# Effects of IT-Enabled Management Accounting Systems on Interorganizational Performance

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**Abstract**

The advent of modern technologies for information collection, dissemination and monitoring allows organizations to efficiently transact in interorganizational markets. The success of such relationships as strategic alliances and joint ventures often depends on the availability of information to mitigate the threat of opportunism or to improve coordination and cooperation. Enterprise resource planning systems are modern types of information systems which support collaborative capabilities in interorganizational settings and enable the exercise of interorganizational information sharing and control activities. A firm's management accounting system serves the dual role of decision management and decision control, while it encompasses activities that are both enabled by modern information technology and are critical for monitoring stability in interorganizational relations and for assessing attainment of relational exchange partner performance objectives.

This study examines the role of IT-enabled management accounting systems in an inter-organizational exchange environment. The main objective of the study is to examine the degree of complementarity between decision management and decision control activities in a collaborative, interorganizational business environment. Identified complementarities between decision management and control activities help balance the need for control over an exchange partner and the desire to share information and rely on the other partner not to act in an opportunistic manner. As a result, this study also examines whether the constructs of inter-organizational partner trust and risk sharing mediate the effects of IT-enabled management accounting systems design on relational performance. A field survey is used to measure model constructs and empirically test research hypotheses. The study results demonstrate that information technology-enabled capabilities facilitate the complementary use of decision management and decision control activities in inter-organizational relationships, while the constructs of inter-organizational partner trust and risk sharing mediate the effects of complementary decision management and decision control capabilities on inter-organizational performance. The study presents contributions in that it demonstrates boundaries in management accounting systems design which ensure that a certain degree of fit is achieved in making choices regarding inter-organizational decision control and decision management.

Keywords: *Management accounting systems, integrated information systems, inter-organizational decision control and decision management, inter-organizational trust, risk sharing, inter-organizational performance.*

**JEL Classifications**: *B20, C31, C42, M40.*

# Effects of IT-Enabled Management Accounting Systems on Interorganizational Performance

The advent of modern technologies for information collection, dissemination and monitoring allows organizations to efficiently transact in interorganizational (I-O) markets. The success of I-O relationships such as strategic alliances and joint ventures often depends on the availability of information to both parties to decrease the threat of opportunism (Bakos and Brynjolfsson 1993; Williamson 1975; Zaheer and Venkatraman 1994) or to improve coordination and cooperation (Gulati and Gargiulo 1999). Enterprise resource planning systems (ERPS) are touted as modern information systems which span the whole of organizational activities and processes (Davenport 1998; Kumar and Van Hillegersberg 2000). ERPS assist organizations by supporting efficient collaborative capabilities in I-O settings, and enabling the exercise of I-O information sharing and control activities that are critical for monitoring stability in I-O relations and assessing attainment of relational exchange partner performance objectives.

Past literature in management accounting suggests that management accounting systems (MAS) are complex administrative mechanisms designed in response to the organizational problem of controlling (that is, measuring outcomes and rewarding productive behavior) and partitioning decision rights (Jensen and Meckling 1992). Traditional types of MAS include budgets and other planning tools which serve the dual purpose of decision management and decision control. Decision management rights relate to managers' ability to initiate and implement decisions, while decision control relates to the rights of higher-level managers or the board of directors to ratify decisions and monitor outcomes (Zimmerman 1995, 2006). Management accounting systems (MAS) are distinguished from management control systems - MCS (Simons 1990; 1995), in that both decision management as well as decision control issues are considered in an inter-organizational, collaborative MAS environment, while MCS only emphasize control issues. In modern organizations, information technology (IT), such as ERPS, plays a prominent role in support of critical MAS functions by facilitating decision management and decision control both within an organization and across organizations in an inter-organizational collaborative environment. IT-enabled MAS is conceptualized in this study as an enterprise-wide system which provides for decision control and decision management capabilitities within the enterprise and across it and its inter-organizational partners.

Traditionally, the argument was made that a fundamental tension underlies the dual role of MAS, in that the goal of facilitating management decision making often conflicts with control goals (e.g., Zimmerman 1995, p. 9). For instance, a budget that is implemented by management is later used to monitor performance and thus influences the behavior of the same people who helped set the budget goal. The traditional way of resolving such conflicts was to separate the exercise of decision rights from the exercise of decision control (Fama and Jensen 1983), with separate information systems supporting each role (Zimmerman 1995, p. 3). While this separation seems to have been effectively implemented in the single enterprise context, modern businesses operate within an extended enterprise environment in which such traditional levels of separation may not be as direct in that decisions may have been initiated and implemented in an inter-organizational fashion. In a strategic alliance or a joint venture, for example, two separate organizations engage in cooperative activity which requires a balance between the optimum level of information sharing and control. The exchange of operational plans between two partners in a business alliance, for example, assumes that a minimum level of mutual trust is present, while each of the partners implements control mechanisms to monitor the other partner's actions (Coletti et al. 2005). Past research, however, emphasized those aspects of control system design that are based on assumptions of opportunistic behavior between partners within the context of bounded rationality (Anthony and Govindarajan 2004; Otley and Berry 1980; Simons 1995; 2000). The modern business environment alters these dynamics in that there is a shift toward I-O decision making and control (Hackanson and Lind 2004; Hartmann and Vaassen 2003) based on IT-enabled collaborative activities. Research findings suggest that, in this environment, the implied integration of business processes (Nicolaou 2004a), increased information/control transparency (Nicolaou and McKnight 2006), and other organizational changes (Rikhardsson and Krammergraard 2006) that take place after ERPS implementation, also affect decision management and control processes (Spathis and Constantinides 2004). IT-enabled decision management and control become activities that are integrated with business processes rather than remaining functionally separated (Caglio 2003); thus, ERPSs define the logic by which decision management and control are performed (Dechow and Mouritsen 2005). It is therefore important to examine issues of IT-enabled MAS design in an inter-organizational context.

Given earlier claims of a tension between decision management and control and the importance of such activities in an inter-organizational exchange environment, as enabled by the use of modern ERPS, it is important to examine complementarities in these IT-enabled activities. The economic theory of complementarity emphasizes the potential importance of interactions between different elements of organizational design (Athey and Stern 1998) and provides a basis for understanding how various elements of organizational strategy and management process relate to one another (Milgrom and Roberts 1990, 1995). Complementarity theory can help explain why firms adopt clusters of activities and develop capabilities that are critical in a cooperative I-O environment. The theory suggests that seemingly conflicting choices in I-O decision management and decision control may be complements and could thus be clustered into a consistent set of activities that can be effectively managed. Thus, a major research issue that arises relates to whether IT-enabled decision management and decision control activities can complement each other in a non-conflicting fashion, so as to ensure the success of the inter-organizational relationship.

This paper examines the role of IT-enabled MAS in an interorganizational environment. The main objective of the study is to examine the degree of complementarity between decision management and decision control activities in a collaborative, interorganizational business environment. Identified complementarities between decision management and control actitivities help balance the need for control over an exchange partner and the desire to share information and rely on the other partner not to act in an opportunistic manner (Bromiley and Cummings 1995; Coletti et al. 2005; Cummings and Bromiley 1996). As a result, this study also examines whether the constructs of I-O trust and I-O risk sharing mediate the effects of IT-enabled MAS Design on I-O relational performance.

Prior research has shown that management accountants now assume an expanded role and perform both decision making and control activities in organizations (Siegel 1999). As a result, the examination of the role of MAS in an I-O environment is a worthwhile pursuit that will offer insights about complementarities in decision management and control activities which are useful in management accounting and control system design. Such insights would also extend the findings of recent research which has presented evidence about the effects of I-O network ties on accounting controls (Chua and Mahama 2007) and on the subsequent effects of accounting control on cooperative behavior and perceptions of trust in an exchange partner (Coletti et al. 2005). As it has been argued in recent accounting literature, there is a "need for research on the extended enterprise that is linked to traditional management accounting research but which challenges these traditional boundaries using literatures that have begun to explore the contours of the new organizational landscape" (Anderson and Sedatole, 2003, pp. 38-39).

