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Adoption and Impacts of Interorganizational Business Process Standards: Role of Partnering Synergy

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Notwithstanding potential benefits, such as quality of interorganizational relationships and operational and strategic gains, adoption of information technology (IT)-enabled interorganizational business process standards (IBPS) is still limited. Given that these standards are designed for interorganizational business processes, we suggest that adoption of these standards depends not only on the factors pertinent to a focal firm but also on factors that represent synergies between a focal firm and its trading partners. In this paper, building on the technological, organizational, and environmental (TOE) framework and interorganizational theories, we propose a model that postulates that a set of TOE factors will have synergistic effects (i.e., interactions between a focal firm's and its partner's factors) on IBPS adoption. We tested our model in a study of 248 firms (124 dyads) in the high-tech industry implementing RosettaNet-based IBPS and found that three TOE factors (i.e., process compatibility, standards uncertainty, and technology readiness) had synergistic effects and two factors (i.e., expected benefits and relational trust) had direct effects on IBPS adoption. We also found that IBPS adoption led to greater relationship quality (i.e., partnering satisfaction) and operational efficiency (i.e., cycle time). Further, we found that IBPS adoption mediated the effect of TOE factors on partnering satisfaction and cycle time.

Key words: interorganizational relationships; business process; process standards; process compatibility; standards uncertainty; cycle time; relationship quality; partnering synergy; synergistic effects
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Introduction

Successful interorganizational relationships (IORs) are critical to firm performance, particularly in today's hypercompetitive business environment (Jap and Anderson 2007, Palmatier et al. 2007). Firms across the world spend millions of dollars to create and sustain effective IORs (Hult et al. 2004, Rai et al. 2009). For example, UPS spent $9 billion between 1986 and the late 1990s to improve its interorganizational processes and relationships with trading partners (Farhoomand and Ng 2000, Hult et al. 2004). Many firms invest in interorganizational systems (IOS)—information technology (IT)-based innovations, such as electronic data interchange (EDI), electronic procurement innovations (EPIs), supply chain management (SCM), and customer relationship management (CRM) systems—that can help improve the quality of IORs (e.g., Patnayakuni et al. 2006; Rai et al. 2006, 2009; Straub et al. 2004). Although such IT innovations can potentially boost organizational ability to leverage IORs for strategic benefits, many firms fail to realize this potential because they lack IT-enabled interorganizational process integration capabilities or mechanisms (Barua et al. 2004, Rai et al. 2006). Consequently, more than 60% of firms in the United States across different industries conduct business-to-business transactions through manual processes and disconnected IT systems (Wailgum 2006). This poses a formidable challenge for firms related to how IT can be leveraged to make IORs more successful (Malhotra et al. 2005, 2007; Rai et al. 2006). In recent years, many researchers have suggested IT-enabled *interorganizational business process standards* (IBPS)[1]—open

[1] IBPS are designed and developed by consortia of firms in an industry to automate, integrate, and facilitate value chain activities that are interorganizational in nature—e.g., SCM, collaborative forecasting, new product development, and inventory management

specifications for integrating and automating interorganizational business processes using IT as a solution to improve IORs (e.g., Chang and Shaw 2009, Gosain et al. 2003, Malhotra et al. 2005, Markus et al. 2006, Nelson et al. 2005, Zhao et al. 2005). IBPS provide specifications for interrelated, sequential tasks and business documents that are agreed upon and shared by trading partners to achieve a defined and common business objective (Bala and Venkatesh 2007). Articles published in academic and practitioner outlets have noted that despite potential benefits, the adoption and diffusion of IBPS are still limited (Bala and Venkatesh 2007, Chang and Shaw 2009, Malhotra et al. 2005, Wailgum 2006).

Like other types of IOS (e.g., EDI systems, SCM systems), adoption of IBPS requires a concerted approach by a focal firm and its trading partners (Gosain et al. 2003, Malhotra et al. 2005). For example, in the context of EDI, Chwelos et al. (2001) noted (p. 306), "[A]doption of EDI requires coordination between at least two firms, the relationship between the firm and its prospective trading partner(s) becomes salient. In the best-case scenario, both firms agree that adoption is in their best interest." Several others have also underscored the importance of mutual and synergistic adoption characteristics for IOS (Grover and Saeed 2007, Hart and Saunders 1997, Patnayakuni et al. 2006). Recently, Rai et al. (2009) noted in the context of EPI assimilation that "including suppliers and buyers and employing a dyadic research design should generate additional insights about the role of their respective beliefs" (p. 287). This suggests that diffusion of IBPS will depend on the factors that are pertinent to both a focal firm and its trading partner(s). In particular, understanding factors that are *only* related to a focal firm will not provide a complete picture of IBPS adoption, and understanding factors related to its trading partner(s) is also important.

Notwithstanding the importance of understanding a focal firm's and its partner's factors related to IOS adoption, our review of prior research has suggested that there has been little or no work that examined the influence of these factors simultaneously. Although prior research has provided rich insights on the factors[2] that determine IOS adoption, these factors were primarily considered from a focal firm's point of view. For example, the determinants of EDI adoption have been studied from the perspective of one side of a buyer-seller dyad—i.e., buyer (Chwelos et al. 2001) or seller (Hart and Saunders 1997). Teo et al. (2003) examined the determinants of EDI adoption from a focal firm's perspective. Zhu et al. (2006a, b) examined e-business adoption and open-standards based IOS adoption from a focal firm's perspective. Rai et al. (2009) studied assimilation of EPIs from a buyer organization's perspective. In the context of IBPS, Bala and Venkatesh (2007) examined the determinants of IBPS assimilation in dominant and nondominant firms from a focal firm's point of view. We argue that employing a focal firm perspective has essentially provided a one-sided understanding of what is clearly a dyadic phenomenon (Wang and Zajac 2007).

Against this backdrop, our objective is to understand IBPS adoption from a dyadic perspective. Specifically, we seek to understand the joint effects of a focal firm's and its partner's factors on IBPS adoption. Building on the widely used *technological, organizational, and environmental* (TOE) framework (Tornatzky and Fleischer 1990), we develop and test a model of IBPS adoption and impacts. The model is a holistic nomological network that incorporates the influence of synergistic factors—i.e., *interactions* between a focal firm's and its partner's factors—on IBPS adoption, and the impact of IBPS adoption on relationship quality (i.e., partnering satisfaction) and operational efficiency (i.e., cycle time). In developing theoretical arguments for the synergistic factors, we offer three theoretical mechanisms—i.e., *embeddedness*, *learning*, and *influence*—from three major interorganizational theories: interorganizational networks theory, social information processing theory, and institutional theory. Integrating multiple theoretical perspectives has been suggested as important to develop insights on IORs because "none of the theories of interorganizational relationship formation is complete by itself ... there is need for consideration of multiple perspectives as new theories are developed and tested" (Barringer and Harrison 2000, p. 395). This research thus deepens our understanding of IBPS diffusion by highlighting not only the factors that determine IBPS adoption but also the mechanisms through which these factors have synergistic effects on IBPS adoption.

(Nelson et al. 2005). These are also known as *vertical information systems* (VIS) standards and *standard electronic business interfaces* (SEBI) (Malhotra et al. 2007, Markus et al. 2006). For example, RosettaNet's *Partner Interface Processes* (PIPs) is a VIS standard for the high-tech industry (e.g., IT, semiconductor, and electronic components industry). The presence of business process elements (e.g., the message exchange choreography—a sequence of steps required to execute an atomic business process among trading partners) differentiates IBPS from other IOS standards (e.g., EDI standards) that only offer data and communication protocol standards (Malhotra et al. 2007).

[2] These factors include trust, buyer and supplier power, transaction-specific investments, reciprocal investments, information processing needs, institutional pressures, network externalities, technology readiness, and instrumental benefits (Chwelos et al. 2001, Mukhopadhyay et al. 1995, Premkumar et al. 1994, Teo et al. 2003).

Theoretical Background

TOE Framework and Drivers of IBPS Adoption

The TOE framework is one of the most widely used theoretical frameworks for studying the adoption of technology innovation (Iacovou et al. 1995; Zhu et al. 2003, 2004, 2006a). It posits that various contextual factors influence the organizational process of adoption and implementation of a technological innovation (Zhu et al. 2006a). Tornatzky and Fleischer (1990) suggested that these factors represent three important aspects of a firm's context: *technological*, *organizational*, and *environmental*. Technological factors represent the characteristics of current and new technological innovations. Prior research has included various innovation attributes, such as the five innovation characteristics from innovation diffusion theory (i.e., relative advantage, complexity, compatibility, trialability, and observability; Rogers 1995). Examples of organizational factors include size and managerial structure of a firm that is considering the adoption of a new technological innovation (Zhu et al. 2006a). The TOE framework suggests that, in addition to these descriptive factors, organizational resources and organizational innovativeness are important organizational factors (Depietro et al. 1990). Finally, environmental factors represent the characteristics of the environment in which a firm operates, such as industry, competitors, and relationships with partners. Together, these three aspects of a firm's context shape technology innovation adoption and implementation in firms.

Given that IBPS are IT innovations to support IORs, the TOE framework is an appropriate theoretical foundation to understand the contextual factors that influence IBPS adoption and outcomes (cf. Zhu et al. 2006a). Although the TOE framework allows researchers to examine a broad set of contextual factors, we included a manageable, yet theoretically important, set of factors that is relevant to IBPS adoption in our research. Consistent with Zhu et al. (2006a), we undertook a two-step process to identify these factors. These two steps complemented each other and helped us identify a set of factors that is theoretically relevant to the context of IBPS adoption. The first step involved identification of factors from prior IOS adoption research that employed the TOE framework as a theoretical foundation. We identified four TOE factors that were consistently found to be significant determinants of IOS and other types of interorganizational IT innovation adoption: *expected benefits* (Chwelos et al. 2001, Iacovou et al. 1995, Zhu et al. 2006b), *technology readiness* (Chwelos et al. 2001, Iacovou et al. 1995, Zhu et al. 2006a), *organizational innovativeness* (Hurley and Hunt 1998, Rogers 1995), and *relational trust* (Hart and Saunders 1997, Ring and Van de Ven 1992). Among these factors, expected benefits and technology readiness are technology factors because they represent instrumental benefits of adopting an IT innovation and organizational technological capabilities that facilitate the implementation of the innovation (Chwelos et al. 2001; Iacovou et al. 1995; Rogers 1995; Zhu et al. 2006a, b). Organizational innovativeness is an organizational factor because it represents a firm's culture and/or disposition to pursue and embrace innovations (Hurley and Hunt 1998). Relational trust is an environmental factor that captures the extent to which a focal firm expects a certain degree of stability and certainty in its relationship with trading partners who operate in the external environment (Chwelos et al. 2001).

In the second step, we reviewed prior IBPS research to understand characteristics of IBPS and assessed the theoretical relevance of the TOE factors identified in the first step. In addition, we identified factors that were not included in prior TOE-based studies but nevertheless are relevant to IBPS. Prior research has suggested three key characteristics of IBPS (Bala and Venkatesh 2007). The first key characteristic is that IBPS are interorganizational standards, and therefore a mutual and synergistic adoption by two or more partnering firms is needed to benefit from these standards (Markus et al. 2006). Further, these standards facilitate real-time integration of business processes of a focal firm and its trading partners and, therefore, may potentially expose a focal firm's internal information flow to its partners. Therefore, it is critical for trading partners to have a high degree of relational trust between them before implementing IBPS in their IORs to ensure that a firm is not subject to opportunistic behaviors by its trading partners, such as exploitation of vulnerabilities (Krishnan et al. 2006). Hence, we incorporated relational trust, which is an environmental factor, into our model as a key determinant of IBPS adoption.

The second key characteristic of IBPS is that implementation of these standards is resource intensive and requires adopting firms to have substantial technical and business process related expertise (Chang and Shaw 2009). These standards are typically based on XML-based protocols and may require service-oriented architecture (SOA) for successful deployment. Most legacy applications and enterprise systems are not readily compatible with these standards (Cartwright et al. 2005). Therefore, firms are more likely to adopt these standards if there are significant benefits of adoption, suggesting that expected benefits is a critical factor in this context. Further, factors that capture technological capabilities and challenges associated with IBPS implementation are also relevant to this particular characteristic of IBPS. Technology readiness and *standards uncertainty* are two such technological factors that capture this aspect of

IBPS adoption. Building on Bensaou and Anderson (1999), who underscored the importance of uncertainty in the context of IOR-specific investment, we suggest that standards uncertainty is particularly pertinent in the context of IBPS because a firm may be reluctant to adopt particular IBPS until the standards become *de facto* standards in the industry (David and Greenstein 1990).

