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RESEARCH ARTICLE

EXAMINING THE RELATIONAL BENEFITS OF IMPROVED INTERFIRM INFORMATION PROCESSING CAPABILITY IN BUYER–SUPPLIER DYADS[1]

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Information Systems research has studied how buyers and suppliers can benefit from improved information visibility in supply chains characterized by uncertainty. However, the relation-specific information processing solutions that provide visibility can only be exploited if the two firms engage in sufficient coordination efforts. This work takes a nuanced look at how dyadic benefits are derived in the supply chain. Drawing on the information processing view, resource-based view, and transaction cost theory, this study explicates how buyer performance can result from buyer's use of relation-specific information processing solutions and supplier's relational responses. Two interfirm information processing solutions are proposed and examined: the use of IT-based systems for planning and control, and the use of relational (normative) contracts. Based on a sample of 144 manufacturing firms, eight of the nine proposed research hypotheses receive empirical support using PLS analysis. The findings suggest that as buyers and suppliers utilize the IT and relational solutions, they induce relation-specific responses represented as supplier's business process investments and modification flexibility, which in turn lead to positive buyer outcomes. The results help us gain a more granular understanding on how relation-specific interfirm information processing solutions can lead to performance through enhanced interfirm governance capabilities.

Keywords: IT-enabled planning and control, normative contracts, information processing view, resource-based view, transaction cost theory

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Introduction

Today's producers face greater environmental uncertainty than ever before in the supply chain. Such uncertainty reflects primarily two forms of system dynamics in today's complex supply chains, namely, the bullwhip effect and industry clock speed amplification (Fine 2000). The former refers to the increase in variance of demand distortion a company faces, the further upstream it resides in the supply chain (Lee et al. 1997). It occurs because suppliers coordinate based on immediate customers' order data, which are likely to be contaminated by rationing, order batching, and price promotion along the supply chain (Lee et al. 1997). The latter describes the increased rate of industry change a company experiences, the farther downstream it is located in the supply chain (Fine 2000; Mendelson and Pillai 1999). Both of these dynamics make it difficult for buyers to achieve manufacturing goals because their suppliers may not be able to fulfill the amplified, distorted orders or adapt products, processes, or organizations to the changing demand (Zsidisin 2003). Accordingly, this study aims at examining how buyers and suppliers can work together through the use of information technology and relational mechanisms to cope with such supply chain uncertainty to achieve better performance.

Theoretically, coping with supply chain uncertainty requires improvement of information processing (IP) capabilities between buyers and suppliers (Mason-Jones and Towill 1997; Mendelson and Pillai 1998). To improve buyer–supplier coordination, certain *informational responses* may be adopted by buyers. One such typical response is to share richer information (e.g., market sales, inventory status, forecasts, and planning data) with suppliers to mitigate the problem of information distortions when generating supply chain plans (Wang and Wei 2007). However, this may not work well as industry structure is usually more modularized downstream than upstream in the supply chain (Fine 2000). Firms in the downstream supply chain face rapid price changes, shorter product cycles, fresher product lines, and higher technological innovation due to greater outsourcing (Mendelson and Pillai 1999). This makes it difficult to preplan actions as the planning lead times are so short. Instead, rapid adaption to the situation appears to be more effective. Therefore, another often advocated informational response is that buyers reduce the information sources and decision variables they need to contend, to allow more rapid adaptive decision making (Flynn and Flynn 1999; Mendelson and Pillai 1998).

A buyer's informational responses to supply chain uncertainty may not yield benefits without collaboration by the supplier. Suppliers may lack needed resources, and must actively engage in mutual adjustment activities to implement adaptive decisions effectively (Heide and John 1992; Jap 1999). We refer to these as *relational responses* (Makadok 2001). Once these complementary resources and capabilities are ready, effective bilateral coordination and adaptation can result, leading to relational (or relationally derived) rents (Dyer and Singh 1998). If suppliers under-invest *ex ante* or underperform *ex post* in the needed relational responses (Alchian and Demsetz 1972; Grossman and Hart 1986; Williamson 1985), then the full potential of relational rents remains unrealized (Dierickx and Cool 1989; Foss and Foss 2005). In order to mitigate this, there is a need to set up effective governance *ex ante* to secure the appropriate relational responses (Ghosh and John 1999).

This study posits that the problems buyers face in combating supply chain uncertainty can be resolved together with suppliers by fulfillment of mutual information needs and creation of relational rents. Specifically,

- What are buyers' informational responses for facilitating interfirm decision making in response to supply chain uncertainty?
- What are suppliers' relational responses that complement buyers' informational responses to facilitate effective bilateral coordination/adaptation?
- How do buyers incentivize or secure their suppliers' relational responses?
- How do buyers benefit from both their informational responses and suppliers' relational responses?

This study will draw upon the information processing view (IPV) (Daft and Lengel 1986; Galbraith 1974; Tushman and Nadler 1978), resource-based view (RBV) (Dyer and Singh 1998; Lavie 2006; Wernerfelt 1984), and transaction cost theory (TCT) (Alchian and Demsetz 1972; Grossman, and Hart 1986; Williamson 1975, 1985) to illuminate relationships among buyer's informational responses, supplier's relational responses, and buyer performance. Specifically, IPV will be applied to identify distinct interfirm IP mechanisms that buyers can utilize to coordinate with suppliers in response to supply chain uncertainty; RBV will be adopted to justify why supplier's relational responses are needed and how they can generate relational rents; TCT will be utilized to explain why buyer's informational responses can also serve as effective governance mechanisms for ensuring the supplier's appropriate relational responses. A major contribution of this study is the synthesis of the three theories to account for how buyers, when facing supply chain uncertainty, can improve their manufacturing performance through their informational

and supplier's relational responses. The empirical results indeed corroborate our propositions that the buyer's informational responses (i.e., *IT-enabled planning and control* and *normative contracts*) can facilitate the supplier's relational responses (i.e., *supplier's relation-specific business process investments* and *modification flexibility*), which in turn leads to positive buyer performance (i.e., *buyer's manufacturing goal achievement*). Therefore, this study adds granularity on what and how interfirm IP mechanisms can both generate and safeguard relationally derived benefits, thereby extending the IPV's explanatory power to the interorganizational setting.

The remainder of this paper is organized as follows. In the following section, we synthesize IPV, RBV, and TCT to identify the research constructs and formulate a research framework for this study. The subsequent section derives the research hypotheses and the research model. The research methods and measurements are described, followed by the data analysis. The managerial and research implications, future research directions, and limitations are discussed. Finally, the conclusions are presented.

The Research Framework

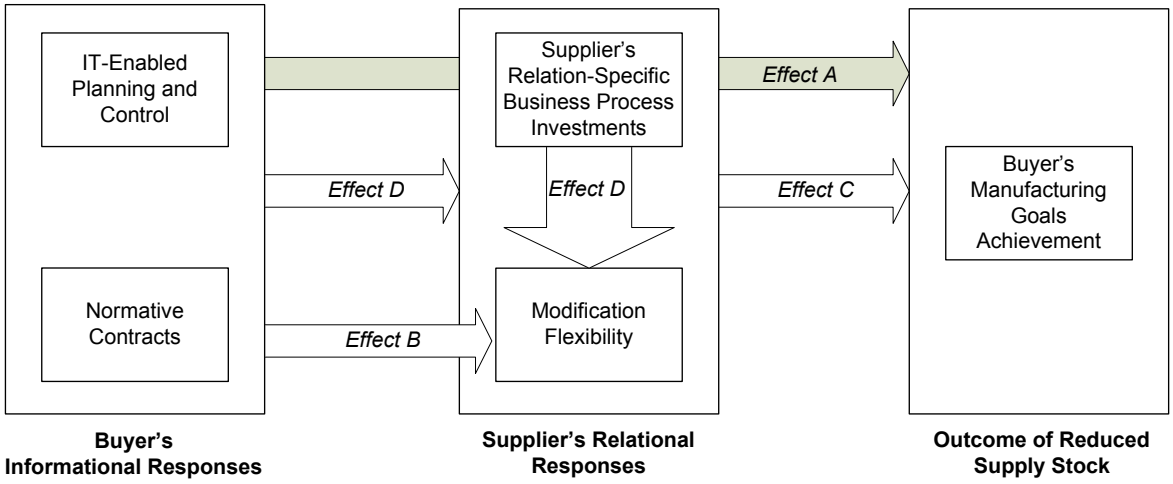
Interfirm coordination is the central issue when trading partners deal with supply chain uncertainty. To mitigate such uncertainty, partners need to overcome three problems. The first is the interfirm IP problem that involves a lack of supply chain visibility and ability to process abundant information in a timely manner (Mendelson and Pillai 1998; Wang and Wei 2007). Partners can seek to cope with uncertainty either through preplanning or adaptation. The second issue pertains to the effectiveness of executing adaptive decisions. Synchronized plans and mutual adaptations are necessary for trading partners to reduce the negative impact of supply shocks. The partners (in our case, suppliers) therefore have to invest in corresponding relation-specific business processes and modify agreements/actions as needed so as to equip themselves with the resources and flexible capabilities required for realizing the potential relational benefits. The third issue deals with the exchange hazards involved with relation-specific investments/adaptations. Without effective governance set up *ex ante*, suppliers may underperform on their relational efforts and thereby make the implementation of adaptive decisions difficult.

Overall, the above discussion can be formulated as the research framework depicted in Figure 1. This study suggests that (1) buyer's informational responses can mitigate the interfirm IP problems encountered with synchronized plans (Effect A, see Figure 1) and mutual adaptation (Effect B), (2) supplier's relational responses can enhance the resources and capabilities needed for improving the quality of execution of adaptive decisions (Effect C), and (3) buyer's informational responses can facilitate and secure supplier's relational responses directly and indirectly through supplier's relation-specific business process investments (Effect D). This study holds that the buyer's informational responses can serve as both the interfirm IP mechanism as well as the governance mechanism (Mesquita and Brush 2008), affecting different aspects of the supply chain partnership. The relationships among the building blocks of the framework will be established by integrating IPV, RBV, and TCT. The definitions of the research constructs and relevant concepts are summarized in Table 1.

Information Processing View and Buyer's Informational Responses

The information processing view posits that organizations can achieve a given level of performance if their organizational design matches the inherent level of uncertainty. Galbraith (1974) suggests that decision makers can either preplan the activities to reduce uncertainty, and thus facilitate subsequent task execution, or be flexible to adapt the activities at the time of the uncertain event. Both strategies require distinct information processing support.

The first strategy applies to the situation where information (e.g., forecasts, plans, schedules, etc.) exists for arranging activities *prior* to task execution (Daft and Lengel 1986). Decision makers simply need to obtain sufficient information to make sound plans, even if they are contingent in nature. If the required information cannot be fully acquired, the resulting plans would not be useful for handling unexpected events during task execution, leading to lower task performance (Galbraith 1974). In the buyer–supplier relationship, task uncertainty can increase when interfirm task interdependence and environmental dynamism are higher (Bensaou and Venkatraman 1995). Task interdependence indicates that any task change in firm A depends on task execution in firm B (and vice versa) (Thompson 1967). Both parties would encounter higher task uncertainty if no effective coordination and control mechanisms were in place (Tushman and Nadler 1978). Environmental dynamism further increases the needs of continual monitoring, feedback, and adjustment between the parties. Any uncoordinated preplanning then will exacerbate the task uncertainty experienced by the parties. Accordingly, trading parties who are engaged in joint decision making under volatile business environments should enhance their interfirm IP capacity in order to generate more synchronized plans and hence reduce task uncertainty.



