat & Dexter 2001) are all instances where discussed diffusion theory generalizations could not be directly applied and new models were subsequently developed to understand and explain adoption patterns.

Literature Gap

In interorganizational systems(IOS) literature various models have been developed to identify adoption drivers. Most of the prior studies have used diffusion of innovation theory (Rogers, 1983), which investigate innovation attributes along with the organizational innovativeness literature (Damanpour, 1991; Wolfe 1994; Premkumar and Ramamurthy 1995) that examines characteristics of organizations in their adoption and diffusion decisions. Teo et al. (2003) suggested the lens of institutional theory to predict institutional pressures as drivers of IOS based interorganizational linkages. However, an integrative adoption and diffusion model incorporating drivers from multiple theoretical perspectives and combining different adoption rationales with testable predictive power is still needed. Historically, the literature has characterized innovations dichotomously as product vs process, administrative vs technological and incremental vs radical (Damanpour, 1991), and has provided limited corresponding operationalizations of these characterizations on continuous scales nor tested them for mediating or moderating effects in adoption models at individual, organizational or inter-organizational levels. In addition, not fully yet explored external environment factors may influence the adoption and diffusion of new technologies because of their unique features and characteristics.

This study addresses an existing literature gap by proposing an integrative model based on multiple theoretical perspectives namely strategic choice (directed diffusion of innovation, organizational innovativeness) and institutional theory (organizational roles, incentives and responsive structures) suggest the presence of different rationales for IOS adoption. The model incorporates drivers suggested from the existing IOS adoption literature, that from initial data gathering appear relevant to RFID adoption and its subsequent integration. The model seeks to explain RFID adoption, a new and emerging technology, that possesses special features such as

inter-organizational linkages similar to EDI and other existing IOS, but at grander scales transcending the tight linkages and processes as seen with EDI. Untested in the IOS adoption literature, the model also incorporates environmental factors believed to be important in RFID adoption such as perceived consumer and stakeholder privacy, and standard convergence (legal standards, software, hardware and data standards). The model facilitates testing of differences in drivers of adoption based on their adoption rationale which likely relates to subsequent intended integration and use of the technology. Finally, the model operationalizes perceived technology radicalness as a continuous construct moderating adoption intent and its' antecedents.

Adoption Rationales and Post Adoption Integration

An important consideration in the adoption of new technology is the motivation or rationale behind its adoption. Although it would seem that an organization's adoption decision is driven by well thought out internal and external assessments with a clear objective to improve performance there may be other factors such as conforming to external pressures from the organizational field (Scott, 1987) to gain legitimacy which may drive adoption. This is true even more when there is technological uncertainty induced by network externalities and mutual interdependencies (Katz and Shapiro 1986; Markus 1987) among adopters. In case of adoption of interorganizational systems (IOS) such as EDI or e-business that integrate organizations, pressures from dominant partners (customers/suppliers) are likely to be significant (Premkumar and Ramamurthy, 1995; Chwelos et al. 2001; Teo et al. 2003). While identifying factors that drive RFID technology adoption it is also important to explore the effects of the underlying motivations or rationale behind adoption, which may shed light on how the technology is subsequently integrated and used by organizations. For example, we may find that in situations where rationale for adoption is conforming to institutional environment pressures there might be a very superficial adoption to satisfy legitimacy needs (which may be reflected in low minimal levels of early integration of the technology). Similarly if the decision to adopt is motivated by strategic and efficiency gains to improve organizational performance we may find evidence of a significant effort undertaken to integrate the technology with existing systems within and across organizations.

The rationales to adopt technology can be broadly classified into two categories: 1) a "rationalistic" strategic choice (Whittington, 1988) perspective oriented towards improving efficiency and organizational performance, and 2) an institutional perspective (DiMaggio-Powell, 1983) oriented towards efforts to maintain legitimacy (Kling 1980, Markus 1983).

Understanding rationale invoked in adoption decisions may prove useful in explaining many superficial implementations which fail to deliver adoption benefits and lead to unexpected IT diffusion patterns. The focus of most studies and adoption models of interorganizational systems (Chwelos, Benbasat & Dexter 2001; Ramamurthy et al. 1999; Iacovou & Benbasat 1995; Premkumar & Ramamurthy, 1995; O'Callaghan, Kauffman & Konsynski, 1992) has been theories which fall under the rationalistic perspective (strategic choice theories) such as diffusion of innovation (Rogers, 1983) and organizational innovativeness (Damanpour, 1991) where voluntary adoption decisions are made to achieve organizational goals. Studies invoking institutional rationale for IOS technology adoption with the exception of Teo et al. (2003) are few and far between. To the best of my knowledge, I am not aware of any study that combines these two perspectives and empirically tests for their differential effects on adoption and subsequent expected integration.

Strategic choice and institutional rationales however are not mutually exclusive and may both be present simultaneously (Green 2002). DiMaggio and Powell (1983) suggest complimentary nature of strategic and institutional rationales by their recognition of two kinds of isomorphism: competitive and institutional. Scott (1987) suggests institutional arguments as complementing and contextualizing rational and efficiency arguments rather than opposing them (Dacin, 1997). This paper suggests both rationales to be prevalent in the adoption and integration of RFID technology, which has been viewed as an interorganizational tool for the purpose of this study.