The third key characteristics of IBPS is that implementation of these standards requires substantial changes to a firm's existing business processes to be compliant with the standards specifications (Bala and Venkatesh 2007, Cartwright et al. 2005). Implementation of IBPS requires not only process integration with trading partners but also integration with internal business processes. Such integration is possible if IBPS specifications are compatible with internal processes. For example, IBPS require seamless and real-time information flow between trading partners. If a firm does not have the capability to support this requirement, it is more likely that it will find that IBPS are not compatible with internal business processes. Building on Rogers (1995), who proposed compatibility as a key attribute of innovations, we suggest *process compatibility* is a technological factor that will inform the process change aspect of IBPS adoption. Process compatibility is a critical concern because many firms have high routine rigidity, i.e., they are unable to change existing work processes and practices that are deeply embedded in their value systems or culture and that they consider a source of success (Gilbert 2005, Nelson and Winter 1982).

Table 1 provides definitions of the six TOE factors that we identified from our two-step process. We suggest that these factors will have synergistic effects on IBPS adoption due to the different theoretical mechanisms that we discuss in the theory development section. Although prior research has suggested other organizational factors, such as firm size, and environmental factors, such as length of relationships, dependency, and institutional pressures (e.g., normative, mimetic, and coercive), that influence IOS adoption, we did not include them as focal variables in our model because these variables have been theorized and found significant previously in the context of IBPS adoption (e.g., Bala and Venkatesh 2007). However, we do include them as control variables.

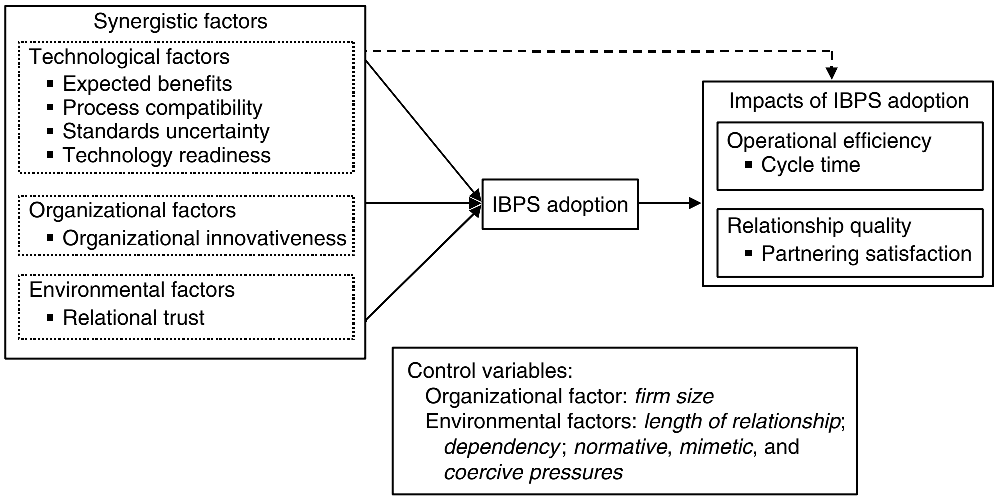
Theory Development

Figure 1 presents our model of IBPS adoption and impacts. The model posits that the six TOE factors discussed in the previous section will influence IBPS adoption, which in turn will lead to organizational outcomes. The model also posits that IBPS adoption will partially mediate the influence of TOE factors on organizational outcomes. The core tenet of this model is *partnering synergy* conceptualized at a dyadic level, which suggests that IBPS adoption hinges not only on factors that directly influence each firm's adoption decision but also on factors that are *synergistic* to trading partners. In this section, we first discuss theoretical mechanisms for the synergistic effects. We then hypothesize why and how the TOE factors will have synergistic effects on IBPS adoption.

Table 1 Definition and Source of TOE Factors

Contexts	Factors	Definition	Source	Effects
Technological	Expected benefits	The degree to which a firm expects operational and strategic benefits from adopting IBPS.	Chwelos et al. (2001), Iacovou et al. (1995), Zhu et al. (2006b)	Synergistic effect from embeddedness mechanism
	Process compatibility	The degree to which IBPS are perceived as being consistent with precursor methods for executing interorganizational processes.	Premkumar et al. (1994), Ramamurthy et al. (1999), Rogers (1995)	Synergistic effect from embeddedness and learning mechanisms
	Standards uncertainty	Inability to forecast accurately whether IBPS and associated technologies will be stable over time and able to deliver the intended outcomes.	Beckman et al. (2004), Bensaou and Anderson (1999)	Synergistic effect from influence and learning mechanisms
	Technology readiness	The degree to which a focal firm has necessary technology infrastructure and IT human resources to implement IBPS.	Chwelos et al. (2001), Iacovou et al. (1995), Zhu et al. (2006a)	Synergisitic effect from learning and embeddedness mechanisms
Organizational	Organizational innovativeness	Innovativeness is the notion of openness to new ideas as an aspect of a firm's culture.	Chwelos et al. (2001), Hurley and Hult (1998)	Synergistic effect from influence and learning mechanisms
Environmental	Relational trust	The expectation held by one firm that another will not exploit its vulnerabilities when faced with the opportunity to do so.	Hart and Saunders (1997), Krishnan et al. (2006), Ring and Van de Ven (1992)	Synergistic effect from embeddedness and influence mechanisms

Figure 1 **A Synergistic Model of IBPS Adoption and Impacts**



Note. The dotted line indicates that IBPS adoption partially mediates the influence of (a) *technology readiness*, *process compatibility*, and *standards uncertainty* on *cycle time* and (b) *expected benefits* and *relational trust* on *partnering satisfaction*.

Theoretical Mechanisms for Synergistic Effects

Consistent with prior research and interorganizational theories, we argue that firms doing business with one another will form a dyadic relationship based on interdependence and cooperation (Anderson et al. 1994, Kim et al. 2006, Perrone et al. 2003). Research on IORs has suggested that firms are increasingly becoming *deconstructed* because they are relying on coordinated relationships with other firms to make value chain activities (e.g., new product development, manufacturing, research and development, procurement, inventory management, forecasting, sales, and marketing) more effective and efficient (Palmatier et al. 2007, Rai et al. 2006). Firms now work closely with other firms to manage the flow of goods and services along the value chain. A dyadic relationship represents a form of strong tie in which boundary spanners from a firm leverage social capital to access information and resources from their counterparts to gain value for the firm (Anderson et al. 1994). Firms in a dyadic relationship form network inertia—"a persistent organizational resistance to changing interorganizational dyadic ties or difficulties that an organization faces when it attempts to dissolve old relationships and form new network ties"—that is a source of interdependence, cooperation, and synergy between the participating firms (Kim et al. 2006, p. 704). Thus, we expect that partnering synergy will have a significant influence on a focal firm's decision to adopt and deploy innovations that affect IORs.

We build on interorganizational theories to develop three theoretical mechanisms to justify *why* synergistic factors will influence IBPS adoption: *embeddedness*, *learning*, and *influence mechanisms*. The embeddedness mechanism is based on interorganizational network theories that postulate the notion of *relational embeddedness*; i.e., a firm with embedded ties to another firm will form a strong tie based on familiarity, trust, and commitment (Hagedoorn 2006, Kim et al. 2006, Uzzi and Lancaster 2003). This will lead to sharing private information (e.g., unpublished information about a firm's strategy, distinctive competencies, undocumented product capabilities, inside management conflicts or succession plan, critical supplier and customer dependencies, unpublished innovations, and underlying motives; Uzzi and Lancaster 2003). A similar argument is made in the attachment literature, which suggests that boundary spanners in IORs tend to form strong exchange relationships and share knowledge about organizational values, norms, and future plans (Seabright et al. 1992). Hagedoorn (2006) suggested that dyadic embeddedness is an important form of relational embeddedness in which a focal firm creates a partnering relationship with another firm. It is likely that such a relationship will be embedded (as opposed to arm's length) and participating firms will share private information with each other. Network inertia, a salient characteristic of dyadic relationships that refers to a persistent organizational resistance to changing IORs, also indicates the strength of embeddedness in dyadic relationships (Kim et al. 2006). Overall, the embeddedness mechanism will help partners understand each other's position on matters of mutual interest.

The learning mechanism is based on social information processing (Salancik and Pfeffer 1978) and organizational learning (Daft and Weick 1984) theories. Social information processing theory suggests that the social environment is the immediate source of information for individuals and it provides cues that individuals use to construct and interpret events (Salancik and Pfeffer 1978). In the context of a dyadic relationship, it is possible that boundary spanners from one firm will gather cues from their counterparts about the other firm's culture, values, and goals (Palmatier et al. 2007). Organizational learning theory suggests that one of managers' main tasks is to gather, process, and act on information from the environment that is critical to organizational success (Hult et al. 2004). In sum, the learning mechanism suggests that a focal firm will have an understanding of its partners' positions and views on matters of common interest that in turn will influence its outcomes (e.g., IBPS adoption).

Finally, the influence mechanism is based on institutional theory (DiMaggio and Powell 1983) that suggests three sources of institutional isomorphism—i.e., the process of gaining political and institutional legitimacy and market positions: *coercive*, *mimetic*, and *normative influences*. These sources force firms to conform to norms, traditions, and social expectations in an institutional environment and expedite the process of homogenization at the interorganizational level (Oliver 1997). Prior research theorized and found that these influences were key drivers of IOS and IBPS adoption in firms (Bala and Venkatesh 2007, Teo et al. 2003). We extend the prior conceptualizations of influence mechanisms by focusing on the influence process in dyadic relationships. Specifically, we suggest that the coercive and normative pressures will underlie partners' influences on each other in a dyadic context. In such a context, mimetic influence is less pertinent because it represents the influence of successful competitors. A dominant firm can exert coercive pressure on its trading partner in a dyadic relationship by requiring the adoption of IBPS (Bala and Venkatesh 2007). If a firm is dependent on its partner for revenues and resources, it is more likely that the partner will be able to exert a coercive influence. In the context of IORs, normative pressure operates through the development of shared mental model. DiMaggio and Powell (1983) suggested that managers develop a shared mental model in two ways: (1) because of their similar professional training, managers develop a shared mental model of the institutional environment and act accordingly and (2) managers interact with each other through professional and trade associations and form perceptions of industry norms and expectations. Boundary spanners in a dyadic relationship will develop a shared mental model through their interactions and become aware of each other's plans and reactions toward IBPS adoption. Consequently, normative influence will be a key factor driving IBPS adoption.

Role of Boundary Spanners in Synergistic Effects

The three mechanisms that we discussed here suggest that boundary spanners in IORs play a critical role in stimulating the synergistic effects on IBPS adoption. Zaheer et al. (1998, p. 143) noted that an IOR is not "faceless and monolithic, it is actively handled and managed by individual boundary spanners ... [who] are more closely involved in the interorganizational relationship than other members of the organization, and tend to interact with their counterparts to a greater extent ...." Boundary spanners develop a close approximation of positions and views of their counterparts on different matters of interest. Further, because of the strength and duration of relationship that are typically high in a dyadic relationship, boundary spanners develop a sense of confidence in their counterparts' behaviors (Palmatier et al. 2007). The embeddedness mechanism suggests that firms in a dyadic relationship share private information that they may not share otherwise through boundary spanners. In practice, boundary spanners develop close interpersonal relationships (e.g., attachment; Seabright et al. 1992) with their counterparts and discuss various issues relevant to their respective firms. The learning and influence mechanisms suggest that boundary spanners develop a shared understanding of different matters that are of interest to both. Thus, boundary spanners develop an understanding of how and what their counterparts think of different factors pertinent to IBPS adoption.

We argue, based on the premise of embeddedness and learning mechanisms, that this understanding is an accurate reflection of what the boundary spanners in the partnering firm truly feel about these factors. Hence, we theorize that given that adoption of IBPS is essentially a mutual and synergistic decision, decision makers in a focal firm adjust their assessment of the relative importance of a given factor in concert with their partner's assessment of the same factor. This adjustment process is consistent with the anchoring and adjustment heuristic that suggests that decision makers adjust their initial perceptions based on new information and signals they receive from different sources, including the environment (Kahneman and Tversky 1973). Overall, boundary spanners in IORs help shape the nature of synergistic effects of a focal firm and its partner's factors on IBPS adoption.

Synergistic Effects of Technological Factors

Expected Benefits

Expected benefits represent the anticipated benefits gained from adopting a new technology innovation—here, IBPS (Zhu et al. 2006b). The theoretical rationale for expected benefits can be derived from the innovation diffusion theory that posits that potential adopters will conduct an explicit or implicit cost-benefit analysis and adopt an innovation that yields more benefits than the idea it supersedes (Rogers 1995, Zhu et al. 2006b). Firms are more likely to adopt IBPS if decision makers perceive that IBPS will provide operational and strategic benefits. Various benefits of adopting IBPS have been suggested: cost reduction, operational efficiency, improved coordination, knowledge creation and sharing, and partnering flexibility (Gosain et al. 2003, Malhotra et al. 2005). RosettaNet, for example, offers the following benefits of adopting its partner interface processes (PIPs): (1) reduction in cycle time; (2) reduction in inventory costs; (3) improved productivity through automation; (4) standardized and simplified business processes; and (5) measurable supply chain return on investment (RosettaNet 2007).

