SUPPLIER-SUPPLIER INTERACTIONS AND THEIR EFFECTS ON SUPPLY

PERFORMANCE: AN EMPIRICAL STUDY

by

Zhaohui Wu

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ABSTRACT

Many researchers have investigated the dynamics of buyer-supplier relationships and have considered their impacts on the suppliers' supply performance. Supply performance is defined as the manifested capability and operations outcome of supplying a buyer. Recently, researchers have proposed that the relationships between suppliers also affect a supplier's supply performance.

This study examines how supplier-supplier interactions affect suppliers' supply performance and the role of the buyer in the supplier-supplier interactions. It proposes and tests both a moderating model and a mediating model to understand the relationships among the buyer's influence, supplier-supplier interactions and supply performance. This study looks at a triadic relational context where a buyer purchases components from two competing suppliers.

Empirical data are collected from buyers from three divisions of a company and two of their respective suppliers in each relational triad.

The research finding ascertained a clear link between supplier-supplier interactions and supply performance. The finding is interpreted in the context of the research setting and discussed through the theoretical lenses of supply chain relationship and supply chain management strategy. The implications for management and future research are also discussed.

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CHAPTER 1

OVERVIEW OF THE RESEARCH

Introduction

This chapter provides an overview of the entire study, describes the research background and brings focus to the research question. Specifically, this chapter discusses how supply chain management (SCM) practices such as supply base consolidation have changed the inter-organizational relationships in US manufacturing industries. Then, it proposes basic research questions, delineates the inter-organizational relationship context of this study, and lays out the organization of the study.

Research Background

Although supplier base consolidation is not the focus of the study, it is necessary to describe this business practices since it elicits close interdependence between organizations in a supply chain. Such close interdependence makes the research topic of this study relevant to business practice.

For more than a decade, buying companies have been establishing collaborative relationships with their strategic suppliers. Through supplier development efforts, the buying companies have made remarkable progress helping suppliers improve product quality and delivery, and reducing product cost. This achievement ultimately improves the overall supply performance and benefits the buying company (Choi and Hartley, 1996; Ellram, 1995; Krause, Handfield and Scannell, 1998). Going beyond supplier development efforts, buying companies also involve suppliers in new product development, joint production forecasting and planning (Asanuma, 1985; Clark, 1989; Hartley, Meredith, McCutcheon and Kamath, 1997; Kamath and Liker, 1994). As the buyers recognize the benefits of collaboration, they create long-term partnerships with critical suppliers and establish joint ventures in order to coordinate production activities (Asanuma, 1989; Clark and Fujimoto, 1991).

Concomitant with the strategic partnership between a buyer and its suppliers is the ever-increasing market competition for lower cost, better quality and faster delivery cycle. Since the early 1990s, buying companies have started to consolidate their supply base, thereby reducing the number of suppliers and implementing a tiering supply chain structure (Murphy, 2003). As a result, buying companies outsource many of their existing "non-core" in-house production operations to capable first-tier suppliers. The smaller group of tier-one suppliers in turn takes on responsibilities and supplies complete subsystems (Nishiguchi, 1994; Nishigushi and Brookfield, 1997).

Supplier base consolidation and supply chain tiering not only change the buyersupplier relationship, they also elicit interesting changes in the relationship among suppliers. As the buying company becomes reliant on a small group of competent suppliers to provide complex subsystems, assemblies or complete services, the suppliers' business operations in turn become more interdependent. Instead of interacting with the buying company directly, now the suppliers have to communicate and work among themselves and communicate more frequently.

Interaction among suppliers has important implications for purchasing performance (Choi, Wu, Ellram and Koka, 2002). Interactions may bring together joint capacity and resources in production and operations. They may spark synergy among suppliers in product development. Interactions may also lead to collusion among suppliers that obscures inefficiency and ultimately is detrimental to every supply chain member. In sum, a buying company has every interest in managing the interactions among suppliers.

Supplier-supplier interactions impose a different supply management challenge. Although the interactions among the suppliers affect the buyer's business performance directly, the interactions usually take place only among suppliers. The buyer is an internal outsider: the buyer is the focal point of the suppliers' business activities, yet it is more difficult for the buyer to tell how two other companies should mind their business than to make a request on a supplier for a contractual matter. In other words, the relationships among suppliers are *indirect* from the buyer's perspective. Despite such challenges, it is definitely to the buying company's benefit to understand the dynamic interactions among the suppliers and proactively manage such interactions to attain the desired supply performance.