## BACKGROUND AND HYPOTHESES DEVELOPMENT

The I-O environment faced by a business organization presents unique theoretical as well as practical challenges for management accounting and control. I-O exchanges, including both business alliances and joint ventures, have significantly grown in importance, while there is also an increased number of failures (Anderson and Sedatole 2003; Chalos and O'Connor 2004; Das and Teng 2000; Ireland, Hitt and Vaidyanath 2002).

The instability in I-O exchanges has been attributed, at least in part, to lack of trust among exchange partners (Coletti et al. 2005; Harrigan 1988; Zaheer and Venkatraman 1995). Coletti et al. (2005) conducted a laboratory experiment and found that a strong control system with appropriate incentives and observed outcomes that were transparent to all partners, induces cooperation and enhances partner trust. An extreme level of strict control, however, was found not to be conducive to cooperation (Coletti et al. 2005). Further, Chua and Mahama (2007) report that I-O network ties with 'significant others' influence the operation of accounting controls in the focal supply alliance. These findings imply that a complementary level of decision management and control activities should be considered in I-O relationships.

The clustering of choices in decision management and control practices is supported by economic complementarity theory, which asserts that two factors are complementary when the level of one varies according to the level of the other (Milgrom and Roberts 1990; 1992; 1995). The choice of decision management and control activities is the result of adoption of economic-rational firms of a coherent business strategy that exploits complementarity (Milgrom and Roberts 1990) in the face of identifiable change events in information technology, as represented by the adoption and use of ERPS (c.f., Davenport 1998). ERPS adoption is not a marginal decision but rather involves substantial and closely coordinated changes in organizational processes and a whole set of activities (Nicolaou 2004a; 2004b; Nicolaou and Bhattacharya 2006; Ross and Vitale 2000; Scott and Vessey 2000; Soh, Kieh and Tay-Yap 2000; Stephanou 2000). Prior studies have also emphasized that successful deployment of IT resources is often accompanied by significant organizational change (Brynjolfsson and Hitt 2000; Brynjolfsson et al. 2002), including synergies with formal reporting structures and informal relationships within and across firms (Barney 1991). The use of ERPS could help develop synergistic organizational capabilities which have a positive influence on firm performance (cf. Kumar and Van Hillegersberg 2000). This study therefore develops a research framework that considers the central role of IT-enabled MAS in influencing performance. Figure 1 presents the research framework for the study.

*** Insert Figure 1 about here ***

The levels of I-O decision management and decision control activities represent endogenous choices that define MAS design. Such choices may vary based on exogenous factors related to the degree of I-O coordination and information sharing that is enabled by the adoption and use of ERPS. The research framework relates the presence of IT-enablers on MAS design and examines the effect of MAS design choices on I-O relational performance. The argument will be made that the degree to which MAS design choices are complementary (i.e., non-conflicting) will have a positive impact on I-O performance. This performance effect will be mediated by two critical I-O mechanisms: I-O risk sharing and I-O partner trust. These two mechanisms should help better explain the effects of MAS design on performance, as these effects could be made stronger if a firm actually meets the risk reduction, partner monitoring, and partner cooperation goals that served as the primary motivators for the initiation of the inter-organizational relationship.

**ERPS Use and I-T Enabled MAS Design**

An important role of ERPS in modern organizations is to integrate business functions and activities both internally within the organization's environment, and also externally, within the inter-organizational environment where the organization exchanges information with business partners (Nicolaou 2004a). An organization's information infrastructure is thus built on critical capabilities offered by process and data integration in ERPS (Davenport 1998; 2000a; 2000b). ERPS are part of the whole genre of integrated information systems which also include analysis-oriented strategic enterprise management systems and business intelligence applications (Rom and Rhode 2006). The greatest usefulness of ERPS implemented in the late 1990's has been on facilitating coordination and control at the operational level of a business. Nicolaou (2004b) uses a sample of 124 ERP adopting firms and reports that expected benefits are clustered into improved productivity and decision making, external integration, and internal integration/improved customer service. The expansion of an organization's infrastructure (processes, skills, and technologies) across the I-O environment, however, calls for an expansion of such benefits to also encompass expected support for an organization's strategic planning and managerial control vision (cf. Anthony 1988).

The increased integration offered by ERPS, both within and across the enterprise, enable collaborative capabilities that help combine traditional features of decision management and decision control. Similarly, past research in I-O systems has shown that these systems improve coordination in business relationships which allows polar modes of market and hierarchical network structures to co-exist (Holland and Locket 1997). Because IT enables integration of information flows among networked firms, it makes possible relationships that combine market and hierarchy features simultaneously (Amigoni et al. 2003). I-O systems were also shown to assist organizations develop unique informational capabilities with partners in a business exchange, which then leads to improved operational and financial performance (Barua et al. 2004). This is because organizational characteristics typically mediate the manner in which IT implementations add value to an organization's activities. For example, Barua et al. (1995) argue that IT is complementary with organizational characteristics and processes, and that investment in IT and reengineering cannot succeed if done in isolation. Thus, the use of I-O systems, such as ERPS, is an integral part of an organization's strategy which makes possible strategic choices in MAS design that combine decision control and decision management capabilities simultaneously.

The organizational strategy literature has also emphasized the importance of developing strategies that allow the formation of organizational competencies over time (e.g., Swamidass and Newell 1987). Realized strategies, as defined by Mintzberg (1978), emerge through events and environmental interactions as they unfold over time (Dent 1990). Different organizations, therefore, may develop specific strategies that will allow the formation of specific competencies over time. Prior research argues about the potentially important effects of such specific strategies on the design of management accounting and control systems (Abernethy and Lillis 1995; Langfield-Smith 1997). Empirical findings demonstrate that a firm's strategy relating to the adoption of JIT production and EDI systems has significant direct and indirect effects on the scope of use and perceived effectiveness of a cost management system (Nicolaou 2002), while the fit between manufacturing strategy and the use of cost management systems that support a firm's information needs in strategic and operational decision making was found to influence a firm's ability to attain desired objectives in its value chain (Nicolaou 2003). A firm's system design strategy on using integrated systems, furthermore, was found to strongly interact with both internal as well as inter-organizational coordination and control constraints to determine perceived system effectiveness in the provision of high-quality decision-facilitation and control information (Nicolaou 2000). The above research implies that the specific content of an organization's adopted strategy is distinct but closely related to organizational capabilities that allow for its successful implementation. As the use of ERPS streamlines internal business processes and provides needed infrastructure for IT-enabled I-O processes, it is also expected to have a significant influence on MAS design and on the development of complementary capabilities that may enhance a firm's performance. The following hypothesis is therefore advanced:

*H1: The use of ERPS characterized by integration and collaboration in the I-O environment, will have a positive impact on the development of complementary I-O decision management and decision control capabilities.*

**Complementarity in Choices in I-O MAS Design**

A MAS encompasses both decision coordination and decision control activities (Zimmerman 1995; 2006). The levels of decision management and control represent endogenous choices in MAS design. In modern organizations, the effective coordination of plans and execution of control relate to capabilities that are enabled by the use of integrated ERPS. The choice of a set of monitoring/control and coordination/decision making practices, however, may not be done independent of each other. In terms of the economic theory of the firm (Milgrom and Roberts 1990; 1992; 1995), such activities are increasingly viewed as complementary factors of production. Two factors (or resources) are complementary when the level of one varies according to the level of the other; the primitive idea is described by the extremes in Figure 2.

*** Insert Figure 2 about here ***

In Figure 2, extreme complements are contrasted by extreme supplements. A production function exhibiting a zero elasticity of substitution (fixed coefficients) creates complements. In this situation, the relative price of one factor to another can change without changing the ratio in which the factors are used. This should produce a high positive correlation between the two factors in cross-sectional data and very high positive correlation in time-series data. In contrast, when factors are extreme substitutes for one another, they are price sensitive. With an infinite elasticity of substitution, only the more economical factor is utilized over a broad range of relative prices. When the relative price crosses a critical point however, the other factor suddenly becomes the more cost efficient and a dramatic switch occurs. For perfect substitutes, a zero correlation would typically be found in cross-section data with a high negative correlation sometimes captured in time-series data. The observed correlation between a pair of factors should help determine the level of complementarity between the factors and the nature of the production possibilities frontier. The choice of decision control and decision management activities should result in highly correlated factors, which are complementary.

