Perceived Information Quality in Data Exchanges: Effects on Risk, Trust, and Intention to Use

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This study examines the role of information quality in the success of initial phase interorganizational (I-O) data exchanges. We propose perceived information quality (PIQ) as a factor of perceived risk and trusting beliefs, which will directly affect intention to use the exchange. The study also proposes that two important system design factors—control transparency and outcome feedback—will incrementally influence PIQ. An empirical test of the model demonstrated that PIQ predicts trusting beliefs and perceived risk, which mediate the effects of PIQ on intention to use the exchange. Thus, PIQ constitutes an important indirect factor influencing exchange adoption. Furthermore, control transparency had a significant influence on PIQ, while outcome feedback had no significant incremental effect over that of control transparency. The study contributes to the literature by demonstrating the important role of PIQ in I-O systems adoption and by showing that information cues available to a user during an initial exchange session can help build trusting beliefs and mitigate perceived exchange risk. For managers of I-O exchanges, the study implies that building into the system appropriate control transparency mechanisms can increase the likelihood of exchange success.

Key words: perceived information quality; B2B electronic commerce; electronic data exchanges; perceived risk; trust; interorganizational performance
History: Laurie J. Kirsch, Senior Editor; H. Raghav Rao, Associate Editor. This paper was received on April 29, 2005, and was with the authors $8\frac{3}{4}$ months for 3 revisions.

Interorganizational (I-O) electronic exchanges are important because they provide an efficient coordination mechanism for transacting business. Organizations that build electronic partnerships with suppliers, for example, may gain cost efficiencies and eliminate paperwork delays. Hence, data exchanges can be a key to exchange partner success (Chwelos et al. 2001, Wang and Seidmann 1995). After examining the websites of several business exchanges, we concluded that they vary widely in the quality of transaction-related information they share with users. These differences could significantly affect user adoption of electronic data exchanges.

A data exchange represents one example of interorganizational systems (IOS), by which we mean information systems used by two or more organizations (Riggins et al. 1994). The study of IOS is part of a broader inquiry on how interorganizational relation-ships (IORs) develop. Although the general IOR development literature has become very diverse (Oliver 1990), it revolves around several common themes. First, the *relationships* among the parties are critical. Studies often consider such relationship issues as how to decrease the threat of opportunism (Bakos and Brynjolfsson 1993, Zaheer and Venkatraman 1994) or how to improve coordination and cooperation among the parties (Gulati and Gargiulo 1999). For instance, close buyer–supplier relationships increase information sharing (Bakos and Brynjolfsson 1993), and a close, trusting exchange relationship improves information sharing. Specifically, Bensaou and Venkatraman (1995) find that throughput of information forms a structural capability that addresses information-processing (IP) needs. *Uncertainty* constitutes a second and related theme. Exchange partners must overcome perceived uncertainty either through the IOR itself or

through structures set up to mitigate individual risk (Gulati and Gargiulo 1999, Oliver 1990). For example, Bensaou and Venkatraman (1995) present a model of how IP capabilities address corresponding IP needs caused by IOR uncertainty. A third theme is that *time matters*. The embeddedness of relations, for example, takes time to develop (Gulati and Gargiulo 1999). Dealing with fewer exchange partners means one can spend more time with each, developing the relationship (Bakos and Brynjolfsson 1993).

This study develops an adoption model that addresses aspects of these three themes. With regard to the importance of IOS *relationships*, we focus on a unidirectional component of the relationship that may be critical to system adoption (i.e., buyer perception of the relationship in terms of the quality of information shared by the exchange partner). In terms of the *uncertainty* theme, we examine the uncertainty-addressing roles of both trust and perceived risk. Perceived risk refers to a specific kind of uncertainty a user perceives, providing a window on the degree of uncertainty the system user feels in the situation. The IOR literature views trust, a key relationship variable, as an effective way to address uncertainty (Bensaou 1997, Bensaou and Venkatraman 1995, Gulati and Gargiulo 1999, Ring and Van de Ven 1994). While it is not unusual to study either risk or trust in the IOR, it is less common to address them both, as researchers like Pavlou and Gefen (2004) have. With respect to the *time* factor, we examine the exchange relationship at its inception. This is important because the beginning of any relationship is its most tenuous and uncertain timeframe (Gulati and Gargiulo 1999), when first impressions dominate and the question of adoption hangs in the balance. Few have studied initial relationship IORs, though some have studied them in stages (e.g., Malone et al. 1987, Bakos and Brynjolfsson 1993, Riggins et al. 1994, Wang and Seidmann 1995).

While building on existing literature, we also fill two research gaps. First, we examine how perceived information quality (PIQ) factors into the IOS adoption equation. Although studying information quality is not unique, we contribute by incorporating this construct into an IOR theory-based model of systems adoption. The resulting model shows how PIQ plays a role in IOS adoption. Second, we examine the effects of two PIQ antecedents with IOS design implications: control transparency and outcome feedback.

Literature Review and Research Model

The IOS literature has focused attention on the outcomes or benefits of IOS. Wang and Seidmann (1995) and Riggins et al. (1994) show that IOS exchanges provide efficient information sharing, improved coordination, and risk minimization. Garicano and Kaplan (2001) suggest that business-to-business (B2B) relationship success depends on the ability of technology to reduce transaction costs, including both coordination costs and motivation costs. B2B exchanges reduce coordination costs by providing high information quality that enables partners to transact efficiently. Lower coordination costs make markets more attractive than hierarchies (Malone 1987, Malone et al. 1987) and enable changes in firm size (Gurbaxani and Whang 1991). Other IOS benefits include reduced errors, reduced inventory costs, and higher exchange quality (Malone et al. 1987, Bakos and Brynjolfsson 1993).

The IOS literature has also focused on factors that influence IOS adoption. Researchers have studied this question from the theoretical lenses of economics, social networks, organization theory, or some combination of theories. Economics researchers propose that incentives induce IOS adoption (Riggins et al. 1994, Wang and Seidmann 1995). For example, Wang and Seidmann develop a model of the subsidies a buyer might provide to suppliers who adopt its EDI system. Riggins and associates present an optimal two-stage subsidy policy for buyers to offer to suppliers. These models suggest that incentives influence suppliers' IOS adoption.

While economics researchers focus on incentives, sociological researchers focus on networks and social/structural relations. For example, Gulati and Gargiulo (1999) posit that IOS adoption occurs due to embeddedness (Granovetter 1985), strategic interdependence, and structural differentiation. Embeddedness involves features that bring partnering success: trust, information sharing, and joint problem solving (Uzzi 1996). Information sharing by itself may involve deception (Patnayakuni et al. 2006), but information sharing with trust should bring exchange success. Gulati and Gargiulo find that I-O networks form

when trusting-network embeddedness mechanisms address uncertainty about the competence, reliability, or expected behavior of potential partners. Thus, Gulati and Gargiulo suggest that similarity, trust, reputation, past direct alliances, third-party ties, and interdependence lead to IOS adoption.

Bensaou (1997) and Bensaou and Venkatraman (1995) integrate across theoretical lenses. They combine transaction cost economics, organization theory, and political economy to model IOR formation. For example, Bensaou and Venkatraman's IP model shows how the fit between IP needs and IP capabilities leads to IOR performance. The IP capabilities address key IP needs caused by uncertainty about the exchange partner, task, and environment. They show how all three theory bases address uncertainty in the exchange via joint action, information exchange, and coordination.