Statement of Problem and Two Research Questions

This issue of supplier-supplier interactions is captured in Choi et al.'s recent conceptual paper (2002). The study conceptualizes three archetypical supplier-supplier

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relationships; each archetype has different implications for the supplier's supply performance. The general assertion of this conceptual paper is that supplier-supplier relationships have a direct effect on the buyer's purchasing performance. It brings to focus the notion that inter-organizational relationships are interconnected. That is, a buyer needs to manage a broader set of relational links beyond its immediate supplier.

The first research question addressed by this study is to test the general proposition brought forth by Choi et al. (2002). Specifically, this study seeks to understand the proposed direct linkage between supplier-supplier relationships and a supplier's supply performance:

How do interactions among suppliers affect the respective supply performance of each supplier engaged in the relationship?

The second question focuses on the role of the buyer in managing the interactions between suppliers:

If a buyer influences the interactions between the suppliers, how does the influence affect the way the suppliers interact with each other?

Brief Illustration of the Research Context

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The research context of this study is briefly explained in this section. The purpose is to bring to focus a concrete relational framework. A more detailed specification of this research context for empirical research is introduced in Chapter 4.

This study looks at a supplier-supplier relationship that is similar to that in Choi et al.'s study (2002). This relationship entails a purchasing scenario that involves a buyer and two competing suppliers. As depicted in Figure 1, the buyer is purchasing similar or complementary components from two suppliers. The suppliers are competitors in the sense that their manufacturing processes and production capabilities are compatible. In other words, the two suppliers are substitutable for one another in making the parts that the buyer buys; the suppliers also exist in the same tier of the buyer's supply chain.

This triadic buyer-supplier-supplier relational setting elicits potentially meaningful interactions between the suppliers. The reason is that the two suppliers are strategically bound. On the one hand, they compete for the same business. On the other hand, they supply complementary parts to fulfill a common need of the buyer. This makes potential collaboration between the suppliers possible. As a consequence, one supplier's decision will have an impact on the other's. It becomes meaningful for these suppliers to consider strategic choices as to how they should engage with one another.

General Overview of the Research Models and Constructs Definitions

This study proposes two models. The first model is a moderating model. As illustrated by Figure 2, a buyer's influence on supplier-supplier interactions moderates the effect of supplier-supplier interactions on supply performance. Essentially the moderating model argues that the buyer's influence would change the strength or direction of the relationship between supplier-supplier interactions and supplier's supply performance.

The second model is a mediating model. It argues that the effect of a buyer's influence on a supplier's supply performance is mediated through supplier-supplier interactions. This mediating model recognizes the direct relationship between supplier-supplier interactions and supplier's supply performance, an assertation made by Choi et al. (2002). The mediating model is illustarted in Figure 3. Theoretical arguments for the two models will be presented in Chapter 3.

In the proposed model, Supplier-Supplier Interactions defines the collaborative behavior that two suppliers of a given buying company engage in. Buyer's Influence on Supplier-Supplier Interactions defines the behavioral actions that a buyer carries out to facilitate interactions between suppliers. Finally, a supplier's Supply Performance defines the manifested capability and operations outcome of supplying a product to a buyer. Each construct will be defined in Chapter 4.

Organization of the Study

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This study constitutes eight chapters. Chapter 1 raises two research questions. Chapter 2 examines the relevant literature on buyer-supplier and supplier-supplier relationship and theories relevant to this study. Then, building on the existing research, two theoretical models are proposed in Chapter 3. This is followed by an introduction of the research methodology and data analysis in Chapters 4 and 5. Research results are reported and discussed in Chapter 6 and 7. Finally, Chapter 8 summarizes the research findings and discusses research limitations and future research.

Contribution

This study makes theoretical, empirical and practical contributions to the understanding of supply management. In terms of theory development and theory testing, the study is the first empirical study that correlates supplier-supplier relationship with supply performance. It moves beyond a vertical conceptualization of buyer-supplier relationships. In this sense, the study takes an incremental step and brings supply chain relationship study to a broader relationship context. The study also provides insights into supply chain management practices. Namely, this study ascertains that relationship between suppliers have a significant impact on supply performance. Buyers should structure and influence supplier-supplier relationships for the betterment of supply performance.