Turning our view orthogonally to outputs instead of inputs, increasing returns to scale often accompany complementarities (Milgrom and Roberts 1990) when a good fit (or production mix) exists between complements (Arthur 1989). As past research has examined some of the links between control and cooperation (Coletti et al. 2005), an enhanced level of decision control that induces enhanced decision management will be expected to result in enhanced performance. If an organization, however, adopts an IT strategy that is not consistent with complementary relationships in I-O decision management and control, it is likely to not realize returns to scale (Milgrom and Roberts 1995) and suffer a reduction in corresponding I-O capability and subsequent performance. This is a similar effect as that observed in organizations that have not aligned their information technology and strategy (Davenport 2000a).

In essence, an organization's control strategy cannot be set independent of its I-O coordination strategy which sets the boundaries for trusted information sharing in an environment that would otherwise be characterized by uncertainty in a partner's behavior. Consequently, a major issue in management accounting system design is to identify those boundaries and ensure that a certain degree of fit is achieved in making I-O decision control and decision management choices. As a result, the following hypothesis is advanced:

*H2: The complementarity in choices between decision control and decision management practices in MAS design will enhance an organization's capability to interact in the I-O environment and will have a positive influence on inter-organizational performance.*

**Effects of Complementary MAS Capabilities on I-O Partner Trust and Risk Sharing**

In I-O cooperative relationships, it is imperative that one considers shifts in governance structure (Brinbirg 1998; Cooper and Slagmulder 2004). A governance structure is defined as the set of mechanisms that create both incentives to interact and safeguards that protect each party against the risk of opportunistic behavior on the part of the other (Cooper and Slagmulder 2004; Williamson 1979). As a result, effective governance optimally corresponds to the types of interactions taking place in an I-O exchange (cf. Williamson 1981; 1991). The choice of decision management and control in MAS design shapes an organization's I-O governance structure in interacting with its trading partners. The degree to which these choices are complementary, they may enable capabilities that allow for the dual objective of controlling opportunistic behavior while also motivating cooperation among partners. The findings of Coletti et al. (2005) also suggest that an "optimal" control environment positively influences the creation of inter-partner trust and cooperation, while strict control may have undesirable consequences.

Related organizational research has shown that a cooperation mechanism based on trust may supplement traditional mechanisms of governance through opportunism, especially in situations where neither partner can exert control over the other's actions (Sako and Helper 1998). In the I-O exchange literature, trust has been defined as the willingness of a party (the trustor) to be vulnerable to the actions of another party (the trustee) based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control the trustee (Mayer et al. 1995). Cummings and Bromiley (1996) and Bromiley and Cummings (1995) rest their definition of inter-organizational trust on the assumption that organizations understand the utility of acting with good-faith, honesty, and limited opportunism. As a result, trust is defined as the belief that an organization makes good-faith efforts to maintain commitments, whether explicit or implicit, is honest in negotiations that might have preceded interaction, and does not take unfair advantage of another (p. 303). Zaheer et al. (1998) also define inter-organizational trust as an expectation that encompasses the three components of reliability, predictability, and fairness. The formation of partner trust in an I-O environment, therefore, depends on how a partner feels about the other, what they believe that the other will do when faced with a situation offering a "trust dilemma," and whether the partner will operate in a fair manner. Similarly, in organizational alliances, governance by trust implies that exchange partners do not exercise excessive control over one another and therefore utilize trust as an informal control mechanism in order to enhance the effectiveness of transactions (Das and Teng 1998; Tomkins 2001).

Alternative research perspectives have emphasized the presence of behavioral uncertainty in I-O relations and the need to manage transaction risks (Gulati and Singh 1998). The increased use of IT-enabled I-O processes may increase uncertainty between business partners and accentuate motivation costs in the business relationship (Garicano and Kaplan 2001). Motivation costs are associated with informational asymmetries and imperfect commitment (Milgrom and Roberts 1992), which require additional levels of control over the other business partner. Information sharing and information availability among exchange partners, however, can improve perceptions about the quality of information being exchanged, which in turn has been shown to reduce perceptions of risk in the exchange (Nicolaou and McKnight 2006). Risk perceptions are defined by the presence of outcome uncertainty or the degree of controllability in potential outcomes (Sitkin and Pablo 1992). As a result, the availability and sharing of relevant monitoring information among exchange partners in an I-O relationship, will act to decrease the level of risk that is perceived by each partner in the exchange and will symmetrically disperse knowledge about necessary control actions and attainability of outcomes. This study therefore adopts the construct of "risk sharing" to capture such effects.

To maintain stability in an alliance, trading partners need to manage at least one pair of competing tensions between them. This relates to the presence of self-interested behavior as it collides with mutual partner interests and common benefits that can result from potential cooperation (Das and Teng 2000). As a result, the achievement of a degree of fit in complementary elements of an organization's MAS design should have an impact on I-O partner trust perceptions as well as on the willingness of partners to share risks in order to avoid undesirable outcomes in an exchange. The following hypotheses are therefore advanced:

*H3a: The complementary choice of decision control capabilities in MAS design will have a significant positive impact on perceptions of risk sharing in an I-O exchange.*

*H3b: The complementary choice of decision management capabilities in MAS design will have a significant positive impact on perceptions of partner trust in an I-O exchange.*

**Direct Determinants of Performance**

The construct of I-O performance has been addressed in past research and defined as a manager's assessment of whether the alliance is productive, profitable and contributes toward enhancing sales or a firm's competitive advantage (Parkhe 1993; Simonin 1997). Zaheer et al. (1998) have also defined the construct of "supplier performance" to encompass the observed performance of an exchange partner in meeting requirements, which could be another important dimension of I-O performance. As such dimensions were found important in past research, this study also employs these perceptual dimensions in the definition of the construct of I-O performance.

The effective interaction in an I-O environment achieved through risk sharing and enhanced partner trust is proposed to have a direct effect on I-O performance. Amigoni et al. (2003) also argue that the cooperative design of an I-O relationship and the availability of information sharing among exchange partners provide a basis for maintaining stability and for sustaining the inter-organizational relationship. Further, a firm that effectively participates in an I-O collaboration may be more capable in managing the uncertainty that is present in such interdependent relationships. Lack of trust in an exchange partner has been found in past research to adversely affect I-O performance. Groot and Merchant (2000) report that trust in exchange partners reduces control tightness which helps enhance performance in a joint venture, while Harrigan (1988) found that joint ventures last longer when their partners trust each other. A firm's ability to effectively interact with partners in an I-O network has also been associated with exchange partner performance (Zaheer et al. 1998). This is observed because inter-organizational trust helps reduce the costs of I-O coordination, negotiation, and conflict (Zaheer and Venkatraman 1994; Zaheer et al. 1998). Bakos and Brynjolfsson (1993) point out, however, that while the information sharing involved in an I-O relationship entails the risk of opportunistic behavior, it can be mitigated if the relationship is characterized by trust. While uncertainty in an I-O environment could induce firms to become more vertically integrated, evidence suggests that firms interact more and share risks with trusted partners, rather than absorb uncertainty within the firm's borders (Lorenzoni and Lipparini 1999). These studies suggest that the degree of trust and risk sharing in an I-O relationship are important determinants of I-O performance. Because partner trust assesses the reliability, predictability, and fairness of an I-O partner, and risk sharing assesses the degree of information sharing and controllability in I-O relationship outcomes, they are both expected to influence the stability of the relationship and the performance of the exchange partner. As a result, the following hypothesis is advanced:

*H4a: I-O risk sharing will have a positive influence on I-O performance.*
*H4b: I-O partner trust will have a positive influence on I-O performance.*

The complementarities that are generated by the use of ERPS in inter-organizational, collaborative settings, relate to the design of decision management and decision control elements in a firm's MAS that may be necessary for success in an I-O environment. Complementary IT-enabled MAS capabilities should thus positively affect I-O performance, as H2 hypothesizes. The combined effects of I-O partner trust and risk sharing, however, could mediate the direct effect of complementary MAS capabilities on I-O performance. In I-O exchange systems with shared control information, for example, the performance effects of quality in the exchanged information were found to be strongly mediated by trust building and risk reduction mechanisms (Nicolaou and McKnight 2006). In an analogous manner, I-O partner trust forms a central mental construct in a relationship (Mayer et al. 1995, Morgan and Hunt 1994), and risk sharing should have a strong effect because it dampens the uncertainty that exists in an inter-firm relationship. Thus, I expect the combination of I-O partner trust and risk sharing to mediate the effects of complementary MAS capabilities on I-O performance. In the presence of a mediation effect, the direct effect hypothesized in H2 should be expected to become non-significant.