The literature emphasis on addressing uncertainty with relational interventions implies that trust and perceived risk are crucial for managing uncertainty in I-O exchanges. Trust is a key relationship variable that reduces uncertainty (Gulati and Gargiulo 1999). Bensaou (1997) finds that two relationship climate indicators—goal compatibility and perceived fairness—predict buyer–supplier cooperation in both the United States and Japan. He cites Smitka's (1991) analysis that Japanese automaker "relationships were governed neither by market nor hierarchy but by trust" (1997, p. 118). Bakos and Brynjolfsson (1993) suggest that closer relationships with suppliers can lower operations risk and opportunism risk, especially as IT use increases. Close buyer–supplier relationships imply dealing with fewer partners, which Bakos and Brynjolfsson (1993) suggest often has noneconomic advantages such as innovation, information exchange, trust, flexibility, and responsiveness. They also point out that IOS information sharing entails the risk of opportunism that trust can mitigate. Hence, it appears important to examine how risk, trust, and information sharing interrelate in the IOS setting.

Gulati and Gargiulo (1999) posit that embedded relations increase trust and decrease uncertainty about the attributes or behavior of partners. Embeddedness, however, takes time to develop. Gulati and Gargiulo suggest that people initially need cues to

assure them that the partner is competent and reliable. This implies that research should examine the factors leading to I-O alliances not only as the parties become experienced, but also at relationship inception, when risk and partnership uncertainty (Bensaou and Venkatraman 1995) are usually highest, and when trust starts to form. Bensaou and Venkatraman (1995) emphasize that trust and other factors must address relationship uncertainty. In sum, the literature suggests that trust and risk are important to IOS adoption, and early relationship cues may play a role.

Model Overview

This paper builds on the above literature by positioning both trust and perceived risk as complementary antecedents of intention to use the exchange. By focusing on perceived risk and trust, the model reflects the "climate of the relationship," which Bensaou found to be "the most robust predictor" of buyer–supplier cooperation (1997, p. 118). We then justify a role in the model for PIQ and two of its information-sharing-related antecedents, which act as cues about the exchange. Figure 1 displays the research model.

PIQ and Information Systems Design

Early information systems research serves as a foundation for the PIQ concept. In this research, PIQ represents a user's reaction to the characteristics of output information versus the user's information requirements (Bailey and Pearson 1983). To better understand PIQ and its dimensions, we examined the traditional IT success literature (e.g., DeLone and McLean 2003) and frameworks of (1) information integrity (Boritz 2004), (2) data quality (Lee et al. 2002, Wang and Strong 1996), and (3) information quality (Bovee 2004).

(1) *Information Integrity.* Information integrity incorporates the core components of accuracy, timeliness, and completeness, each of which make information relevant and reliable. The broader perceived information-quality construct should therefore capture the cumulative impact of these dimensions (Boritz 2004, p. 21).

(2) *Data Quality.* MIT's total-quality data management program researchers extensively examined the definition and dimensions of the PIQ construct (e.g.,

Figure 1   Research Model
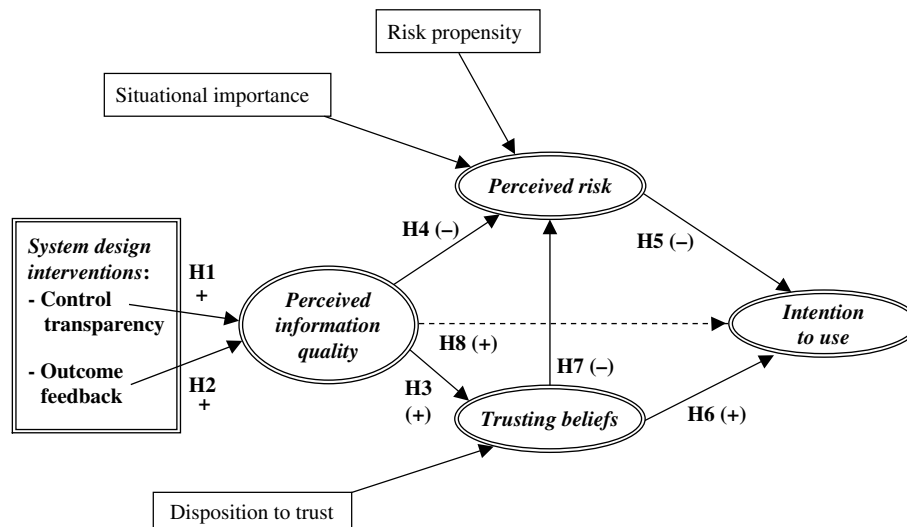
Note. The link that is proposed to be mediated is represented with dotted lines.

Lee et al. 2002, Wang and Strong 1996, Wang and Wang 1996). They capture the dimensions intrinsic (e.g., accuracy), contextual (e.g., relevance, timeliness, completeness), and representational quality, along with accessibility (Lee et al. 2002, Wang and Strong 1996). The PIQ dimensions they identify using ontological principles (Wang and Wang 1996) also accord with many dimensions extant in the IS literature (e.g., Bailey and Pearson 1983; DeLone and McLean 1992, 2003; Goodhue 1998; Zmud 1978). For example, DeLone and McLean refer to "accuracy, relevance, understandability, completeness, currency, dynamism, personalization, and variety" (2003, p. 21).

(3) *Information Quality.* One judges information quality using the criteria of relevance, accessibility (validity), interpretability, and integrity (composed of accuracy and completeness) (Bovee 2004), while the application context affects which dimensions are most relevant.

After examining various PIQ-related definitions and the above dimensions, we define PIQ to mean cognitive beliefs about the favorable or unfavorable characteristis of the currency, accuracy, completeness, relevance, and reliability of the exchange information. This definition adopts many important aspects of PIQ in the literature. It does so while excluding some aspects of PIQ that appear less relevant to this study's application, such as dynamism, personalization, variety, and interpretability. For example, websites employ personalization for continuing system use rather than for the initial system use studied here.

PIQ is distinct from the constructs system quality and service quality. A taxonomy of the information systems success literature (DeLone and McLean 1992, 2003) has demonstrated that system quality and PIQ are distinct factors of system success. System quality relates to the process followed for system design and to the specific features designed into a system (e.g., Hamilton and Chervany 1981), while PIQ captures user reactions to the facts and figures the system produces (e.g., Bailey and Pearson 1983, Ives et al. 1983). Other work distinguishes website information quality from website system quality (Barnes and Vidgen 2001, McKinney et al. 2002). PIQ is also distinct from service quality (Kettinger and Lee 1997; i.e., the courtesy, responsiveness, and empathy of service providers), as shown by DeLone and McLean (2003). PIQ also differs from credibility, which means how believable a party is (Tseng and Fogg 1999).

Antecedents of PIQ
System quality (McKinney et al. 2002) and system design (Wang and Wang 1996) influence PIQ. Boritz (2004) says information integrity—a core component of PIQ—depends on system processing integrity,

which sets an upper bound on information integrity. A system demonstrates processing integrity if its processes are complete, accurate, timely, and authorized.

Past research has done little to study specific antecedents of PIQ, such as system-design interventions that could influence PIQ by enabling system-processing integrity. We propose that two specific system-design interventions—control transparency and outcome feedback—will influence PIQ because they provide users information or cues by which to form PIQ-related judgments. Both control transparency and outcome feedback pertain to information that the exchange provider shares with the user. Hence, each is important because researchers need to know more about how information sharing affects IOS adoption and need to develop effective ways to share information in an exchange (Patnayakuni et al. 2006). Control transparency and outcome feedback are distinct from PIQ in that they each refer to the extent to which the exchange provider shares particular kinds of information, while PIQ refers to user perceptions of the *quality* of the overall information the exchange provides.