RFID Technology

RFID (Radio Frequency Identification) is a means of automatic identification of objects using radio signals and provides improved data collection and handling through greater accuracy, speeds and visibility. Basic identification data is carried in transponders known as tags read by transceivers that decode and transmit data to attached computers for processing where it can be associated with database information such as product, business processes and organization data.

It is expected that RFID technology will provide "real time" information in tracking products and also opportunities for creating rich product profiles resulting in organizational cost savings in theft prevention, inventory management and quality control as well as indirect benefits such as better business customer management, partner collaboration, and altered processes from strategic insight. In addition several recent applications of RFID technology projects have shifted in focus from goods identification and tracking to complete systems integration initiatives. Over the last decade, RFID has been implemented to improve goods tracking throughout supply chains (SC),

access control for security, livestock management, waste management tracking, inventory control, and transportation fleet management. As RFID use grows in its trajectory of becoming a commonly adopted technology, firms have begun thinking up new ways of leveraging RFID's technological capabilities. They did this by making active RFID tags, which can provide status information on tagged items either through the tag itself or in conjunction with associated censor devices to all relevant interfacing existing computer systems.

UPS recently started using RFID in an initiative to better track packages and its delivery fleets. Through RFID, UPS can monitor its packages in seconds even those out of sight, then process that information throughout relevant computer systems including internal operations, fleet management, accounting, customer management, and its web site. Through systems integration and leveraging fast available RFID data, UPS can improve service and lower costs.

Leading retailers such as WalMart and Target and manufacturers such as Proctor and Gamble and Gillette have endorsed the technology and are pilot-testing its use for full-scale implementation. The technology not only has direct benefits for both ends of the SC but also has many indirect benefits that have not yet been understood or realized.

RFID as IOS Tool

Business adoption of RFID is relatively new and therefore as with most new information technologies its true potential both independent and in conjunction with other technologies is not yet fully understood. Its adoption considerations and the consideration's weights for internal organizational stakeholders and across the SC are important. RFID can be viewed both as an internal as well as an interorganizational tool. Hence, relative strength differences may exist among adoption drivers depending upon anticipated uses of RFID (internal to the organization and/or between organizations). However, we believe that internal organizational use adoption drivers would be a subset of inter-organizational level drivers. RFID combined with information management systems can create effective IOS capable of providing visibility across SCs and delivering direct and indirect benefits to participating SC partners. Thus, RFID has the capability and hence can be the impetus to electronically integrate SC firms. This study therefore views RFID as an interorganizational system (IOS) and uses existing literature models of adoption of other IOS such as EDI and e-business(B2B) as a basis for establishing a model of RFID adoption. Multi-party adoption of RFID is expected to be similar to EDI's, but with much broader impact to commerce and practice due to its more open infrastructure, which includes nonproprietary technologies, processes, and relatively easy operability with exist systems.

While direct IOS adoption benefits are quantifiable, some indirect benefits may only be realized through improved collaboration between SC partners and the transformation of business processes that result in competitive advantage gains (Cash and Konsynski 1985). This paper focuses on manufacturer/retailer SCs and specifically on factors that drive the adoption and expected integration of RFID's by the manufacturers, retailers, distributors and vendors/consultants. The likelihood of direct and indirect benefits for both manufacturers and retailers from RFID adoption is high and the case for benefits although unequal resulting from collaborative RFID adoption efforts is very strong according to IBM Consulting. Hence, in this study focusing on manufacturers and retailers in SCs seems appropriate. When RFID information is used across SCs with inventory management systems it becomes an interorganizational tool with greater potential benefits derived from increased SC partner participation and commitment and subsequent refinements of organizational processes.

Purpose

This study's objective is to explore factors driving RFID technology adoption and the extent to which different rationales/considerations (strategic and institutional) relate to expected adoption and integration of RFID with existing intra and inter organizational systems. Drawing on multiple theoretical bases and prior IOS adoption literature this study proposes a model for RFID adoption by focusing on these issues: 1) What major factors influence RFID adoption and expected integration by an organization? 2) What are the different considerations/ rationales in RFID adoption and integration and the associated weights assigned to those considerations by different supply-chain stakeholders? 3) Is there a difference (increase/decrease) in effect strength of drivers based on perceived radicalness of RFID technology among adopting organizations?

Section II of this study outlines factors suggested in prior literature as key drivers of IOS adoption. Section III presents the research model and develops and presents the hypotheses from this study. Section IV describes the research methodology used to build the conceptual model. Section V presents a discussion of evidence and associated implications and conclusions.

II. LITERATURE REVIEW - RFID & Prior IOS Adoption

When reviewing studies from the past 15+ years that used an IOS adoption context and were published in top IS and related journals and conferences, fifteen studies* that met the above mentioned criteria and were included in this review as a representative sample. Drivers consistently tested and found to be significant in the existing IOS adoption studies form part of

our model and are listed in Table 1. External environment factors (perceived standards convergence, perceived stakeholder privacy & perceived consumer privacy) and moderator (perceived radicalness) are not incorporated in this review as these are new constructs in the IOS adoption context and are proposed in this study.