- Effect A: Improving interfirm IP capability for facilitating synchronized preplanning (IPV)
- Effect B: Improving interfirm IP capability for facilitating mutual adaptation (IPV)
- Effect C: Developing complementary resources that can facilitate buyer to acquire relational rents from improved interfirm coordination/adaptation (RBV)
- Effect D: Offering effective governance that can induce and secure the needed idiosyncratic investments (TCT)

Figure 1. Research Framework

Table 1. Definition of Theoretical Concept and Research Construct

Concept/Construct	Definition	Key References
IT-enabled Planning and Control (ITP&C)	ITP&C refers to the buyer's utilization of IOISs and Internet applications to share market data/forecasts, coordinate plans, and track control information with its suppliers.	Saeed et al. (2005) Stadler (2005, 2009)
Normative Contracts (NC)	NC refers to a set of mutual expectations and understandings between trading partners. They are group-oriented implicit understanding, reflecting a social consensus and reinforcement of specific behaviors and exchange patterns between trading partners.	Brown et al. (2006) Heide and John (1992) Lusch and Brown (1996) Rousseau (1995)
Supplier's Relation-specific Business Process Investments (SRBPI)	SRBPI refers to the idiosyncratic investments made by a supplier in key business processes, such as operating processes, administrative processes, and quality-control processes, that are specific to a buyer.	Subramani (2004) Subramani and Venkatraman (2003)
Modification Flexibility (MF)	MF refers to the ability of buyers and suppliers to adjust their behaviors or the terms of the agreement in response to environmental changes and the needs of their partners.	Evans (1991) Young-Ybarra and Wiersema (1999)
Buyer's Manufacturing Goals Achievement (BMGA)	BMGA refers to the four competitive manufacturing priorities achieved by the buyer: quality, dependability, cost, and manufacturing flexibility.	Narasimhan and Jayaram (1998)

The second strategy applies to the situation where there is no exact resolution to how a task should be performed before task execution (Daft and Lengel 1986). For example, decision makers may have difficulty in understanding input information because they do not have common cognitive maps to make sense of the information (Huber 1991), limiting their ability to use the information to reach mutual agreement for task execution. In a buyer–supplier relationship, such an informational problem is very likely to occur because partners inevitably possess different frames of reference. The distinct

interpretation and understanding of environmental stimuli might lead to divergent opinions about the needed action (Huber 1991; Weick 1995). Further, in a rapidly changing environment, unexpected events tend to make existing plans obsolete quickly and demand frequent replanning. Under such circumstances, deferring decision making until the uncertain event is settled and then reacting quickly appears to be more effective than preplanning (Galbraith 1974). Given the limited time for reaction, informational-focused strategies may be used to reduce the IP needs for mutual adaptation (Mendelson and Pillai 1998). For example, adoption of reduced supplier bases can decrease the information sources and decision variables with which a buyer needs to contend (Flynn and Flynn 1999). The longer a buyer deals with fewer suppliers, the easier it is to develop norms that facilitate collective sense making and judgment during joint decision making (Lusch and Brown 1996), thus facilitating improved mutual adaptation. Both of these informational strategies are reflected in the constructs described below.

IT-enabled Planning and Control (ITP&C). Relying on only ordering information to coordinate supply chain activities creates the bullwhip effect. It has, therefore, been suggested that partners improve their coordination and control capabilities by adopting systemic control, information transparency, time compression, and accurate forecasting to combat the uncertainty (McCullen and Towill 2002). Typically, buyers are more knowledgeable about the downstream market demand and thus play a key role in improving interfirm coordination and control (Dejonckheere et al. 2004). One prominent informational response is to utilize interorganizational information systems (IOISs) and Internet applications to share market data/forecasts, plans, and control information with suppliers, referred to here as *IT-enabled planning and control* (ITP&C) (Saeed et al. 2005). ITP&C has been increasingly supported by application systems that can facilitate collaborative planning in demand fulfillment, material requirements, production, transportation, and inventory as well as systematic tracking of supply chain transactions in real time (Stadler 2009; Wood 2007). Thus, ITP&C allows suppliers to access the most updated sales, plans, and schedules from their buyers. With the improved visibility, buyers also can better control production, inventory, and logistics activities with suppliers (Klein and Rai 2009; Seidmann and Sundararajan 1997; Wang and Wei 2007). Accordingly, with effective ITP&C, the partners should have greater interfirm IP capability to execute well-informed plans and better coordinate joint activities under conditions of supply chain uncertainty.

Normative Contracts (NC). In the supply chain, industry clockspeed amplification compresses the time for firms to react. With a limited time frame, trading partners will experience difficulty in processing a lot of information (Mendelson and Pillai 1999). Further, variant frames typically held by different partners will also make preplanning more difficult and less effective. Under such circumstances, it may be advantageous for trading partners to reduce information processing and preplanning until the state of world is settled, and then react rapidly (Galbraith 1974; Mendelson and Pillai 1998). For example, trading partners can adopt collaborative planning, forecasting, and replenishment (CPFR), which relies on joint problem solving, rather than exchanging and processing more information, to handle exceptional events (Simatupang et al. 2002). Nonetheless, decision making during joint problem solving still can incur substantial coordination and negotiation costs if partners' interpretations about the unexpected events and judgments on the needed adaptations are different. Normative contracts can be used to set a common framework for understanding and facilitate joint problem solving (Artz and Brush 2000). These contracts refer to a set of mutual expectations and understanding between exchange parties (Brown et al. 2006; Lusch and Brown 1996). They are group-oriented, implicit understandings, reflecting a social consensus and reinforcement of specific behavioral patterns between the parties (Rousseau 1995). The norms specify the obligations, rules, outcomes, contributions, and sanctions germane to the exchange relationship (Ring and Van de Ven 1994). They can help buyers and suppliers combat unexpected events since they can guide and incentivize the parties to achieve collective judgment and thereby reach a mutual agreement on the needed adaptation (Heide and Miner 1992; Lusch and Brown 1996; Noordewier et al. 1990; Weick 1995). We therefore submit that when facing an environment in which unexpected events occur frequently, the greater the extent that a buyer develops normative contracts with its supplier, the less the negotiation incurred for making adaptive decisions.

Resource-Based View and Supplier's Relational Responses

While the buyer's informational responses described above can satisfy interfirm IP needs, the benefits ultimately depend on whether the adaptive decisions facilitated by such responses are properly executed by both buyers and suppliers. Buyers have to rely on their suppliers to realize anticipated benefits of reduced supply shocks. Consequently, suppliers need to develop and implement complementary resources and capabilities that allow them to respond effectively (i.e., with coordinated plans and mutual adjustments) to the buyer's informational responses. These are the supplier's relational responses, reflecting the idea that ultimately they help the buyer and supplier achieve what the RBV has termed relational rents (Dyer and Singh 1998). RBV posits that firms can create economic rents by either resource-picking or

capability-building (Makadok 2001). Such resources and capabilities have been traditionally argued to be confined within firm boundaries (Amit and Schoemaker 1993; Dierickx and Cool 1989). However, success of some interfirm collaborations reveals that external partners also can contribute to the creation of supernormal profits (relational rents, in the exchange relationships). Dyer and Singh (1998) further elaborate on the key sources of relational rents, including (1) investments in relation-specific assets, (2) joint learning resulted from substantial knowledge exchange, (3) creation of unique alliance outputs due to a combination of complementary yet scarce resources and capabilities, and (4) lower transaction costs owing to the existence of effective governance. Following the logic of RBV, this study contends that supplier's relational responses are pivotal to developing the resources and capabilities needed for fulfilling synchronized plans and mutual adaptations in response to supply chain uncertainty, thereby, creating relational rents for buyers. The relational responses in this study described below comprise mainly of (1) and (4) as the key sources of relational rents.

Supplier's Relation-Specific Business Process Investments (SRBPI). ITP&C enables buyers to coordinate business functions, like procurement, production, and transportation, with suppliers. The planning tasks are typically conducted at different levels of aggregation with varied planning intervals ranging from "aggregated long-term" to "detailed short-term" planning (Stadler 2005), generating improved supply chain actions (Cachon 2003; Corbett and de Groote 2000). The buyer's planned activities have to take the supplier's resource constraints into consideration and the supplier's operations have to align with the buyer's planning outcomes (Stadler 2009). Ideally, proper execution of such synchronized supply chain plans should reduce supply shocks and hence lead to superior buyer performance. But suppliers can seldom fully exploit these plans because the complementary resources for carrying out planned activities are either absent or insufficient (Dyer and Singh 1998; Ray et al. 2004). Such a deficiency occurs because there is a lack of *supplier's relation-specific business process investments* (SRBPI) to exploit synchronized plans, such as operating, administrative, and quality-control processes specific to the needs of a particular buyer (Subramani 2004; Subramani and Venkatraman 2003; Zaheer and Venkatraman 1994). For example, suppliers may need to invest in compatible internal planning and control systems in order to respond to the buyer's demand forecasts, production plans, and replenishment schedules more promptly (Saeed et al. 2005). They may also have to invest in supply chain process integration with the buyer so the product development, production, and logistical processes of both parties can be more interconnected and streamlined (Chen et al. 2009a; Rai et al. 2006). Also, the economic value of SRBPI will be reduced if there are no synchronized plans in place for exploiting these idiosyncratic investments (Subramani 2004). Similarly, the synchronized plans facilitated by ITP&C cannot be executed precisely if the corresponding suppliers do not invest in such business processes. As a result, the business processes improved by SRBPI are complementary resources to the buyer since these processes can facilitate the execution of the synchronized plans and create relational rents for the buyer.

Modification Flexibility (MF). While normative contracts can facilitate mutual adaptation decisions during joint problem solving, the realization of these decisions depends on whether both buyers and suppliers can flexibly carry out the needed adjustments (Hallén et al. 1991). Such flexibility is *ex post* instead of *ex ante* (i.e., actions are taken to react to problems after an unexpected event; Evans 1991). For buyers and suppliers to exercise the corrective action, their relationship has to be subject to ready modification (Evans 1991). For example, a buyer who adopts the make-to-stock strategy may face demand uncertainty in product form because of continuously changing customer tastes. This uncertainty in turn creates ongoing need for mutual adaptation between partners. If either firm is unwilling or unable to make the necessary adjustment, the buyer will experience difficulty in meeting its customers' needs (Wathne and Heide 2004). This study, therefore, examines such a recuperative capability of exchange relationship in terms of *modification flexibility*. This refers to the ability of buyers and suppliers to adjust their behaviors or the terms of the agreement in response to environmental changes or partner needs. Modification flexibility requires that buyers and suppliers (1) observe and respect the informal obligations of the relationship and (2) possess the ability to realize mutual adjustments without degrading performance (Golden and Powell 2000; Young-Ybarra and Wiersema 1999). The former indicates the need to have effective IP and governance mechanisms to inform and incentivize mutual adaptation decisions (Langlois 1992; Mesquita and Brush 2008); the latter indicates that trading partners should be well equipped to execute the needed adjustments (Gosain et al. 2004-05; Malhotra et al. 2005). Modification flexibility, thus, is essential to bring about effective joint problem solving and thereby enable continuous value creation in the partnership (Dyer and Singh 1998; Ghosh and John 1999).

Transaction Cost Theory and Relationship between Buyer's and Supplier's Responses

Both SRBPI and MF involve suppliers' relation-specific investments (Hallén et al. 1991; Williamson 1985). From the perspective of TCT, such idiosyncratic investments can result in appropriable quasi-rents, exposing suppliers to holdup risk

and possibly significant bargaining costs when mutual adaptations are needed (Klein et al. 1978). In addition, SRBPI is often intangible while bilateral efforts to achieve modification flexibility are indivisible (Alchian and Demsetz 1972). This makes the supplier's relational responses largely non-contractible *ex ante* and difficult to measure *ex post* (Barzel 1982; Cheung 1983). Consequently, suppliers may either under-invest *ex ante* or shirk *ex post*, inhibiting value creation in the relationship (Chi 1994; Ghosh and John 1999; Grossman and Hart 1986). TCT suggests that buyers and suppliers can setup effective governance mechanisms *ex ante* to reduce the cost of exchanges and ensure the contractual performance *ex post* (Alchian and Woodward 1988; Williamson 1985). In this study, we posit that the buyer's informational responses can serve as the needed safeguards for the partnership. This is because in order to integrate the information flows for supply chain coordination and adaptation (i.e., ITP&C), both buyers and suppliers have to invest in relational interaction routines (Patnayakuni et al. 2006). Also, normative contracts, developed through either long-term interactions or bilateral dependence, can reduce opportunistic actions and incentivize relational behaviors in the exchanges (Lambe et al. 2000; Lusch and Brown 1996). Thus, both informational responses can enable a mutual commitment of the trading partners, safeguarding them from the risks of *ex ante* under-investment and *ex post* under-performance (Williamson 1983, 1985).