As noted earlier, IBPS implementation is resource intensive and requires substantial changes to business processes. Decision makers incorporate these aspects of IBPS implementation as they develop perceptions about expected benefits from IBPS. In addition to tangible benefits, decision makers learn about intangible benefits of IBPS adoption that cannot be easily measured (e.g., improved knowledge sharing and coordination) from the trade press, promotions by standards-development consortia, trading partners, and other boundary spanning activities (e.g., seminars and workshops). We suggest that decision makers will develop a sense of their counterpart's appraisal of expected benefits of IBPS through the embeddedness mechanism (Hagedoorn 2006, Uzzi and Lancaster 2003). Boundary spanners from trading partners that have a high degree of dyadic embeddedness are likely to know each other's assessment of various expected benefits of IBPS implementation. We suggest that this assessment will reinforce (i.e., adjust) the role of expected benefits in the process of IBPS adoption decision. In particular, if managers from a focal firm find that their counterparts view that IBPS implementation is highly beneficial, it is more likely that they will critically evaluate different facets of expected benefits to determine how their firm can also leverage these benefits by adopting IBPS. Thus, we hypothesize as follows.

Hypothesis 1 (H1). *Expected benefits will have a synergistic effect on IBPS adoption such that the positive effect of expected benefits on IBPS adoption will be stronger for a firm whose partner has high expected benefits.*

Process Compatibility

Compatibility has been suggested as an important determinant of innovation adoption in firms (Fichman 2000, Rogers 1995). Research on standards has also suggested that compatibility is a key consideration for firms before adopting a particular standard (Chen and Forman 2006, David and Greenstein 1990). Given that IBPS are developed externally by industry consortia, the issue of compatibility is critical because these standards may not be compatible with a firm's internal business processes. We conceptualize the notion of process compatibility from prior research and theories on organizational routines that suggest that firms develop a stable pattern of routines or processes based on historical success in the market (Feldman and Pentland 2003, Nelson and Winter 1982). Successful routines are institutionalized over time and become a part of organizational values and norms. Zollo et al. (2002) developed the notion of interorganizational routines that are stable patterns of interaction among two firms developed and refined in the course of repeated collaborations. Bala and Venkatesh (2007) argued that notwithstanding the benefits of changing routines by implementing IBPS (e.g., to reduce variance in routines), managers may feel that changing to externally developed IBPS will cause a major disruption in existing successful routines that are embedded in a firm's values and culture and may also result in a loss of control and power over their interorganizational processes (Porter 2001). Therefore, process compatibility (or lack thereof) is a crucial factor in IBPS adoption decisions.

We suggest that decision makers in a focal firm will not be willing to adopt IBPS if these standards are not compatible with internal processes (i.e., if business logic, message flow, and message contents orchestrated in the IBPS are not compatible with those of existing processes). Further, employees may resist IBPS implementation and may not execute the new processes appropriately if they feel that these processes are incompatible with their existing routines. We suggest that boundary spanners of a focal firm will have an understanding of their trading partners' view toward process compatibility through embeddedness and learning mechanisms. They will place varying degrees of importance on their firm's process compatibility depending on their partner's view of process compatibility. For instance, if a trading partner has a high degree of process compatibility, a focal firm may place less importance on its own process incompatibility because boundary spanners may expect that the trading partner will help the focal firm go through the challenges associated with process change (Bala and Venkatesh 2007). A trading partner with a high level of process compatibility will be able to guide a focal firm as it tries to change business processes to make them compatible with IBPS. Consequently, a trading partner's high process compatibility will buffer the relationship between a focal firm's process compatibility and its IBPS adoption. Thus, we hypothesize as follows.

Hypothesis 2 (H2). *Process compatibility will have a synergistic effect on IBPS adoption such that the positive effect of process compatibility on IBPS adoption will* *be stronger for a firm whose partner has high process compatibility.*

Standards Uncertainty

Uncertainty, particularly technology-related uncertainty, has been shown to have a substantial impact on IOS implementations and IOR-specific investments (Bensaou and Anderson 1999, Grover and Saeed 2007). Uncertainty has traditionally been treated as a broad environmental factor with several dimensions, such as market, product, demand, and technology uncertainty. We conceptualize standards uncertainty as a technology factor (as opposed to an external factor) because it represents the perception of whether the process specifications and associated technologies will be stable over time and able to deliver the intended benefits. As noted earlier, a firm may not be willing to adopt a standard until it becomes a *de facto* standard in the industry (David and Greenstein 1990). IBPS are based on recently developed XML specifications that are still evolving significantly. In addition, the process specifications in IBPS may vary from industry to industry, which makes them difficult to adopt for firms that have cross-industry IORs (Zhao et al. 2005). Further, decision makers may perceive that technologies needed to implement IBPS and process choreography embedded in IBPS are not stable and are going to change in the future. Therefore, standards uncertainty is expected to play a critical hindering role in IBPS adoption.

Considering the costs associated with implementing IBPS (e.g., costs associated with technology infrastructure, IT human capital, and change management) and difficulty in changing business processes, it is more likely that decision makers will not make a favorable adoption decision if they perceive IBPS specifications are not stable and may not become a *de facto* industry standard in the long run. Decision makers may develop such perceptions for several reasons—e.g., there are competing standards in the industry, the standard is not developed by industry-wide consortia, and the standard is not supported by major firms in the industry. The influence of standards uncertainty on a focal firm's IBPS adoption decision can be explained by the *path dependency hypothesis* that suggests that a firm's ability and willingness to adopt an innovation depends on its related experience with prior innovations (Zhu et al. 2006b). If decision makers perceive that IBPS are not going to be stable over time, it is more likely that they will stick to their current interorganizational processes to avoid potentially high implementation costs and to maintain existing relationship-specific assets. However, if boundary spanners perceive that their counterparts have a low degree of uncertainty related to IBPS, they will reevaluate (i.e., adjust) their own positions with respect to standards uncertainty. Boundary spanners will receive this signal through influence and learning mechanisms. A low degree of standards uncertainty in a trading partner signals stability and legitimacy of IBPS. During this reevaluation process, if boundary spanners agree with their counterpart's assessment and lower their own level of standards uncertainty, it is more likely that there will be greater IBPS adoption between these trading partners. Hence, we expect that the negative influence of standards uncertainty on a focal firm's IBPS adoption will strengthen in the presence of low standards uncertainty in a trading partner. Thus, we hypothesize as follows.

Hypothesis 3 (H3). *Standards uncertainty will have a synergistic effect on IBPS adoption such that the negative effect of standards uncertainty on IBPS adoption will be stronger for a firm whose partner has low standards uncertainty.*

Technology Readiness

Technology readiness has been found to be an important determinant of IOS adoption in much prior work. Our conceptualization of technology readiness is consistent with Zhu et al. (2006a), who emphasized two aspects of technology readiness—i.e., technology infrastructure and IT human resources. We also include the willingness of a firm to invest in these two aspects of technology readiness. From a technology infrastructure point of view, implementation of IBPS requires an IT solution that helps integrate external and internal business processes and systems. In other words, data and business documents received from trading partners need to be integrated and processed seamlessly by internal systems. Considering that about 60% of firms rely on legacy or spreadsheet-based applications for interorganizational processes (Wailgum 2006), it is likely that these firms may not have the necessary technology infrastructure in place for IBPS implementation. The role of competent human resources is even more critical because IBPS implementation requires personnel who have an understanding of both technological and process aspects of these standards (Cartwright et al. 2005).

As noted earlier, IBPS are based on recently developed XML-based languages and protocols, and most traditional technology infrastructure and legacy systems are not readily compatible with these languages and protocols (Gosain et al. 2003). In some cases, a specialized middleware technology is required to translate the XML messages and business documents. In addition to the translation, business process choreography needs to be interpreted and integrated with the internal processes and systems. Hence, firms not only need specialized technology infrastructure to support IBPS but also require expert IT personnel who are able to implement and support the technology infrastructure and business process choreography. Overall, firms with a greater technology readiness are in a position conducive to adopt and implement IBPS.

We suggest that technology readiness will have a synergistic effect on IBPS adoption primarily through learning and embeddedness mechanisms. These two mechanisms will help a focal firm understand the IT landscape and IT-related human capital of its trading partners. If a trading partner has high technology readiness, boundary spanners of a focal firm gather from learning and embeddedness mechanisms that the focal firm will be able to adopt IBPS regardless of its own technology readiness because the trading partner will be able to help the focal firm implement IBPS. Consequently, boundary spanners of a focal firm will place less importance on the firm's own technology readiness. If a partner has a low technology readiness, a focal firm will carefully evaluate its own technology readiness and determine if it can implement IBPS using its own technological capabilities and also help its trading partners implement IBPS. In this situation, if a focal firm also has low technology readiness, it is more likely that it will not be willing to adopt IBPS. However, if it has a high technology readiness, it is more likely that it will be able to help its trading partners to implement IBPS. It can also exert normative and/or coercive pressures on its trading partners to implement IBPS. Therefore, technology readiness is important in this situation. Thus, we hypothesize as follows.

Hypothesis 4 (H4). *Technology readiness will have a synergistic effect on IBPS adoption such that the positive effect of technology readiness on IBPS adoption will be stronger for a firm whose partner has low technology readiness.*

Synergistic Effect of Organizational Factor: Organizational Innovativeness

Organizational innovativeness is the openness to new ideas as an aspect of a firm's culture (Hurley and Hunt 1998). An innovative firm constantly seeks to find ways to respond to customer needs and market demands (Hurley and Hunt 1998). We suggest that if a firm has a culture of innovativeness, it is more likely to consider adopting technological innovations, such as IBPS, to improve coordination with its trading partners and increase the agility in its value chain activities. Further, an innovative firm will be more responsive to the needs of its trading partners and thus is more likely to adopt innovations that can help improve the relationship with its partners. We argue that an innovative firm will be in a better position to adopt IBPS for two key reasons. First, an innovative firm is less likely to be vulnerable to organizational inertia (i.e., resource and routine rigidities), a major barrier to innovation implementation, because of its experience and prior success with innovation implementation. Decision makers in such a firm are more likely to be willing to invest in innovations and change routines or work processes that can potentially lead to greater market success. Employees in such a firm are more likely to be favorable to changes in their routines or work processes because of new innovation implementation. Second, innovativeness has been found to influence organizational growth and profitability (Cho and Pucik 2005). These incentives will drive an innovative firm to continue exploring new ideas so that it can sustain the path of growth and profitability.

Managers of a focal firm will develop a sense of their trading partners' organizational innovativeness through learning and influence mechanisms. Research on managerial cognitions has suggested that managers constantly gather information from their environment to make operational and strategic decisions (Daft and Weick 1984). Firms typically provide signals and cues about their innovativeness (e.g., product and/or service innovations, new technology implementations) through different communication channels, such as press releases, news articles, and managers' participation in professional meetings and conferences. The learning mechanism, which we discussed earlier, suggests that boundary spanners will gather these signals and cues and develop a sense of their trading partners' level of innovativeness (Palmatier et al. 2007). Influence mechanisms will also play a role here because boundary spanners will be cognizant of their trading partners' innovative activities and potentially adopt them because of normative pressure (DiMaggio and Powell 1983). We suggest that if managers of a focal firm get a signal that their trading partner has a strong culture of innovativeness, it is more likely that they will leverage their own innovativeness as a vehicle to improve their relationship with this trading partner. Given that IBPS are a fruitful avenue to improve and sustain relationships with trading partners (Bala and Venkatesh 2007, Chang and Shaw 2009), managers of a focal firm will attempt to find ways to exploit their firm's innovativeness to implement IBPS. Thus, we hypothesize as follows.

Hypothesis 5 (H5). *Organizational innovativeness will have a synergistic effect on IBPS adoption such that the positive effect of organizational innovativeness on IBPS adoption will be stronger for a firm whose partner has high organizational innovativeness.*

Synergistic Effect of Environmental Factor: Relational Trust

Relational trust has been found to be a key determinant of the quality and performance of IORs

(Krishnan et al. 2006, Ring and Van de Ven 1992). Consistent with prior research that discussed the importance of trust in the context of relationship-specific investments—e.g., IOS adoption (Hart and Saunders 1997)—we expect that relational trust will be a significant predictor of IBPS adoption. Given that IBPS implementation requires substantial resource commitment and willingness to change organizational routines or processes, a firm will be willing to make investments in IBPS to automate business processes with a trading partner if there is a high degree of trust in the relationship. Hart and Saunders (1997) provided two theoretical rationales for why relational trust will be a key determinant of IOS adoption and use: (1) it will encourage firms to make investments in information sharing, and (2) it will discourage opportunistic behavior. Further, transaction cost economics (TCE) theory suggests that opportunistic behavior increases uncertainty in IORs, which in turn hinders investments in relationship specific assets (Williamson 1995). A high degree of relational trust will mitigate uncertainty by discouraging opportunistic behavior. Thus, a focal firm is more likely to adopt IBPS to automate interorganizational processes with a trading partner if there is a high level of relational trust between them.