Researchers suggest that control transparency refers to the amount and type of information available to interested parties (Finel and Lord 1999) so they know the transaction is taking place properly. The transparency concept originated from *cost transparency*, defined as the sharing of negotiation-related cost information between exchange partners that they would otherwise not share (Lamming 1993). That is, transparency denotes the selective exchange of sensitive information to reduce opportunistic behavior. Research indicates that product attribute transparency and cost transparency reduce ex-ante uncertainty about the partner's behavior by reducing monitoring costs (Pant and Hsu 1996, Rindfleisch and Heide 1997).

In communication contexts, Williams (2005) defines *organizational transparency* as the extent to which the organization provides relevant, timely, and reliable information to external constituents to meet stakeholder demands. Just as transparency in supply relationships deals with the exchange of sensitive information and tacit knowledge, so transparency in I-O data exchanges would encompass disclosure of system-control elements that would benefit the exchange user. Hence, we define control transparency

as the availability of adequate information to verify or assess the data exchange taking place. Control transparency relates to behavior control (Ouchi 1979), which Kirsch (1997) lists as a formal control used to monitor the behavior of the agent. Control transparency indicates the extent to which one makes available the information needed to provide some behavioral control of an exchange process.

Control transparency leads to positive judgments about the level of exchange information quality. It stands to reason that the greater the control transparency, the more the user will feel assured that the exchange is timely, complete, and accurate, resulting in favorable PIQ. Methods that better represent what the decision maker wants to know about real-world conditions improve the quality of decision-making information (Kinney 2000). A system design intervention-like control transparency can provide high-quality current information for decision making. As a result, high control transparency will produce higher PIQ:

HYPOTHESIS 1. *In an electronic I-O exchange, perceived information quality will be higher when control transparency is high than when control transparency is low.*

We define outcome feedback as the availability of specific information about exchange *outcomes*. In a data exchange, for example, outcome feedback would include initial order fulfillment or shipment status data. While control transparency relates to behavioral control, outcome feedback relates to outcome control in Kirsch's (1997) control typology. Outcome feedback means the extent to which a provider makes available the information needed to control exchange outcomes. We distinguish it from feedback on actual outcomes in that it refers to interim outcome information rather than final verification that the exchange was successful.

The availability of specific exchange outcome feedback should positively affect PIQ because it bolsters initial user judgments of information quality before the final exchange outcome (i.e., shipment arrival) is known. Past research on feedback mechanisms has examined their role in influencing partner reputation and trustworthiness (e.g., Ba and Pavlou 2002, Early 1986). Feedback provides outcome information to control the other (Ouchi 1979), which augments one's expectation of exchange success. The

more one knows about interim outcomes, the more one should positively evaluate information received from the exchange as accurate, timely, relevant, complete, and reliable. Hence, outcome feedback should enhance PIQ.

Further, we believe that outcome feedback will enhance PIQ above and beyond the effect of a high level of control transparency. While control transparency shares information with exchange users so they know the transaction proceeds correctly, outcome feedback reaches beyond by sharing information about exchange outcomes. These variables are also complementary in terms of timing. As the order proceeds, the user wants to know it is being done correctly, which high-control transparency provides. Later, the user needs to know if the order is being fulfilled, which is addressed by outcome feedback. Because of these complementary effects, outcome feedback should incrementally enhance PIQ even when control transparency is high.

Hᴦᴘᴏᴛʜᴇꜱɪꜱ 2. *In an electronic I-O exchange with high-control transparency, perceived information quality will be higher when outcome feedback is high than when outcome feedback is low.*

Researchers could study several other antecedents of PIQ, such as information content depth and breadth (Agarwal and Venkatesh 2002), information currency (Nielsen 2000), or overall system reliability. We selected control transparency and outcome feedback first because we had confidence they would predict PIQ, second because we could experimentally manipulate them, and third because we could derive practical applications from them.

Direct Effects of PIQ

This research examines PIQ effects on trust and risk during initial exchange interaction. Trust addresses uncertainty about a major IOR issue: The competence, reliability, or expected behavior of potential exchange partners (Gulati and Gargiulo 1999). We employ the trusting beliefs component of the trust concept typology of McKnight and Chervany (2001–2002). Trusting beliefs means one believes the other party has beneficial characteristics, and implies favorable perceptions about the I-O exchange partner—that the partner is honest (i.e., has integrity and keeps commitments),

benevolent (i.e., responsive to the partner's interests, not just its own), and competent (i.e., has the ability to do what the partner needs done). IS research uses these components of trusting beliefs more frequently than any others (Bhattacherjee 2002, Gefen et al. 2003a, Jarvenpaa et al. 2000). McKnight et al. (1998, 2002a) posit that trusting beliefs may form quickly due to cues from first impressions, sociocognitive processes, dispositions, or institutional influences.

Carr and Smeltzer (2002) find that the extent of automated links among buyers and sellers does not influence trust. Most purchasing managers they interviewed thought the technology itself did not build trust. Hence, to build partner trust, exchange providers must do more than merely provide electronic linkages. Fung and Lee (1999) and Keen et al. (2000) propose that information quality should be an important trust-building mechanism in online interactions. Because PIQ includes such positive information traits as accuracy, it should influence trusting beliefs–integrity in the exchange provider. In a similar way, people trust a speaker who gives truthful or credible information (e.g., Giffin 1967). PIQ also reflects information that is timely and responsive to the organization's needs (Goodhue 1995a). Responsiveness relates to benevolence (see Table 1, McKnight et al. 2002a) because it implies that the exchange provider cares enough to provide helpful information (cf. Gefen and Govindaraiulu 2000). Therefore, PIQ should produce trusting belief–benevolence. PIQ reflects information that is accurate, reliable, and correct in detail (e.g., Goodhue 1995a), which implies that the source of the information is competent. Therefore, PIQ should positively relate to trusting belief–competence. PIQ should thus positively influence all three aspects of trusting beliefs, although we expect trusting beliefs to form a unitary construct early in the relationship, as others have found (Gefen 2000, McKnight et al. 2002b).

Hᴦᴘᴏᴛʜᴇꜱɪꜱ 3. *In an electronic I-O exchange, perceived information quality will positively influence trusting beliefs in the exchange provider.*

In general, IORs involve significant levels of uncertainty and risk (Gulati and Gargiulo 1999). We define perceived risk as the extent to which one believes uncertainty exists about whether desirable outcomes

will occur. This definition includes part of Sitkin and Pablo's (1992) broader perceived risk concept, which includes outcome uncertainty, outcome divergence likelihood, and extent of undesirable outcomes. PIQ should help reduce the uncertainty (and thus risk) related to exchange outcomes because of the worth of information shared. PIQ will influence perceived risk because high-quality information would provide what is needed to conduct the exchange in a controlled manner. Similarly, a strong belief that the information is accurate, current, and relevant would mitigate perceived risk regarding the exchange.