Research Model and Hypotheses

Based on the prior discussion, we forward our basic thesis. In increasingly competitive environments, manufacturing firms compete on the basis of cost, quality, flexibility, and reliability (Hayes and Wheelwright 1984). Achieving such manufacturing goals depends not only on an individual firm's capabilities but also on whether the firm can successfully leverage and exploit its suppliers' resources and capabilities (Narasimhan and Jayaram 1998; Tracey et al. 2005). However, supply chain uncertainty will increase buyers' IP needs with their suppliers (Lee et al. 1997; Mendelson and Pillai 1998; Tushman and Nadler 1978). When such IP needs are not addressed through either preplanning or mutual adaptation, supply shocks could occur and hence reduce buyers' performance (Galbraith 1974; Zsidisin 2003). Therefore, there is a need for buyers to improve interfirm coordination with their suppliers in order to cope with supply chain uncertainty and enhance manufacturing performance. For example, Simatupang et al. (2002) suggest that supply chain members increase their information sharing, logistics synchronization, collective learning, and incentive alignment with their partners in order to facilitate interfirm coordination and improve supply chain performance. But their study does not offer clear theoretical reasoning as to how the proposed mechanisms can facilitate effective interfirm coordination. There is also a dearth of studies that examine how various interfirm coordination mechanisms work in handling supply chain uncertainty. This paper draws on IPV, RBV, and TCT to shed light on this issue. As per the research framework in Figure 1, we will examine how (1) enhanced interfirm IP capabilities, (2) increased complementary resources and capabilities, and (3) effective governance can facilitate effective interfirm coordination and adaptation. This can help buyers cope with supply chain uncertainty and improve performance. Below, we discuss the individual hypotheses.

Antecedents of Buyer's Manufacturing Goal Achievement

Traditionally, manufacturing firms rely on production planning and control systems to generate reliable price/delivery date quotations and achieve efficient utilization of manufacturing resources (Persona et al. 2004). These systems typically perform tasks such as material requirements planning, demand management, capacity planning, and the scheduling and sequencing of jobs. They can help reduce work in progress, minimize shop floor through times and lead times, lower stockholding cost, improve responsiveness to demand change, and improve delivery date adherence (Stevenson et al. 2005). But, the systems usually fail to take into account supplier-side variables (Kehoe and Boughton 2001), such as supplier's capacity constraints, random yield in manufacturing processes, variability in delivery lead times, and uncertain planning or product rationing factors (Zsidisin 2003). In the supply chain, moreover, suppliers are challenged by the bullwhip effect and amplified industry clock speed. The former can erroneously lead suppliers to try to fulfill inaccurate demands, whereas the latter can compress suppliers' response time for reacting to demand changes. When the suppliers cannot cope with supply chain uncertainty successfully, their performance level may fluctuate and become unreliable to buyers. These supplier dynamics inevitably generate supply shocks and thereby deteriorate the buyers' manufacturing performance (Kauffman and Mohtadi 2004).

ITP&C can resolve this problem by allowing buyers to access and make use of the supplier-side information more easily and efficiently. Through SCM-oriented IOISs and Internet applications (e.g., SAP's mySAP.com), buyers can incorporate supplier's demand, procurement, production, and transportation plans into their own planning and control systems on a real-time basis (Buxmann et al. 2004). Such systems, for example SAP's Advanced Planner and Optimizer, can utilize

various rules and organizational/resource constraints to generate globally optimized supply chain and production plans (Stadler 2005, 2009). The buyers then can use these plans to better utilize their internal manufacturing and logistical resources. Through ITP&C, the buyers also can share with suppliers the relevant planning and control outputs to support vertical coordination and collaborative planning (e.g., CPFR) (Saeed et al. 2005; Wood 2007). The synchronized planning and control across firms then improves buyer–supplier coordination and allows buyers to acquire qualified products and services from suppliers more reliably, flexibly, and efficiently (Simatupang et al. 2002). Since ITP&C permits the buyers to improve internal resource utilization while decreasing supply shocks, it should become easier for them to achieve manufacturing goals. Therefore, this study submits that

> *Hypothesis 1: The greater the degree a buyer utilizes IT-enabled planning and control in its interactions with suppliers, the greater is its manufacturing goal achievement.*

Although ITP&C can facilitate buyers and suppliers to preplan jointly for responding to supply chain uncertainty, buyers are still unable to benefit fully from ITP&C if synchronized plans are not executed properly. It is, therefore, suggested that the corresponding business and operational activities need to be aligned in order to achieve effective interfirm coordination (Simatupang et al. 2002). In fact, supply chain processes typically pool together partners' information, physical, and financial resources and flows (Rai et al. 2006) to carry out supply chain exchanges (Ray et al. 2004). To make such interfirm processes effective, suppliers must streamline and interconnect their own operating, administrative, and quality-control processes with the common processes (Chen et al. 2009a; Gosain et al. 2004-05). This requires suppliers to make specific investments in such business processes (i.e., SRBPI) in order to synchronize their internal business and operational activities with ITP&C and enable buyer performance (Subramani 2004).

For example, suppliers may invest in administrative processes by customizing their production planning and control systems, which can generate timely available-to-promise (ATP) information for satisfying specific buyers' coordination needs (Stadler 2005). Suppliers may also invest in modifying their manufacturing, inventory replenishment, and shipping activities so as to make their production and logistical activities more responsive to the buyers' planning and control outputs (Simatupang et al. 2002). Without such SRBPI, the buyers who adopt the make-to-order (MTO) strategy will encounter severe supply shocks because their suppliers cannot respond to and fulfill their plans effectively and efficiently (Subramani 2004). In contrast, specific investments made by suppliers can create more streamlined supply chain processes, enabling buyers to leverage their suppliers' manufacturing and logistical services in response to planning and control outputs (Chen et al. 2009b; Lavie 2006). Since SRBPI can facilitate improved execution of synchronized plans and hence relieve buyers from potential supply shocks, buyers should be able to achieve a greater extent of manufacturing goals (Dyer and Singh 1998; Lavie 2006). Therefore, we propose

> *Hypothesis 2: The greater the degree of relation-specific business process investments made by a buyer's suppliers, the greater is its manufacturing goal achievement.*

Modification flexibility allows buyers and suppliers to adapt to uncertain situations or unexpected events more effectively (Galbraith 1974; Young-Ybarra and Wiersema 1999). It represents relational behaviors through which partners exploit alternative ways of adapting to events that are exceptional in the rapidly changing environment (Gosain et al. 2004-05; Lusch and Brown 1996). CPFR, for example, is an arrangement through which buyers and suppliers collaboratively develop plans, forecasts, and orders for supply chain uncertainty resolution (Cassivi 2006). The process starts by structuring a (formal or informal) front-end agreement between the partners, outlining the requirements, objectives and collaborative programs with key supply chain metrics. Then, the partners share information with each other in order to develop synchronized plans, forecasts, and orders. Once an unexpected event arises in the course of supply chain execution, the partners have to identify and resolve the exception jointly. The modified, mutually agreed plans, forecasts, and orders in turn allow them to adjust their production planning and control accordingly, facilitating better exploitation of overall production and logistical resources. The effective mutual adjustment allowed by modification flexibility thereby permits the partners to respond to unforeseen supply chain contingencies and to cocreate value continuously (Galbraith 1974; Heide 1994; Heide and John 1992).

Modification flexibility also allows partners to coevolve the lineup of their joint assets, capabilities, and knowledge they can assemble or reconfigure (Eisenhardt and Brown 1999; Helfat and Raubitschek 2000), making iterative loops of reconnaissance, improvisation, and rapid reaction easy (Eisenhardt and Galunic 2000; Lengnick-Hall and Wolff 1999). The partners can acquire, assimilate, accumulate, transform, and exploit collaborative know-how over time (Simonin 1997; Zahra and George 2002). With such relational learning, buyers and suppliers become more knowledgeable about each other's needs and wants. This facilitates

joint problem solving and mutual adaptation (Selnes and Sallis 2003) and enhances the ability of the buyers (and suppliers) to handle unforeseen contingencies and achieve higher performance. Therefore, we propose

Hypothesis 3: The greater the degree of modification flexibility between a buyer and its suppliers, the greater is its manufacturing goal achievement.

Relating Buyer's Informational Responses to Supplier's Relation-Specific Business Process Investments

As discussed above, SRBPI can enable suppliers to fulfill buyers' requirements (i.e., plans) based on more integrated supply chain processes. But, the extent to which such SRBPI would be made and will be useful hinges on the degree of process interdependence between the suppliers and their buyers. Process interdependence will increase when buyers utilize IOISs and Internet applications to share information, coordinate plans, and track transaction status with their suppliers (i.e. ITP&C) (Thompson 1967). For example, buyers may request production plans and capacity status from their suppliers and then have their scheduled delivery plans or actual shop floor orders released to the suppliers (Shah et al. 2002). Meanwhile, suppliers can perform specified supply chain activities for the buyers by conforming to the plans shared through ITP&C (Saeed et al. 2005; Wood 2007). With the advanced interfirm IP capacity, ITP&C can further allow buyers to transmit detailed, time-specific supply chain plans to suppliers for tighter integration (Choudhury and Sampler 1997). Thus, the extent of process interdependence between the partners increases as a result of the more frequent reciprocal interactions enabled by ITP&C.

Of course, increased interfirm interdependence requires a better alignment of the internal operations of both buyers and suppliers with the mechanism of ITP&C (Simatupang et al. 2002). Without this, the partners cannot utilize the shared information supported by ITP&C, jeopardizing both parties' performance. For instance, lack of integration of suppliers' internal systems and processes with ITP&C may create significant coordination and operation costs when suppliers attempt to synchronize internal activities in response to buyers' requests (Gosain et al. 2004-05). Similar detrimental effects will arise if buyers fail to integrate their workflow and enterprise application with ITP&C for accessing and utilizing suppliers' information (Kobayashi et al. 2003; Saeed et al. 2005). Thus, this study maintains that the greater the extent a buyer utilizes ITP&C to coordinate with its suppliers, the greater the extent the suppliers (and the buyer) will invest in relation-specific business processes for more effective interfirm coordination. Of course, according to TCT, suppliers might be exposed to the hold up risk when making such SRBPI (Klein et al. 1978; Williamson 1985). This concern, however, should be safeguarded by the credible commitment (hostage) exhibited by the buyer's reciprocal, IT-related specific investments in implementing ITP&C (Anderson and Weitz 1992; Williamson 1983). As a result, we submit the following hypothesis:

Hypothesis 4: The greater the degree a buyer utilizes IT-enabled planning and control in its interactions with suppliers, the greater are its suppliers' relation-specific business process investments.

Even though ITP&C has the capacity to safeguard the holdup risk associated with SRBPI, suppliers may still under-invest *ex ante* or shirk *ex post* (Alchian and Demsetz 1972; Chi 1994; Grossman and Hart 1986). Such hazards emerge from the intangibility of SRBPI because business process improvement is hard to quantify and, hence, measure (Barzel 1982; Cheung 1983). SRBPI are costly to be specified in formal contracts *ex ante* and difficult to be verified and enforced *ex post* (Godfrey and Hill 1995). Therefore, scholars increasingly emphasize the use of relational governance to complement formal contracts to avoid the potential costs of renegotiation and haggling (e.g., Dyer and Singh 1998; Poppo and Zenger 2002; Williamson 1985). Normative contracts offer such relational governance and are represented by the set of mutual expectation and understanding between exchange partners (Baker et al. 2002; Macneil 1978). They can affect how trading partners interact with each other when dealing with unexpected events (Brown et al. 2006; Lusch and Brown 1996). Hence, trading partners bonded by normative contracts tend to follow certain patterns of behavior and agreed-upon values guided by the shared norms, such as overlapping roles, joint planning, mutual adjustments, self-control, long-term orientation, and mutuality of interests (Heide 1994; Heide and John 1992; Heide and Miner 1992; Williamson 1985). From the supplier's perspective, the long-term orientation of normative contracts implies that future gains would be shared out by its buyer once the supplier makes sufficient relation-specific investments (Heide and Miner 1992), the norms of self-control could restrain the supplier from opportunistically shirking (Klein and Leffler 1981), and the norms of mutuality can ensure that the buyer would indeed share the benefits with the supplier fairly in return for the SRBPI (Ring and Van de Ven 1994). As such, normative contracts can serve as the informal self-enforcing agreements for reducing supplier's incentive to under-invest or shirk and thus induce the needed SRBPI (Dyer and Singh

1998; Lusch and Brown 1996; Telser 1980). Therefore, we submit that a buyer can rely on the capacity of normative contracts to encourage its suppliers to make greater SRBPI.