Figure 1. Buyer-Supplier-Supplier Relationships Framework



Figure 2. Proposed Moderating Model



Figure 3. Proposed Mediating Model

CHAPTER 2

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LITERATURE REVIEW

The objective of literature review is to apply existing theory and research to understand four critical issues: (1) the triadic relational context in which the interactions between suppliers take place (see Figure 1), (2) the inter-organizational relationship characteristics and relational dynamics between the suppliers in the proposed triadic relationship context, (3) the buyer's strategic activities in managing the relationship between the suppliers, and (4) inter-organization relationship as a resource to a firm. These four issues are the building blocks of the theory proposed in the next chapter. To accomplish this objective, this chapter will review three areas of literature: (1) buyersupplier relationship, (2) supplier-supplier relationship, and (3) the inter-organizational relationship literature across academic disciplines.

Buyer-Supplier Relationship

Although the buyer-supplier relationship is not the focus of this study, it is important to review this area of the literature. The reason is that the buyer-supplier relationship literature provides an analytical framework and the language to describe supplier-supplier relationship, the focus of this study. The buyer-supplier relationship literature will be reviewed from three perspectives: governance structure and relational characteristics, sourcing strategy and supplier development. Governance Structure and Relational Characteristics

The study of buyer-supplier relationships has drawn scholars from across diverse business fields, including supply chain management, marketing, strategy, organizational science and economics. One basic question concerns the different types of contractual relationship that a buyer has with its suppliers and associated relational characteristics (Barney, 1996; Coase, 1937; Lorenzoni and Lipparini, 1999; Walker and Weber, 1984; Williamson, 1979).

By looking at the vertical and dyadic buyer-supplier relationship, the economic theory of transaction cost is one of the most widely adopted theoretical lenses to study the contractual relationship that governs a buyer and a supplier. The theory argues that a firm chooses different ways of engaging its exchange partners in order to reduce the overall cost of doing business, or the co-called "transaction cost" (Coase, 1937; Dwyer and Oh, 1988; Macneil, 1974; Williamson, 1987). Based upon the specific attributes of the purchase, the theory suggested two choices of structuring exchanges: a "market" that uses price mechanism to control exchanges or a "hierarchy" which vertically integrates production within a firm (Williamson, 1979). He argued that hierarchy is used as a response to opportunistic behavior from the suppliers, which could happen when the transaction costs of monitoring suppliers' behavior is high or evaluation of suppliers' performance outcome is difficult. Hill (1990) disagreed with the effectiveness of hierarchy and pointed out that when the market reached competitive equilibrium, the market mechanism can reduce the risks of opportunistic behavior from suppliers. In his more recent research, Williamson recognizes that firms should also consider a hybrid

form of economic organizations, that is, a network (1991). The hybrid type of organizing economic activities emphasizes cooperative relationships between a buyer and a seller.

Each of the three forms of governance structure--hierarchy, market and network-connotes certain relationship types. Scholars categorize buyer-supplier relationship into two types: exit and voice. The concept of exit and voice originated from Hirschman (1970). It refers to a buyer's problem-solving method. *Exit* means that a buyer will find a new supplier when problems occur, whereas *voice* means that a buyer will work with an incumbent supplier to resolve problems as they arise. Drawing from contract law, Macneil argued that a buyer and a seller adopt different contractual relationships depending on the attributes of the procured product (1974). Specifically, when it is difficult to specify the outcome of the final product, a buyer would like to establish voicebased, or cooperative, buyer-supplier relationship. It gives both contracting parties the flexibility to modify the contract terms and address unpredictable outcomes. It also allows the buyer to monitor a supplier in the contract fulfillment process to reduce the potential for opportunistic behavior. Such voice-based buyer-supplier relationships reduce overall transaction cost for the buyer (Williamson, 1979).

The two types of buyer-supplier relationship, exit and voice, are often referred to as cooperative and competitive buyer-supplier relationship characteristics in recent business literature (Helper, 1991a). These relational characteristics constitute a universal language that can also describe supplier-supplier relationships.

Over the past two decades, supply chain management researchers have been particularly keen on assessing and promulgating the merits of cooperative relationships

exhibited between a buyer and a supplier (Choi, 1999; Choi and Hartley, 1996; Dyer, 1996a, b; Dyer and Nobeoka, 2000; Dyer and Singh, 1998; Ellram, 1990; Ellram and Edis, 1996; Helper, 1991a, b; Hill, 1990; Klein, Crawford and Alchian, 1978; Williamson, 1987). As a result, we have witnessed a shift from exit-based to more voicebased buyer-supplier relationships among US manufacturing industries. Strategic purchasing based on buyer-supplier alliances has been considered as a strategic competitive weapon of a buying company (Helper, 1991a; Kraljic, 1983; Olsen and Ellram, 1997).