Constructs	Hypothesized Direction			Adoption		Int. Diffusion (diversity)		Ext. Diffusion (volume)	
	AD	ID	ED	Dir	Sig	Dir	Sig	Dir	Sig
Organizational Readiness									
Top Management Support	5+	4+	4+	4+	3	5+	4	5+	3
IS Infrastructure & Capabilities	3+	0	0	3+	1	1+	1	1-	0
Financial Readiness	1+	0	0	1+	1	0	0	0	0
Technology									
Perceived Benefits	8+	3+	3+	7+	4	3+	3	3+	1
Perceived Costs	1-	0	0	1-	1	0	0	0	0
Interorganizational Pressures									
Normative Pressures									
Industry, trade and professional association pressures	2+	2+	2+	2+	0	2+	0	2+	1
Favorable transactional climate	2+	0	0	1-	0	0	0	0	0
Coercive Pressures									
Dominant partner pressures	6+	3+	3+	5+	4	2+	1	2+	0
Regulatory pressures	1+	0	0	1+	0	0	0	0	0
Mimetic Pressures									
Competitive pressures	8+	0	0	8+	7	0	0	0	0
Status pressures	0	0	1+	0	0	0	0	1+	1

Table 1. Constructs significant from prior IOS adoption literature

* AD=adoption; ID=internal diffusion; ED=external diffusion; SIG=significant; DIR=direction; (Grover & Golsar, 93, JMIS; Grover, 96, Decision Sc.; Zaheer & Venkatraman, 94, Management Sc.; Premkumar et al., 94, JMIS; Iacovou et al., 95, MISQ; Premkumar & Ramamurthy, 95, Decision Sc; Massetti & Zmud, 95, MISQ; Chau & Tam, 97, MISQ; Kettinger & Grover, 97, Decision Sc.; Crook & Kumar, 98, Information & Management; Hart and Saunders, 98, JMIS; Chwelos et al., 01, ISR; Chatterjee et al., 02, MISQ; Zhu et al., 02, ICIS; Teo et al., 03, MISQ)

A summary of the prior literature suggests IOS adoption studies have primarily been driven by two theoretical bases: 1) diffusion of innovation (Rogers, 1983) - focusing on attributes of innovation and 2) organizational innovativeness (Damanpour, 1991; Wolfe 1994) - focusing on organizational characteristics. Considering that IOS are subject to network externalities, critical mass and mutual interdependence arguments have been used to explain adoption patterns. Power, influence and trust (Chwelos et al. 2001; Hart & Saunders, 1997) between partner organizations based on resource dependence theory (Pfeffer & Salancik, 1978) have also been used to explain IOS adoption. Except Teo et al. (2003) viewing IOS linkage adoption from an institutional theory (DiMaggio and Powell, 1983) perspective, most studies have examined adoption from a

strategic choice perspective with a view to increase efficiency and improve organizational performance. This study builds a model to predict RFID adoption and expected integration by including drivers from both the strategic choice and institutional perspectives. It also operationalizes a new construct: perceived radicalness in IOS adoption context.

III. FRAMEWORK, RESEARCH MODEL AND HYPOTHESES

Existing IS literature on IOS adoption is based on many different theoretical frameworks. Tornatzky-Fleischer's (1990) technology-organization-environment framework for example developed for general technological innovations adoption has been applied to e-business (Zhu et al., 2002). Their framework identifies a three-aspect firm's context (technological, organizational, and environmental) that influence a firm's adoption and implementation processes. Iacovou et al., (1995) proposed an EDI adoption model with technological (perceived benefits), organizational (organizational readiness) and environmental (external pressure) suggested as adoption influencers with Chwelos et al., (2002) expanding the model to include interorganizational factors (external pressure, trading partner readiness). Premkumar-Ramamurthy, (1995) also suggested that technological factor (internal need), organizational factor (top management [TM] support) and interorganizational factors (competitive pressure and exercised power) influence a firm's adoption decision mode. This paper outlines four-types of adoption influences for RFID technologies, which are categorized as technological, interorganizational-pressure, organizational-readiness, and external-environmental factors and one moderating influence characterized as perceived radicalness.

Based on diffusion of innovation, organizational innovativeness and institutional theory literature and on the operationalizations of constructs at different levels (technology, inter-organizational, organizational and environmental) the key factors and constructs which have consistently been found to be influential and critical in IOS adoptions have been included in the proposed model for RFID adoption (Fig. 1). The model draws upon the IOS adoption research stream (Iacovou., 1995; Premkumar-Ramamurthy, 1995; Chwelos et al. 2002; Zhu 2002) and was developed and supported using semi-structured interviews and RFID adoption business press announcements. The research model (Fig. 1) includes two technological factors (perceived benefit and perceived costs), three inter-organizational pressure factors (coercive pressures, normative pressures, and mimetic pressures), three organizational readiness factors (top-management support, IS infrastructure/capabilities, financial readiness) and three external environment factors (perceived standard convergence, perceived stakeholder privacy, perceived consumer privacy) have been suggested as predictors of RFID adoption intent and level of