HYPOTHESIS 4. *In an electronic I-O exchange, perceived information quality will negatively influence perceived risk of the data exchange.*

Direct Determinants of Intention to Use

In the exchange context, intention to use means the intent to employ the exchange in the future. Intention to use derives from the theory of reasoned action (TRA) literature (Fishbein and Ajzen 1975), as exemplified by TAM (Technology Acceptance Model) research (e.g., Davis 1989, Davis et al. 1989). TRA suggests external variables such as personal values or beliefs about the broader work environment should directly affect beliefs that lead to specific intentions. Much of the work in TRA/TAM has focused on two key beliefs—perceived usefulness and ease of use—and their antecedents. However, other variables may also predict intention to use. In a field study, Lucas and Spitler (1999) found that perceived ease of use and usefulness did not significantly relate to intentions toward, or use of, IT; instead, workload, social norms, and job differences predicted usage. This finding suggests that researchers need to examine other factors of intention to use, such as perceived risk and trusting beliefs.

Risk theory suggests that risk perception will negatively affect willingness to perform a risky behavior (Keil et al. 2000, Sitkin and Pablo 1992). One has to accept some risk to adopt an exchange system, because transactions may or may not go as expected. Sitkin and Weingart (1995) report that decision makers tend to make more risky decisions when perceived risk is low. Given that the use of an electronic exchange is risky, risk perception is likely to negatively affect a user's intention to continue to use the

exchange. Jarvenpaa et al. (2000) and Pavlou (2003) found business-to-consumer (B2C) perceived risk negatively affected intention to transact with a Web vendor.

HYPOTHESIS 5. *In an electronic I-O exchange, perceived risk will negatively influence intention to use a data exchange.*

Like perceived risk, trusting beliefs acts as an evaluative mechanism regarding the extent to which users expect positive outcomes. Trust encourages I-O system adoption because it reduces opportunism and conflict in a relationship (Zaheer and Venkatraman 1994, Zaheer et al. 1998). Trust also reduces uncertainty about the partner (Gulati and Gargiulo 1999, Luhmann 1979), a critical I-O success factor (Bensaou and Venkatraman 1995). Research has considered trust a factor in developing or adopting electronic IORs for some time. For example, Hart and Saunders (1998) found that supplier trust led to diversity of EDI use, and Zaheer and Venkatraman (1994) found that the level of trust an insurance agency had in an insurance carrier was the strongest predictor of the degree of electronic integration between the partners, surpassing other predictors such as asset specificity and reciprocal investments. In relationship marketing, Morgan and Hunt (1994) found trust to positively influence commitment to the relationship and negatively influence propensity to leave the relationship. Because trusting beliefs assess the competence, benevolence, and honesty of the exchange provider, they will influence the intention to continue using the exchange. In an ERP study, Gefen (2004) found client trust predicted perceptions that the relationship was worthwhile. Researchers in B2C e-commerce also have found that trust influences intended use (Gefen et al. 2003a).

HYPOTHESIS 6. *In an electronic I-O exchange, trusting beliefs will positively influence intention to use a data exchange.*

Relationship Between Trusting Beliefs and Perceived Risk

Trusting beliefs has been found to influence perceived risk related to a Web store (Jarvenpaa et al. 2000). Pavlou (2003) and Pavlou and Gefen (2004) found

this to be true in the online auction domain. Others propose that trust will decrease risk or risk perceptions (Bakos and Brynjolfsson 1993, Bensaou 1997) and increase risk-taking in a relationship (Mayer et al. 1995). Also, research finds that trust reduces uncertainty (Bensaou and Venkatraman 1995, Gulati and Gargiulo 1999, Morgan and Hunt 1994), which is similar to risk. While research still equivocates regarding whether trusting beliefs will predict perceived risk or vice-versa (Koller 1988, Pavlou and Gefen 2004), most evidence suggests that trust influences risk perceptions (Gefen et al. 2003b). Placing trust as an antecedent of perceived risk harmonizes with psychological accounts of how trusting—as a leap of faith—provides a sense of assurance even when outcomes are unclear (Holmes 1991).

HYPOTHESIS 7. *In an electronic I-O exchange, trusting beliefs will negatively influence perceived risk.*

Mediation of PIQ by Perceived Risk and Trusting Beliefs

PIQ should positively affect system outcomes, as proposed by DeLone and McLean (2003). High PIQ, for example, sends a strong message to the user that the transaction will be performed properly and thus should affect the likelihood of future exchange use. However, the combined effects of trusting beliefs and perceived risk on outcomes may be even stronger. Trust forms a central mental construct in a relationship (Mayer et al. 1995, Morgan and Hunt 1994), and risk should have a strong effect because it taps the uncertainty that exists in a new online endeavor. Thus, we expect the combination of trusting beliefs and perceived risk to mediate the effects of PIQ on intention to use. Trusting beliefs and perceived risk not only form powerful and definitionally distinct predictors, they also complement each other in at least two important ways. First, trusting beliefs refers to perceptions about the characteristics of a person, while perceived risk refers to perceptions about the nature of the data exchange itself. Second, trusting beliefs refers to positive characteristics that tie into one's hopes, while perceived risk refers to negative characteristics that relate to one's felt uncertainties and suspicions. Thus, together they should mediate the effect of PIQ on intent to use a data exchange in the future.

HYPOTHESIS 8. *In an electronic I-O exchange, the effects of perceived information quality on intention to use will be mediated by trusting beliefs and perceived risk.*

Hypothesis 8 suggests mediation within our experimental context. In a real-world setting, PIQ may affect intention to use by lowering transaction costs or by some other means. Thus, while it is likely that perceived risk and trusting beliefs will have significant mediating effects (as argued above), they may not fully mediate the effects of PIQ in every setting.

Finally, we employ a number of control constructs for which no formal hypotheses are advanced. First, we include situational purchase importance (extent to which the exchange is vital or critical to the organization) as a manipulated control variable proposed to affect perceived risk. This control is needed because prior studies in industrial marketing found that the importance of the purchase situation has a significant influence on an individual's participation in the purchasing decision (McQuiston 1989) and on the purchasing organization's evaluation of the purchase situation (Kirch and Kutschker 1982). However, because situational importance was not central to our theory, we included it only as a control. Doing so helps eliminate the possibility that our findings result from specifying one particular level of transaction importance. Second, to control for the influence of the trusting/risk-taking personalities of study subjects, we introduced the effects of risk propensity and disposition to trust (personality-type controls) on perceived risk and trusting beliefs, respectively. Risk propensity represents the tendency of individuals to take risky actions and affects perceived risk (Sitkin and Pablo 1992). Disposition to trust represents an individual's general tendency to trust others (Rotter 1971) and serves as a plausible alternative antecedent of trusting beliefs (Gefen et al. 2003a, McKnight et al. 2004).

Research Method

Research Approach

We employ a combined questionnaire and experimental simulation approach (Keil et al. 2000, Tsiros and Mittal 2000, Yoo and Alavi 2001). Use of a questionnaire enables us to measure respondents' perceptions of model constructs. Thus, we can understand which

perceptual factors matter to our dependent variables. Use of an experimental setting enables us to establish a level of control not possible in a field study. That is, we can control for extraneous factors in order to test causal relationships with minimum outside interference. The experimental setting also allows us to manipulate variables of import to the study. Manipulating variables provides control over variable timing, which is necessary for testing causality. Thus, manipulation provides stronger causal evidence than do survey studies.

This study bears resemblance to the one in Webster and Trevino (1995), in that we provide subjects an experimental experience meant to simulate a real-world exchange and then elicit their reactions via a questionnaire. The experimental setting enables us to manipulate control transparency and outcome feedback. Because these are design features an IOS may or may not have, we felt it critical to experimentally test the hypothesized effects of having or not having these features in the system.