Although we expect that all three theoretical mechanisms will play a role in the synergistic effect of relational trust, we suggest that the embeddedness and influence mechanisms will be particularly salient. The influence of a focal firm's relational trust on IBPS adoption for interorganizational processes with a partner will intensify if managers of the focal firm believe that the partner also has a similar level of relational trust. Managers of a focal firm will develop this belief because of the embeddedness mechanism discussed earlier that suggests that firms with embedded ties are more likely to form a strong tie based on trust and commitment (Hagedoorn 2006). Further, if managers of a focal firm feel that a partner has a high degree of relational trust, they are more likely to reciprocate (by increasing relational trust) because of the influence mechanism and adjustment process discussed earlier. This reciprocation will enhance the influence of relational trust on IBPS adoption of a focal firm. Thus, we hypothesize as follows.

Hypothesis 6 (H6). *Relational trust will have a synergistic effect on IBPS adoption such that the positive effect of relational trust on IBPS adoption will be stronger for a firm whose partner has high relational trust.*

Outcomes of IBPS Adoption

Firms are more likely to adopt IBPS to achieve certain outcomes, such as operational efficiency and IOR quality. Chang and Shaw (2009) suggested that IBPS implementation can influence two levels of business values: first order and second order. Our focus is on the first-order business values that represent the immediate impacts of an IT innovation on important business processes. The second-order business values are typically broad firm performance, such as sales growth and market share. It may take years for a firm to achieve these benefits from IBPS implementation. In addition, there are many other organizational and environmental factors that can potentially influence these second-order business values. Chang and Shaw (2009) noted that the first-order business values derived from IBPS adoption also influence the second-order business values. We focus on two first-order business values: operational efficiency and relationship quality. We conceptualize operational efficiency as the reduction in *cycle time*. Cycle time has been widely used as a key outcome of interest to understand process performance (e.g., Hult et al. 2004). Given that IBPS are process standards, cycle time is an appropriate outcome to assess operational efficiency gained from IBPS. There has been limited scientific evidence of the impact of IBPS adoption on process level outcomes, such as cycle time. We expect that if a firm is able to successfully implement IBPS and integrate them into its value chain, it is more likely see a reduction in cycle time because IBPS will standardize the message and document exchange between two trading partners and reduce the amount of time needed to complete a process cycle. Further, standardization through IBPS will reduce transaction errors and increase clarity in message and documentation. RosettaNet, for example, claims that adoption of RosettaNet-based IBPS in supply chain processes can reduce manual transactions by 80%, inventory level from four to two weeks, and planning time from eight to four weeks (RosettaNet 2007). Roos (2001) noted that RosettaNet-based IBPS reduced cycle time in order management processes from two weeks to two days for a major Intel supplier. Thus, we hypothesize as follows.

Hypothesis 7 (H7). *IBPS adoption will be negatively associated with cycle time.*

Another important outcome of interest is *partnering satisfaction*, which represents the relationship quality between trading partners. Satisfaction is a positive affective state resulting from a favorable appraisal of different aspects of a working relationship (Smith and Barclay 1997). Partnering satisfaction is the degree to which boundary spanners in a focal firm have a positive appraisal of a working relationship with a trading partner. Given that IBPS provide seamless information flow between trading partners, improve coordination and synchronization in interorganizational processes, and reduce process variations and errors

(Gosain et al. 2003), a focal firm will have more visibility into its partner's processes and have better understanding of the status of a transaction. This will reduce uncertainty associated with a transaction and help trading partners set realistic expectations. Consequently, partners are more likely to be satisfied with each other following the implementation of IBPS. Thus, we hypothesize as follows.

Hypothesis 8 (H8). *IBPS adoption will be positively associated with partnering satisfaction.*

Mediating Role of IBPS Adoption

Consistent with Kobelsky et al. (2008), who theorized and found that TOE factors influence firm performance, we expect that the TOE factors will influence IBPS outcomes. However, we argue that this effect will be partially mediated by IBPS adoption. In particular, we suggest that IBPS adoption will partially mediate the effects of (a) technology readiness, process compatibility, and standards uncertainty on cycle time and (b) expected benefits and relational trust on partnering satisfaction. There is no theoretical basis to expect that the organizational factor in our model, i.e., organizational innovativeness, will influence cycle time and partnering satisfaction because this factor represents an internal characteristic of a firm and thus is unlikely to affect outcomes of IBPS adoption that typically depend on technological and/or relationship-specific factors. Further, organizational innovativeness represents a general propensity of a firm to explore new ideas or innovations. It does not necessarily influence the extent to which a firm is able to gain benefits from a specific innovation once the innovation is adopted (Chwelos et al. 2001). Hence, although there may be an association between organizational innovativeness and IBPS outcomes, there is no theoretical reason for organizational innovativeness to influence these outcomes.

We expect that IBPS adoption will partially mediate the influence of three technology characteristics, i.e., process compatibility, standards uncertainty, and technology readiness, on cycle time because IBPS adoption takes place as a result of a firm's appraisal of these characteristics as a vehicle to achieve successful organizational outcomes. Although expected benefits and relational trust are likely to be associated with cycle time, there is no theoretical reason to expect these two factors will have a causal influence on cycle time. We suggest that to achieve a reduced cycle time in an interorganizational business process (e.g., order-to-cash process), the IBPS need to have a high degree of compatibility with existing processes, the IBPS specifications should have a high degree of stability, and a firm needs to have a high degree of technology readiness to implement IBPS. However, these factors will not be sufficient to achieve a reduced cycle time if a firm fails to adopt and implement IBPS in its value chain. Therefore, we suggest that in addition to the direct effect of these factors on cycle time, there will be significant effects of these factors on cycle time that are likely to operate through IBPS adoption. Thus, we hypothesize as follows.

Hypothesis 9 (H9). *IBPS adoption will partially mediate the effects of* (a) *process compatibility*, (b) *standards uncertainty, and* (c) *technology readiness on cycle time.*

We expect that IBPS adoption will partially mediate the effect of expected benefits and relational trust on partnering satisfaction. We do not have a theoretical reason to expect that technological factors, such as process compatibility, standards uncertainty, and technology readiness, will have an influence on partnering satisfaction. Expected benefits are likely to influence partnering satisfaction because they represent instrumental benefits of implementing IBPS with a particular trading partner. If managers of a focal firm expect that IBPS will facilitate significant operational and strategic benefits from the relationship with a trading partner, it is more likely that they will be satisfied with the relationship with the trading partner. However, we argue that if a focal firm and its trading partners fail to implement IBPS, it is more likely that expected benefits from IBPS will not be able to ensure partnering satisfaction between these two firms. Therefore, the influence of expected benefits on partnering satisfaction will operate through IBPS adoption. Along the same line, we argue that relational trust will influence partnering satisfaction mediated by IBPS adoption. If a focal firm expects that its trading partner will not exploit its vulnerabilities (i.e., a high level of relational trust), it is more likely to be satisfied with its trading partner (Krishnan et al. 2006, Zaheer et al. 1998). However, we suggest that the relationship between relational trust and partnering satisfaction may not be salient in the long run if trading partners do not have an efficient and reliable way of conducting business transactions. If transactions are not done efficiently and accurately, it is more likely that trading partners will not be as satisfied in their relationship. Given that IBPS adoption is expected to increase transactional efficiency and accuracy, and offers a mechanism for greater process integration, we expect that the direct effect of relational trust on partnering satisfaction will be mediated by IBPS adoption. Thus, we hypothesize as follows.

Hypothesis 10 (H10). *IBPS adoption will partially mediate the effects of* (a) *expected benefits and* (b) *relational trust on partnering satisfaction.*

Control Variables

To assess the unique contribution of the theoretically derived constructs in explaining IBPS adoption, we control for organizational and environmental factors considered to be important determinants of IOS adoption. We included six control variables: *firm size*; *length of relationship*; *dependency on trading partner*; and *normative, mimetic, and coercive pressures*. *Firm size*, an organizational factor, can potentially influence innovation adoption (Zhu et al. 2006a). It is more likely that large firms are in a better position to adopt IBPS because of their ability to invest in resources needed for IBPS implementation. *Length of relationship* and *dependency on trading partners* are also likely to influence IBPS adoption. Prior research has suggested and found that when partners have a long-term relationship with each other, they are likely to make decisions (e.g., investments in relationship-specific assets) that will provide mutual benefits and ensure continuation of the relationship (Patnayakuni et al. 2006). Similarly, *dependency on trading partners* (i.e., the degree to which a focal firm needs business-related resources and/or services that its trading partners can provide) has been found to be a critical determinant of investments in relationship-specific assets (Chwelos et al. 2001, Dyer and Singh 1998, Klein and Rai 2009). Building on institutional theory, prior research has suggested and found that *normative* (i.e., the extent to which a focal firm is influenced by norms shared through relational channels by firms in its environment), *mimetic* (i.e., the extent to which a focal firm changes over time to become more like other firms in its environment), and *coercive* (i.e., formal or informal pressures exerted on a focal firm by other firms in its environment upon which the focal firm is dependent) *pressures* significantly influenced EDI and IBPS adoption (Bala and Venkatesh 2007, Teo et al. 2003).

Method

Context and Sample

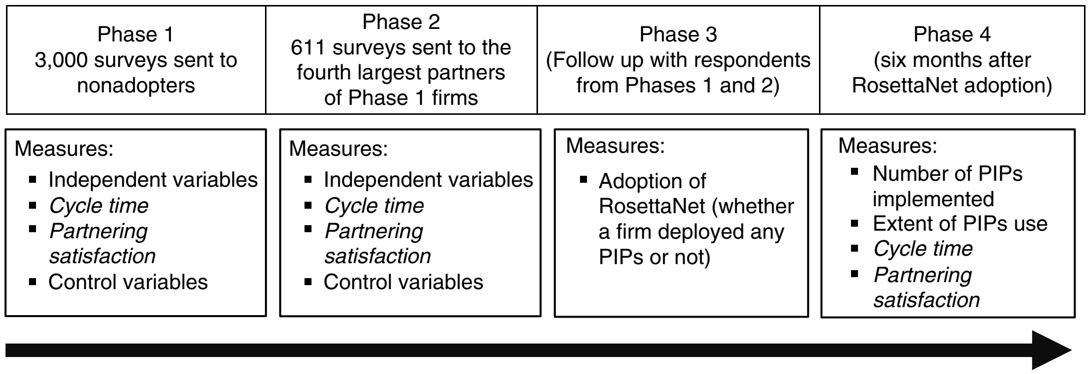
We collected dyadic data from firms in the high-tech industry that were considering adoption of RosettaNet-based IBPS. Given the nature of the model and relationships proposed, collecting dyadic (matched pair) data was essential for this study. We collected data from 124 clients and their partners (248 total firms) of an IT solutions provider that provides an integrated solution for RosettaNet-based IBPS among others. Founded in 1998, RosettaNet is a nonprofit consortium aimed at facilitating business-to-business exchanges in the high-tech industry—e.g., electronic components, semiconductor manufacturing, and telecommunications. RosettaNet was an appropriate setting for this study because it is one of the few industry consortia that is dedicated to collaborative development and rapid deployment of process standards known as PIPs. RosettaNet PIPs define business processes between trading partners by specifying the activities, decisions, and roles for each partner involved in a particular business activity. Each PIP includes a document with business logic, message flow, message content, and a business process choreography (e.g., sequence of activities). In the high-tech industry, RosettaNet is considered the leading industry standard for interorganizational business processes (Zhao et al. 2005). Likewise, there are different process standards for other industries. There are also industry-independent process standards (see Zhao et al. 2005). By focusing on a single IBPS in a single industry, we were thus able to control for certain organizational (e.g., product, market) and environmental (e.g., regulatory environment) variables. It is important to note that IBPS, such as RosettaNet, do not replace IOS, such as SCM systems. IBPS specify business documents and choreography for interorganizational business processes, and these specifications are typically integrated with SCM and other enterprise systems to develop a comprehensive technology and process solution for interorganizational transactions.

Data Collection Procedure

Our data collection spanned about two years and comprised four phases. Our data collection procedure is consistent with prior research that collected dyadic data (i.e., Perrone et al. 2003). Given that the basic unit of IORs is a dyad, prior research has emphasized the importance of dyadic research design to examine issues related to IORs (Anderson et al. 1994, Klein and Rai 2009, Straub et al. 2004). However, because of practical limitations associated with such research design, it is often difficult to collect dyadic data (Klein and Rai 2009). Some studies are based on data from only one side of an IOR, and some other studies have dyadic data holding one side of the dyad to be constant (Hart and Saunders 1997, Malhotra et al. 2005, Klein and Rai 2009, Zaheer et al. 1998). The goal of our research design was to conduct a true dyadic study.