expected integration. We propose new constructs: perceived standard convergence, stakeholder privacy and consumer privacy to capture effects of external environmental factors such as adoption and alignment of RFID data and software standards, legal standards for allocation of decision rights and intellectual property within/between industries along with stakeholder and consumer privacy concerns. To address incremental vs radical innovation literature limitations and with IOS adoption, we operationalize technology perceived radicalness as a continuous construct and suggest it moderates relationships between core constructs and adoption intent.
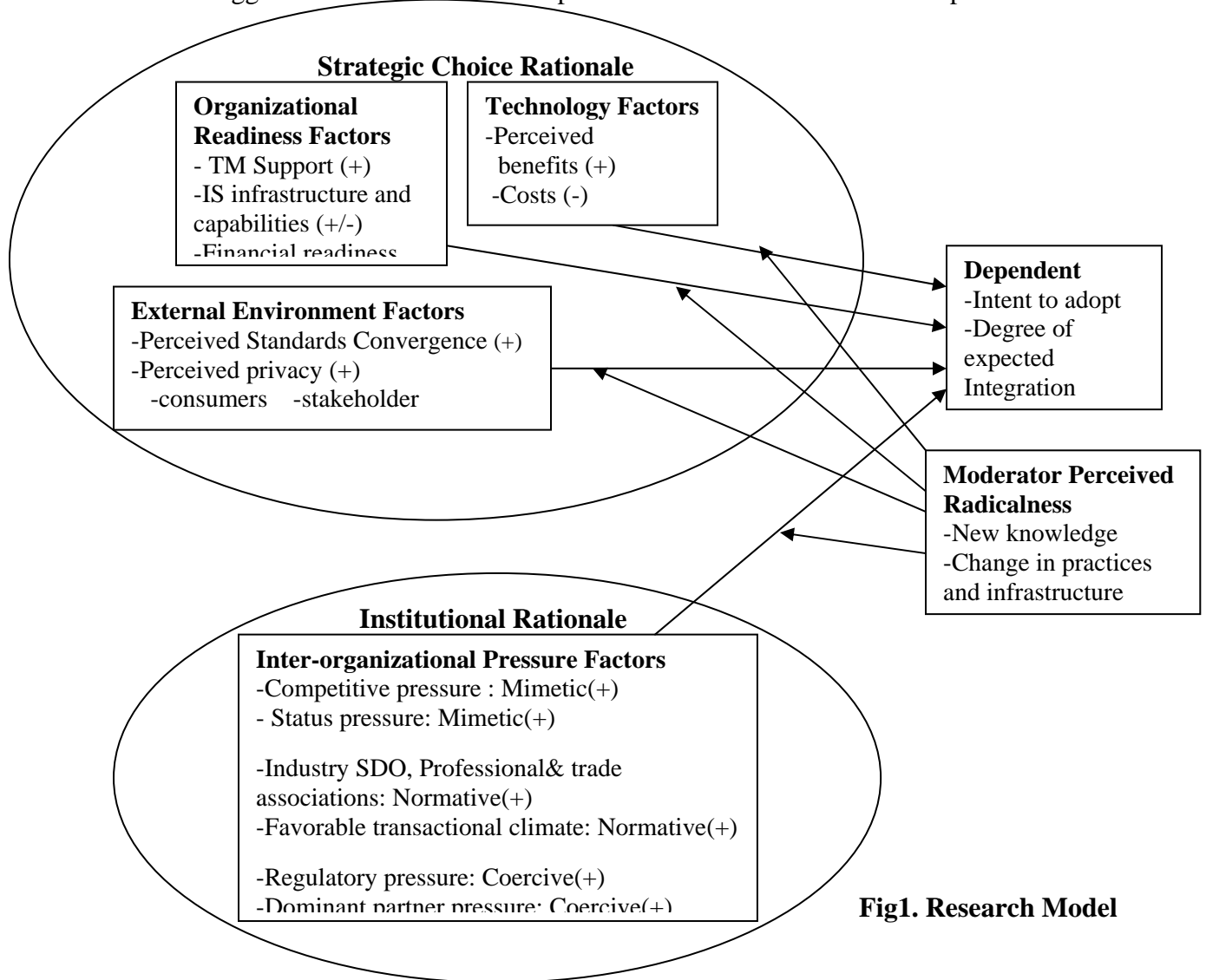
Fig1. Research Model

Dependent Variables:

The research model proposes two dependent constructs i.e. 1) adoption intent and 2) level of expected integration. The intent to adopt has been used extensively as the dependent variable in IOS adoption literature (Chwelos et al. 2003; Teo et al. 2003). It builds on the theory of reasoned

action (Fishbein & Ajzen, 1975), which suggests that behaviors are determined by intentions to perform the behavior and intentions are good predictors of behavior. According to Cooper and Zmud(1990), adoption can be looked upon as a process with different stages of adoption and implementation. During the implementation stage, organizational actions can be mapped to the different stages that reflect the level of technology integration with existing systems both within and across organizations. The level of expected integration construct in this model is defined as the degree to which organizations intend to integrate and use the technology subsequent to adoption. This construct tries to discriminate between minimal or superficial adoption on one end to extensive integration both internally and between organizations. Masetti and Zmud(1996) have studied actual integration levels and its sub-dimensions in IOS adoption, Gallivan (2001) stresses that technology assimilation takes into account both contextual factors and events in terms of extended, integrative and emergent technology use, while Premkumar and Ramamurthy(1995) also refer to integration from a general perspective.

Technological Factors

Tornatzky-Fleischer (1990) defined technological factors as perceived characteristics related to a technology. Most past studies used innovation diffusion theory as the base for IOS adoption research. Relative advantage (Rogers 1983) or perceived benefit (Iacovou et al. 1995) have been found to be key determinants of adoption of innovations. Perceived innovation characteristics such as complexity, compatibility, (Tornatzky-Klein 1982), costs and communicability (Premkumar et al. 1994) were identified for example as important EDI adoption predictors. Being consistently cited as important adoption factors, perceived benefits and perceived costs were technological factors selected as facilitators and inhibitors of adoption intent in this study.