## RESEARCH METHOD

To examine the study's research questions, a combined archival and field survey methodology has been employed on a target sample of US public companies. A mail survey will provide data from the Chief Financial Officers of organizations involved in I-O alliance activity. The archival method will primarily assist in the identification of organizations involved in strategic alliances, so as to enhance the internal validity of the selected sample.

### Sample and Respondent Selection

The sample for the study was extracted through a search of public companies which report alliance or joint venture activity in the "*Mergent*" database. This work has resulted in the identification of 1,896 separate alliances that were created by 893 different US public companies with third partners between the years 1982 and 2005. Of those alliances, 38 percent involved an international partner, while 70 percent were initiated in the 1990s, 8 percent occurred before that time, and the other 22 percent occurred between the years 2000-2005. The industry membership of alliance adopter companies included 47 percent in manufacturing (SIC code 2 or 3), 13 percent in hotels and other lodging places (SIC code 7), 10 percent in depository institutions (SIC code 6), 9 percent in transportation (SIC code 4), among other industries with smaller participation. The chief financial officer (CFO) for each of those companies was selected as the appropriate target respondent for the study, as a CFO should have an understanding of the potential effects of the use of IT on the effective operation and control of an alliance.

### Data Collection

The research instrument asks the potential respondent to choose one alliance their firm has had or currently has with another business entity. Such an alliance could be the result of a strategic agreement between two firms and it might have involved the creation of a third entity (as in a joint venture) or not. The respondents have been instructed to focus on the relationship with this I-O alliance partner when responding to the various items included in the research instrument. Following Dillman's (1978) recommendation for conducting effective surveys, several steps were taken during the entire data collection process: (a) a preliminary draft of the research instrument was evaluated by expert panels, including faculty members and two individuals (CFOs) from the target population. The instrument was revised as a result of pre-testing, ensuring the face validity of the constructs and items; (b) a preliminary letter explaining the study objectives was sent to each selected organization before mailing the first wave of surveys; (c) the first wave was mailed with a business-reply envelope and a letter requesting participation. The instrument was also coded on the author's web space and potential respondents were given the choice of completing the paper-based or web-based version of it; (d) a postcard reminder was sent about a week after the initial mailing; (e) a second reminder packet (including a copy of the original questionnaire and web access instructions) was mailed to nonrespondents within eight weeks of the original mailing; and finally, (f) an email request was sent to nonrespondents with a direct link to the questionnaire web-address. The response rate from all attempts is seventeen percent, as a total number of 116 responses were received over an effective sample of 677 target respondent firms. Table 1 presents sample characteristics.

*** Insert Table 1 about here ***

Tests for non-response bias were performed to determine (a) whether the distribution of the effective sample of 677 organizations in the response or nonresponse categories was independent of available demographic characteristics (industrial classification, gross revenue and number of employees) and (b) whether early and late respondents provided significantly different responses. Chi-square tests indicated no significant differences in the three demographic characteristics. The Hotelling's $T^2$ statistic also indicated no significant differences in the multivariate means of early versus late respondents.

**Measurement of Model Constructs**

For construct measurement, it is important to distinguish between IT-enabled MAS characteristics and the set of complementary MAS capabilities that are enabled by ERPS. Firms that are involved in I-O alliances may develop unique capabilities through the adoption of integrated systems (such as ERPS) that support collaborative activities. Such unique capabilities primarily relate to the development of collaborative activities in an I-O context, not to the adoption or use of the system itself. The proper management of appropriate factors that contribute to the acquisition of unique capabilities relates to the complementary capabilities construct, while the mere adoption of ERPS and the availability of related technological capabilities relate to the construct of IT-enabled MAS characteristics. The items used to measure all constructs are shown in Table 2.

*** Insert table 2 about here ***

Table 2 shows the five items used to measure IT-enabled MAS characteristics. The items are intended to measure the availability of such IT capability as web-based extranets for data sharing, web-based access over a partner's database, use of IT as a platform to build an organization's information infrastructure, use of ERP add-on modules and collaborative capabilities. As defined earlier, decision management (DM) activities are based on the set of those activities that take place in an I-O collaborative environment in order to initiate and implement business plans, while decision control (DC) activities relate to those activities that take place in an I-O environment in order to ratify the adoption of business plans and monitor implementation. As a result, the constructs of IT-enabled DM and DC capabilities are each measured using new items (shown in table 2) which capture the extent to which ERPS facilitate or enable the performance of such activities in an I-O environment. As no prior validated items exist for the measurement of these constructs, the items shown in Table 2 have been originally developed in this study.

The short-version of the trusting beliefs scale as developed and validated by McKnight et al. (2002) was adapted to measure I-O Partner Trust for this study. The scale has been used in prior studies with high item and construct reliability (e.g., Nicolaou and McKnight 2006). In addition, the study measures supplementary objective indicators of trust, such as repeated ties, international nature of an alliance, and number of partners in an alliance, as justified by Gulati and Singh (1998).

A battery of risk sharing items has also been developed in this study to operationalize the risk sharing construct. Risk sharing in this context is used to measure perceptions due to the sharing of risks and the dispersion of uncertainty throughout all partners in the I-O relationship. Past research has shown that sharing of business and financial risks were important motivators of I-O alliances (Gulati and Singh 1998; Groot and Merchant 2000), while risk sharing was also found to be an important sub-dimension of the interdependence that characterized the underlying logic of alliance creation (Borys and Jemison 1989; Gulati and Singh 1998).

To isolate and extract the potential confounding effect of other variables, I measured two factors that may have an influence on perceptions of I-O risk sharing. I included four items to capture the extent of reliance on formal and legal controls to monitor the alliance. This is similar in concept to Das and Teng's (2001) construct of behavior control and for the purposes of this study, I have adapted the scale of formal monitoring and control that was previously validated by

Muthusamy and White (2005). In addition, the impact of I-O cooperation on I-O risk sharing was controlled for, as a firm's cooperation with an exchange partner determines the degree to which the partners may seek mutual interests rather than pursue self-interest in the alliance. Das and Teng (2000) recommend using three items of cooperation, which I have adopted in this study. A fourth item (item a.iii in Table 2) was developed in this study as it was suggested by a CFO who participated in the pre-testing phase of the research instrument.

Inter-organizational performance is measured using a number of items capturing perceptions of alliance performance. Alliance performance was measured from the perspective of the focal firm using a set of items that capture the strategic benefits of the alliance. Similar measures of performance have been used in past I-O studies. Past research has suggested that alliance performance can be assessed by the extent to which the relationship is productive or worthwhile (Heide and Miner 1992; Van de Ven and Walker 1984), while others captured performance by the extent to which the alliance contributes to profits, market share or competitive advantage (Parkhe 1993; Simonin 1997). As a result, six items were developed in this study to capture the financial and strategic dimensions of I-O alliance performance; in addition, three items are used to assess the perception of overall alliance performance. Exchange partner performance has been defined in past research as the extent to which the supplier has fulfilled the buyer's requirements in terms of price, timeliness of delivery, input quality, and supplier flexibility (Zaheer et al. 1998). This study adapts this definition to develop one overall item of exchange partner performance which supplements the alliance performance measures.

## DATA ANALYSIS AND RESULTS

### Partial Least Squares (PLS) Analysis

The study used partial least squares (PLS) for data analysis because it 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. I used bootstrapping with 200 resamples to assess path estimate significance. While covariance-based structural equation methods, such as LISREL, impose significant constraints on data, PLS avoids these difficulties by offering a component-based strategy to the measurement of latent constructs and to the estimation of predictive structural coefficients in a model (Fornell and Bookstein 1982). In addition, PLS is superior to factor and regression analysis in that it assesses the measurement model within the context of the overall structural model. PLS may produce higher estimates for indicator loadings at the expense of lower path coefficients in the inner model. This bias may be avoided by having a large enough sample, which must be equal to at least 10 times the greatest number of links predicting a given latent construct. In this study, the present sample size of 116 cases well exceeds this minimum requirement.