While use of experimental control increases the study's rigor, our use of a simulated exchange increases the study's relevance because we designed conditions similar to those found in real-world exchanges. The degree of control transparency and outcome feedback provided in real-world exchanges varies substantially. For example, we found that a low-quality paper exchange (www.paperexchange.com) had no data input controls, such as input field verification, and presented no completed order for the user to verify, whereas a high-quality automotive supply exchange (www.covisint.com) had data input validation controls and immediate order confirmation. Hence, we felt that manipulating control transparency and outcome feedback would enable us to determine the effects of design differences seen in actual practice.

Participants
Sometimes, studies are questioned because they ask subjects to play a role to which they cannot relate (Gordon et al. 1986). We addressed this, first, by collecting data from both actual purchasing managers ($n = 26$), and a sample of mature (executive/part time) MBA students ($n = 69$) employed full time as technical workers (8% programmers, 21% engineers) and business/financial experts (9% marketing professionals and 62% managers, controllers, or directors).

Real-world experience helped respondents relate to the exchange buyer role. Second, we gave participants detailed instructions and practice so they felt comfortable with the task (see Experimental Procedures and Task below). Although we would have preferred to use all purchasing managers, our respondents are desirable because they have enough experience to relate well to the role played. Purchasing managers participated during an industry/academia event, while MBAs participated for extra credit during regular class time. Participant mean age was 37 years for purchasing managers and 27 years for MBA students. On average, purchasing managers had worked 11 years and 69% were male, while MBA students had worked 6 years and 52% were male. *T*-tests revealed no significant mean differences on any measured construct when classifying sample groups according to professional expertise (purchasing managers, technical experts, business experts), student versus nonstudent, or among experimental iterations. Effects found among student groups in single laboratory settings are as likely to generalize as are findings from real-world subjects in single-unit field studies, per Lynch (1999).

Experimental Design
The experimental design varied control transparency (Hi/Lo), outcome feedback (Hi/Lo), and situational importance (Hi/Lo). We manipulated situational importance only to increase experimental variance and to provide a control (Figure 1). Thus, the design is a $2 \times 2 \times 2$ between-subjects arrangement with two of the eight cells empty (Table 1). The two empty cells are for high feedback but low transparency conditions—less likely scenarios for an actual exchange and less important to our research questions. We randomly assigned treatments by varying the Web-based data-exchange model subjects used and the

Table 1   Experimental Design

Situational importance	Control transparency	Outcome feedback	
		Hi	Lo
Hi	Hi	Exchange A	Exchange C
	Lo	n/a	Exchange B
Lo	Hi	Exchange A	Exchange C
	Lo	n/a	Exchange B

Table 2   Distinguishing Features of the Three Web-Based Data Exchanges

Data exchange characteristic	Data Exchange "A" Hi control transparency; hi outcome feedback	Data Exchange "B" Lo control transparency; lo outcome feedback	Data Exchange "C" Hi control transparency; lo outcome feedback
Transaction data validation —Customer number —Quantity ordered —Item number	All validated	No validation	All validated
Confirmation message about acceptance of order	Full confirmation—Message confirms acceptance of order and shipment to the user/customer	Limited confirmation—User receives order transmittal message, but no order acceptance or shipment confirmation	Limited confirmation—User receives order transmittal message, but no order acceptance or shipment confirmation

level of situational purchase importance associated with a case scenario (low or high importance). Table 2 shows the levels of outcome feedback and control transparency that Exchanges A, B, and C provided. The experimental design enables testing of Hypothesis 1 (high-control transparency leads to higher PIQ) by comparing the mean PIQ results of Exchanges B and C. Because Exchanges A and C both have high-control transparency, the design enables testing of Hypothesis 2 (even in the presence of high-control transparency, high-outcome feedback leads to higher PIQ) by comparing the mean PIQ results of Exchanges A and C.

Experimental Procedures and Task
The first page of subject instructions described the basic technology supporting Web-based data exchanges using extensible markup language (XML), giving subjects a common basic knowledge. Next, a two-page description familiarized them with either information Exchange A, B, or C, depending on their treatment. The three exchanges allowed each individual to carry out Web-based raw-material order transactions, providing a sense of reality. We then provided subjects detailed instructions on how to enter transactions using the exchange. Next, two practice transactions familiarized subjects with the exchange.

The case scenario asked participants to portray the role of a purchasing manager in a manufacturing plant placing a needed raw-materials order. We told subjects their plant's supplier had recently developed the Web-based ordering exchange on which subjects had just practiced. To manipulate situational importance, the scenario asked the manager to place an order with a dollar value higher/(lower) than usual, which

the manager needed filled in a short/(long) timeframe. The high-situational importance treatment had a high-dollar-value order that was needed shortly, while the low-situational importance treatment had a low-dollar value needed within a long timeframe. Subjects were instructed to enter an actual order transaction (see Figure 2 for sample page). The products ordered were identical across treatments.

Measurement of Endogenous and Control Variables
The experimental package then asked subjects to answer questions measuring the endogenous model variables (see Table 3 and description below). The study used a reflective PIQ scale, with items selected from Goodhue (1995a, b, 1998), Doll and Torkzadeh (1988), and Bailey and Pearson (1983). The items represent the currency, accuracy, relevance, completeness, and reliability aspects of the data exchange, which are often-used PIQ dimensions.

We adopted the 11-item McKnight et al. (2002a) trusting beliefs scale. Three perceived risk items (1–3) were adapted from Sitkin and Weingart (1995), along with two items we created as a precaution because their scale had reliability of only 0.75. After examining the TAM literature, we created four intention-to-use items. Davis originally designed intention to use to tap into "behavioral expectations" of respondents' own "future [system use] behavior" (1989, p. 331). Thus, Items 1–3 capture expected future behavioral use. We wished to capture one more nuance of intention to use. Liu et al. (2004) found that two items about recommending the site and two items about using/visiting the site again formed a cohesive construct with a Cronbach's alpha of 0.92. Recommending system use to others implies one is committed to continue using it oneself. Thus, it should relate closely

Figure 2   Control Transparency in Exchanges A and C

to repeated use. Thus, item four taps into recommending system use to others with similar needs. Scales reported in Keil et al. (2000) and Lee and Turban (2001) were used to measure risk propensity and disposition to trust, respectively.

Data Analysis and Results

We used analysis of variance (ANOVA) to test the experimental effects and partial least squares (PLS) to test the measured part of the research model. The PLS method applies best to such nascent theories and complex models (Chin 1998, Fornell and Bookstein 1982) as this study embodies. PLS simultaneously assesses the structural (theoretical) and measurement model and produces R^2 estimates used to examine model fit, as in traditional regression analysis. We

used bootstrapping with 200 resamples to assess path estimate significance.