Hypothesis 5: The greater the degree a buyer utilizes normative contracts in its interactions with suppliers, the greater are its suppliers' relation-specific business process investments.

Relating Buyer's Informational Responses to Modification Flexibility

As argued earlier, mutual adaptation is more effective than preplanning for buyers and suppliers to cope with the supply chain uncertainty characterized by fast-paced environmental change. However, performing mutual adaptation could involve negotiation costs, particularly if the parties lack common understanding and incentives for collaboration (Artz and Brush 2000). A lack of common understanding implies that buyers and suppliers could hold divergent views on how to deal with unexpected events. Thus, they have to spend more effort on persuading and teaching each other in order to reach a mutually acceptable resolution (Langlois 1992). Normative contracts can reduce such negotiation costs due to their underlying set of mutual expectations and understanding for interaction (Brown et al. 2006; Lusch and Brown 1996). The contracts can serve as a common frame of reference, informing parties about the agreed-upon values of their exchange relationship and the expected behaviors for mutual adaptation (Artz and Brush 2000; Baker et al. 2002; Huber 1991). Buyers and suppliers can then find it easier to make sense of the unexpected events and make a collective judgment on the needed adaptations (Weick 1995). For example, common understanding of overlapping roles, joint planning, and expected behaviors signal to the parties that mutual adaptation is a joint responsibility and requires proactive participation (Heide 1994; Lusch and Brown 1996). Second, similar to SRBPI, modification flexibility is non-contractible and thus subject to the hazards of underinvestment and shirking (Alchian and Demsetz 1972; Chi 1994; Grossman and Hart 1986). As indicated earlier, normative contracts can serve as the informal self-enforcing mechanism to bring out the needed flexible actions from the partners (Dyer and Singh 1998; Telser 1980). Consequently, the norms of long-term orientation motivate the parties to forgo present rewards with the expectation of long-run equity (Heide and Miner 1992), the norms of mutual adjustment result in more flexible exchange behaviors when adaptations are needed (Heide and John 1992), and the norms of self-control reduce the concerns of hold up potential (Klein and Leffler 1981). Because normative contracts provide the framework for buyers and suppliers to modify agreements and adjust behaviors more easily, the partners governed by such contracts should exhibit greater modification flexibility when mutual adaptation is needed (Young-Ybarra and Wiersema 1999). Therefore, we propose

Hypothesis 6: The greater the degree a buyer utilizes normative contracts in its interactions with suppliers, the greater is their modification flexibility.

Although normative contracts can facilitate joint problem solving, renegotiating and executing mutually acceptable adaptations can still be hindered by coordination and bargaining costs. First, the speed and efficiency of performing adaptive activities are pivotal to the success of a supply chain characterized by fast-paced changes (Gunasekaran 2008). Hence, there is a need for buyers and suppliers to streamline informational flows and interconnected processes in order to reduce coordination efforts involved in executing the needed adaptations (Gosain et al. 2004-05). Suppliers' relation-specific business process investments can contribute to institutionalizing such mechanisms for structuring coordination. With more streamlined supply chain processes, buyers and suppliers can sense, respond to, and perform the needed actions more efficiently. Consequently, coordination costs involved with mutual adaptation will be reduced, making the modification of exchange activities easier.

Second, TCT suggests that asset specificity can inhibit buyers and suppliers from modifying their agreements due to bargaining costs (Young-Ybarra and Wiersema 1999). Bargaining costs arise because the non-invested party could threaten to terminate the relationship in order to appropriate the quasi-rents (Klein et al. 1978). This assertion, however, only applies to investments that are transaction-specific rather than relation-specific (Madhok and Tallman 1998; Vivek et al. 2008). This is because the opportunistic behavior of holding up the invested party in the former case would not hurt the non-invested party's interests. In this study, however, SRBPI belong to the latter category and are complementary to buyers' use of ITP&C. They enlarge the buyers' pool of process resources shared with the suppliers (Lavie 2006). Thus, the buyers would have less incentive to hold up such suppliers since this would dissipate any relational rents they could obtain (Dyer and Singh 1998; Foss and Foss 2005). Further, the supplier's relation-specific investments can transform an exchange relationship from the situation of a large numbers bidding competition into one of bilateral dependence (Williamson 1985). Such fundamental transformation effect can induce the buyers to make the needed adaptations rather than switch to alternative exchange relationships, because it

is not easy for buyers to induce other suppliers to make the same specialized investments. The suppliers similarly are likely to make adjustments for preventing their SRBPI from becoming obsolete. Accordingly, SRBPI also serves as the self-enforcing safeguard that can motivate both buyers and suppliers to modify previous agreements when needed (Dyer and Singh 1998). Since supplier's relation-specific business process investments can reduce the coordination and bargaining costs involved with mutual adaptation, both buyers and suppliers thus should be more willing to modify their agreements and activities in response to unexpected events. Therefore, we propose

Hypothesis 7: The greater the degree of relation-specific business process investments made by a buyer's suppliers, the greater is their modification flexibility.

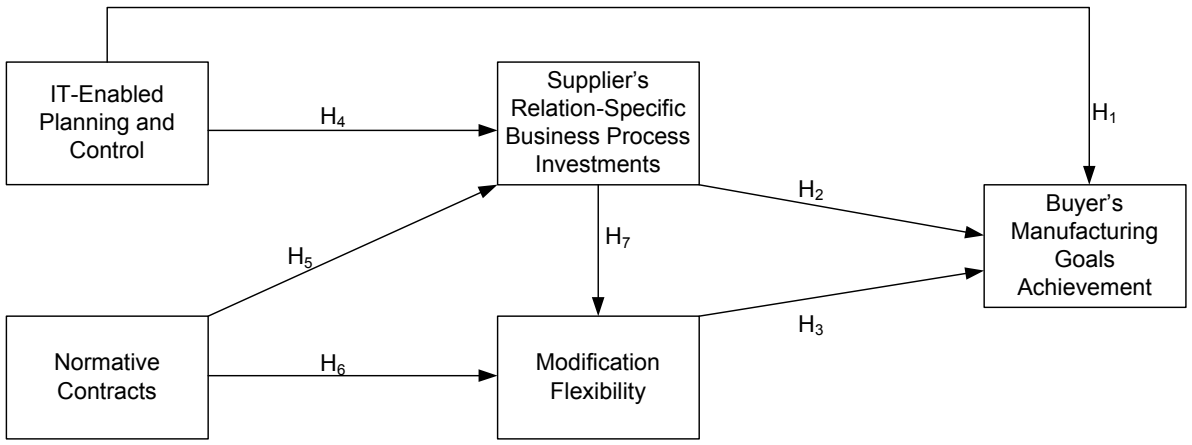
While normative contracts are argued to have a positive effect on modification flexibility, this study contends that buyer's use of IT-enabled planning and control (ITP&C) would not directly influence modification flexibility without first motivating suppliers to make the corresponding relation-specific business process investments. Modification flexibility indicates that buyers and suppliers respond to unexpected events by modifying previous agreements and behaviors. Although the partners need a supportive interfirm IP capability to resolve exceptions, the advanced information processing and communication capacity that ITP&C offers only plays a limited role in this (Tushman and Nadler 1978). ITP&C can pave the way for buyers and suppliers to react rapidly and efficiently in response to unexpected events (Gosain et al. 2004-05). As argued earlier, buyers' use of ITP&C increases interfirm process interdependence that can motivate suppliers to make SRBPI in order to better respond to and fulfill the buyers' more demanding requests. SRBPI facilitates suppliers to streamline and interconnect their operating, administrative, and quality-control process with the mechanisms of ITP&C. The more integrated supply chain processes then can benefit from the execution of mutual adaption decisions. This allows buyers and suppliers to reconfigure supply chain activities without incurring significant coordination costs. Consequently, we argue that ITP&C can improve modification flexibility, not because of its advanced interfirm IP capacity, but because it facilitates the development of more integrated interfirm processes that can streamline the execution of modified supply chain activities (Gosain et al. 2004-05; Rai et al. 2006). As such, we submit that IT-P&C can generate a positive, indirect effect on modification flexibility through the leverage of SRBPI.

Hypothesis 8: The greater the degree a buyer utilizes IT-enabled planning and control in its interactions with suppliers, the greater is the modification flexibility achieved through the leverage of its suppliers' relation-specific business process investments.

In contrast to ITP&C, normative contracts do not have a direct effect on buyer's manufacturing goal achievement in our model. Normative contracts are purposely crafted implicit, incomplete contracts that offer informal, general, and percept-like definitions of proper behaviors (Lusch and Brown 1996). Even though normative contracts can set the norms of decision making and behavior between partners, such norms would not benefit the partnership without first encouraging proper cooperative behaviors and developing integrated interfirm processes. When serving as a common frame of reference for making sense of uncertain or unexpected events, normative contracts help partners agree on the required mutual adaptations for dealing with the events. The norms of cooperative behavior then benefit the actual practice of the adaptations (i.e., modification flexibility). Thus, the presence of modification flexibility facilitates the conversion of the modified agreements into realized adjustments that impact buyer performance positively. This implies that normative contracts can generate a positive, indirect effect on BMGA by leveraging modification flexibility (H9b). Further, normative contracts can also play the role of the incentive mechanism for inducing SRBPI. As argued earlier, SRBPI is essential for partners to achieve seamless internal and interfirm process integration. Such integration can facilitate the partner's ability to communicate and execute the preplanned as well as modified supply chain activities in response to supply chain uncertainty. This beneficial effect of the normative contract through the leveraging of SRBPI should, therefore, have a positive impact on the performance of the buyer (H9a). We conclude by proposing that the influence of normative contracts on BMGA is mediated through modification flexibility and specific investments.

Hypothesis 9a: The greater the degree a buyer utilizes normative contracts in its interactions with suppliers, the greater is its manufacturing goal achievement through the leverage of its suppliers' relation-specific business process investments.

Hypothesis 9b: The greater the degree a buyer utilizes normative contracts in its interactions with suppliers, the greater is its manufacturing goal achievement through the leverage of their modification flexibility.



Note 1: Mediation effects:
H_8: IT-enabled planning and control → Supplier's relation-specific business process investments → Modification flexibility
H_{9a}: Normative contracts → Supplier's relation-specific business process investments → Buyer's manufacturing goal achievement
H_{9b}: Normative contracts → Modification flexibility → Buyer's manufacturing goal achievement
Note 2: Control variables: Environment uncertainty, Buyer power, log (Buyer's firm size)
Note 3: The controlled relationships are
Environmental uncertainty → Supplier's relation-specific business process investments
Environmental uncertainty → Modification flexibility
Environmental uncertainty → Buyer's manufacturing goal achievement
Buyer power → Supplier's relation-specific business process investments
Buyer power → Modification flexibility
Size → Buyer's manufacturing goal achievement
Note 4: The signs of all of the hypotheses are positive

Figure 2. Research Model

Control Variables

We specified environmental uncertainty, buyer power, and buyer's firm size as control variables for controlling possible spurious effects in the research model. Environmental uncertainty is the major source of interfirm coordination problems and has resulted in the requirements of various supply chain coordination efforts (Lee et al. 2000). Hence, it was specified as a control variable for buyer's manufacturing goal achievement, supplier's relation-specific business process investments, and modification flexibility. Buyer power was also specified as the other control variable for supplier's relation-specific business process investments and modification flexibility since it has been suggested as an important factor influencing interfirm coordination efforts (e.g., Hart and Saunders 1998). Finally, buyer's firm size was specified as the third control variable for buyer's manufacturing goal achievement, since large firms usually have greater resources to improve their manufacturing goals. Drawing on the nine hypotheses and the specification of the control variables, the research model is depicted in Figure 2.