**Item Quality Checks**

In accordance with research guidance (Churchill 1979), I first examined items that did not perform. First, I 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. As a result of this analysis, I dropped risk sharing item 'd' and coordination items 'a.ii' and 'b' (see table 2) because they loaded at less than 0.5 on their respective constructs. Second, I examined item loadings and cross-loadings derived from a PLS measurement model. Decision making capability item 3 also loaded on performance and the exchange partner performance single item also loaded on decision making capability. In addition, I-O performance item 'g' loaded on I-O trust; DC item 2 and DM capability item 2 loaded on each other construct; as a result, I have decided to eliminate these eight items. Before doing so, I made sure their removal did not affect the theoretical significance of their respective constructs (Gefen et al. 2003).

**PLS Measurement Model**

After culling out these items, I tested the measurement model for convergent and discriminant validity (Boudreau et al. 2001). 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, a measure similar to Cronbach's alpha (standard: 0.7 or above), and average variance extracted (AVE) which measures whether the variance captured by a construct is larger than the variance due to measurement error (standard: 0.5 or above) (Fornell and Larcker 1981). PLS provides information which can be used to estimate item-latent construct loadings and cross-loadings[1]. Each item loaded on its own construct at 0.5 or above, indicating individual item reliability. All internal consistency reliability (ICR) coefficients met the 0.7 standard, with the exception of the cooperation scale which attained an ICR of 0.68 (Table 3). Table 3 also demonstrates that all constructs met the 0.5 AVE criterion, supporting convergent validity.

*** Insert Table 3 about here ***

Discriminant validity means the extent to which measures of constructs are empirically distinct (Davis 1989). First, I 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

[1] Item-construct loadings and cross-loadings are not readily computed by PLS; these must be manually constructed using the following procedure suggested by Chin (2000): The loadings of individual items on their respective constructs and on all other constructs (loadings and cross-loadings) are generated by correlating construct scores ($\xi$) with their respective PLS-provided standardized (rescaled) indicators (x'). Construct scores are calculated by multiplying each standardized indicator with its respective regression weight ($\Pi_\xi$) on each latent construct. This procedure must be verified for correctness by checking the calculated loadings to those provided by PLS and exact matches must be obtained in the results.

other blocks (Chin 1998) and all items passed this test. Another test of discriminant validity compares the square roots of the AVE of two measured constructs (shown on the Table 3 diagonal) to the correlation between the two constructs. This test is met by all constructs in the model.

**PLS Structural Model**

Table 4 presents the PLS structural model results, while Figure 3 presents the same results in a diagrammatic format. The model explains 58.8% of the variance in I-O performance, with similar results for the other variables. In terms of hypothesis tests, the path coefficients from MAS characteristics to DC and DM capability are significant (t=6.60 $p$<.01 and t=1.74; $p$<.05, respectively), while the path from DC capability to DM capability is also highly significant (t=9.44 $p$<.01). These results support research hypothesis H1 and the proposition that IT-enabled DC capability enhances the level of DM capability. The results also support Hypothesis H3a, in that DC capability affects risk sharing (t=3.03; $p$<.01) and DM capability has a significant impact on trusting beliefs (t=3.44; $p$<.01). In addition, the Cooperation and Behavior Control constructs both have a significant effect on Risk Sharing (t=6.60 $p$<.01 and t=1.74; $p$<.05, respectively), indicating they are significant controls in the measurement of the risk sharing construct, while the objective measures of partner location and number of partners are significant controls in the measurement of I-O Partner Trust. For H4a, the results show that risk sharing affects I-O performance (t=1.79; $p$<.05), while for H4b, I-O Partner Trust has a significant effect on I-O performance (t=6.02; $p$<.01).

*** Insert Table 4 and Figure 3 about here ***

Research hypothesis H2 predicts that the complementary influence of DC and DM capability will have a significant direct effect on I-O performance, when their indirect effects are excluded from the model. To test H2, I first examined the individual effects of DC capability and DM capability on I-O performance. As shown in table 4, when DC capability and DM capability are individually included in the model, they have a significant individual influence on I-O Performance (t=2.70 and 4.12; $p<.01$, respectively). The hypothesis, however, argues that complementary effects are observed when strategies are pursued in combination; in fact, the data show that a significant pairwise correlation exists between DC and DM capability (r=0.759; $p<.01$). The two constructs are thus highly correlated as they are pursued simultaneously, albeit they are distinct from each other, as demonstrated by the discriminant validity analysis (table 3). Further evidence of complementarity is provided by the fact that when both direct effects are allowed to influence performance, the link from DC capability to performance loses significance (t=0.52; n.s.), while the direct effect of DM capability on performance maintains its significance (t=3.55; $p<.01$). Figure 4 shows these results in a path diagram format. This shows that in the presence of DC capability, DM capability still exhibits a significant effect and could thus complement the effect of DC capability in influencing performance. These results therefore support H2.

*** Insert Figure 4 about here ***

The theory development in the study also presents the proposition that Risk Sharing and I-O Partner trust will mediate the effects of DC and DM capability on I-O performance. Two related techniques were used to test this proposition. First, power analysis may provide information about the significance of omitted paths in a reduced model (Cohen 1988). Specifically, I restricted the Figure 1 model to only include the paths from DC and DM capability to I-O performance, while the other direct paths of risk sharing and I-O trust were excluded. The percentage of variance explained for performance is reduced from 58.8% to

22.3%, as compared to the full unrestricted model presented in Figure 1. Chin (1998, 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 ($R^2_{included} - R^2_{excluded}$) / ($1 - R^2_{included}$). The effect size due to the omission of the risk sharing and I-O trust paths equals 0.47, which is a large effect size (cf. Cohen 1988). This indicates that risk sharing and I-O trust have an important effect on I-O performance and should not be excluded from the model.

Second, Baron and Kenny (1986) suggest that perfect mediation holds if the significant relationship between DC and DM capability and I-O performance is not significant when one controls for the mediator constructs of risk sharing and I-O trust (cf. Baron and Kenny 1986, 1177). When a path from risk sharing (only) to I-O performance is added to the restricted model, the previously significant direct effect of DC capability on I-O performance becomes nonsignificant (t=-0.80; n.s.). When a path from I-O trust (only) is added to the restricted model, the previously significant effect of DM capability on performance similarly becomes nonsignificant (t=0.79; n.s.). When the paths from both risk sharing and I-O trust are included, resulting in the full model corresponding to Figure 1, the effects of DC and DM capability on I-O performance are also nonsignificant (t=1.01; n.s. and t=0.59; n.s., respectively), as reported in Table 4. Thus, risk sharing and I-O trust perfectly mediate the relationship between DC and DM capability and I-O performance, supporting this proposition.

## DISCUSSION AND IMPLICATIONS

This study asks the question as to whether an organization's I-O control strategy and I-O coordination strategy are inter-dependent. In an environment where integrated IT systems facilitate the design of complementary DC and DM capabilities in MAS, the effective employment of such practices should influence performance in inter-firm relationships. The study also asks the question as to whether a firm's IT-enabled capabilities can help set the boundaries for trusted information sharing in an environment that would otherwise be characterized by uncertainty in a partner's behavior.

The study's results support its theoretical arguments. The study has demonstrated that IT-enabled MAS characteristics are critical for the successful utilization of complementary practices that can be used to exercise both decision control and decision management activities in I-O relationships. As a result, this study extends prior literature in information systems which advocates the enabling role of IT, while it also extends management accounting research in this area which advocates systemic approaches to examining the effectiveness of MAS design (e.g., Chenhall 2003; Chenhall and Langfield-Smith 1998). Both I-O trust and risk sharing were shown to represent effective mechanisms in a governance structure that effectively employs complementary capabilities to enhance I-O performance. The mechanisms of trust and risk sharing, in their mediating role, explain how the positive effects due to complementarity in fact occur. This suggests that in inter-firm alliances, it is important to develop relationships that are in fact characterized by mutual trust and a desire to share risks.