Manipulation and Control Checks
The last section of Table 3 displays the manipulation checks for control transparency and outcome feedback. We placed the manipulation check items after all the model variable items to avoid inducing demand effects. F-tests on the two-situational importance manipulation check items show that subjects in the high-situational importance condition provided significantly higher ratings (Item 1 means: high—6.3, low—4.9, $F = 28.7$; Item 2 means: high—6.4, low—4.8, $F = 34.3$). Both the control transparency manipulation check item (means: Exchange A—5.5, Exchange B—2.3, Exchange C—5.2, $F = 69.3$) and the outcome feed-

Table 3   Measurement Items and Manipulation Checks

Perceived Information Quality (*seven-point scale, strongly agree to strongly disagree*)
1. The exchange provides data that is current enough to meet my business needs. (currency)
2. There are accuracy problems in the data I use or needed in this exchange.* (accuracy)
3. The data maintained by the data exchange is pretty much what I need to carry out my tasks. (relevance)
4. The transaction data transmitted are actually processed by the exchange. (completeness)
5. The exchange maintains data at an appropriate level of detail for my purposes. (relevance)
6. The data I enter on the exchange can be relied upon. (reliability)
7. The data is up-to-date enough for my purposes [*dropped*]. (currency)
8. The exchange provides up-to-date information with regard to past transactions. [*dropped*] (currency)
9. The same data I enter on the form are the ones received by the vendor. (accuracy/completeness)

Trusting Beliefs (*seven-point scale, strongly agree to strongly disagree*)
1. I believe that this vendor would act in my best interest.
2. If I required help, the vendor would do its best to help me.
3. The vendor is interested in my well-being, not just its own.
4. The vendor is truthful in its dealings with me.
5. I would characterize the vendor as honest.
6. The vendor would keep its commitments.
7. The vendor is sincere and genuine.
8. The vendor is competent and effective in providing this data exchange.
9. The vendor performs its role of providing the data exchange very well.
10. Overall, the vendor is a capable and proficient Internet data exchange provider. [*dropped*]
11. In general, the vendor is very knowledgeable about issues of Web-based data exchanges.

Perceived Risk (*seven-point, using adjectives below as end-points*)
Considering the case assigned to you, how would you rate the overall risk of carrying out transactions using this exchange?
1. Extremely low/extremely high.
2. Much lower than acceptable level/much higher than acceptable level. [*dropped*]

How would you characterize the possibility of using the data exchange offered by this vendor to carry out purchasing transactions?
3. Significant opportunity/significant threat.*
4. Potential for gain/potential for loss.*
5. Positive situation/negative situation.* [*dropped*]

Intention to Use (*seven-point, extremely likely, extremely unlikely*)
1. What is the likelihood that you would continue using this exchange in the future to carry out transactions similar to the ones described in your case? [*dropped*]
2. If I was faced with a similar purchasing decision in the future, I would use this data exchange again.
3. If a similar ordering need arises in the future, I would feel comfortable using this data exchange again to place my order.
4. I would recommend use of this data exchange to other colleagues who may be faced with similar ordering needs as the one described in my case.

Items for Manipulation Checks
  Control Transparency (*seven-point scale, strongly agree to strongly disagree*)
  1. The exchange provides adequate information for me to assess the reliability, validity, and accuracy of the data exchanged.

  Outcome Feedback (*seven-point scale, strongly agree to strongly disagree*)
  1. The exchange provides specific feedback to me about the fulfillment of my transmitted purchase order.
  2. The exchange provides adequate feedback to me with regard to the expected shipment of my order.

  Situational Importance (*seven-point scale, critical to not critical*)
  1. How would you rate the accurate completion of this order for your company's success?
  2. How would you rate the timely fulfillment of this order by your supplier for your company's success?

*Reverse-scored items.

back manipulation checks (Item 1 means: A—5.3, B—2.0, C—2.9, $F = 31.5$; Item 2 means: A—6.0, B—2.5, C—3.5, $F = 46.7$) demonstrate that both manipulations worked. Also supporting the efficacy of the manipulations, we found significant mean PIQ item differences ($p < 0.001$) between each pair of exchange types (AB, AC, BC). F-tests of demographics showed that gender ratio, age, and work experience did not differ across the six experimental conditions.

Questionnaire Item Quality Checks
In accordance with research guidance (Churchill 1979, Boudreau et al. 2001), we took three steps to cull out items that did not perform. First, we examined

measurement invariance of each scale to see whether the measurement items varied/covaried in the same manner across treatments, using Box's M (see Carte and Russell 2003 for procedure). PIQ Items 7 and 8 and perceived-risk Item 5 violated measurement invariance conditions and were dropped. Second, we assessed individual item reliability by examining an item's factor loading on its own construct. As a rule of thumb, an item must load at least 0.5 on its own construct (e.g., Yoo and Alavi 2001, p. 379). We dropped perceived-risk Item 2 because it loaded at less than 0.5. Third, we examined item loadings and cross-loadings derived from a PLS measurement model. Trusting beliefs Item 10 also loaded on PIQ, and intention to use Item 1 also loaded on perceived risk. We decided to eliminate these two items. Before doing so, we made sure their removal did not affect the theoretical significance of their respective constructs (Gefen et al. 2003a).

Testing of Experimental Treatment Effects

We tested research Hypotheses 1 and 2 using traditional ANOVA. We entered PIQ as the dependent variable and entered cell assignment in Exchange A, B, or C (in that order) as the single factor (see Table 1). One-way orthogonal planned contrasts were conducted in which we compared the mean values of PIQ between Exchanges B and C, which isolates the Hypothesis 1 control transparency effect (contrast coefficients: 0, −1, 1), and between Exchanges A and C, which isolates the Hypothesis 2 outcome feedback effect (contrast coefficients: 1, 0, −1). The first planned contrast provided support for Hypothesis 1 by showing that PIQ was significantly higher when control transparency was high (Exchange C) than when it was low in Exchange B (difference = 2.05; $t = 8.29$; $p < 0.000$). The second planned contrast did not support Hypothesis 2, in that, in the presence of high-control transparency, PIQ did not significantly differ in the high (Exchange A) versus low (Exchange C) outcome feedback conditions (difference = 0.253; $t = 1.01$; $p = 0.317$).

PLS Measurement Model and Validity Tests

After the item quality checks described above, we tested the measurement model (measured constructs only) for convergent and discriminant validity

(Boudreau et al. 2001, Straub 1989). Convergent validity means how well each latent construct captures the variance in its measures. Convergent validity can be evaluated by examining individual item reliability (standard: 0.5 or above), composite construct reliability (similar to Cronbach's alpha—standard: 0.7 or above), and average variance extracted (AVE), which measures whether the variance the construct captures exceeds the variance due to measurement error (standard: 0.5 or above) (Fornell and Larcker 1981). PLS provides information used to estimate item-latent construct loadings and cross-loadings, as explained by Agarwal and Karahanna (2000). Each item loaded on its own construct at 0.5 or above (Table 5), indicating individual item reliability. All internal consistency reliability (ICR) coefficients met the 0.7 standard (Table 4—lowest is 0.89). Table 4 demonstrates that all constructs met the 0.5 AVE criterion, supporting convergent validity.

Discriminant validity means the extent to which measures of constructs are empirically distinct (Davis 1989). First, we assessed discriminant validity by examining the extent to which each measured construct has higher loadings on the indicators in its own block than indicators in other blocks (Chin 1998). Table 5 shows that all items pass this test. Second, a strict test of discriminant validity calls for the AVE of two measured constructs to be greater than the correlation between the two constructs. A more relaxed

Table 4   Descriptives, Correlations, and Validity Statistics

	Mean	Std dev	1	2	3	4	5	6
1. PIQ	4.67	1.43	0.82$^\xi$					
2. Perceived risk	4.06	1.39	−0.48	0.86				
3. Trusting beliefs	4.27	1.11	0.57	−0.59	0.80			
4. Intention to use	4.21	1.64	0.36	−0.58	0.53	0.95		
5. Disposition to trust	4.04	0.97	0.43	−0.56	0.47	0.46	0.91	
6. Risk propensity	4.08	1.43	0.12	−0.26	0.24	0.23	0.20	1.00
ICR*			0.94	0.89	0.95	0.96	0.95	n/a
AVE$^\delta$			0.68	0.73	0.64	0.90	0.83	n/a

Notes. Correlations greater than |0.202| are significant at $p < 0.05$; correlations greater than |0.263| are significant at $p < 0.01$.