Our source company gave us a list of 3,000 client firms in the high-tech industry that were aware of and were considering adopting RosettaNet-based IBPS. In the first phase of our data collection, we sent a survey to senior executives in these firms who were responsible for supply chain processes. We asked them to forward the survey to a senior manager who had a boundary spanning role (e.g., purchase, supply chain, and/or client manager). The boundary spanners were asked to select the fourth-largest partner (in terms of dollar amount of transactions made in the past year) and answer the survey questions with respect to this partner. Given that there was the potential for selection bias as the boundary spanners might

Figure 2 **Data Collection Procedure**



select a key partner with favorable relationships, this approach, consistent with Perrone et al. (2003), of selecting the fourth-largest firm helped us control for selection bias because boundary spanners were not able to select their preferred key partner. We asked the boundary spanners to provide the contact information of this key trading partner (i.e., the fourth-largest partner firm) and not to discuss this survey with the contact in the partner company to reduce perceptions of coercion by the partner or other biases. We also asked them to consult relevant senior managers to answer questions pertinent to technology readiness, standards uncertainty, and organizational innovativeness. For example, the boundary spanners were asked to consult the senior IT executives to answer questions related to technology readiness and standards uncertainty. This approach of getting input from relevant employees to answer survey questions is consistent with prior research (e.g., Malhotra et al. 2005). We also encouraged them to hold a meeting with appropriate individuals and fill in the survey during the meeting. We received 611 (about 20% response rate) responses in three months (after three reminders). We compared the characteristics of early and late respondents on key control variables and found no differences.

In the second phase, we sent the same survey to the fourth-largest partners (611 firms) using the contact information that was provided by the boundary spanners in the first phase and asked them to answer the questions with respect to either the focal firms from phase 1 or a key trading partner of their choice. We followed the exact same procedure that we followed in phase 1, i.e., the boundary spanners were asked to consult relevant senior managers to answer questions pertinent to technology readiness, standards uncertainty, and organizational innovativeness. Respondents in the second phase were allowed to freely choose a key partner (i.e., we did not force them to choose the partner who mentioned them as a key partner in the first phase of data collection). We received 401 usable responses in the second phase. However, boundary spanners from 167 firms did not select the focal firms from phase 1 as their key partners while answering the survey questions. We excluded these firms from our analysis. Overall, we received 234 matched pair responses (468 total firms) from the first and second phases.

In the third phase, we collected RosettaNet adoption data from these 234 matched pair firms and received 190 matched pair responses. This phase spanned about six months and required constant contact with the firms to learn whether they had adopted RosettaNet. In the fourth and final phase, which was a survey conducted six months after the implementation of PIPs, we sent a survey to the boundary spanners with questions about RosettaNet PIPs adoption and pre- and post-implementation outcomes. Given that firms implemented different RosettaNet PIPs, the outcome data for cycle time (pre and post) was associated with specific business processes identified by the respondents. In the case of the firms that did not adopt any PIPs, they provided pre- and post-implementation data for an end-to-end business process of their choice. Our final sample was 124 matched pairs (248 firms). Of these 124 pairs, 71 reported RosettaNet PIP implementation. Figure 2 shows our data collection procedure.

As can be expected, there was attrition because of the need for matched-pair and follow-up data. We compared the firm characteristics (i.e., size and revenue) between the firms in the final sample and the firms contacted in each of the phases and did not find any statistically significant differences. This sample size is comparable to prior IOR research employing dyadic data—e.g., Perrone et al. (2003) had 238 usable responses and 119 dyads. We also compared the firm characteristics (i.e., size and revenue) between firms that adopted and firms that did not adopt RosettaNet PIPs and did not find any significant differences. The boundary spanners were typically senior managers responsible for purchasing, supply chain, customer relationships, and marketing

(76%). The remaining 24% were senior IT and finance managers who were responsible for supply chain relationships and interorganizational transactions. Of the 248 total boundary spanners, 21% were women, the average age was 41.42 (standard deviation 5.51), and the average organizational tenure was 8.9 years (standard deviation 4.32).

Measures

Measures were adapted from prior research wherever possible. Given that TOE factors were primarily based on prior research, we were able to use previously validated items. We modified these items to fit with the IBPS context. We solicited feedback on the modified items from senior managers of our source company and from scholars to ensure face and content validities. Minor modifications were made based on their feedback. We pilot tested the items with executive MBA students and found acceptable psychometric properties. Appendix A presents information about the measures. We used a seven-point Likert scale to measure all the constructs except IBPS adoption.

Dependent Variables. *IBPS adoption* was measured as the product of the number of PIPs adopted and extent of use of the PIPs. *Extent of use of PIPs* was assessed as the percentage of transactions conducted through PIPs. Consistent with Rai et al. (2009), the percentage was captured in seven groups (e.g., none; 1% to 15%; 16% to 30%; 31% to 45%; 46% to 60%; 61% to 75%; 76% to 100%). The use of the product term to assess *IBPS adoption* ensures robustness of our measure because it captures two essential characteristics of *IBPS adoption*—i.e., extent of implementation and extent of utilization. Focusing on these two aspects independently will not provide a true picture of *IBPS adoption* in a firm. For example, if a firm implements six PIPs, but only 5% of its transactions are done using these PIPs, this firm will not receive as high a score as a firm that only implements three PIPs but conducts 50% of its transactions using these PIPs. The outcomes of IBPS adoption were measured using existing measures. Consistent with Hult et al. (2004), *cycle time*, a measure of operational efficiency, was assessed based on number of business days to execute a business process using RosettaNet PIPs. For the pre-implementation cycle time, respondents provided cycle time for the processes for which they were considering adopting IBPS. *Partnering satisfaction*, a measure of relationship quality, was assessed using three items from Smith and Barclay (1997).

Independent Variables. *Relational trust* was measured as a second-order formative construct with 11 items adapted from McKnight et al. (2002). These items were grouped into three dimensions of trust: ability, benevolence, and integrity. Consistent with Chin et al. (2003) and Diamantopoulos and Winklhofer (2001), we used a principal components analysis to determine factor scores for relational trust from these 11 items that we used in our data analysis. *Expected benefits* items were adapted from Chwelos et al. (2001). We modified these items to make the benefits appropriate for IBPS. Given that expected benefits represent anticipated benefits from adopting IBPS, we included various aspects of potential benefits (e.g., coordination, productivity, cost and error reduction, information sharing) while operationalizing expected benefits. However, with respect to the actual outcomes of *IBPS adoption*, we measured *cycle time* and *partnering satisfaction* because these two outcomes essentially capture the various aspects of *expected benefits*. For example, a reduction in *cycle time* indicates improved coordination, greater productivity, reduced cost, and fewer errors. Similarly, *partnering satisfaction* is a reflection of improved coordination and better information sharing. *Process compatibility* items were adapted from Venkatesh et al. (2003), who reviewed various constructs related to technology adoption at the individual level. We modified these items to fit with the IBPS context to capture whether IBPS specifications were compatible with existing work processes. We adapted *standards uncertainty* items from the technology uncertainty items used by Bensaou and Anderson (1999). *Organizational innovativeness* items were adapted from Hurley and Hult (1998), who developed five items to capture innovativeness as an aspect of organizational culture. *Technology readiness* items were developed based on the conceptualization of technology readiness from Zhu et al. (2006b), who suggested two aspects of readiness—i.e., technology infrastructure and IT human capital. We incorporated both aspects in our technology readiness items.

Control Variables. *Firm size* was measured based on total number of employees. *Length of relationship* was measured as the number of years that the partners were in a business relationship. We resolved inconsistencies in partner reports by contacting both firms for clarification. *Dependency on trading partner* was measured using two items from Hart and Saunders (1998) and Chwelos et al. (2001). We measured *normative*, *mimetic*, and *coercive pressures* using items adapted from Teo et al. (2003). We also controlled for pre-implementation levels of *cycle time* and *partnering satisfaction* to understand the extent of change that can be attributed to *IBPS adoption*.

Data Analysis Approach

Although the research model shown in Figure 1 is an integrated model of *IBPS adoption* and impacts, it was tested in two phases to accommodate both firm-level (i.e., single-level) and dyadic (i.e., multilevel) data in our analysis. In phase 1, we conducted dyadic data analysis following the guidelines of Kenny et al. (2006), who suggested a two-step approach to dyadic analysis. In the first step, an assessment of dyadic dependence is performed. This step helps us assess the degree of interdependence between the partners with respect to the data that were collected from both partners. The second step is model testing using an appropriate data analytic techniques. Several data analytic techniques are appropriate for dyadic data analysis (see Kenny et al. 2006): ANOVA, PROC MIXED (an SAS procedure), structural equation modeling (SEM), and hierarchical linear modeling (HLM). Each of these techniques has strengths and weaknesses. Kenny et al. (2006) suggested that HLM is the most appropriate approach for dyadic data analysis because of its ability to handle different levels of variables within a single analytical model. Therefore, considering the multilevel and interdependent nature of the data that we collected (individual firms nested in dyadic relationships), we used HLM and followed the data analytic approach outlined in Campbell and Kashy (2002) and used in Campbell et al. (2005). HLM explicitly accounts for the nested nature of the data and can simultaneously estimate the impact of factors at different levels on lower-level outcomes while maintaining appropriate levels of analysis for the predictors (Raudenbush and Bryk 2002). In our case, level 1 represents the individual firms ($N = 248$) and level 2 represents the dyads ($N = 124$). The cross-level model that we tested is shown below:

$$\begin{aligned} Y_{ij}(\text{IBPS adoption}) = {} & \gamma_{00} + \gamma_{10}(\text{firm-specific factors}) \\ & + \gamma_{20}(\text{partner-specific factors}) \\ & + \gamma_{01}(\text{synergistic factors}) \\ & + u_{0j} + r_{ij}. \end{aligned}$$

We used HLM 6.0 to test this cross-level model (Raudenbush et al. 2004). Following the guidelines of Campbell and Kashy (2002), we created two data files for nondistinguishable (or interchangeable) dyads for the HLM analysis.[3] Given that firms in our sample had multiple roles (e.g., supplier or buyer) in their supply chains, we felt that it would be misleading if we merely treat them as supplier or buyer—hence, we considered them nondistinguishable from a data analysis point of view. This is a typical characteristic in the high-tech industry where a firm (e.g., Intel or Cisco) can be a supplier of a certain electronic components and a buyer of certain other components. We used restricted maximum likelihood estimation for the analyses. Following convention, all the independent variables were grand mean centered (e.g., Campbell and Kashy 2002).

In phase 2, we conducted regression analysis using HLM 6.0 in which *IBPS adoption* was the independent variable and IBPS outcomes (i.e., *cycle time* and *partnering satisfaction*) were the dependent variables. Before conducting any substantive analysis in both phases, we tested for outliers, heteroscedasticity, and multicollinearity in our data set and did not find any significant problems in this regard. Following Cohen et al. (2003), we conducted the Levene's test for homogeneity of variance and found that the dyads have equal variances (p-value > 0.05 for all the variables). We also checked the variance inflation factors (VIFs) of independent variables and interaction terms to ensure that there was no multicollinearity and found that the VIFs ranged from 1.07 to 1.22, suggesting that there was no threat of multicollinearity in our analysis.

Results

To test for validity of the scales, we conducted an exploratory factor analysis (oblimin rotation). Appendix B presents the results from factor analysis. Factor loadings were consistent with Rai et al. (2006) and Chwelos et al. (2001). All items loaded on the respective factors, thus indicating that the scales exhibited internal consistency and discriminant validity. Table 2 presents the descriptive statistics and correlations for the entire sample ($N = 248$). Bivariate correlations among the variables were all in the expected direction. The table also shows that the scales were reliable (Cronbach alpha > 0.83). The correlations were not greater than the square root of the average variance extracted (AVE) for each variable, thus supporting discriminant validity.

Assessment of Dyadic Dependence

To assess the degree of dependence because of the dyad, we computed for each variable the intraclass correlation (ICC) that expresses the degree of dyadic dependence in a variable (Kashy and Kenny 2000). In other words, the ICC represents the amount variance in a variable explained by the group membership. An ICC close to zero indicates the absence of dyadic dependence, a positive ICC means positive dependence or similarity between dyads, and a negative ICC means negative dependence or dissimilarity between dyads. ICCs are also shown in Table 2. As shown in the table, except for *organizational innovation*, all variables have a significant

[3] Nondistinguishable or interchangeable dyads are those for which the actors and partners have no distinguishable characteristics that are of theoretical or empirical importance. For example, a dyad of male roommates is nondistinguishable and a dyad of husband and wife is distinguishable.