Methodology

Survey Procedure

A cross-sectional mail survey was administrated to collect data from randomly selected large and medium-sized manufacturing firms in Taiwan. A draft survey was developed mainly based on measures identified in the literature. After compiling the English version of the questionnaire, the draft survey items were first translated into Chinese by a bilingual research associate and then verified and refined for translation accuracy by one MIS professor and two senior doctoral students. The Chinese version of the draft was then pre-tested by two senior IS managers and two senior purchasing

managers for face and content validity, resulting in wording modifications of several survey items. The final version of the survey was distributed in 2005 to the senior purchasing managers of 980 manufacturing firms randomly selected[2] from the directory *Top 5000 Largest Firms in Taiwan* published by China Credit Information Services, Ltd. The purchasing managers were asked for their perceptions of their firm's relationship with a major supplier. Given the close working relationship between the responding firms and their major supplier, the senior purchasing manager should be sufficiently knowledgeable to answer the survey questions (Lusch and Brown 1996).

Sample

After one follow-up mailing, 154 surveys were returned, with 144 usable for subsequent analysis, yielding an effective response rate of 14.7 percent. Although the response rate is not high and lower than expected, it is still acceptable and comparable to other studies in supply chain management (cf. Stock et al. 2000). The characteristics of the responding firms are depicted in Table 1. Among the responding firms, 86.1 percent have assets of greater than NT 1.2 billion, and around 51 percent have over 500 employees. In terms of industry distribution, the automobile, chemical, machine and tool, metal, textile, paper-making, food, and other categories each accounts for 1 to 9 percent of the responding firms, which is close to the industry distribution profile of our sampled firms. However, the computer and electronics industry category accounts for 55.2 percent of the responding firms, which is significantly greater than the proportion it accounts for in our sampled firms (37.2%). This may be due to the fact that the Taiwanese government has initiated a series of large-scale IT-enabled SCI sponsoring projects, such as Plans A and B, specifically for local computer and electronics firms since 1999 (Chen 2002), Hence, these firms tended to respond to our survey more actively, introducing potential bias to the resulting samples. Overall, the above analysis indicates that the results of subsequent analyses may be generalizable to medium to large-sized manufacturing firms in Taiwan, but it should be noted that our results appear to reflect more computer and electronics firms.

To further check the representativeness of the responding firms, we conducted two statistical analyses to check the problem of nonresponse bias (Armstrong and Overton 1977). First, we compared the responding and non-responding firms in terms of company assets and number of employees. Moderately significant differences between the two groups were found based on the independent sample t test ($p = 0.003$ and 0.007, respectively), indicating that the responding firms are greater in the mean value of the two characteristics than the nonresponding firms. Second, the respondents were further divided into two halves based on the dates of return. The comparisons on company assets and employee numbers of the two groups showed no significant differences based on the results of the χ^2 test ($p = 0.556$ and 0.558, respectively). Although the first test showed that there is moderate non-response bias in our sample, it still seems to be reasonable since this study is based on buyer's perspective. The fact may also reflect that, unlike smaller firms, large firms are more technologically competent and resourceful in using IOIS or Internet applications for improving interfirm IP capabilities and thereby are more willing to respond to our survey (Kauffman and Mohtadi 2004).

Measures

IT-Enabled Planning and Control (ITP&C). Prior studies suggest that IT can support information sharing, resource planning, operations and process management, and joint decision-making in the manufacturing or supply chain context (Rai et al. 2006; Saeed et al. 2005). Consistently, this study captured the concept of IT-enabled planning and control by examining the focal buyer's use of IOIS or Internet applications for coordinating market information, order tracking, production capacity, inventory level, logistics activities, conflict resolution, quality control, and material/component design with its major supplier. Measurement items were selectively adapted from Frohlich and Westbrook (2001) and Narasimhan and Kim (2001), creating a formative scale for the construct.

[2]Taiwan's Ministry of Economic Affairs (MOEA) began its *e-Manufacturing industry promotion project* in 1999, and the automobile, chemical, computer & electronics, machine & tool, metal, textile, food, and paper industries were selected as the targets for the project. These eight industries were regarded as an appropriate target population for this study as the project reported that over 6,400 firms had begun implementing various forms of SCI initiatives. Because the participating firms of the project were medium to large in size and the eight industries account for over 90% of the 2,724 manufacturing firms listed in the directory *Top 5000 Largest Firms in Taiwan*, the list was considered an appropriate sampling frame for this study. Given that the sampling error, confidence level, and degree of variability were set to 5%, 95%, and 0.8, respectively, this study applied the formula ($n = Z^2pg/e^2$), where n is the sample size, Z is the abscissa of the normal curve that cuts off an area α at the tail, e is the desired level of precision, and p is the estimated proportion of firms that have adopted SCI, and q=1-p, and determined the least necessary sample size to be 245 (Cochran 1963). After applying the finite population correction procedure, the least necessary sample size was adjusted to 224. Based on our past experience of 15% to 25% response rate for conducting a survey in Taiwan, this study finally drew 980 firms, by means of simple random sampling procedure, from the listed 2,724 manufacturing firms for survey distribution.

Table 2. Demographic Characteristics of the Responding Firms (n = 144)

Sample Statistics	Percentage of Firms*
Industry	
Automobile	7.6 (5.2)
Chemical	5.5 (12.7)
Computer & Electronics	55.2 (37.2)
Machine & Tool	6.2 (10.1)
Metal	8.3 (11.6)
Total Assets (NT$)	
Less than $0.8 Billion	1.4
$0.8 – $1.2 Billion	12.5
$1.3 – $2 Billion	20.3
$2.1 – $4 Billion	30.0
$4.1 – $8 Billion	12.4
Over $8 Billion	23.4
Number of Employees	
Less than 100	4.2
101 – 500	44.8
501 – 1000	17.2
1001 – 3000	25.7
Over 3000	8.1

*The number shown in parentheses is the proportion of firms that belong to a specific industry in our sampled firms.

Normative Contracts (NC). This measure assessed the extent to which normative contracts are utilized for coordinating the focal buyer's relationship with its major supplier (Lusch and Brown 1996). We used the term *mutual understanding* in the survey items to capture the frame of reference that the parties relied upon for guiding their relational behaviors. Accordingly, the construct was assessed in terms of the mutual understandings in the aspects of role specification, planning and adjustment processes, monitoring procedures, and incentive systems for coordinating the relationship (Heide 1994). Measurement items were adapted from Lusch and Brown (1996) and Heide (1994), establishing a formative scale for the construct.

Supplier's Relation-Specific Business Process Investments (SRBPI). Supplier's relation-specific business process investments was measured by assessing the reciprocal investments made by the focal buyer's major supplier in the aspects of operating procedures (e.g., production processes), administrative procedures (e.g., trading processes) and business process reengineering in the relationship (Subramani 2004; Subramani and Venkatraman 2003). Although these are intangible investments and are usually unobservable by third parties (e.g., the court), Zaheer and Venkatraman (1994) suggested that such investments still can be perceived by the buyer due to their reciprocal nature. Thus, we focused on assessing the focal buyer's perception of the extent of realized reciprocal investments made by its major supplier for the relationship. Five items were then selectively adapted from Artz and Brush (2000), Buvik and Grønhaug (2000), Buvik and John (2000), and Subramani (2004), developing a formative scale for supplier's relation-specific business process investments.

Modification Flexibility (MF). As per Young-Ybarra and Wiersema (1999), modification flexibility was operationalized as the ability of buyers and suppliers to adjust and modify their agreements or behaviors as needed. This study aimed at assessing realized relational behaviors rather than flexibility norms (Lusch and Brown 1996). Therefore, we asked the respondents to rate their degree of agreement regarding the accuracy of the statements about the interaction behaviors in the exchange relationship of their firm and major supplier. Consequently, six items measuring exchange partners' flexible behavior to different contingencies or adjustment requirements were identified, forming a reflective scale for the construct (Young-Ybarra and Wiersema 1999).

Buyer's Manufacturing Goal Achievement (BMGA). Buyer's manufacturing goal achievement was evaluated in

terms of the four competitive manufacturing priorities achieved by the buyer, including quality, dependability, cost, and manufacturing flexibility.[3] The achievement of the four competitive priorities was assessed in light of the improvement in each aspect of buyer's manufacturing performance after launching and operation of the IOIS and Internet applications. Fourteen items adapted from Narasimhan and Jayaram (1998) were utilized to assess the four dimensions, creating a formative scale for the construct.

Control Variables. Environmental uncertainty was operationalized as unpredictability of a buyer's demand to its supplier in the aspects of purchasing volume, product specifications or features, and service support. A formative scale adapted from Artz and Brush (2000) was used for this study. Buyer power captures a buyer's dominance relative to its major supplier for the former offers valued resources to the latter. It was operationalized as (1) whether a supplier depends on its buyer for offering product specification and design as well as market information, and (2) the availability of alternative buyers that can supply these resources (Boyle and Dwyer 1995). Firm size of the buyer was measured in terms of the natural logarithm value of buyer's revenue.

Results

Our analysis focused on measurement validation and hypothesis testing. Validation efforts assessed the absence of common method bias and the reliability and validity of the measures, while hypothesis testing analyzed the proffered hypotheses. Structural equation modeling with partial least squares (PLS) was used to perform a simultaneous evaluation of both measurement quality (measurement model) and construct interrelationship (structural model). PLS provides the ability to model latent constructs even under conditions of non-normality and small- to medium-size samples (Chin 1998a). By using ordinary least squares as the estimation technique, PLS performs an iterative set of factor analyses and a bootstrap procedure to estimate the significance of the paths. In this study, we used PLS-Graph Version 3.00 to evaluate the measurement properties and test hypotheses (Chin 1994).

Common Method Bias

We adopted a single-informant approach to collect survey data and therefore the possibility of common method bias should be assessed (Podsakoff et al. 2003). Harman's single factor test was employed to examine whether a significant amount of common variance exists in the data (Podsakoff et al. 2003). All the construct items were cast into principal components factor analysis. The result yielded 10 factors with eigenvalues greater than 1.0, which accounted for 75.4 percent of the total variance. The first factor captured only 27.6 percent of the variance in the data. These results indicated the absence of a substantial amount of common method variance in the data. Consequently, common method bias should not be a serious problem in the study.

Measurement Model

Item reliability, convergent validity, and discriminant validity serve to evaluate measurement properties in PLS. Individual item reliability can be examined by observing the item-to-construct loadings. A factor loading of 0.707 and above indicates 50 percent or more of the variance in the item is shared with the latent construct, while a factor loading less than 0.5 should be dropped (Hulland 1999). In Appendix A, all of the factor loadings are greater than 0.715 and exhibit an acceptable quality of item reliability.

Convergent validity can be examined in terms of reliability of constructs, composite reliability of constructs, and average variance extracted (AVE) by constructs (Fornell and Larcker 1981). Cronbach's alpha can be utilized for assessing construct reliability, which measures homogeneity of items in a construct based on the assumption that each item in the scale contributes equally to the latent construct. Composite reliability of constructs uses item loadings estimated in the measurement model to compute the measure of internal consistency (Werts et al. 1974). Both measurement properties are interpreted as acceptable with a score of 0.70 or above (Nunnally 1978). AVE reflects the variance captured by indicators. A score of 0.5 or above is desirable, meaning that the variance captured by indicators is greater than the measurement errors. In Appendix A, the values of Cronbach's alpha,

[3]The OM literature indicates that manufacturing flexibility is a multidimensional construct, whose dimensions may include *temporal* and *range* and its operationalized metrics covers *efficiency*, *responsiveness*, *versatility*, and *robustness* (e.g., Golden and Powell 2000). Considering the space limitation of questionnaires and little added value to operationalize manufacturing flexibility with the above approach, this study made a tradeoff by adapting Narasimhan and Jayaram's (1998) simplified scale and letting the respondents interpret the meaning of flexibility. This study, nevertheless, made sure that the wording for measuring the three types (i.e., process, volume, mix) of manufacturing flexibility are conceptually distinct. We also tested the structural model by using the reduced version of buyer's manufacturing goal achievement (by dropping the three manufacturing flexibility items) and found that the pattern of the structural relationships held against that of using the original scale. Therefore, it should not pose severe problems to our research results that we operationalized manufacturing flexibility with a simpler scale.