An implication of this study is that there exist critical design issues in IT-enabled MAS that are in fact controllable by management. In the design of systems that span I-O relationships, decisions can be made about the adoption of a technological infrastructure that may facilitate the development of unique organizational capabilities. Consequently, a major theoretical contribution of this study is to identify boundaries in MAS design which ensure that a certain degree of fit is achieved in making I-O decision control and decision management choices. The study findings also address the recent call made by Coletti et al. (2005), which raises the issue of identifying boundary conditions within which a control system will have a positive influence on partner trust and cooperation.

The main focus of I-O relations is on innovation and development of new competencies – not just on collaboration, as is the focus in the supply chain management literature. As a result, this study extends research on I-O relations and provides insights that help focus future research in the design of effective I-O MAS. This focus supports the use of an organizational capabilities framework for the study of complementary decision management and decision control phenomena in I-O relationships. Much in the same way that a firm's coordination strategy is the strategic choice element in the determination of I-O network structures (Holland and Lockett 1987), the IT-enabled MAS choices for decision management and control also reflect the strategic choice elements for the success of I-O relationships.

This study demonstrates that it is the design and organization of information that is the major explanatory variable of governance choices in net-enabled business relationships. While inter-firm relationships depend on IT for the integration of information flows among networked firms, it is the effective use of IT which confers stability to I-O arrangements.

Complementary relationships among strategic elements of a firm's I-O MAS are based on capabilities developed by the organization through the deployment and use of IT resources (ERPS). The consistency of a set of ERPS implementation activities with such capabilities, therefore, should be a prerequisite for success; the current study fills a void in the current literature which attempts to examine performance effects due to the presence or absence of a number of ERPS implementation factors. The current study demonstrates that significant benefits (both direct and indirect) of ERPS implementation relate to the development of complementary capabilities in decision management and control. The current study informs future research which might examine control/trust tradeoffs or requisite control in the design of MAS in an extended enterprise environment.

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## TABLE 1

### Sample Characteristics

| | | |
|---|---|---|
| **Response Rate** | | |
| Original Sample from Mergent Database ...................................................... | | 893 |
| Less: | | |
| Undelivered questionnaires with no forwarding information... | 67 | |
| Declined response due to time pressures ................................. | 49 | |
| Declined response due to non-participation in surveys ............ | 65 | |
| Declined response for unspecified reasons | 35 | (216) |
| Effective Sample Size | | 677 |
| Number of completed questionnaires received | | 116 |
| *Effective Response Rate* ........................................... | | *17.13%* |

**TABLE 2**
**MEASUREMENT ITEMS OF MODEL CONSTRUCTS**

**Measurement of IT-enabled MAS Characteristics (***7-point scale, strongly agree to strongly disagree):*

1. The use of IT enables use of web-based extranets or other data sharing methods with my exchange partner.
2. My alliance partner allows me to have electronic web-based access over relevant portions of their internal database.
3. IT systems served as an essential platform to help build my firm's information infrastructure, including web enablement capabilities.
4. My firm's use of IT systems enables use of web-based add-on modules, including supply chain and customer relationship management.
5. My firm utilizes web-based collaborative capabilities enabled by its IT systems.

**Measurement of Complementary Capabilities in MAS Design (***7-point scale, strongly agree to strongly disagree):*

*Decision Control (DC) Capability:*

Information provided by my firm's IT systems enables:

1. adequate control over outcomes or results of actions taken by my exchange partner in the alliance.
2. the assessment of alliance (exchange partner) performance over a number of operating metrics, including delivery on schedule, sharing of production plans, and minimization of production delays.
3. use of web-based monitoring routines which provide information about partner performance over a number of specific metrics.
4. my firm to better monitor exchange partner performance.

*Decision Management (DM) Capability:*

1. The use of IT systems in general has allowed my firm to better coordinate decisions with the exchange partner in this alliance.
2. My firm's IT systems provide adequate information for me to make decisions that affect the relationship with my exchange partner in this alliance.
3. My firm's IT systems provide adequate information for me to plan in advance the potential outcomes of decisions which impact my relationship with this exchange partner.
4. The use of IT systems collaborative capabilities has allowed my firm to better coordinate decisions with the exchange partner in this alliance.
5. The use of IT systems increases transparency of my alliance partner's cost structure.

**I-O Partner Trust (***7-point scale, strongly agree to strongly disagree)*

1. If I required help, this partner would do its best to help me.
2. This partner is interested in my well-being, not just its own.
3. I would characterize this partner as honest.
4. This partner would keep its commitments.
5. This partner performs its role in the alliance very well.
6. Overall, this partner is a capable and valuable member of this alliance.

**Trust Builders** (objective measures):

1. Number of prior alliances my firm has had with this exchange partner in the last 15 years:_______ (coded as 1 if greater than zero; otherwise coded as 0).

2. My exchange partner in this alliance is located in one of the following geographic regions: (coded as 1 if in Americas, 0 otherwise)
   i. Americas; ii. Europe; iii. Japan; iv. China; v. India; vi. Other (please specify).
3. Number of business partners that are involved in this alliance: ______ (coded as 1 if equal to 2 – including focal firm; 0 otherwise).

**I-O Risk Sharing** (*7-point scale, not important at all to very important):*
Rate the importance of the following items in relation to your alliance with this exchange partner:

a. sharing business risks.
b. stabilizing earnings within the business segment of this alliance.
c. sharing regional markets.
d. reducing/sharing costs of research and development.
e. reducing competition in the market where the alliance is active.
f. securing know-how possessed by your exchange partner.

**I-O Performance** *(7-point; strongly disagree to strongly agree)*:
Please rate the performance of the strategic alliance:
Financial Dimension:

a. has been very profitable
b. has generated a high volume of sales
c. has achieved a high earnings growth

Strategic Dimension:

d. has improved my firm's strategic competitiveness
e. has strengthened my firm's strategic position
f. has significantly increased my firm's market share

Overall:

g. has been very satisfactory
h. has fully met my firm's expectations
i. all in all, we expect that the strategic alliance with this exchange partner will continue in the long-run.

Exchange Partner Performance:

1. Please rate your exchange partner's performance in following the terms of your agreement. (*measured as 1=very poor; 4=fair; 7=excellent*).

**Alliance-Specific Formal Controls** (*strongly disagree to strongly agree, 1-7 rating scale*):
a. We often consult with legal experts to sort out problems in the alliance.
b. We strictly follow the contracts to coordinate this alliance.
c. We rely on legal means to ensure the partner firm meets its obligations.
d. Rules have been strictly enforced in the alliance.

**Coordination** (*7-point response scale, never to always*):
a. To what extent do you and your partner in this alliance:
i. exercise mutual forbearance in your dealings with each other?
ii. make demands that might be damaging to the other partner? *
iii. refrain from "poaching" on each other's business?
b. How often did you and your partner disagree on who should have control over key decisions during the alliance? *

* reverse-scored.