Table 2 **Descriptive and Correlation Matrix ($N = 248$)**

Constructs	Mean	S.D.	ICC	AVE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 *Firm size*	1,222	587	0.09	NA	NA																
2 *Length of relationship*	6.21	3.55	—	NA	0.13*	NA															
3 *Dependency*	4.44	1.38	0.25***	0.71	0.24***	0.08	NA														
4 *Normative pressure*	4.80	1.40	0.28***	0.70	−0.20**	0.13*	0.13*	NA													
5 *Mimetic pressure*	4.28	1.22	0.30***	0.75	−0.07	0.16**	0.31***	0.28***	NA												
6 *Coercive pressure*	4.40	1.20	0.34***	0.70	−0.15*	0.05	0.38***	0.24***	0.17**	NA											
7 *Relational trust*	3.60	1.17	0.31***	0.74	0.08	0.17**	−0.18**	0.14*	0.17**	0.08	NA										
8 *Expected benefits*	3.04	1.28	0.51***	0.78	0.1	0.15*	0.17**	0.03	0.16*	0.05	0.28***	0.92									
9 *Process compatibility*	3.71	1.20	0.28***	0.79	0.04	0.14*	0.07	0.16*	0.17**	0.08	0.04	0.32***	0.89								
10 *Standards uncertainty*	3.72	0.98	0.27***	0.70	0.07	0.02	0.04	−0.15*	−0.19**	0.04	−0.16*	−0.13*	−0.01	0.91							
11 *Org. innovat-iveness*	4.27	1.04	0.11	0.74	0.15*	0.07	0.05	0.04	0.03	0.08	0.14*	0.10	0.01	−0.22***	0.87						
12 *Technology readiness*	3.20	1.08	0.12†	0.73	0.14*	0.04	0.03	0.02	0.04	0.01	0.11	0.06	0.04	−0.17**	0.25***	0.83					
13 *IBPS adoption*	19.94	7.75	0.46***	NA	0.19**	0.17**	0.16**	0.24***	0.20***	0.21***	0.35***	0.36***	0.40***	−0.30***	0.24***	0.21***	NA				
14 *Cycle time (pre)*	4.23	2.21	—	NA	0.10	0.14*	0.15*	0.15*	0.13*	0.10	0.22***	0.17**	0.19**	−0.08	0.16*	0.08	0.13*	NA			
15 *Partnering sat. (pre)*	4.01	1.80	—	0.80	0.07	0.16*	0.14*	0.14*	0.08	0.16*	0.25***	0.15*	0.18**	−0.09	0.08	0.10	0.15*	0.33***	0.84		
16 *Cycle time (post)*	3.55	1.89	—	NA	0.24***	−0.13*	−0.18**	0.17**	0.16*	0.04	−0.30***	−0.28***	−0.25***	0.04	−0.17**	−0.20***	−0.46***	0.17**	−0.19**	NA	
17 *Partnering sat. (post)*	4.44	1.60	—	0.75	0.22***	0.15*	0.17**	0.19**	0.02	0.20***	0.31***	0.29***	0.28***	0.02	0.20***	0.23***	0.46***	0.15*	0.15*	−0.49***	0.86

Notes. Cronbach alpha shown in diagonals.
NA: Not applicable, $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

ICC, indicating that there are dyadic dependencies in the variables and a significant proportion of variance in the variables can be explained by the dyads. For example, *IBPS adoption* has an ICC of 0.46 ($p < 0.001$), which suggests that dyad members were similar with respect to their *IBPS adoption* behavior and 46% of the variance in *IBPS adoption* can be explained by dyads. Dyad membership was not able to explain significant variance in *organizational innovativeness*, suggesting that partners in our sample were not very similar in terms of *organizational innovativeness* as an aspect of organizational culture. We believe that *organizational innovativeness* is a general aspect of a firm's culture and is not associated with any specific innovations that may be pertinent to IORs. Further, it is an intraorganizational characteristic (e.g., an internal capability) that provides competitive advantage and growth. Firms, therefore, may not form IORs based on another firm's innovativeness.

Predicting *IBPS Adoption*

Table 3 provides the results related to *IBPS adoption*. As the table shows, four control variables—i.e., *firm size*, *dependency*, *normative pressure*, and *coercive pressure*—were significant predictors of *IBPS adoption*, suggesting that firms are more likely to adopt IBPS if they are large and dependent on certain trading partners and if there are pressures from trading partners to adopt IBPS. The control variables explained 12% of the variance in *IBPS adoption* (see Model 1 on Table 3). We theorized that six synergistic factors—i.e., *expected benefits* (H1), *process compatibility* (H2), *standards uncertainty* (H3), *technology readiness* (H4),

Table 3 Predicting IBPS Adoption

	IBPS adoption								
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Control variables									
Firm size	0.13*	0.08	0.02	0.01	0.07	0.08	0.02	0.04	0.02
Length of relationship	0.08	0.04	0.04	0.04	0.03	0.06	0.06	0.05	0.04
Dependency	0.17**	0.09†	0.05	0.06	0.06	0.05	0.09†	0.07	0.06
Normative pressure	0.16**	0.13*	0.14**	0.15**	0.13*	0.14**	0.13*	0.12*	0.12*
Mimetic pressure	0.08	0.05	0.00	0.01	0.01	0.06	0.02	0.04	0.00
Coercive pressure	0.16**	0.11*	0.11*	0.09†	0.12*	0.13*	0.09†	0.11*	0.08
Main effects									
Expected benefits (firm)		0.23***						0.14**	0.13*
Process compatibility (firm)			0.25***					0.19**	0.17**
Standards uncertainty (firm)				−0.24***				−0.17**	−0.16**
Technology readiness (firm)					0.22***			0.18**	0.15**
Organizational innovativeness (firm)						0.14**		0.05	0.04
Relational trust (firm)							0.23***	0.15**	0.14**
Expected benefits (partner)		0.11*						0.01	0.01
Process compatibility (partner)			0.13*					0.09†	0.08†
Standards uncertainty (partner)				−0.18**				−0.11*	−0.11*
Technology readiness (partner)					0.14**			0.01	0.06
Organizational innovativeness (partner)						0.13*		0.07	0.04
Relational trust (partner)							0.14**	0.06	0.03
Synergistic effects									
Expected benefits (firm) × *Expected benefits* (partner)		0.04							0.01
Process compatibility (firm) × *Process compatibility* (partner)			0.16**						0.14**
Standards uncertainty (firm) × *Standards uncertainty* (partner)				0.24***					0.19**
Technology readiness (firm) × *Technology readiness* (partner)					−0.16**				−0.14**
Org. innovativeness (firm) × *Org. innovativeness* (partner)						0.04			0.03
Relational trust (firm) × *Relational trust* (partner)							−0.05		−0.04
R^2	0.12	0.22	0.26	0.27	0.25	0.16	0.21	0.38	0.52
Adj-R^2	0.10	0.19	0.23	0.24	0.22	0.13	0.18	0.36	0.50
ΔR^2		0.10**	0.14**	0.15**	0.13**	0.04	0.09*	0.26***	0.14**

Note. $N = 248$ firms (124 dyads); $^{\dagger}p < 0.10$. $^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

organizational innovativeness (H5), and *relational trust* (H6)—would significantly influence *IBPS adoption*.

Table 3 shows that *expected benefits* did not have a synergistic effect on *IBPS adoption*. Thus, H1 was not supported. However, *expected benefits* of a firm had a significant direct effect on its *IBPS adoption* ($b = 0.13$, $p < 0.05$) in the final model (Model 9). As shown in Table 3, *process compatibility*, *standards uncertainty*, and *technology readiness* had significant synergistic (i.e., interaction) effects on *IBPS adoption* ($b = 0.14$, $p < 0.01$ for *process compatibility*; $b = 0.19$, $p < 0.01$ for *standards uncertainty*; and $b = -0.14$, $p < 0.01$ for *technology readiness*), thus supporting H2, H3, and H4. *Relational trust* and *organizational innovativeness* did not have a significant synergistic effect on *IBPS adoption*; thus, H5 and H6 were not supported. *Relational trust* had a significant direct effect on its *IBPS adoption* ($b = 0.14$, $p < 0.01$) in the overall model (Model 9). Although *firm size*, *dependency*, *normative pressure*, and *coercive pressure* had a significant influence on *IBPS adoption* in the control variables-only model (Model 1), only *normative pressure* ($b = 0.12$, $p < 0.05$) was significant in the overall model (see Model 9). Overall, our model explained 52% of the variance in *IBPS adoption*.

We followed Cohen et al. (2003) to plot the significant interactions. Specifically, we plotted the HLM equation at conditional values of partner's *process compatibility*, *standards uncertainty*, and *technology readiness* (one standard deviation above and below the mean). As shown in Figure 3, at high levels of a partner's *process compatibility*, the relationship between a focal firm's *process compatibility* and *IBPS adoption* is stronger than at low levels of a partner's *process compatibility*. The figure also suggests that if a partner has low *process compatibility*, a focal firm's *process compatibility* is unrelated to its *IBPS adoption*, suggesting that a trading partner's high *process compatibility* provides an impetus for a focal firm to assess the critical role of *process compatibility* in making *IBPS adoption* decision. Figure 4 shows the interaction plot for *standards uncertainty*. Consistent with H3, the figure suggests that at low levels of a partner's *standards uncertainty*, the relationship between a focal firm's *standards uncertainty* and *IBPS adoption* is stronger. In particular, *standards uncertainty* has a strong negative influence on *IBPS adoption* of a focal firm if its trading partners have a low degree of *standards uncertainty*. If a partner has high *standards uncertainty*, a focal firm's *standards uncertainty* is unrelated to its *IBPS adoption*. Finally, Figure 5 shows the interaction plot for *technology readiness*. Consistent with H4, the figure shows that the positive effect of *technology readiness* on *IBPS adoption* in a focal firm is stronger in the presence of low *technology readiness* in its trading partners. If a trading partner has high *technology readiness*, a focal firm's *technology readiness* is unrelated to *IBPS adoption*. This indicates that if a trading partner has high *technology readiness*, decision makers in a focal firm do not place much importance on *technology readiness* in determining *IBPS adoption* because they expect that they will likely to get technological support from the trading

Figure 3 **Synergistic Effect of *Process Compatibility* on *IBPS Adoption***

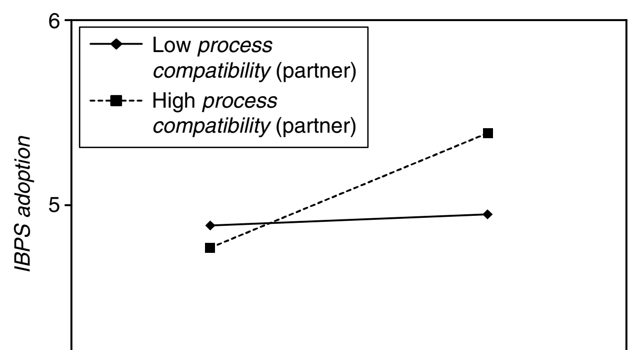


Figure 4 **Synergistic Effect of *Standards Uncertainty* on *IBPS Adoption***

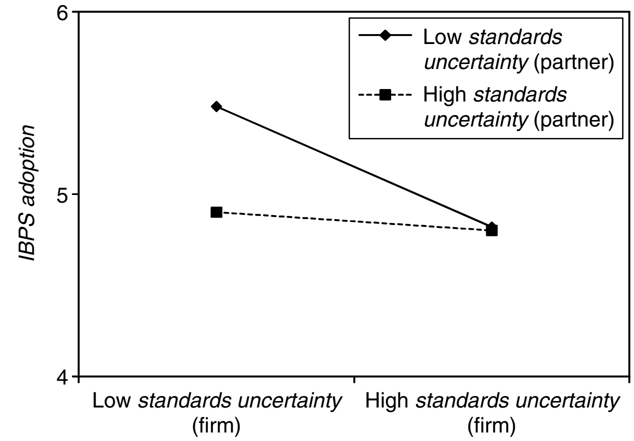


Figure 5 **Synergistic Effect of *Technology Readiness* on *IBPS Adoption***

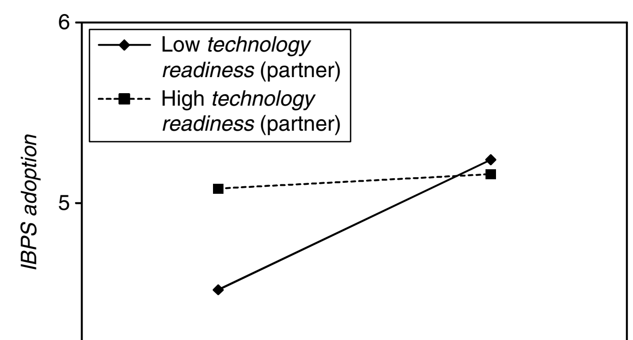


Table 4 **Impacts of *IBPS Adoption***

	Outcomes of *IBPS adoption*			
	Cycle time		*Partnering satisfaction*	
Independent variables	Model 1	Model 2	Model 1	Model 2
Firm size	0.23***	0.20***	0.21***	0.19***
Length of relationship	−0.10	−0.07	0.13*	0.10
Dependency	0.08	0.05	0.06	0.04
Cycle time (pre)	0.17**	0.14*		
Partnering satisfaction (pre)			0.13*	0.13*
IBPS adoption		−0.38***		0.40***
R^2	0.10	0.22	0.11	0.24
ΔR^2		0.12***		0.13***

Note. $N = 248$ firms; $^{\dagger}p < 0.10$. $^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

Table 5 **Mediating Role of *IBPS Adoption***

	DV: *Cycle time*			DV: *Partnering satisfaction*	
	Model 1	Model 2	Model 3	Model 1	Model 2
Independent variables					
Process compatibility	−0.12*				
Standards uncertainty		0.01			
Technology readiness			−0.12*		
Expected benefits				0.08	
Relational trust					0.12*
Mediator					
IBPS adoption	−0.41***	−0.40***	−0.39***	0.44***	0.44***
R^2	0.19	0.19	0.19	0.19	0.20

Notes. $N = 248$ firms; $^{\dagger}p < 0.10$. $^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

partner to deploy IBPS. We further discuss these synergistic effects in the discussion section.