Table 3. Descriptive Statistics and Correlation Coefficients of the Research Constructs

Variable	Mean	S.D.	1	2	3	4	5	6	7
1. ITP&C	3.182	.999							
2. NC	3.870	.597	.264**						
3. SRBPI	3.305	.902	.372**	.268**					
4. MF	3.829	.543	.224**	.547**	.347**				
5. BMGA	3.714	.527	.300**	.251**	.343**	.357**			
6. EU	2.317	.855	-.054	-.088	.135*	-.175*	-.038		
7. BP	3.467	.729	.332**	.253**	.480**	.341**	.227**	.050	
8. SIZE	3.664	1.256	.099	.076	.001	.078	.092	-.183*	.108

Notes: **p < 0.001, *p < 0.05, two-tail test
ITP&C: IT-enabled planning and control, NC: Normative contracts,
SRBPI: Supplier's relation-specific business process investments, MF: Modification flexibility,
BMGA: Buyer's Manufacturing Goal Achievement, EU: Environmental uncertainty,
BP: Buyer power, SIZE: ln(Buyer's revenue)

composite reliability, and AVE indicate that, except for buyer power, all other constructs meet the tests of convergent validity. Moreover, it should be emphasized that for a formative construct like buyer power, it is not necessary to satisfy convergent validity since the indicators are considered to "form" as opposed to "reflect" a construct and, thus, need not covary or be interchangeable with each other[4] (Jarvis et al. 2003).

Discriminant validity can be assessed by observing the factor loading of indicators to verify whether the measures of constructs are different from each other (Chin 1998b). Since PLS-Graph does not provide cross-loading information on other constructs, we used the procedure suggested by Gefen and Straub (2005) to generate cross-loading values. Discriminant validity is assured when (1) each item's correlation with its own construct is greater than its cross-correlation with other constructs, (2) the value of the square root of the AVE of each construct is larger than the correlations of this construct to all other constructs, and (3) correlation between pairs of constructs is below 0.9. Appendix B shows each item's correlation with its own construct (factor loading) and its correlations with other constructs (cross-loadings), and Table 3 depicts the descriptive statistics and correlation matrix of the research constructs. The results demonstrate that the above conditions for discriminant validity hold.

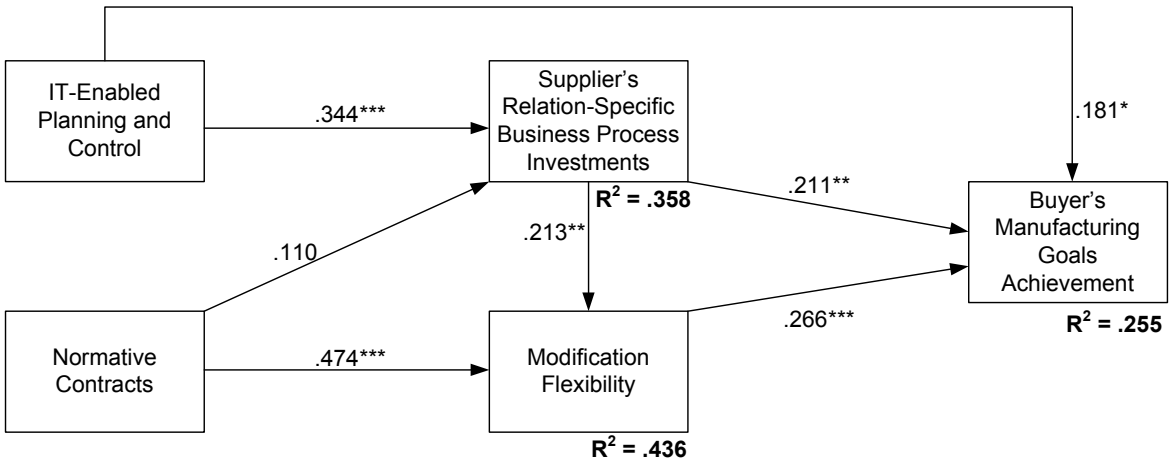
[4]As a guide to future researchers, we also tested the significance level of item weights for each construct. Except for the NC_R1, NC_I2, NC_I3, BMGA_Q4 and BMGA_D1, the other item weights were significant at p < 0.1. For the sake of maintaining content validity, these items were retained in the subsequent analyses (Petter et al. 2007).

Structural Model

Direct Effect. The proposed research model was assessed by examining the significance of paths in the structural model. With PLS, a bootstrap procedure with 500 subsamples was used to generate *t*-statistics and standard errors (Chin 1998b). Figure 3 shows the estimated path coefficients with significance level in the structural model. Except for hypotheses 5, all other path coefficients are significant, providing support for H_1 to H_4, H_6, and H_7. In addition, the *R*-square values of the three endogenous variables are larger than 25 percent, indicating that significant amounts of variance in these variables are well explained by the proposed independent and control variables.

Mediation Effect. We further used mediation analysis techniques to assess the mediation effects suggested by H_8 and H_9 (Baron and Kenny 1986). The first approach compares two sets of research models (fully mediated models) against their competing, partially mediated model (incorporating additional direct paths between ITP&C and modification flexibility as well as normative contracts and BMGA, respectively). In each set of research models, the competing models are nested and, hence, the significance of the added explanatory power of the newly introduced paths can be evaluated by (1) calculating the f^2 statistic in terms of $(R^2_{\text{partial mediation}} - R^2_{\text{full mediation}})/(1 - R^2_{\text{partial mediation}})$, and (2) computing a pseudo *F*-statistic[5] (Chin et al. 2003). Based on this procedure, the f^2 were 0.012 and 0.001 for the two

[5]The pseudo *F*-statistic is computed using the formula $f^2 \times (n–k–1)$, with 1, (n–k) degrees of freedom where n is the sample size and k is the number of constructs in the model.



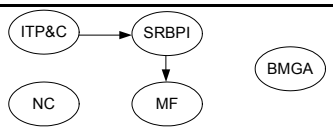
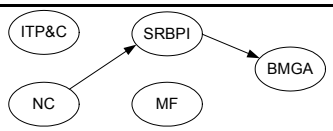
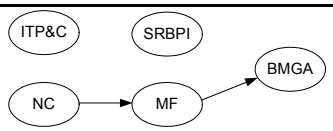
Note 1: The effects of controlled relationships

- Environmental uncertainty $\xrightarrow{-.130^{**}}$ Supplier's relation-specific business process investments
- Environmental uncertainty $\xrightarrow{-.182^{***}}$ Modification flexibility
- Environmental uncertainty $\xrightarrow{-.039}$ Buyer's manufacturing goal achievement
- Buyer power $\xrightarrow{.309^{***}}$ Supplier's relation-specific business process investments
- Buyer power $\xrightarrow{.128^{*}}$ Modification flexibility
- Size $\xrightarrow{.067}$ Buyer's manufacturing goal achievement

Note 2: *p < .1, **p < .05, ***p < .01

Figure 3. Results for PLS Analysis

Table 4. Significance of Mediated Path from ITP&C to MF and NC to BMGA

Indirect Effect	Mediated Path	Hypothesis	No.	Graphical Representation	Path	z-statistics
ITP&C → MF	ITP&C → SRBPI → MI	H_8	M_1		.073	1.697**
NC → BMGA	NC → SRBPI → BMGA	H_{9a}	M_2		.023	0.888
	NC → MF → BMGA	H_{9b}	M_3		.126	2.066**

partially mediated models, resulting in non-significant pseudo $F(1, 136)$-statistics of 1.687 and 0.135, respectively, indicating that the additional variance explained by the newly introduced direct paths did not significantly add to the explanatory power of the respective models.

The second approach assesses the two sets of mediation effect, as depicted in Table 4, by examining the magnitude and the significance level of the effect. The magnitude of mediation is computed as the product of the standardized path coefficients of the mediated path, and the standard error of the

mediated path is computed based on the standardized path coefficients and standard deviation of the direct paths among the independent, mediating, and dependent variables[6] (Hoyle and Kenny 1999). The yielded *z*-statistics shown in Table 4 indicate that two out of the three examined mediation effects are significant at $p < 0.05$.

Overall, we found support for six of the seven direct-effect hypotheses in the research model. Our results also reveal that the two mediation-effect hypotheses received moderate empirical support. These findings are discussed below.

Discussion

Contributions to the IS Literature

Past IOIS literature mainly examines how and why trading partners utilize IOIS strategically to appropriate monopoly rents from their counterparts (e.g., Bakos and Treacy 1986; Grover and Saeed 2007). It rarely examines the alternative appropriation patterns of expropriating relational rents (a notable exception is Klein and Rai 2009). However, the significant influence of supply chain uncertainty on firm competitiveness implies that enhancing interfirm IP capability becomes an increasingly important avenue for achieving bilateral value. This study focuses on this issue, and investigates whether cooperative use of IOIS (in our case, IT-enabled planning and control) and relational governance (in our case, normative contracts) can serve as useful interfirm IP solutions for improving buyer's manufacturing performance in the supply chain context.

Our research contributes to the empirical literature by providing evidence that

(1) IT-enabled planning and control (as an interfirm IP mechanism) can improve BMGA by facilitating synchronized planning across firms and exploiting buyer resources (H_1).

(2) Normative contracts (as an interfirm IP mechanism) can increase modification flexibility by improving joint decision making and problem solving (H_6).

(3) Suppliers' relation-specific business process investments and modification flexibility are suppliers' relational responses. These are essential for realizing the synchronized plans and mutual adaptation, and confer relational rents for buyers (H_2 and H_3).

(4) As governance mechanisms, IT-enabled planning and control induces supplier's relation-specific business process investments (H_4) while normative contracts are effective in bringing about modification flexibility (H_6).

(5) IT-enabled planning and control can also contribute to the realization of mutual adaptation by motivating relation-specific investments, leading to modification flexibility (H_8)

(6) Normative contracts are effective for improving buyer's manufacturing performance (only) by leveraging modification flexibility (H_{9b}).

(7) Supplier''s relation-specific business process investments set an important foundation for enabling modification flexibility (H_7).

Implications for Practice

In today's fast-paced environment, the ability to integrate, build, and reconfigure interfirm competencies in response to uncertainty is critical to the performance of all supply chain members. While concepts such as dynamic capabilities (Eisenhardt and Martin 2000; Teece 2007) and agility (Sambamurthy et al. 2003) have been advocated as viable means to attend this end, they are criticized for lack of precise definitions and viewed as difficult to assess (Overby et al. 2006; Pavlou and El Sawy 2011). This study sheds light on the issue by identifying the interfirm capability platform that partners can rely on to handle supply chain uncertainty. Such platforms are constituted by advanced interfirm IP mechanisms (i.e., IT-enabled planning and control as well as normative contracts) and complementary relational capabilities (i.e., relation-specific business process investments and modification flexibility). It is only when these capability components work together seamlessly that a coordinated and coevolved interfirm resource configuration can help resolve supply chain uncertainty. We point out several suggestions for practitioners who want to develop these capabilities for realizing relational benefits from these capabilities.

First, based on interfirm IP (and coordination) requirements, we identify two distinct approaches that trading partners can use to respond to supply chain uncertainty. Synchronized preplanning capabilities within and across firms are possible if information can be effectively exchanged. When synchronized preplanning is infeasible under accelerated industry

[6] An approximation for the standard error of the mediated path is computed using the formula square root of $p_1^2s_2^2 + p_2^2s_1^2 + s_1^2s_2^2$, where p_1 is the path coefficient of the path from independent variable to mediating variable, p_2 is the path coefficient from mediating variable to dependent variable, and s_1 and s_2 are the corresponding standard deviations.

clock speed, mutual adaptation becomes critical. Therefore, we suggest that trading partners evaluate which interfirm coordination modes are more relevant to them based on their position in the supply chain. If upstream in a long supply chain characterized by stable market demand, they can rely more on IT-based planning to coordinate supply chain activities. Alternatively, if they are closer to a more volatile end market, then they require mutual adjustment capabilities in addition to IT-based mechanisms.