Perceived benefits

Perceived Benefit has consistently been found to be an important predictor of adoption intent (i.e. Iacouvou et al. 1995). As was with EDI technology (Pfeiffer 1992), RFID technology is likely to bring both direct and indirect benefits to retailers and manufacturers. Direct benefits are mostly operational savings resulting from increased internal efficiency of the organization whereas indirect benefits refer to opportunities and gains resulting from RFID's impact on business processes and relationships. Some direct benefits for the retailers include improved inventory management, reduced stock-outs, decreased theft, and fewer scanning errors. These benefits are possible due to enhanced product visibility and automatic real-time tracking.

Some indirect retailer benefits include higher customer satisfaction from fewer stock-outs and faster service at purchase or return time and improved consumer purchase insight patterns. For manufacturers some direct benefits include improved inventory management, reduced stock-outs due to increased visibility and faster, more accurate assessment of customer requirements and indirectly improved consumer insight, greater understanding of value-chain problem areas, and improved efficiencies and reduced costs resulting from reengineering of business processes. Some indirect benefits can be derived through manufacturer-retailer collaboration efforts and may become a new basis for competitive advantage for both. Hence, based on diffusion of innovation theory (Rogers 1983), perceived relative advantage/perceived benefit (both direct and indirect) is likely to be a key predictor of intent to adopt and integrate RFID.

H1A: Technological factor perceived benefits will have a significant positive relationship with both adoption intent and level of expected integration.

Perceived Costs

Saunders & Clark (1992) examined the impacts of perceived benefits and costs on EDI adoption and found that perceived higher costs leads to lower intent to adopt. Similarly, the less expensive the innovation, the more likely it will be adopted (Rogers, 1983), but innovation costs relative to innovation benefits are more meaningful. Although cost is a significant inhibitor of innovation adoption, its links to diffusion are not clear. Some researchers argue once an adoption investment is made, higher costs may motivate firms to more actively diffuse it within, thus diluting its costs (Zaltman et al, 1973). With RFID, the costs of RFID tags, integrating RFID with information and resource management systems, purchasing new hardware and software, reengineering business processes and replacing existing infrastructure may be inhibitors of adoption.

H1B: Technological factor perceived costs will have a significant negative relationship with adoption intent but a significant positive relationship with level of expected integration.

Inter-organizational Pressure Factors

Issues focusing on actions of other firms influencing IOS adoption are characterized as inter-organizational pressure factors. External pressure, for example, has been identified as a driver of intent to adopt in EDI studies along with sub-constructs (i.e. competitive pressure, industry pressure, enacted SC partner power and SC partner dependence) based on resource dependence arguments (Chwelos et al., 2001). Socio-political factor such as exercised power of SC partners was observed with EDI to be an important adoption driver. A favorable transactional climate between SC partners on the "Cooperation-conflict continuum" is important in IOS adoption

(Premkumar-Ramamurthy, 1995). Teo et al. 2003 suggested coercive, mimetic and normative pressures as types of institutional pressures that predict adoption of IOS based inter-organizational linkages. Institutional isomorphism (Dimaggio &Powell, 1983) argue that organizations have a need for acceptance and legitimacy which drives them to conform to institutional environment pressures and that institutional isomorphism is a "useful tool for understanding politics and ceremony that pervade … modern organizational life." They then suggested three mechanisms: coercive, mimetic and normative through which institutional isomorphism occurs. In this study, competitive pressure, industry pressure, regulatory pressure, net exercised SC power, and favorable transactional climate have been suggested as influences, which manifest themselves through institutional pressures that drive RFID adoption. It is further suggested that organizations face coercive, mimetic and normative pressures from organizations within their SC and organizational field (i.e. regulatory bodies, industry/trade associations, successful competitors, and influences from perceived successful prominent organizations).

Coercive pressures

Coercive pressures are defined as formal/informal pressures, which result from organizations that the focal firm is dependent for resources (Dimaggio & Powell, 1983) and is analogous to the resource dependence argument (Pfeffer & Salancik, 1978). Coercive pressures on organizations may stem from many different sources such as regulatory bodies, resource dominant organizations and parent corporations (Teo et al. 2003). Dominant organizations within the SC and in the institutional environment could pressure dependent organizations to adopt programs, policies, and technologies that are favorable to them. With RFID technology as discussed earlier, significant benefits would be realized if the focal firm's SC partners simultaneously adopted thus allowing sharing and flowing of information across the SC. It would be likely that resource dominant organizations adopting RFID would ask their dependent partners to also adopt plus there likely would be pressures from regulatory bodies to become RFID compliant. Hence,

H2: Coercive pressures would be positively and significantly related to RFID adoption

H2A: Pressures from dominant partners to adopt RFID would be positive and significant.

H2B: Pressures from regulatory bodies to adopt RFID would be positive and significant.