Impacts of *IBPS Adoption*

Table 4 shows the association of *IBPS adoption* with two key outcomes—*cycle time* and *partnering satisfaction*. As expected, *IBPS adoption* had a significant negative association with *cycle time* ($b = -0.38$, $p < 0.001$) and a positive association with *partnering satisfaction* ($b = 0.40$, $p < 0.001$), controlling for the control variables and pre-implementation *cycle time* and *partnering satisfaction*, supporting H7 and H8. The negative association with *cycle time* indicates that *IBPS adoption* reduced the number of business days needed to execute an interorganizational business process (e.g., order management) and the positive association with *partnering satisfaction* suggests that *IBPS adoption* improved the quality of relationship between the partners. *Firm size* had a significant influence on *cycle time* ($b = 0.20$, $p < 0.001$) and *partnering satisfaction* ($b = 0.19$, $p < 0.001$), suggesting that large firms typically have a long cycle time and these firms have a greater level of satisfaction with their trading partners.

Given that *IBPS adoption* is composed of number of PIPs adopted and the extent of use, it is possible that these two variables have a differential impact on *cycle time* and *partnering satisfaction*. However, our analysis did not reveal any such difference. Particularly, we found that the association between both measures of *IBPS adoption* and IBPS impacts remained virtually identical. We further tested these relationships making *IBPS adoption* a formative construct and ran a partial least squares (PLS) structural model following Chin et al. (2003). The results remained unchanged (i.e., the PLS coefficients of first-order formative construct *IBPS adoption* were almost identical to the HLM coefficients), suggesting that our measure of *IBPS adoption* is robust.

Mediating Role of *IBPS Adoption*

We followed the four-step approach proposed by Baron and Kenny (1986) to test for the mediation effect of *IBPS adoption* on IBPS outcomes. The purpose of the first three steps is to establish that zero-order relationships among independent, dependent, and mediator variables exist. The correlation table (Table 2) and Tables 3 and 4 establish that significant zero-order relationships exist between TOE factors and *IBPS adoption*, TOE factors and IBPS impacts, and *IBPS adoption* and IBPS impacts. Table 5 presents the fourth step of Barron and Kenny's mediation test. As shown in Table 5, *process compatibility* and *technology readiness* had significant effects on *cycle time* in the presence of *IBPS adoption* as a mediator. *Standards uncertainty* did not have a significant effect. Thus, we found partial support for H9. *Relational trust* had a significant effect on *partnering satisfaction* in the presence of *IBPS adoption*. However, *expected benefits* did not have a significant effect. Thus, H10 was partially supported. Overall, these results suggest that in addition to the direct influence on operational efficiency and relationship quality, *IBPS adoption* plays a key mediating role in the relationship between a focal firm's technological capabilities, organizational characteristics, and environmental factors and these important outcomes.

Discussion

Prior research on IOS adoption has provided a rich set of factors that firms consider while making adoption decisions. IBPS is a form of IOS that requires a mutual adoption (e.g., a firm cannot use these standards unless one or more of its trading partner(s) implement the same IBPS). Our objective in this research was to examine the joint influence of a focal firm's and its partner's factors on IBPS adoption. Building on the TOE framework, we developed a model of IBPS adoption and impact and theorized and tested the influence of synergistic (i.e., interaction between firm and partner factors) factors on IBPS adoption. We found that three synergistic factors, i.e., interactions between a focal firm's and its trading partner's process compatibility, standards uncertainty, and technology readiness, had a significant influence on IBPS adoption. We also found that expected benefits and relational trust had significant direct effects on IBPS adoption. IBPS adoption had a significant influence on two different organizational outcomes, i.e., operational efficiency measured as cycle time and relationship quality measured as partnering satisfaction. Further, IBPS adoption mediated the effect of three TOE factors, i.e., process compatibility, standards uncertainty, and technology readiness, on cycle time and the effect of expected benefits and relational trust on partnering satisfaction. These findings have important theoretical and practical implications.

Theoretical Contributions

We drew on prior research on IOS adoption and used the popular TOE framework as a theoretical foundation to examine the concurrent impacts of a firm's and its partner's factors on IBPS adoption. Our key thesis was that given that IBPS adoption is a dyadic phenomenon, it will hinge not only on a focal firm's characteristics and inputs but also on its partner's characteristics and inputs (Wang and Zajac 2007). Our research makes at least four key contributions to the IS literature. First, we theorized and empirically validated the independent and joint influences of a focal firm's and its partner's factors on IBPS adoption. Given that implementation of IBPS is a mutual and synergistic activity, understanding the nature of this influence is important for theory and practice (Gosain et al. 2003; Malhotra et al. 2005, 2007). To the best of our knowledge, this is one of the first studies that simultaneously examined the influence of a firm's and its partner's factors on an IOS adoption. Second, we introduced two constructs that are relevant to IBPS adoption and implementation: *process compatibility* and *standards uncertainty*. Although we adapted these constructs from prior research (Fichman 2000, Rogers 1995), we conceptualized and operationalized them from a process standards point of view. We found that these constructs had significant direct and synergistic effects on IBPS adoption. Third, we identified three different mechanisms, i.e., embeddedness, learning, and influence mechanisms, for synergistic effects and offered theoretical explanations for each of these mechanisms. Finally, we theorized and tested the impact of IBPS adoption on two types of outcomes: operational efficiency and relationship quality. Although IBPS-developing consortia, such as RosettaNet, have been claiming positive impact of process standards, this was one of first scientific validations of the impact of IBPS implementation on the performance and quality of IORs. We also theorized and tested the mediating role of IBPS adoption in the relationships between TOE factors and organizational outcomes.

Building on interorganizational theories (i.e., interorganizational networks theories, social information processing theory, and institutional theory), we developed a model to explain dyadic relationships in the context of IBPS adoption and offered theoretical mechanisms to explain why TOE factors will independently and jointly influence IBPS adoption. We theorized that given the interdependent nature of relationship in interorganizational dyads (e.g., supplier-buyer or distributor-retailer), a focal firm's IOR-related decisions (e.g., IBPS adoption) will depend not only on its characteristics and inputs but also on its partner's characteristics and inputs. The three theoretical mechanisms that we developed, i.e., embeddedness, learning, and influence mechanisms, offer insights on how and why partner factors will interact with a focal firm's factors in predicting IBPS adoption. Although prior IOS adoption research has underscored the importance of partner factors (Chwelos et al. 2001, Hart and Saunders 1997), it does not offer theoretical justifications for and empirical validation of synergistic effects between a focal firm's and its partner's factors in predicting and explaining IOS adoption. Our work thus extends prior research that primarily focuses on a focal firm's factors by providing theoretical mechanisms and empirical support for the influence of partnering synergy on IBPS adoption.

Among the six TOE factors, we found that three technology factors were consistently significant across different models (see Table 3): process compatibility, standards uncertainty, and technology readiness. Compatibility has been found to be an important driver of innovation adoption (Rogers 1995), but our findings suggest that in the context of IBPS, a focal firm's adoption will depend not only its own process compatibility but also on the compatibility of these standards with its partner's business processes. In particular, in the presence of high process compatibility in a trading partner, a focal firm will place more importance on its own process compatibility while making an IBPS adoption decision. If boundary spanners of a trading partner perceive that their firm has high process compatibility, their counterparts from a focal firm will be aware of it through embeddedness and learning mechanisms. The focal firm will audit its own processes to assess the extent to which these processes are compatible with IBPS. If the processes are compatible, decision makers will be confident of making the IBPS adoption decision knowing that their trading partners also have high process compatibility. In contrast, if trading partners have low process compatibility, a focal firm will deemphasize its own process compatibility and focus on other factors that are more likely to ensure successful adoption and implementation of IBPS.

We found a similar effect for standards uncertainty. If boundary spanners of a focal firm view that the firm's trading partners have a low standards uncertainly, it is more likely that the focal firm's own view of standards uncertainty will not play a substantive hindering role in making IBPS adoption. Further, low levels of standards uncertainty in a focal firm may not lead to greater adoption of IBPS if trading partners have high levels of standards uncertainty. Prior research has suggested that a key reason for uncertainty is incomplete knowledge (Beckman et al. 2004). Firms attempt to cope with uncertainty with various adaptation strategies and try to reduce uncertainty in their environment (Bensaou and Anderson 1999). If a focal firm assesses that there is high standards uncertainty associated with IBPS, one obvious adaptation strategy is to not invest in IBPS. However, if its trading partners view that IBPS are stable and there is less uncertainty, a focal firm may attempt to get more information from its trading partners and other sources to develop a more complete and accurate knowledge of uncertainty related to IBPS. In the end, if a focal firm adjusts its view of standards uncertainty to a lower level, there is greater likelihood of adopting IBPS because standards uncertainty is no longer a hindering force. In contrast, if a focal firm still views IBPS as having high levels of uncertainty, there is less of a likelihood of adopting them even if its trading partners have low levels of standards uncertainty. These findings augment our current understanding of the role of uncertainty in relationship-specific investments by offering additional adaptation mechanisms in which firms engage to cope with uncertainty.

The significance of technology readiness suggests that technological capabilities, such as technology infrastructure and human capital, are critical for a firm's decision to adopt and deploy IBPS. This finding is consistent with prior research that found a significant influence of technology readiness on IOS adoption (Zhu et al. 2006a). However, we extend prior research by providing insights on the role of trading partners' technology readiness in IBPS adoption decisions at a focal firm. In particular, our findings suggest that if trading partners have high technology readiness, a focal firm does not emphasize its own technology readiness because it probably expects that the trading partners will offer technological assistance during IBPS implementation. In contrast, if trading partners do not have high technology readiness, a focal firm reevaluates its own technological capabilities and makes the IBPS adoption decision based on this assessment. Our findings indicate that firms complement and support each other with respect to technological capabilities during the process of IBPS adoption and implementation.

These findings and associated theoretical justifications have important implications because much prior research has studied the TOE factors from a focal firm's perspective. We offer insights on how TOE factors have synergistic effects on IBPS adoption, i.e., how boundary spanners of a focal firm take into consideration views of their counterparts while making IBPS adoption decisions. These findings also have implications for IOR theories that focus on resource similarity and resource complementarity as drivers of relationship-specific investments and outcomes (Harrison et al. 2001, Wang and Zajac 2007). In particular, we found that the role of the factors that are related to organizational routines and uncertainty is consistent with the logic of resource similarity—i.e., firms that have a *similar* understanding of and/or position in these factors are more likely to engage in relationship-specific investments such as IBPS adoption (Wang and Zajac 2007). These factors capture behaviors of a firm (e.g., what to do) that are bound by rules and customs and that do not change much from one iteration to another. It is difficult to change these factors because firms develop inertia and like to maintain status quo. Process compatibility and standards uncertainty are two such factors for which a similarity in trading partners' understanding and position leads to greater IBPS adoption. In contrast, our findings indicate that the role of the factors that are related to a firm's competence and/or capabilities to perform a behavior (e.g., how to do) is consistent with the logic of resource complementarity, suggesting that trading partners do not necessarily have to have the same levels of competence and/or capabilities to invest in relationship-specific assets. It is more likely that trading partners will help each other to make relationship-specific innovations successful in the event that a partner lacks in certain capabilities to implement these innovations. These findings further our current understanding of resource similarity and complementarity in IORs.

Our findings extend prior research on IOS adoption that did not examine the influence of TOE factors on organizational outcomes. We found that except for standards uncertainty, the other TOE factors, i.e., relational trust, expected benefits, process compatibility, technology readiness, and organizational innovativeness, are associated with cycle time and partnering satisfaction. We theorized and found support for a partial mediation of IBPS in the relationship between these factors and organizational outcomes.