Second, our findings indicate that by improving information visibility, IT can facilitate coordinated planning between trading partners and help firms successfully respond to supply chain uncertainty. However, despite IT, there still exists uncertainty regarding whether the partners can fully utilize the information and execute synchronized plans well. Our research shows that with appropriate supplier responses in their internal planning and control systems and business processes, buyers can exploit IT better. Thus, IT, internal or interfirm, is indeed useful for supply chain partners to achieve greater performance, but other aspects specific to their relationship should not be overlooked. Investments specific to the relationship and helpful in generating relational rents should be encouraged and carefully governed. We, therefore, suggest that buyers who seek to overcome supply chain uncertainty by instituting IT-enabled interfirm planning and control systems should also induce greater supplier investments specific for interfirm process integration. These investments are pivotal to the realization of the anticipated benefits from better coordinated supply chain operations (Buvik and Grønhaug 2000; Buvik and John 2000).

Third, our research also indicates that normative contracts can facilitate collective sense making, making it easier for partners to respond to unexpected events more effectively. Achieving such modification flexibility hinges not only on reaching collective judgment about the adaptations but also on incentives and capabilities for executing such adjustments. Our findings suggest that IT-enabled modification flexibility, supported by supplier's specific investments, allows supply chain partners to perform mutual adjustments with reduced coordination costs. Further, both normative contracts and relation-specific investments need time, resources, and managerial attention to develop. Selecting and evaluating a more limited number of suppliers to build, maintain, and enhance a true partnership becomes critical. Of course, how to balance between the economies of the market economy and relational rent for maximizing supply chain competitiveness remains a challenging managerial task. Accordingly, we suggest that partners who have already developed normative contracts can also institute IT-enabled planning and control systems and induce supplier's specific investments in process integration to enhance the efficiency and the effectiveness of mutual adaptation. Those who have not, but have installed ITP&C systems, can work toward establishing greater "norms" in the contractual relationship, in order to be able to achieve better adaptation through modification flexibility. With such an IT supported "enhanced" exchange relationship, the partners can better adapt to unexpected events without detrimental effect (like supply shocks) from those events.[7] Lacking either of them may put the supply chain at a competitive disadvantage.

Finally, although buyers' informational responses can increase the up-front transaction costs due to their relation-specific nature, our findings suggest that they can indeed motivate and safeguard the specific investments needed for developing coordinated plans and effecting mutual adaptation. As such, once IT-enabled planning and control systems and normative contracts are institutionalized, the supply chain partners can avoid significant *ex post* transaction costs when responding to supply chain uncertainty. Therefore, for supply chain partners who seek to cope with supply chain uncertainty through virtual integration, we suggest that relation-specific IP mechanisms could be more favorable for them. The governance capacity through these mechanisms can save the additional transaction costs required for alternative incentive or safeguard mechanisms, possibly even making them self-enforcing.

Implications for Research

This study attempts to integrate IPV, RBV, and TCT into a coherent theoretical foundation to explain how and why IT and relational interfirm IP solutions can be utilized by trading

[7]Since the computer & electronic industry accounts for over 50% of our responding sample, we further replicated the structural model analysis with two split subgroups, one of which consists of purely computer & electronics firms ($n_1 = 80$) and the other composed of firms from the other industries ($n_2 = 64$). In the first subsample, two of the seven hypothesized direct effects (H_3 and H_7) were not significant; in the second subsample, one hypothesized direct effect (H_2) was not significant. The results showed that the pattern of the hypothesized influences of buyer's informational responses on supplier's relational responses were the same for both subsamples. Thus, both ITP&C and normative contracts remain the feasible self-enforcing safeguards to induce supplier's relational responses, no matter which industry they belong to. However, in addition to ITP&C, the results showed that buyers in the computer & electronics industry also rely on SRBPI to improve their manufacturing goal achievement while buyers in other industries tend to rely on modification flexibility to achieve it. Such a difference indicates that different industries tend to pursue distinct forms of relationally derived benefits of the improved interfirm IP capability. Consequently, these analyses suggest that (1) most structural relationships appearing in Figure 3 should be moderately generalizable across industries, especially the part of the influences of buyer's informational responses on supplier's relational responses, and (2) our suggestion that with improved interfirm IP capability, firms can pursue distinct types of relationally derived benefits according to their industry characteristics (e.g., the nature of uncertainty encountered) is preliminarily evidenced by the above exploratory analysis.

partners to cope with supply chain uncertainty and hence improve buyer performance. Our approach provides a nuanced look at the causal mechanisms at play, informed by an integrated view of these theories.

Our research sheds light on several aspects of the design of interfirm IP mechanisms. First, while IT-based mechanisms are powerful in improving informational visibility for coordinating joint activities, they are not a perfect means of facilitating the joint decision making and problem solving needed for mutual adaptation. The literature of IOIS largely advocates the information visibility attributes of such systems as critical. We suggest that supplementary IP mechanisms such as normative contracts can augment interfirm IP capabilities for dealing with the uncertainty that IT solutions cannot resolve fully.

Second, improved interfirm IP capabilities cannot be easily leveraged for anticipated benefits. The coordinated plans or mutual adaptation decisions facilitated by IT have to be executed well in order overcome uncertainty and hence improve performance. But this only holds rhetorically within individual organizations (e.g., Tushman and Nadler 1978). Partners may lack the complementary resources to execute plans efficiently or incentives and capabilities to modify existing agreements and activities. Therefore, we argue that additional relational investments or adaptations (e.g., supplier's relational responses) are necessary for realizing the anticipated benefits across firms. This has not been emphasized by the IPV-based IOS literature, which focuses on investigating the effect of the fit between uncertainty and IP mechanisms on performance (e.g., Bensaou and Venkatraman 1995; Premkumar et al. 2005). The mediating role of suppliers' relational responses between interfirm IP mechanisms and performance has not been examined in the RBV-based IOS literature either. The current study provides more granularity than previous research in understanding how interfirm IP mechanisms, accompanied with complementary resources and capabilities, can cope with supply chain uncertainty to yield superior performance.

Third, our results show the significant, positive effect of normative contracts on buyers' manufacturing goals achieved, enabled by modification flexibility. In fact, normative contracts appear to be the most important driver of modification flexibility. While it is surprising that normative contracts lack a significant effect on relation-specific investments in our mode, we cannot overlook their potential impact on other aspects of the relationship that were not included in our model. For example, in addition to modification flexibility, normative contracts may serve as the crucial foundation for trading partners to develop broader interfirm dynamic capabilities for greater supply chain competitiveness.

Finally, Last, in a world of onerous transaction costs, trading partners inevitably have to incur costs on motivating, bargaining, and haggling over the specific investments needed in developing complementary resources and capabilities. Thus, crafting effective governance mechanisms *ex ante* becomes necessary for economizing on such transaction costs *ex post* (Williamson 1996). Our research shows that relationally based IP mechanisms such as IT-enabled planning and control and normative contracts can also serve as effective formal and informal safeguards (Dyer and Singh 1998). Consequently, we contribute to the TCT-based IOS literature by showing that advanced interfirm IP mechanisms (e.g., IOISs) can mitigate *ex post* transaction costs not by reducing asset specificity of the exchange (Clemons et al. 1993) but by safeguarding the mutual commitment to the partnership (Kim and Mahoney 2006).

Conclusions

Limitations

This study has several limitations. First, we used cross-sectional data to empirically assess our theoretical model. Although the proposed research hypotheses were derived theoretically, the results still reflect associations rather than causality. Second, because we adopted a single-informant approach from a buyer's perspective, the threat of respondent bias is possible even though we have checked thoroughly and found that such an issue did not appear to be significant. Third, the measures of the research constructs are perceptual rather than objective, and thus the results of the assessment might not reflect the real world accurately due to potential informant bias and random errors. Moreover, although the measures were adapted from prior studies and subject to various examinations for ensuring their quality, further development and validation are still needed. Fourth, over half of our sample came from the computer and electronics industry. Although our further analysis found that most of the structural relationships held across this industry and the group of all other industries, the interrelationships among suppliers' relational responses and buyers' manufacturing goal achievement still appeared somewhat different. This implies that some of our findings might be industry-specific, weakening the generalizability of our results. Finally, since our data were collected exclusively in Taiwan, the empirical results reported might not fully represent the phenomenon elsewhere, especially in Western countries. The cultural factor may play a role in some of the constructs included in the model, such as normative contracts and supplier's relation-specific business process investments.

Future Research Directions

Our approach to modeling the relationships among buyers' informational responses, suppliers' relational responses, and buyer performance takes on a strong efficiency assumption of economic actors, which might oversimplify reality (Williamson 1996). It is also possible that buyers' informational responses and suppliers' relational responses are the outcome of structuration in response to various institutional pressures. For instance, suppliers have been increasingly asked to share heavier investment responsibility and exhibit greater flexibility (Sydow and Windeler 1998). Therefore, further research efforts remain needed about the reciprocal interactions of buyers' informational responses and suppliers' relational responses.

We offer the following suggestions for future research. First, institutional factors were beyond the scope of this study, in an attempt to keep the theoretical arguments consistent and the model parsimonious. However, our results for control variables indicate that both buyer power and environmental uncertainty have significant influences on suppliers' relation-specific business process investments and modification flexibility. The findings suggest that institutional and environmental factors may also provide additional explanatory power. Future research may take an institutional or a bargaining power approach to investigate this subject matter (Crook and Combs 2007).

Second, even though supply chain management has been increasingly emphasized in many industries, the extent to which type of relational benefits (i.e., vertical coordination versus collaborative adaptation) is favored should still depend on environmental demands. Therefore, future research may attempt to clarify the effects of environment and industry on firms' interfirm IP strategy for pursuing relational benefits. Besides, this study does not examine the potential influence of the result of sharing relational rents on a trading partner's incentive to make relation-specific coordination efforts. Thus, we may oversimplify reality by assuming that supply chain companies would always pursue greater relational rents without considering the appropriability regime. Future research hence is encouraged to investigate the influence of fairness issue on supply chain companies' relational behaviors in improving interfirm IP capability (Husted and Folger 2004).

In conclusion, we hope that the model offered here can be further scrutinized as part of a program of research aimed at examining IT-based and other IP-based mechanisms, and their positive and negative effects. In contemporary environments, dyadic relations in supply chains are fundamental to achieving benefits, and understanding the causal agencies at work in these relationships can help us in implementing good systems solutions.