Normative pressures

Normative pressures occur in relational channels among network members when norms are shared during consensus building thus potentially increasing a norm's influence. Communication among SC partners and among members of professional bodies and industry trade associations

concerning benefits and best practices related to innovations would result in shared beliefs and persuade organizations to adopt technologies. With RFID, a technology with network effects and dependencies, this scenario is highly likely given trade and professional association memberships and transactional climate between SC partners being important factors in norm sharing and diffusion. Hence, with RFID, favorable transactional climate between a focal firm that supports RFID adoption and its SC partners and has memberships to professional and trade associations, which sanction RFID technology use, normative RFID adoption pressures would increase.

H3: Normative pressures would be positively and significantly related to RFID adoption

H3A: Normative pressures from professional associations, trade associations and industry-based standard developing organizations sanctioning RFID adoption would be positive and significant.

H3B: Normative pressures from sharing of knowledge and best practices between partners through the existence of favorable transactional climate would be positive and significant.

Mimetic pressures

Mimetic pressures result from organizations response to uncertainty (DiMaggio-Powell, 1983). In uncertain conditions, with no clear course of action unavailable, organization leaders tend to mimic/copy actions of perceived successful organizations (Mizuruchi-Fien, 1999). Mimetic pressures are driven by industry bandwagon effects (following successful competitors) or driven by status (following prominent organizations) (Kraatz, 1998). With RFID adoption, technology uncertainty may exist due to differences in firms that are strongly influenced to mimic firms considered industry leaders or competitors who are considered to have successfully adopted.

H4: Mimetic pressures would be positively and significantly related to RFID adoption

H4A: Mimetic pressures from competitors within the industry which have adopted RFID and are perceived as successful would be positive and significant in RFID adoption.

H4B: Mimetic pressures from prominent organizations which have adopted RFID and are perceived as leaders would be positive and significant in RFID adoption.

Organizational Readiness Factors

Internal organizational characteristics and properties have been identified as organizational factors (Chwelos et al., 2001) influencing IOS adoption. Organizational readiness, availability of financial and technological resources (people, technology, expertise) of a firm, has been found to be a key driver of EDI adoption (Iacovou et al. 1995). Some studies include IT sophistication (Chwelos et al. 2001) as a separate construct covering TM know-how and support, expertise, and infrastructure. TM support presence, an internal champion, and organizational compatibility are

some existing organization factors (Premkumar-Ramamurthy 1995) found significant in IOS adoption. In the model put forth, TM support, IS infrastructure and capabilities and financial readiness have been proposed as attributes of organizational readiness.

Top management support

Top management support has been shown to be an important IOS adoption predictor (Premkumar-Ramamurthy, 1995). With RFID, where strategic benefit may be realized through improved partner coordination and business process reengineering, signals need to be sent within and between firms about commitment and importance of the RFID initiative. Long term strategic vision and direction from TM is critical to RFID adoption and integration in and between firms.

H5A: Organizational readiness factor top management support will have a significant positive relationship with both adoption intent and level of expected integration.

IS infrastructure and capabilities

The presence of a good IS infrastructure (hardware, software, and expertise) is the same as possessing technological resources that can enhance adoption facilitation. Technological resources readiness refers to a firm possessing appropriate technology infrastructure, people and expertise to support easy adoption. The presence of appropriate resources reduces costs and efforts in integrate RFID technology with existing systems compared to purchasing or developing new systems and training employees in new skill sets.

H5B: Organizational readiness factor IS infrastructure and capabilities will have a significant positive relationship with both adoption intent and level of expected integration.

Financial Readiness

Financial readiness refers to having enough financial resources available to pay for adopting a new technology, including new systems' learning and integration costs. The presence of financial resources to cover associated RFID costs would increase the likelihood of adoption.

H5C: Organizational readiness factor financial readiness will have a significant positive relationship with both adoption intent and level of expected integration.

External Environmental Factors

Factors external to a firm but influencing a firm's functioning and decision-making (i.e. governmental influences, technology standards development, legal environment, consumer readiness, stakeholders' privacy concerns, technological breakthroughs) have been characterized as environmental factors. Some of these factors such as competitive and industry pressure have

been classified under the environment context by Tornatzky-Fleischer (1990), where as Chwelos et al.'s (2001) interorganizational factors also address some of these influences. Governmental control and regulations (Tornatzky-Fleischer, 1990) and consumer readiness (Zhu et al., 2002) have also been studied as environmental factors. However, in this paper due to the ubiquitous and radical nature of RFID external environment factors such as standard convergence (data, software/hardware and legal standards), perceived stakeholder privacy and perceived consumer readiness are viewed as important environmental influences on a firm's RFID adoption decision.

Perceived Standard convergence

Standard convergence is defined as the degree of consistency of standards between the partner organizations within an industry (vertical) and across industries (horizontal). With RFID adoption, it is important to achieve interoperability between SC partners and to move towards open standards for leveraging cross industry benefits. It is proposed that higher perceived standard convergence would be favorable for adoption as it would result in more transactions using RFID within and across industries, thus greater benefits at possibly lower costs. Hence

H6A: Perceived standards convergence will have a significant positive relationship with adoption intent and level of expected integration.

Perceived privacy

Perceived privacy is the extent to which individuals and organizations believe they have control over information about them being communicated to others. This definition derives from the definition of "Privacy" as being the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others (Westin 1966). In context of RFID, due to its pervasive nature, it is suggested that beliefs of privacy of consumers and/or organizations would foster its adoption while lack of would inhibit.