    *: ICR = internal consistency reliability coefficient.

    δ: AVE = average variance extracted estimate (cf. Fornell and Larcker 1981).

    ξ: Diagonal elements are the square-root of the average variance extracted (AVE) estimate for each construct. Off-diagonal elements are the correlations between the different constructs.

Table 5   Loadings and Cross-Loadings of the Measurement (Outer) Model

Measurement items	PIQ	RISK	TRUST	INT	Disp trust	Risk prop
PIQ1: Data is current enough	**0.84**	−0.42	0.50	0.37	0.41	0.15
PIQ2*: Accuracy problems in data	**0.75**	−0.38	0.44	0.31	0.31	0.01
PIQ3: Data what I need	**0.90**	−0.53	0.54	0.41	0.39	0.11
PIQ4: Data submitted processed	**0.80**	−0.22	0.42	0.19	0.32	0.05
PIQ5: Appropriate level of detail	**0.64**	−0.26	0.35	0.17	0.21	0.04
PIQ6: Data can be relied upon	**0.84**	−0.43	0.47	0.28	0.42	0.16
PIQ9: Same data entered received	**0.54**	−0.35	0.46	0.25	0.24	0.02
RISK1: Overall risk	−0.38	**0.76**	−0.53	−0.52	−0.39	−0.26
RISK3*: Significant threat	−0.41	**0.92**	−0.49	−0.50	−0.56	−0.18
RISK4*: Potential for loss	−0.45	**0.88**	−0.47	−0.47	−0.49	−0.21
TB1: Vendor acts in best interest	0.43	−0.49	**0.81**	0.46	0.40	0.08
TB2: Vendor would help me	0.49	−0.44	**0.81**	0.47	0.42	0.18
TB3: Vendor interested in well being	0.48	−0.51	**0.82**	0.46	0.42	0.12
TB4: Vendor is truthful	0.40	−0.39	**0.53**	0.39	0.19	0.04
TB5: Vendor is honest	0.49	−0.51	**0.86**	0.46	0.44	0.28
TB6: Vendor keeps commitments	0.37	−0.47	**0.83**	0.37	0.37	0.24
TB7: Vendor is sincere	0.50	−0.55	**0.79**	0.40	0.40	0.28
TB8: Vendor is competent	0.52	−0.49	**0.85**	0.36	0.38	0.20
TB9: Vendor performs role well	0.40	−0.23	**0.59**	0.26	0.21	0.03
TB11: Vendor is knowledgeable	0.47	−0.47	**0.83**	0.47	0.42	0.28
INT2: Would use again	0.36	−0.58	0.54	**0.96**	0.41	0.21
INT3: If similar order I would use	0.37	−0.56	0.55	**0.96**	0.44	0.21
INT4: I would recommend use	0.29	−0.51	0.41	**0.92**	0.48	0.24
Disposition to Trust 1	0.42	−0.56	0.46	0.44	**0.93**	0.18
Disposition to Trust 2	0.39	−0.50	0.37	0.38	**0.89**	0.22
Disposition to Trust 3	0.34	−0.48	0.34	0.34	**0.65**	0.30
Disposition to Trust 4	0.36	−0.49	0.41	0.42	**0.92**	0.15
Risk propensity	0.12	−0.26	0.24	0.23	0.20	**1.00**

*Reverse-scored item.

test compares the correlation to the square root of the AVEs (shown on the Table 4 diagonal). The data passes both discriminant validity tests. That is, the highest correlation is between perceived risk and trusting beliefs (−0.59), the absolute value of which is less than the AVEs of either (0.73, 0.64). We also did an exploratory factor analysis that supported these convergent and discriminant validity results.

PLS Structural Model

Table 6 presents the PLS structural model results. The model explains 39.6% of the variance in intention to use, with similar results for the other variables. In terms of hypothesis tests, the results support Hypothesis 3, in that PIQ positively affects trusting beliefs ($t = 5.22$; $p < 0.01$). Hypothesis 4 is supported, in that PIQ negatively affects perceived risk ($t = -2.43$; $p < 0.01$). For Hypothesis 5, we found perceived risk negatively affects intention to use ($t = -4.48$; $p < 0.01$).

We also found a positive effect of trusting beliefs on intention to use, per Hypothesis 6 ($t = 2.64$; $p < 0.01$), and a negative influence of trusting beliefs on perceived risk, per Hypothesis 7 ($t = -3.67$; $p < 0.01$).

Research Hypothesis 8 predicts that perceived risk and trusting beliefs will mediate the effects of PIQ on intention to use. Two related techniques tested Hypothesis 8. First, power analysis may provide information about the significance of omitted paths in a reduced model (Cohen 1988). Specifically, we restricted the Figure 1 model to include only the path from PIQ to intention to use. We found PIQ has a direct positive effect on intention to use ($t = 3.99$; $p < 0.01$). However, the percentage of variance explained for intention to use decreased from 39.6% to 12.9% versus the full Figure 1 model. Chin (1998, pp. 316–317) recommends the calculation of an effect size due to the omission of paths from the model, where effect size (f^2) is calculated as the ratio of $(R^2_{\text{included}} - R^2_{\text{excluded}})/$

Table 6   Measured Research Model (PLS Analysis) Results

Endogenous construct (R^2)	Research hypothesis	Path coefficient	t (sig.)	Hypothesis outcome
Trusting beliefs (38.5%)	Hypothesis 3: PIQ → Trust	0.451	5.22**	Supported
	Control: Disposition to trust → Trust	0.276	3.02**	N/A
Risk perceptions (40.1%)	Hypothesis 4: PIQ → Risk	−0.247	−2.43**	Supported
	Hypothesis 7: Trust → Risk	−0.397	−3.67**	Supported
	Control: Situat'n'l importance → Risk	0.105	1.14; n.s.	N/A
	Control: Risk propensity → Risk	−0.136	−1.65; n.s.	N/A
Intention to use (39.6%)	Hypothesis 5: Risk → Intention to use	−0.415	−4.48**	Supported
	Hypothesis 6: Trust → Intention to use	0.295	2.64**	Supported
	Hypothesis 8: Mediating hypothesis: PIQ → Intention to use (direct effect)	0.008	0.07; n.s.	Supported
	Expected nonsignificant direct effect in the presence of the effects of: —PIQ on intention through trust; —PIQ on intention through risk			

Notes. One-tailed significance levels:
  * $p < 0.05$ ($p < 0.05$ if: $2.367 > t > 1.661$).
  ** $p < 0.01$ ($p < 0.01$ if: $t > 2.367$).

$(1 − R^2_{included})$. The effect size when the perceived risk and trusting beliefs paths are omitted equals 0.44, a large effect size (cf. Cohen 1988). This shows that perceived risk and trusting beliefs have an important effect on intention to use and that researchers should not exclude them from the model.

Second, Baron and Kenny (1986) suggest perfect mediation holds if the significant relationship between PIQ and intention to use is not significant when one controls for the mediator constructs of perceived risk and trusting beliefs (cf. Baron and Kenny 1986, p. 1177). We tested this using perceived risk and trusting beliefs individually and in tandem. When a path from perceived risk (only) to intention to use is added to the restricted model, the previously significant direct effect of PIQ on intention to use becomes nonsignificant ($t = 1.02$; n.s.). The same occurs when a path from trusting beliefs (only) is added to the restricted model ($t = 0.76$; n.s.). When the paths from both perceived risk and trusting beliefs are included, resulting in the full model corresponding to Figure 1, the effect of PIQ on intention to use is also nonsignificant ($t = 0.07$; n.s.), as reported in Table 6. Thus, perceived risk and trusting beliefs mediate the relationship between PIQ and intention to use, supporting Hypothesis 8.