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RESEARCH ARTICLE

EXAMINING THE RELATIONAL BENEFITS OF IMPROVED INTERFIRM INFORMATION PROCESSING CAPABILITY IN BUYER–SUPPLIER DYADS

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Appendix A

Measurement Model: Factor Loading, Cronbach's Alpha, Composite Reliability and AVE

Construct Indicators	Loading	Cronbach's Alpha	Composite Reliability	AVE
IT-enabled planning and control (the extent to which your primary supplier and your company utilize interorganizational information systems and Internet applications to)[a]		**.963**	**.969**	**.794**
(ITP&C1) Trace purchasing order	.884(40.000***)			
(ITP&C2) Exchange price and market information periodically	.856(32.853***)			
(ITP&C3) Quality control on the purchased goods	.900(40.607***)			
(ITP&C4) Cooperate on new material and component testing	.913(47.635***)			
(ITP&C5) Deal with complains and solve conflicts	.891(44.853***)			
(ITP&C6) Coordinate production plan	.911(52.775***)			
(ITP&C7) Coordinate inventory	.897(45.209***)			
(ITP&C8) Coordinate logistics	.874(31.796***)			

Construct Indicators	Loading	Cronbach's Alpha	Composite Reliability	AVE
Normative contracts (the extent to which your primary supplier and your company have mutual understanding of and utilize the following shared norms to regulate each other's trading behavior)[c]		**.929**	**.940**	**.612**
Role assignment[a]		**.947**	**.962**	**.894**
(NC_R1) Role play	.886(16.204***)			
(NC_R2) Responsibility	.981(49.915***)			
(NC_R3) Behavior	.966(31.596***)			
Adjustment[a]		**.865**	**.931**	**.872**
(NC_A1) Dealing with unexpected events	.894(10.787***)			
(NC_A2) Dealing with conflicts	.970(28.004***)			
Monitoring procedures[a]		**.786**	**.902**	**.822**
(NC_M1) Manners of performance evaluation	.937(11.916***)			
(NC_M2) SOP of Production	.874(9.078***)			
Incentive system[a]		**.954**	**.939**	**.837**
(NC_I1) Purchasing price	.867(12.286***)			
(NC_I2) Purchasing volume	.876(10.233***)			
(NC_I3) Purchasing duration	.994(43.323***)			
Supplier's relation-specific business process investments (the extent to which your primary supplier has made the following reciprocal investments to your company)[a]		**.928**	**.946**	**.780**
(SRBPI1) Adjustments of manufacturing process to fit your company's specification of technology and standard	.819(22.966***)			
(SRBPI2) Business processes reengineering to improve the performance of the trading	.885(40.787***)			
(SRBPI3) Significant time and money on training to work with your company	.903(44.476***)			
(SRBPI4) Significant time and money on product and process qualification approved by your company	.927(64.662***)			
(SRBPI5) Significant time and money on timeliness of the trading	.875(33.187***)			
Modification flexibility (the extent to which you agree the following statements about the interactions between your company and your primary supplier)[b]		**.866**	**.902**	**.605**
(MF1) Mutually adjust in response to environmental changes	.738(13.540***)			
(MF2) Flexibly deal with problems which are hard to attribute responsibility	.741(13.770***)			
(MF3) Flexibly respond to each other's requests	.834(27.031***)			
(MF4) Properly and satisfactorily resolve unexpected problems	.777(13.214***)			
(MF5) Find alternative ways instead of stick to original agreements to deal with unexpected problems	.764(15.020***)			
(MF6) Attempt to achieve compromises when conflicts arise	.807(17.089***)			
Buyer's manufacturing goal achievement (the extent of improvements in the following aspects after launching and operation of the interorganizational information systems and Internet applications)[c]		**.939**	**.946**	**.559**

Construct Indicators	Loading	Cronbach's Alpha	Composite Reliability	AVE
Quality[a]		**.897**	**.922**	**.703**
(BMGA_Q1) Product features	.778(10.561***)			
(BMGA_Q2) Product reliability	.821(10.363***)			
(BMGA_Q3) Product durability	.874(17.876***)			
(BMGA_Q4) Product performance	.859(17.603***)			
(BMGA_Q5) Conformance to the product specification	.853(13.905***)			
Dependability[a]		**.892**	**.927**	**.809**
(BMGA_D1) Speed of delivery	.876(22.235***)			
(BMGA_D2) Reliability of delivery	.922(30.205***)			
(BMGA_D3) Lead time	.899(21.296***)			
Cost[a]		**.866**	**.912**	**.776**
(BMGA_C1) Inventory costs	.776(13.354***)			
(BMGA_C2) Shortage costs	.957(43.651***)			
(BMGA_C3) Costs of defected goods	.899(24.891***)			
Manufacturing Flexibility[a]		**.920**	**.948**	**.860**
(BMGA_M1) Process flexibility	.916(20.896***)			
(BMGA_M2) Volume flexibility	.931(27.083***)			
(BMGA_M3) Mix flexibility	.933(27.400***)			
Environmental uncertainty (the extent to which the unpredictability of)[b]		**.833**	**.900**	**.750**
(EU1) the purchasing volume from your primary supplier	.845(26.238***)			
(EU2) product specification or features from your primary supplier	.890(44.852***)			
(EU3) service supports required from your primary supplier	.861(35.182***)			
Buyer power (the extent to which you agree the following statements)a		**.603**	**.791**	**.558**
(BP1) The business area that your company belongs to is an important market for your primary supplier	.715(17.175***)			
(BP2) Your primary supplier requires suggestions about product specification and design from your company	.733(17.126***)			
(BP3) Your primary supplier requires relevant market information from your company	.790(25.478***)			

Note: ***indicates significant at $p < 0.01$ level

[a]Formative measure

[b]Reflective measure

[c]Second-order construct

Appendix B

Cross-Factor Loading

Items	ITP&C	NC_R	NC_A	NC_M	NC_I	SRBPI	MF	BMGA_Q	BMGA_D	BMGA_C	BMGA_M	ENV	BP
ITP&C1	**.884****	.160	.174*	.246**	.166*	.335**	.149	.226**	.297**	.233**	.169*	.001	.274**
ITP&C2	**.856****	.134	.141	.232**	.131	.267**	.145	.229**	.318**	.252**	.167*	.011	.212**
ITP&C3	**.900****	.146	.192*	.333**	.151	.297**	.182*	.214**	.249**	.192*	.150	-.055	.267**
ITP&C4	**.913****	.153	.173*	.298**	.198*	.391**	.178*	.282**	.306**	.260**	.238**	.011	.284**
ITP&C5	**.892****	.160	.201*	.231**	.216**	.363**	.220**	.202*	.233**	.214*	.155	-.034	.315**
ITP&C6	**.912****	.154	.150	.338**	.206*	.287**	.235**	.150	.282**	.279**	.214*	-.068	.296**
ITP&C7	**.898****	.210*	.297**	.371**	.241**	.355**	.239**	.257**	.287**	.279**	.148	-.053	.346**
ITP&C8	**.874****	.242**	.268**	.373**	.288**	.361**	.277**	.168*	.252**	.188*	.149	-.075	.338**
NC_R1	.106	**.887****	.634**	.427**	.668**	.190*	.504**	.122	.125	.079	.113	-.093	.295**
NC_R2	.196*	**.982****	.722**	.537**	.662**	.206**	.509**	.140	.154	.109	.161	-.102	.244**
NC_R3	.192*	**.966****	.690**	.548**	.655**	.187**	.485**	.187*	.193*	.153	.184*	-.094	.249**
NC_A1	.125	.646**	**.895****	.500**	.515**	.129	.361**	.262**	.199*	.214*	.194*	-.041	.137
NC_A2	.258**	.705**	**.971****	.460**	.627**	.220**	.433**	.245**	.209*	.257**	.203*	-.045	.187*
NC_M1	.301**	.519**	.467**	**.938****	.459**	.211*	.345**	.154	.251**	.146	.153	-.095	.207*
NC_M2	.321**	.471**	.445**	**.875****	.432**	.344**	.394**	.186*	.240**	.202*	.283**	-.005	.307*
NC_I1	.156	.612**	.499**	.452**	**.868****	.179*	.415**	.016	.170*	.062	.223**	-.040	.088
NC_I2	.156	.642**	.496**	.439**	**.876****	.165*	.404**	.035	.139	.052	.219**	-.082	.105
NC_I3	.222**	.687**	.617**	.485**	**.994****	.247**	.506**	.131	.241**	.150	.260**	-.064	.192*
SRBPI1	.261**	.127	.120	.239**	.193*	**.820****	.250**	.251**	.270**	.185*	.278**	.095	.379**
SRBPI2	.354**	.160	.190*	.297**	.187*	**.886****	.326**	.360**	.289**	.216**	.291**	.153	.413**
SRBPI3	.318**	.216**	.187*	.255**	.252**	**.903****	.288**	.266**	.225**	.157	.198*	.136	.447**
SRBPI4	.315**	.229**	.206*	.250**	.292**	**.927****	.337**	.247**	.235**	.161	.251**	.111	.467**
SRBPI5	.396**	.168*	.176*	.250**	.192*	**.876****	.359**	.392**	.319**	.265**	.297**	.112	.394**
MF1	.133	.323**	.280**	.204*	.314**	.212*	**.739****	.212*	.229**	.211*	.184*	-.190*	.215**
MF2	.146	.329**	.213*	.223**	.413**	.257**	**.742****	.121	.174*	.130	.265**	-.119	.218**
MF3	.215**	.389**	.331**	.269**	.335**	.270**	**.835****	.269**	.295**	.222**	.329**	-.117	.270**
MF4	.280**	.409**	.471**	.422**	.433**	.378**	**.777****	.374**	.377**	.344**	.370**	-.104	.338**
MF5	.174*	.388**	.339**	.318**	.371**	.197*	**.764****	.256**	.247**	.139	.260**	-.089	.225**
MF6	.111	.569**	.374**	.427**	.526**	.332**	**.807****	.223**	.279**	.141	.202*	-.235**	.365**
BMGA_Q1	.213*	.067	.200*	.018	.055	.282**	.222**	**.779****	.569**	.492**	.388**	-.039	.257**
BMGA_Q2	.145	.185*	.217**	.215**	.142	.206*	.323**	**.822****	.588**	.510**	.433**	-.130	.201*
BMGA_Q3	.182*	.176*	.281**	.244**	.159	.304**	.281**	**.875****	.644**	.518**	.468**	-.035	.275**
BMGA_Q4	.285**	.139	.282**	.149	.123	.374**	.278**	**.860****	.628**	.494**	.481**	.001	.256**
BMGA_Q5	.216**	.107	.170*	.113	.068	.295**	.226**	**.854****	.636**	.479**	.477**	-.029	.291**
BMGA_D1	.316**	.133	.184*	.242**	.210*	.211*	.271**	.641**	**.876****	.591**	.525**	.110	.172*
BMGA_D2	.323**	.167*	.190*	.271**	.252**	.253**	.333**	.691**	**.922****	.625**	.532**	-.039	.208*
BMGA_D3	.231**	.151	.209*	.218**	.206*	.316**	.302**	.644**	**.899****	.601**	.559**	-.029	.211*
BMGA_C1	.210*	.058	.104	.193*	.136	.133	.139	.380**	.518**	**.776****	.585**	-.007	.078
BMGA_C2	.249**	.102	.255**	.162	.121	.199*	.205*	.578**	.640**	**.958****	.610**	-.042	.073
BMGA_C3	.246**	.159	.256**	.170*	.170*	.237**	.308*	.545**	.615**	**.899****	.554**	-.031	.105
BMGA_M1	.190*	.130	.172*	.220**	.219**	.285**	.370**	.470**	.539**	.625**	**.917****	-.043	.126
BMGA_M2	.131	.164	.225**	.184*	.278**	.275**	.311**	.492**	.550**	.618**	**.932****	-.067	.094
BMGA_M3	.204*	.181*	.200*	.219**	.247**	.268**	.277**	.536**	.573**	.544**	**.933****	-.038	.128
EU1	-.159	-.063	-.116	-.093	-.108	.078	-.071	-.020	-.000	.018	-.024	**.679****	.102

Items	ITP&C	NC_R	NC_A	NC_M	NC_I	SRBPI	MF	BMGA_Q	BMGA_D	BMGA_C	BMGA_M	ENV	BP
EU2	.062	-.104	.007	.028	-.031	.161*	-.179*	-.024	.042	-.003	.025	**.891****	.035
EU3	-.023	-.077	-.021	-.101	-.007	.088	-.181	-.089	-.089	-.096	-.126	**.842****	-.038
BP1	.108	.311**	.275**	.197*	.214**	.255**	.328**	.247*	.211*	.002	.079	-.114	**.716****
BP2	.294**	.111	.005	.276**	.057	.446**	.172*	.138	.061	.007	.068	.148	**.734****
BP3	.331**	.164*	.121	.138	.156	.366**	.286**	.303**	.234**	.201*	.139	.045	**.790****

Notes: **p < 0.001; *p < 0.05, two-tail test
ITP&C: IT-enabled planning and control
NC_R: Role assignment
NC_A: Adjustment
NC_M: Monitoring procedures
NC_I: Incentive system
SRBPI: Supplier's relation-specific business process investments
MF: Modification flexibility
BMGA_Q: Quality
BMGA_D: Delivery
BMGA_C: Cost
BMGA_M: Manufacturing flexibility,
EU: Environmental uncertainty
BP: Buyer power