H6B: Perceived privacy for both consumers and organizational stakeholders will have a significant positive relationship with adoption intent and level of expected integration.

Perceived Radicalness

Hage (1980) identified radicalness as one of the "most critical dimensions" of an innovation, however it remains to be thoroughly explored in IOS adoption literature. Radical technologies appear more complex to adopters, generate greater usage resource requirement uncertainty, and have a lower adoption likelihood (Gopalakrishnan-Damanpour, 1994). The degree of perceived radicalness of a technology may hence influence its adoption by individuals and organizations.

Ettlie et al. (1984) define an innovation as radical if it is both new and introduces a magnitude of change. This study defines radicalness of technology as having two key sub-dimensions 1) the degree of new knowledge required for its adoption and 2) the extent of changes it mandates to existing practices and infrastructure for adoption and subsequent implementation to occur. For RFID adoption, besides direct user operational benefits, a very prominent issue is of modifying and altering business processes to leverage indirect benefits. RFID adoption may be perceived as radical because it may 1) require learning new skills and acquiring new infrastructure, 2) provide unforeseen strategic benefits, 3) bring about changes to an organization's internal structure and functioning and 4) change SC partners' interactions. The perceptions of radicalness would impact the strength of relationship between antecedents such as infrastructure and adoption but infrastructure itself is unlikely to impact the perception of technology radicalness. Hence, the proposed adoption drivers are likely to be more significant the more radical the technology is perceived. The proposed moderating effects and supporting arguments have been presented in Table 2.

H7: Perceived radicalness will moderate relationships between technological factors, organizational readiness factors, inter-organizational pressure factors, external environment factors and adoption intent so that relationships will be stronger in the hypothesized directions.

Drivers Effects	Perceived benefits	Perceived costs	Organizational readiness Factors	External Environment factors	Interorganizat-ional pressures
Moderating effect of Perceived Radicalness on model relationships	Stronger Prior literature suggests new technologies are compared to existing with their new functionalities being perceived as more beneficial than previous ones (Gatignon & Xuereb, 1997)	Stronger Implementation costs for more radical technologies would be higher as new infrastructure and learning costs may be high.	Stronger Perceived radicalness strongly associated to uncertainty in terms of having sufficient resources to leverage benefits from the technology (Gopalkrishan and Damanpour, 1994).	Stronger Perceived radicalness associated with greater resources requirement uncertainty (Gopal-krishan & Damanpour, '94) & substantial change, presence of any or all factors contributing to an environment that facilitates adoption may be more critical for radical techs.	Stronger Radicalness associated with implementation complexity and uncertain success (Gopalkrishan & Damanpour, '94) Institutional factors more significant under uncertainity (Dimaggio & Powell, 1983).
Direct effect on adoption Intent and expected integration	Positive Based on diffusion of innovation (Rogers 1983); (Chewlos et al.. 2002)	Negative Based on diffusion of innovation theory(Rogers, 1983);	Positive Based on Iacovou ("95) & organiz-ational innovation literature Damanpour(1991)	Positive Based on news reports and prior literature on privacy, standards and consumer readiness (Zhu et al. 2002)	Positive Based on Institutional theory (Dimaggio & Powell, 1983); Teo et al.2003

Table 2. Direct and moderating effects in the adoption and early integration of RFID

Adoption Rationales

As discussed earlier, organizations adopt new technologies with different underlying rationales (i.e. strategic choice and institutional). The research model proposed in this study suggests both strategic and institutional rationales exist simultaneously during the adoption and integration decisions even though their relative strengths may differ. Based on the findings of Teo et al. 2003, and the radical nature of RFID, it is suggested that in the adoption of RFID technology institutional pressures from organizations would be a stronger driver for adoption than strategic considerations. Since integration requires substantial commitment of resources (effort, time, money), greater integration would be more likely when adoption is voluntary, keeping in mind performance and efficiency benefits, than when it is a response to pressures from organizations. Hence, for expected integration of RFID both internally and externally, it is suggested that for adoption strategic rather than instructional would be stronger predictors.

H8A: Strategic choice & institutional rationales are significant & positive in RFID adoption

H8B: Institutional are stronger predictors than strategic choice rationales in RFID adoption.

H8C: Both strategic choice and institutional rationales are significant and positive in the expected integration of RFID

H8D: Strategic choice are stronger predictors than institutional rationales in more extensive expected integration of RFID

IV. RESEARCH METHODOLOGY

Model Development

In this study, I seek to explore the underlying rationale in adoption of RFID technology or why do organizations adopt RFID technology and also identify how presence of particular drivers for an organization would relate to RFID adoption and expected integration. To accomplish the above mentioned goals and to develop a better understanding of the adoption process, I conducted in depth, semi-structured interviews of executives and RFID program managers and supply chain managers across 10 organizations which have been associated with the RFID initiative. To avoid single respondent bias some of the interviews were conducted with multiple respondents for the same organization. The interviews were conducted over a period of three months (May-July, 2005) and were either face to face or over the phone and usually lasted between 1 and two hours. The organizations spanned the breadth of the supply chain and included, manufacturers/suppliers, retailers, logistics support providers, vendors and consultants.

The questions for the interviews were a mix of open ended questions and structured questions to allow both the flexibility of exploring new contexts but also to help maintain focus on some of the previously identified relevant themes. The interviews were recorded and later summarized in text.