Neither situational importance nor risk propensity had a significant effect on perceived risk ($t = 1.14$; n.s., and $t = −1.65$; n.s., respectively—Table 6), whereas disposition to trust had a significant positive influence on trusting beliefs ($t = 3.02$; $p < 0.01$). We found the inclusion or exclusion of these controls does not affect the significance of the model relationships.

Discussion and Implications

Study Contributions
This study contributes to IS theory in two primary ways. First, we found PIQ to be an important IS variable in this setting because it has a valuable indirect effect (through perceived risk and trusting beliefs) on intention to use the exchange. Hence, this study places PIQ in a new nomological network and demonstrates its worth. While studies link PIQ directly to intention to use (DeLone and McLean 2003), we contribute to the IS effectiveness literature by finding that risk and trust mediate this relationship in the initial I-O exchange domain. Second, the paper builds IS theory by examining the effects of two antecedents of PIQ—control transparency and outcome feedback—which shows that user perceptions of information quality are significantly higher when control transparency is high.

This article's results also address the three IOR literature themes mentioned earlier. First, the results show that trust, representing the relationship between system user and vendor, affects both user perceived data exchange risk and intention to use the exchange. This confirms positive relationships are vital to IOS adoption (Bakos and Brynjolfsson 1993). Second, the strong prediction of intention to use by perceived risk shows users worry about the risk or uncertainty a data exchange represents. Thus, vendors must overcome risk and uncertainty in initial IOS adoption, as the literature suggests (e.g., Bensaou and Venkatraman 1995). Third, as Gulati and Gargiulo (1999) imply, initial partners rely on cues to develop confidence in the exchange partner until they know the vendor well. We found that control transparency cues enable users to develop information-quality beliefs that enhance trust and mitigate perceived exchange risk.

The study also informs other disciplines. First, it informs the IOR literature by introducing PIQ as an important antecedent of trust and risk. Prior IOR research featured either trust or risk as important factors (Zaheer et al. 1998), but not PIQ. Second, it informs the risk literature by showing that information quality mitigates perceived system risk. Third, the study complements existing trust models (e.g., Mayer et al. 1995), by showing that PIQ builds trust. The model shows that disposition to trust and one IS variable, PIQ, can explain more variance in initial trusting beliefs ($R^2 = 0.38$) than McKnight et al. (2004) explained using disposition to trust, structural assurance, reputation advertising, and two assurance seals ($R^2 = 0.13$). The studies are not fully comparable because the McKnight et al. subjects only used the website briefly without the added familiarity our subjects gained through practice sessions and treatment cues. Nonetheless, this study shows PIQ builds trust well vis-à-vis the factors McKnight et al. (2004) used.

Limitations and Research Implications

The limitations of the study provide additional research avenues. The study may not generalize beyond the particular domain studied—a simple I-O data exchange—because particular perceived uncertainties favor how our model works. We recommend that scholars conduct field studies to test the model's generalizability. Because the exchange is online, the user cannot obtain the assurances of interpersonal interaction with the vendor. This favors the efficacy of control transparency and PIQ cues. In the real world, more advanced exchange features are used. Thus, researchers should test the model in more complex exchanges. Further, the simulated nature of this study's exchange did not allow for the possibility of prior contractual arrangements (Gulati and Gargiulo 1999). Contexts using such controls should be studied. Future research should also examine the effects of both control transparency and outcome feedback on PIQ in other domains, especially in contexts in which actual outcomes differ from those anticipated.

Although the study employed some actual purchasing managers as subjects, most subjects were not. Though this did not influence results, future research should study real-world managers in context to examine familiarity, perceived dependency, and other contextual issues. The study employed an experimental methodology, which limits external validity: First, because experimental instructions may affect the results and, second, because the study ignores non-technical contextual factors (cf. Bovee 2004, Damsgaard and Truex 2000). Future field studies should use institutional factors like structural assurance, contextual uncertainty, and familiarity.

We measured variables in one timeframe, suggesting possible common method variance (CMV). We tested for CMV using the Harman one-factor test (see Podsakoff and Organ 1986). A varimax-rotated principal components analysis extracted four factors, accounting for 71% of total variance. No factor explained more than 26% of variance. Hence, we concluded that CMV was not an issue. However, because the study was cross-sectional, we cannot prove causality among endogenous variables. Testing the model longitudinally would clarify the causal relationships.

Study results may be particular to the specific treatment levels used. Research should administer the treatments at different levels. For example, research should test the model when the user receives a message that the shipment has been lost. With negative outcomes, perhaps structural assurances, such as third-party assurance services, would be more in demand (e.g., Mauldin et al. 2006). Similarly, the

results could be a function of the particular variable items used. Scholars should test the model using other items to make sure the results hold.

Mayer et al. (1995) propose that perceived risk moderates the impact of trust on risk taking. Analyzing this possibility, we found perceived risk did not moderate the effects of trusting beliefs on intention to use. Future research should test this and other moderators.

I-O exchange relationships form because of many interactive factors, and this paper examines only a few. Other factors to examine include asset specificity, efficiency, seeking for legitimacy, exercise of power, stability, and necessity (Oliver 1990, Van de Ven 1976, Whetten 1981). Also, the incentive structure should be considered (Riggins et al. 1994, Wang and Seidmann 1995) because it could alter the relationships in the model.

Finally, we found PIQ more strongly predicted both perceived risk and trusting beliefs than did the control variables included in the model. Other variables not modeled, however, also predict risk and trust, such as size or reputation (Jarvenpaa et al. 2000). Hence, future research should examine competing predictors of trusting beliefs and perceived risk.

Implications for Practice
Even though structural assurances such as promises, guarantees, and contractual protections should help lower perceived risk, this study suggests that maintaining high levels of information quality is also critical. Having high perceived information quality involves keeping data current, accurate, reliable, and at the right level of detail. Our findings confirm in the B2B domain the B2C finding of Agarwal and Venkatesh (2002) that site information quality is vital to e-commerce success. The study also suggests that good exchange-system design is key to establishing high PIQ. I-O exchange vendors can build high PIQ by providing control transparency. Control transparency will provide transaction data validation of customer number, quantity ordered, and item number. These steps produce high information-quality beliefs, building trust and reducing perceived risk. Based on our results, I-O exchange adoption depends heavily on perceived risk and trusting beliefs. Therefore, exchange parties should try to develop positive

mutual relationships, such that trusting beliefs remain high and perceived risk low. By acting in a competent, benevolent, and honest manner, partners can maintain high trusting beliefs.

Conclusion
The study produced three key findings. First, the study found PIQ to be highly predictive of trust and perceived risk in an I-O exchange. Second, the study found trust and perceived risk to be significant complementary predictors of intention to use the exchange, and found that they mediate the influence of PIQ on intention to use. Third, the study found that control transparency strongly influenced PIQ, but that outcome feedback did not incrementally influence PIQ. This study extends prior research by showing that PIQ affects I-O exchange adoption through trusting beliefs and perceived risk. It also shows the strong effects of a control transparency design intervention, which suggests that system design is critical to user perceptions of exchange information quality.

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