**TABLE 3**
**DESCRIPTIVES, CORRELATIONS, AND VALIDITY STATISTICS**

**Correlations, AVEs, ICRs**

| | Mean | Std Dev | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1 MAS Charact** | 4.65 | 1.97 | 0.853[ξ] | | | | | | | | | | |
| **2 DC Capab** | 4.45 | 1.68 | 0.537 | 0.899 | | | | | | | | | |
| **3 DM Capab** | 4.56 | 1.79 | 0.515 | 0.759 | 0.832 | | | | | | | | |
| **4 Risk Sharing** | 5.11 | 1.64 | 0.319 | 0.372 | 0.441 | 0.713 | | | | | | | |
| **5 I-O Trust** | 5.44 | 1.48 | 0.226 | 0.149 | 0.378 | 0.393 | 0.914 | | | | | | |
| **6 I-O Perf** | 5.16 | 1.47 | 0.276 | 0.315 | 0.463 | 0.469 | 0.722 | 0.833 | | | | | |
| **7 Trust-Location** | 0.8 | 0.4 | 0.120 | 0.019 | -0.026 | 0.117 | 0.185 | 0.108 | 1.000 | | | | |
| **8 Trust-Prior All.** | 0.13 | 0.34 | 0.075 | 0.180 | 0.158 | 0.057 | 0.079 | 0.134 | -0.002 | 1.000 | | | |
| **9 Trust-#Partners** | 0.27 | 0.44 | 0.224 | 0.197 | 0.161 | 0.096 | 0.232 | 0.144 | -0.042 | -0.001 | 1.000 | | |
| **10 Cooperation** | 4.57 | 1.87 | 0.157 | 0.084 | 0.150 | 0.320 | 0.181 | 0.196 | -0.154 | 0.208 | -0.070 | 0.746 | |
| **11 Beh. Control** | 4.72 | 1.71 | 0.352 | 0.329 | 0.425 | 0.380 | 0.262 | 0.359 | 0.085 | -0.077 | 0.133 | 0.338 | 0.832 |
| ***ICR*** | | | ***0.930*** | ***0.926*** | ***0.871*** | ***0.836*** | ***0.968*** | ***0.948*** | ***1.000*** | ***1.000*** | ***1.000*** | ***0.683*** | ***0.918*** |
| ***AVE*** | | | ***0.728*** | ***0.808*** | ***0.693*** | ***0.509*** | ***0.835*** | ***0.694*** | ***1.000*** | ***1.000*** | ***1.000*** | ***0.556*** | ***0.692*** |

Note: Correlations greater than |0.20| are significant at p<.05; Correlations greater than |0.25| are significant at *p*<.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 4**
**MEASURED RESEARCH MODEL (PLS ANALYSIS) RESULTS**

| **Endogenous Construct ($R^2$)** | **Research Hypothesis** | **Path coefficient** | **t (sig.)** | **Hypothesis Outcome** |
|---|---|---|---|---|
| *DC Capability (28.9%)* | *H1a:* MAS Characteristics → DC Capability | 0.537 | 6.60** | Supported |
| *DM Capability (59.2%)* | *H1b:* MAS Characteristics → DM Capability<br>DC Capability → DM Capability | 0.152<br>0.677 | 1.74*<br>9.44** | Supported |
| *I-O Risk Sharing (25.7%)* | *H3a*: DC Capability → Risk Sharing<br>Cooperation → Risk Sharing<br>Behavior Control → Risk Sharing | 0.284<br>0.225<br>0.210 | 3.03**<br>2.53**<br>2.39** | Supported |
| *I-O Partner Trust (21.5%)* | *H3b*: DM Capability → Trust<br>Partner Location → Trust<br>Prior Alliances → Trust<br>Number of Partners → Trust | 0.350<br>0.202<br>0.024<br>0.184 | 3.44**<br>2.20*<br>0.37<br>2.69** | Supported |
| *I-O Performance (58.8%)* | *H4a*: Risk Sh. → I-O Performance<br>*H4b*: Trust → I-O Performance | 0.151<br>0.615 | 1.79*<br>6.02** | Supported<br>Supported |
| | *H2*: *Complementarity Hypothesis* | | | |
| | DC→ I-O Performance (direct effect) | 0.328 | 2.70** | |
| | DM →I-O Performance (direct effect) | 0.467 | 4.12** | |
| | Both Links in Model: | | | |
| | DC → Performance | -.082 | 0.55; n.s. | |
| | DM → Performance | 0.530 | 3.75 ** | Supported |
| | → In the presence of DM, DC is not significant. | | | |
| | *Mediation Proposition:* | | | |
| | Expected nonsignificant direct effect in the presence of the effects of: | | | |
| | - DC on Performance through Risk Sharing; | 0.101 | 1.01; n.s. | Supported |
| | - DM on Performance through Trust. | 0.087 | 0.59; n.s. | Supported |

One-tailed Significance Levels:
*: $p$<.05 ($p$<.05 if: 2.35>t>1.65
**: $p$<.01 ($p$<.01 if: t>2.35

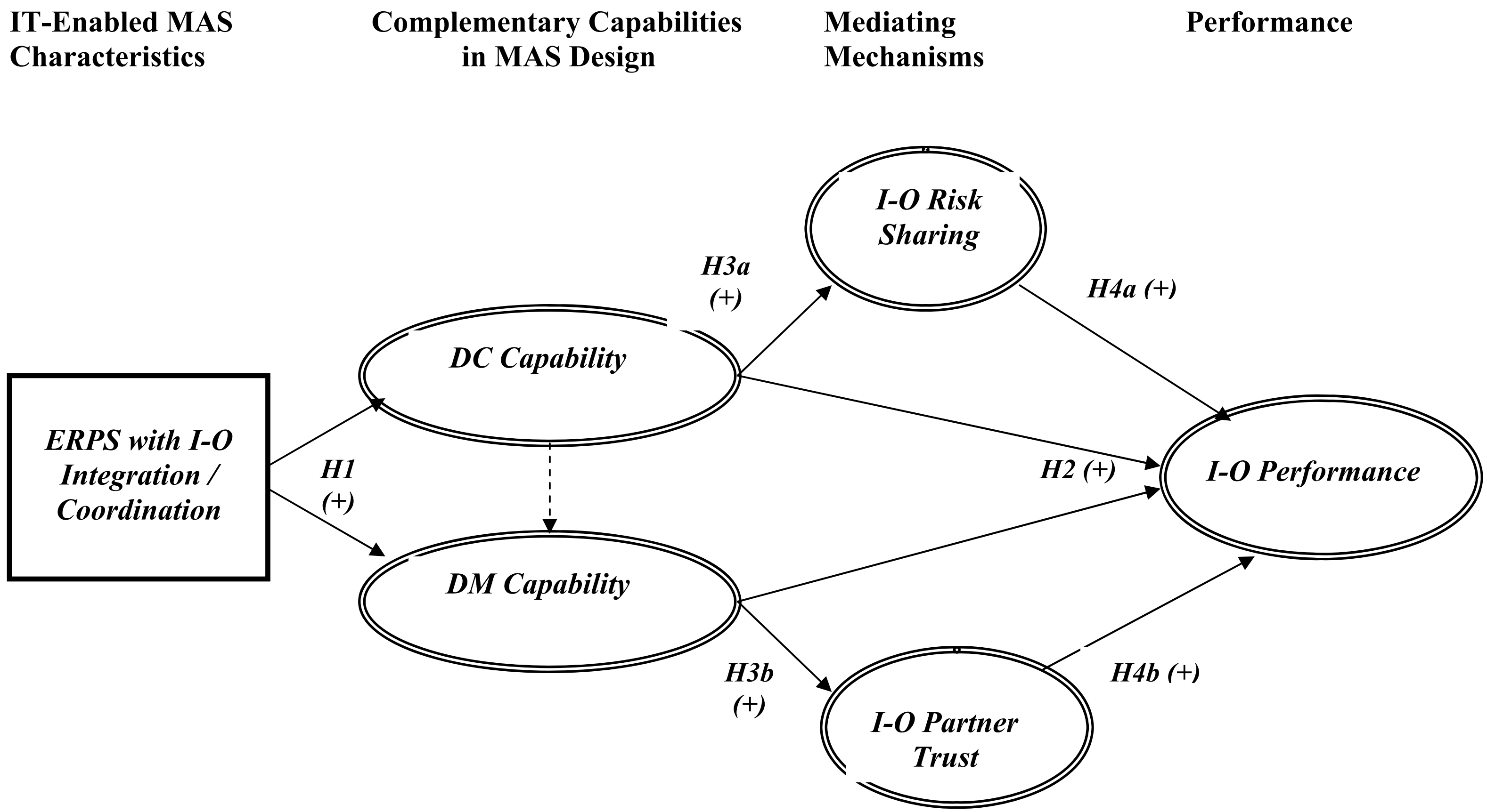


Figure 1. Research Model of the Study

*Note:* Dotted line shows a link in the model for which no formal hypothesis was proposed.