The profiles of the organizations interviewed and the presence of the underlying motivations for their decisions on whether or not to adopt and integrate RFID in the near future have been summarized in Table 4. The analysis was carried out with the underlying assumption that both strategic choice and institutional motivations could coexist in an organization's decision of whether or not to adopt and integrate RFID.

In addition business press articles, discussing firms and their thoughts on the adoption of RFID technologies in the near future, are utilized as well. Reports on web sites related to RFID technology and surveys conducted by a number of consulting firms have been used as additional supporting evidence for model components.

Contextual data found in the interviews and business press has been incorporated and reviewed in a manner consistent with the approach suggested by Krippendorff (1980) and utilized by Slaughter and Ang (1995). Two independent readers evaluated the data for model relevance and supporting constructs. Table 3 presents the frequency of occurrence of each construct in the semi-structured interviews and business pressas support for the model constructs. The data from news reports and interviews along with findings from a survey conducted by Cap Gemini Ernst and Young and packaging industries can be made available upon request.

CONSTRUCTS	FREQUENCY OF OCCURRENCE	% OCCURRED
Technology		
Perceived Benefit	16	88.9%
Perceived cost	9	50%
Organizational Readiness		
TM Support	1	5.5%
IS Infrastructure	3	16.7%
Financial Readiness	3	16.7%
Diffusion Champion Present	5	27.8%
Organizational Readiness	2	11.1%
Interorganizational pressure		
Competitive Pressure	0	0%
Dominant SC Partner pressure	11	61.1%
Industry/Regulatory Pressure	1	5.5%
Favorable P-Transactional Climate	0	0%
External Environment		
Tag Cost Reductions	3	16.7%

Data Standards Adoption	6	33.3%
Software Standards Adoption	6	33.3%
Intellectual Property and Ownership Standards Adoption	7	38.9%
Privacy Concerns	2	11.1%

Table 3. Frequency and percentage of occurrence of relevant constructs in news-reports and interviews

Organization	Industry Sector	Main Supply chain role	RFID adoption role(s)	Strategic Rationale Present	Institutional Rationale Present	Initial Adoption	Expected Integration
A	Home Construction and equipment retailer	Retailer	End user	Yes	No	No	No
B	Consulting*	Solution providers	Provide expertise in RFID adoption	Yes	Yes		
C	Logistics and transportation	Logistics Support and Solution Provider	Expertise and End user	Yes	No	No	No
D	Label Makers And Antenna makers	Logistics	Vendors and End users	Yes	Yes	Yes	Yes
E	Reader Manufacturers*	Technology and solution providers	Vendors	Yes	Yes		
F	Beverage bottling	Suppliers	End User	No	Yes	Yes	No
G	Consumer products (paper based)	Suppliers	End User	Yes	Yes	Yes	Yes
H	Pallets	Suppliers	End User	Yes	Yes	Yes	Yes
I	Hardware,* software, expertise	Consulting/ Solution Providers	Vendor	Yes	Yes		
J	Retail Solutions	Solution providers/manufacturing	End User	Yes	No	Yes	Yes

Table 4: Profile of organizations interviewed and their adoption considerations

V. DISCUSSION AND CONCLUSION

As evident from Table 3, most model-suggested constructs have been mentioned several times in news-reports and semi-structured interviews. The highest occurrence frequency is the construct perceived benefit (88.9%) followed by exercised SC partner power (61.1%) and perceived costs (50%). Also 38.9% responses favor intellectual property and ownership standards adoption, and 33.3% responses favor data and software standards adoption, 27.8% responses favor diffusion champion presence and TM support. 16.7% responses favor tag cost

reductions and suggest external environment factors as important RFID adoption drivers. Industry/regulatory pressure has been mentioned in 5.5% cases explicitly. Some constructs although not directly mentioned (i.e. competitive pressure, favorable transactional climate, consumer readiness) in news-reports or semi-structured interviews were previously found important in IOS adoption studies.

Evidence for both rationales being present simultaneously for the adoption and integration decisions can be found in Table 4. As suggested by a manager from organization G experiencing institutional pressures that also perceives benefits from the use of the technology by linking it upstream and integrating the technology with its internal operations and suppliers. Also some organizations such as A and C with primarily strategic considerations, and no institutional rationales are also less inclined to adopt the technology due to less perceived benefits and lack of readiness. Similarly for organizations with only institutional rationales present with low strategic drivers such as F there is adoption but lower expected integration. Over all, the pattern matching between rationales and their drivers with the expected outcomes in terms of initial adoption and expected integration suggests that while the presence of institutional considerations and its drivers is important for adoption, the presence of strategic choice rationales along with high levels of the drivers is important for integration. For organizations where the key consideration was strategic but very low levels of key drivers were present as in the case of organizations A and B, both adoption and integration were doubtful in the near future. Over all the preliminary analysis of the data lends support to the hypothesis in the study.

In this study, both strategic choice and institutional rationales have been suggested implicitly as the drivers of adoption and expected early integration of RFID technology. Organizational readiness, technological, interorganizational pressure and external environmental factors were suggested explicitly to play a role in the intentions of organizations to adopt RFID and integrate RFID. The study proposes testable hypotheses both at the construct and rationale level which allows relative comparison of the rationales in prediction adoption and integration decisions. The organizational representatives cited in the study, lend credibility to the proposed model and associated hypotheses.

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