In particular, two technological factors, process compatibility and technology readiness, influence cycle time directly and through IBPS adoption, suggesting that having interorganizational processes compatible with industry standards and a high degree of technological capabilities is not sufficient to reduce cycle time if a firm does not implement IBPS into value chain activities. Our findings indicate that relational trust influences partnering satisfaction directly and through IBPS adoption. This suggests that although trust with a trading partner is an important determinant of relationship quality, firms may be able to develop a holistic understanding of relationship quality if they implement relationship-specific innovations, such as IBPS, into their value chain. In other words, implementation of relationship-specific innovations operates as a mechanism through which relational trust helps a focal firm improve relationship quality with its trading partners.

This research contributes to the IOR literature in two ways. First, it offers a set of factors and associated mechanisms that lead to investments in assets that are not relationship-specific (e.g., any firm can implement IBPS because these are open standards) yet are potentially beneficial for IORs. It suggests that even though firms may not consider IBPS a relationship-specific asset because these standards are typically open standards developed by industry consortia, they still consider partner characteristics and inputs a key consideration while making the adoption decision. Second, as noted earlier, this research is one of the first works to scientifically validate the impact of IBPS adoption on metrics related to processes and relationships. Specifically, we found that IBPS can lead to reduced cycle time and greater partnering satisfaction. Improvement in such areas will have strategic value in the long run.

Practical Implications

Our findings have important practical implications. First, boundary spanners in a firm considering the adoption of IBPS need to be aware of the factors that are important for IBPS adoption. They need to consider these factors not only from their own perspectives but also from their partners' perspective. Understanding these factors from both perspectives may help them develop different strategies to influence their trading partners' decision processes with respect to IBPS adoption. Given the positive impacts of these standards on process and relationship performance (i.e., cycle time and partnering satisfaction), it is important that decision makers in firms that are considering the adoption collaborate strategically with their trading partners to implement these standards. As our findings suggest, the adoption depends on factors that are not only important to a focal firm but also to its trading partners. Further, our findings indicate that the factors that determine IBPS adoption also influence organizational outcomes directly and through IBPS adoption. Hence, boundary spanners should carefully assess these factors and be aware of their trading partners' positions and views on the factors that we found significant in our study.

Our findings suggest that although certain factors (e.g., process compatibility and technology readiness) are important for IBPS adoption, it is possible that a focal firm with low levels of these factors can also adopt IBPS under certain conditions. For example, if important trading partners have high process compatibility, it is possible that a firm will adopt IBPS discounting its own levels of process compatibility. Similarly, boundary spanners reevaluate their perceptions of standards uncertainty if important trading partners have low standards uncertainty. Overall, our findings suggest that boundary spanners in early adopters or firms that are actively considering implementing IBPS need to provide cues and signals to their counterparts about their views about process compatibility, standards uncertainty, and technology readiness. We believe that a focal firm will be receptive to these cues and signals because of three mechanisms we discussed earlier: embeddedness, learning, and influence mechanisms. Boundary spanners in a focal firm may perceive that their trading partners will be willing to offer support with respect to challenges associated with process change and standards uncertainty during IBPS implementation. This finding has important implications for IBPS implementations and diffusion. Early adopters should be willing to offer technical and personnel support to their trading partners to expedite the process of implementation and diffusion.

We believe that standards-developing consortia should focus on the factors that we found to be significant. Given that process compatibility, standards uncertainty, and technology readiness were found to be important, we suggest that standards-developing consortia should focus on these factors in promotional events (e.g., seminars, workshops, and symposia) and training programs so that managers can have a realistic understanding of how their existing processes are different from or similar to IBPS specifications, how the standards specifications may change or evolve over time, and what technological infrastructure and skills are necessary to implement these standards. Vendors who offer IBPS solutions can also leverage our findings by offering solutions that will help firms overcome issues related to process compatibility, standards uncertainty, and technology readiness. For example, vendors can offer free upgrade services if certain aspects of standards change over time. Standards developing consortia and vendors can offer change management support to help firms manage organizational changes following IBPS implementation. We believe that if a firm is able to implement IBPS by overcoming the challenges associated with process compatibility, standards uncertainty, and technology readiness because of the support from its partners, standards-developing consortia, and vendors, it is possible that its trading partners will be willing to adopt IBPS as suggested in the synergistic effect model and gain favorable outcomes from IBPS.

Limitations and Future Research

Our findings should be interpreted in light of the limitations of this research. We believe that these limitations will open avenues for fruitful future research. Our first limitation is that we only included a few factors from the TOE framework. We included these factors based on their relevance in our context and on practical considerations (e.g., length of the survey). There are many other factors that can potentially be included in a model of IBPS adoption. Further, various contingent and situational factors (e.g., industry and market characteristics, regulatory policies) can directly influence IBPS adoption or moderate the effects of TOE factors on IBPS adoption. For example, firms that perceive their existing interorganizational processes and systems to be inefficient and have low satisfaction with the current systems and IORs are more likely to consider adopting IBPS. Further, firm dominance and power differences can play a critical role in IBPS adoption (Bala and Venkatesh 2007). Although we controlled for dependency, it is possible that dominant and nondominant partners of a focal firm will have a differential impact on a focal firm's IBPS adoption. Future research can incorporate these and other factors and helps us develop a comprehensive understanding of IBPS adoption. Also, we only included two outcomes of IBPS adoption (i.e., cycle time and partnering satisfaction). IBPS can potentially influence other important outcomes (e.g., economic performance) that can be examined in future research. Related future work should employ other theoretical models, e.g., TCE theory, resource-based view (RBV) theory, agency theory, actor-network theory, and actor-partner interdependence model from the interpersonal relationship literature, and methodological perspectives. For example, social network analysis can be conducted to understand whether structural characteristics of interorganizational networks can influence IBPS adoption and impacts.

Our second limitation is that we only collected data from a single industry and in the context of one type of process standards (i.e., RosettaNet). Although RosettaNet is a leading IBPS in the high-tech industry, there are many others types of IBPS for different industries (Zhao et al. 2005). The results may be different in other industries and for other standards. Therefore, a fruitful future research direction would be to test models of IBPS adoption and impacts in context of other industries and standards. Another limitation is that we collected data from one boundary spanner from an organization who answered questions about organizational characteristics based on his or her perceptions. Although we encouraged inputs from other key organizational members, it is possible that the respondent did not incorporate these inputs and provided inaccurate or biased assessment of organizational characteristics. Data can be collected in future research from multiple senior executives to get an accurate assessment of a firm's characteristics. A final limitation of this research is that we treated each factor separately and did not theorize and test for interaction among the factors. For example, it is possible that in the presence of high standards uncertainty (partner), relational trust (focal firm) will have a stronger effect on IBPS adoption. Further, it is possible that IBPS adoption will moderate the relationship between TOE factors and organizational outcomes. We did not theorize and test for these interaction effects to reduce complexity in our model and to establish a theoretically strong baseline model that can be leveraged in future research to examine these effects on IBPS adoption and subsequent firm performance.

Conclusions

IBPS have created a new opportunity for firms to extend organizational boundaries and create effective IORs leveraging IT and open process specifications. However, a focal firm can only benefit from IBPS if they are simultaneously adopted by its trading partners. We suggested that IBPS adoption will hinge not only on a focal firm's characteristics and inputs but also on its trading partners' characteristics and inputs. However, current theories of IOS adoption do not allow for us to simultaneously examine factors from a focal firm and its trading partners' perspectives. Also, there is little scientific evidence of the impact of IBPS adoption on organizational outcomes. We developed a model that incorporates factors that are synergistically important to a focal firm and its partner while making IBPS adoption decisions and the outcomes of IBPS adoption. We found that synergistic factors were significant determinants of IBPS adoption over and above firm-level factors. We also found that IBPS adoption led to greater operational efficiency and relationship quality. Our findings have implications for firms that are increasingly relying on effective IORs to create unique value for their customers and maximize stakeholders' benefits.

Appendix A. Measures

Relational trust

Ability

1. Our business partner is competent and effective in its interactions with our organization.
2. Our business partner performs all of its roles very well.
3. Overall, this business partner is capable and proficient.
4. In general, this business partner is knowledgeable about its industry and business operations.

Benevolence

1. Our organization believes that this business partner would act in our best interest.
2. If our organization required help, this business partner would do its best to provide assistance.
3. This business partner is interested in our organization's well-being and not just its own.

Integrity

1. This business partner is truthful in its dealings with our organization.
2. Our organization would characterize this business partner as being honest.
3. This business partner keeps its commitments.
4. This business partner is sincere and genuine.

Expected benefits

1. RosettaNet PIPs will improve coordination with our trading partners.
2. RosettaNet PIPs will increase productivity in our value chain.
3. RosettaNet PIPs will help us reduce cost in our value chain.
4. RosettaNet PIPs will improve customer services.
5. RosettaNet PIPs will reduce error rates in business-to-business transactions.
6. RosettaNet PIPs will improve information sharing with trading partners.

Process compatibility

1. RosettaNet PIPs are compatible with our current ways of doing things.
2. RosettaNet PIPs will fit well with our existing work processes.
3. We have to change our current processes to be compliant with RosettaNet. (R)
4. RosettaNet PIPs do not contradict with our current business-to-business transactions.

Standards uncertainty

1. RosettaNet PIPs are still going through frequent changes.
2. We cannot predict the future of RosettaNet as the *de facto* standards in our industry.
3. RosettaNet PIPS still require changes to be more efficient.
4. I am not sure if RosettaNet will be the only standard in our industry.

Organizational innovativeness

1. My organization readily accepts innovations based on research results.
2. Management in my organization actively seeks innovative ideas.
3. Innovation is readily accepted in this organization.
4. People are penalized for new ideas that don't work. (R)
5. Innovation in this organization is perceived as too risky and is resisted. (R)

Technology readiness

1. Our current systems will support PIPs that we need for our business.
2. We have the IT infrastructure that we need to implement RosettaNet PIPs.
3. We have in-house expertise to implement RosettaNet PIPs.

IBPS adoption

Product of: Number of PIPs adopted and extent of use of PIPs.

Cycle time

Number of business days to execute a supply chain business process (e.g., order management).

Partnering satisfaction

1. Overall, my organization is very satisfied with our relationship with this partner.
2. Compared to other relationships I've known or heard about, the relationship with this partner is quite good.
3. We are happy with our working relationship with this partner.

Normative pressure

What is the extent of RosettaNet PIP adoption by your firm's partners currently?
Scale: "none has adopted" to "all have adopted" (seven-point Likert scale)

Mimetic pressure

What is the extent of RosettaNet PIP adoption by your firm's competitors currently?
Scale: "none has adopted" to "all have adopted" (seven-point Likert scale)

Appendix A. Continued

Coercive pressure

What is the extent of pressure from your key partners to adopt RosettaNet PIPs?
Scale: "no pressure" to "strong pressure" (seven-point Likert scale)

Dependency

1. What was the dollar value of your company's sales (or purchase) to (from) this partner last year/what were your company's annual revenues (or cost of goods sold) last year?
2. Rate the importance of this partner: (not at all important to very important)

*Seven-point Likert type scale used for all constructs except dependency and IBPS adoption.
(*R*) = Reverse scored.

Appendix B. Factor Analysis

Constructs	Items	1	2	3	4	5	6	7	8	9	10	11	12	13
1. *Normative pressure*	1	**0.80**	0.37	0.37										
2. *Mimetic pressure*	1		**0.78**	0.38										
3. *Coercive pressure*	1	0.40	0.42	**0.80**										
4. *Dependency*	1	0.38			**0.71**			0.38						
	2	0.40			**0.69**			0.39						
5. *Relational trust*: Ability	1					**0.71**	0.40	0.35						
	2					**0.73**	0.41	0.40						
	3					**0.75**	0.38	0.38						
	4					**0.70**	0.37	0.39						
6. *Relational trust*: Benevolence	1					0.41	**0.69**	0.38						
	2					0.43	**0.71**	0.37	0.43					
	3					0.44	**0.73**	0.40						
7. *Relational trust*: Integrity	1					0.40	0.41	**0.70**						
	2					0.41	0.40	**0.71**						
	3					0.37	0.39	**0.74**	0.41					
	4					0.38	0.37	**0.68**						
8. *Expected benefits*	1								**0.74**					
	2								**0.77**	0.38				
	3						0.43		**0.80**					
	4						0.44		**0.69**	0.39				
	5							0.39	**0.67**		0.39			
	6								**0.73**					
9. *Process compatibility*	1									**0.71**				
	2								0.40	**0.80**	0.38			
	3									**0.80**	0.39			
	4								0.40	**0.74**				
10. *Standards uncertainty*	1										**0.73**			
	2										**0.82**			
	3										**0.70**			
	4										**0.70**			
11. *Organizational innovativeness*	1								0.39			**0.68**	0.40	
	2											**0.70**	0.42	
	3								0.37			**0.71**	0.43	
	4											**0.73**		
	5											**0.72**		
12. *Technology readiness*	1											0.38	**0.71**	
	2											0.39	**0.70**	
	3											0.40	**0.70**	
13. *Partnering satisfaction*	1									0.38				**0.73**
	2									0.37				**0.80**
	3									0.39				**0.82**

*Cross-loadings below 0.35 are not shown.

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