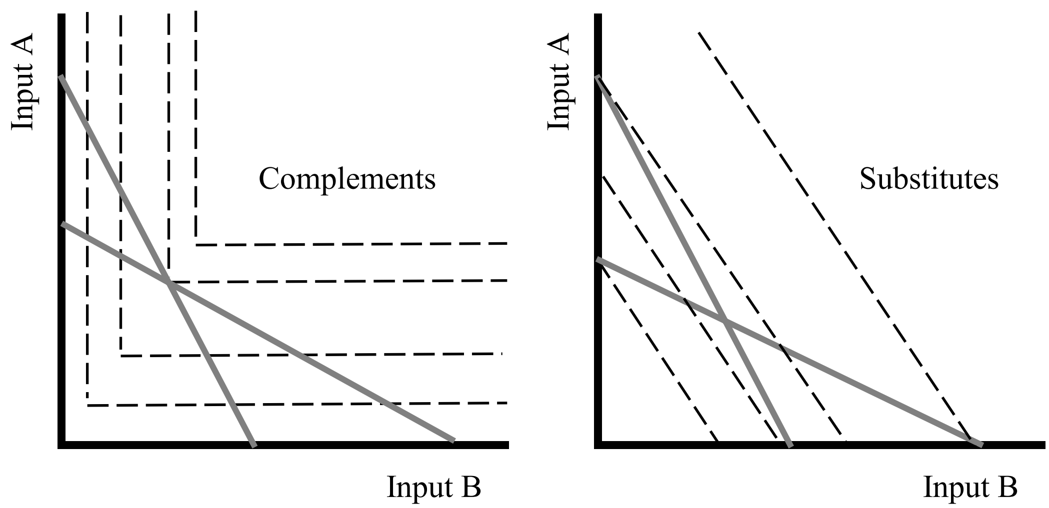


Figure 2. The Case of Extreme Complements and Extreme Supplements

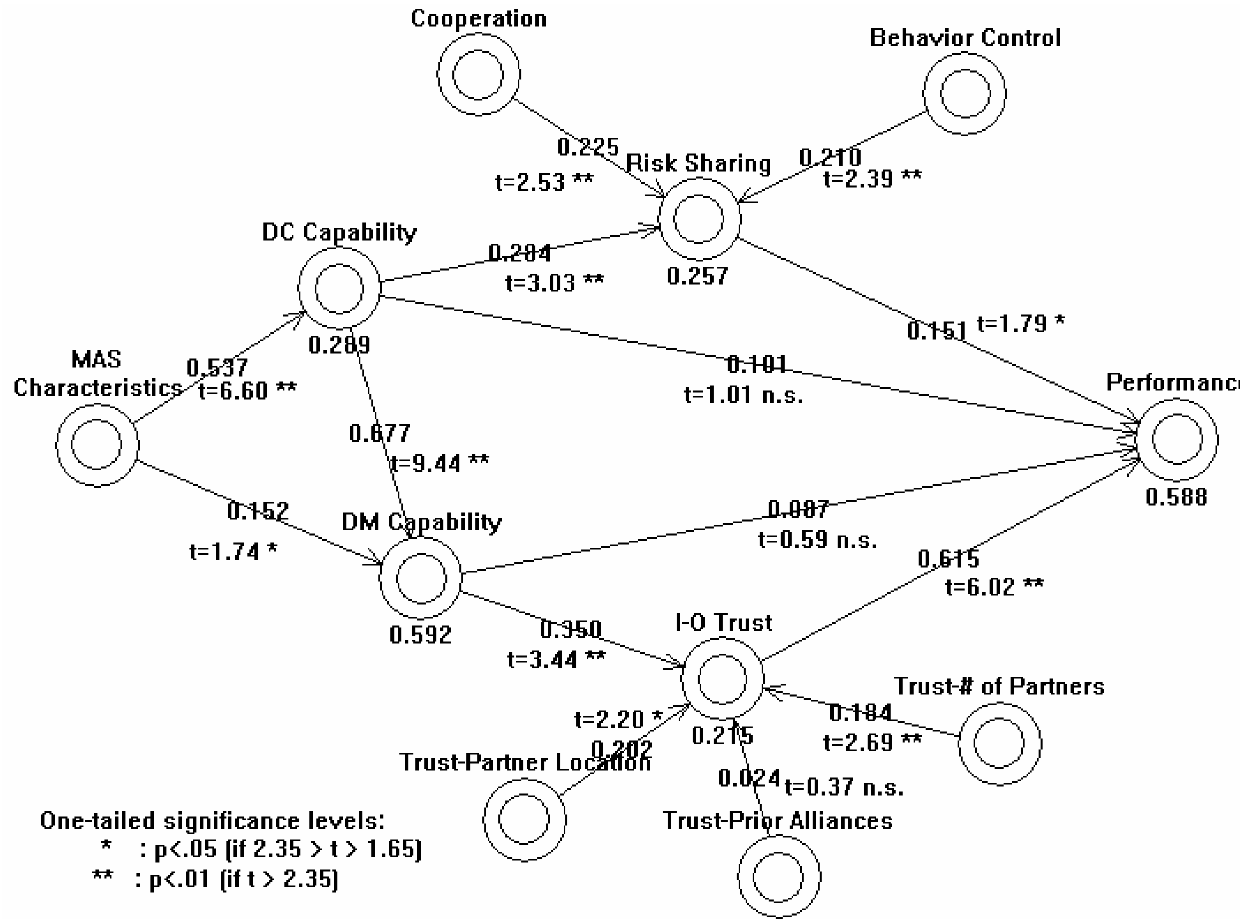


Figure 3. PLS Structural Model Results

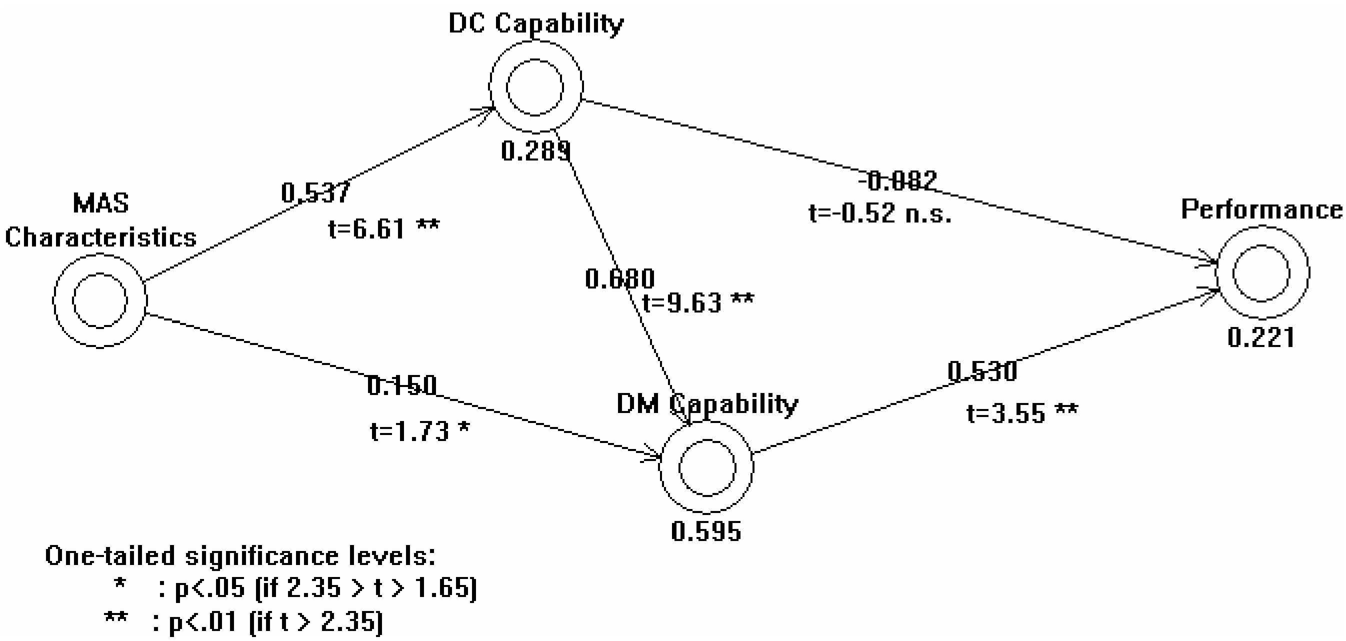


Figure 4. PLS Test of Complementary Effects on I-O Performance