Supplier Development

Supplier development is considered a buyer's strategic weapon (Hartley and Choi, 1996; Krause, Handfield and Scannell, 1998). Long-term oriented cooperation motivates the buyer to engage in supplier development endeavors. With large-scale outsourcing, rapid technological change, and shortened product life cycle, a buying firm's success is becoming more dependent on ensuring that the supplier's capability and operations strategy are aligned with those of the buying firm (Hartley, Meredith, McCutcheon and Kamath, 1997).

Numerous studies have reported supplier development practices and attributed drastic improvement in suppliers' capabilities to supplier development initiatives. For instance, Dyer and Nobeoka (2000) described Toyota's effort to create and manage its Operations Management Consulting Division since the mid 1960s. Through this organization, Toyota sends teams of consultants to the suppliers for a period of time

ranging from days to months. Such supplier development efforts have achieved impressive results in inventory reduction and improvement of worker productivity. Similarly, Choi observed that one major Korean electronics conglomerate, LKF (pseudonym), commits to help its small- to medium-sized domestic suppliers (1999). In this case, LKF's supplier development activities go beyond solving immediate production problems. LKF runs on-going education and training workshops that target 200,000 employees from 1,900 supplier companies. In addition, LKF works with inexperienced suppliers to coordinate expansion overseas and provides financial support to upgrade their technology and capital equipment.

Supplier development demonstrates a buyer's proactive strategic action in managing the buyer-supplier relationship. Further, as the next section will explain, a buyer can delegate supplier development activities to the suppliers by engaging them in collaborative interactions. That is, by creating a learning and open-sharing business environment, a buyer can improve the suppliers' capability without being directly involved in their daily operations.

Multi-sourcing Strategy

Multi-sourcing strategy evokes the relational setting of this study (see Figure 1). It reflects a buyer's strategic objectives in supply management. A buyer uses multiple sources to instigate competition, balance various types of transaction costs and efficiency performance objectives and reduce supply risks (Ansari and Modarress, 1990; Latour, 2001; Porter, 1985; Wu and Choi, 2002). At the same time, the buyer can facilitate

collaboration between the two suppliers to create synergic performance outcome. This idea will be elaborated further when the concept of co-opetition is introduced later in this chapter.

In this study, multi-sourcing is generally referred to as a strategic purchasing practice where a buyer purchases similar or complementary components from two or more competing suppliers (Asanuma, 1985, 1989; Cross, 1995; Fujimoto, 1999; Harryson, 1997; Kamath and Liker, 1994; Miyashita and Russell, 1994; Treleven and Schweikhart, 1988). Accordingly, multi-sourcing is categorized into two types. The first type, where the end item is different, is sometimes called *parallel sourcing*. To use the automotive business as an example, a buying firm (e.g., Toyota) could require one company to supply the powertrain to one vehicle model (e.g., Corolla), and designate another company to supply the powertrain to a different vehicle model (e.g., Camry). Here, although the powertrains from the two suppliers may differ in technical specification, they usually share the same basic product technology. The suppliers are still considered as competitors because they can take on each other's work. Usually, a buyer qualifies several suppliers to manufacture similar components or to supply a commodity group. Each supplier has a contract to supply a component during the whole life cycle of the end product (Richardson and Roumasset, 1995). These suppliers have to compete again every time a new product (e.g., a new vehicle model) life cycle starts. Studying the Japanese automaker's sourcing strategy, Richardson (1993) reported that parallel sourcing motivates the suppliers to compete while preserving the claimed benefits of sole sourcing.

In the second type, a buyer awards a different portion of a system or an assembly to more than one supplier. In other words, the suppliers supply *complementary* parts or components that go into the same end item/assembly. The buyer does so to avoid direct confrontation between suppliers. Such practice, like parallel sourcing, creates an opportunity where the suppliers are linked together by a common goal structure. The common goal structure induces possible collaboration between suppliers (Deutsch, 1949; Nisbet, 1972).

Multi-sourcing strategy is a common industry practice. In McMillan's study of components suppliers of Toyota and Honda (1990), 28% and 38% were single-sourced respectively, while another 39% and 44% were dual-sourced, and the remaining components had three or more suppliers. Studying automotive OEMs in the US and Japan as well as Japanese transplants in the US, Cusumano and Takeishi (1991) reported that on average these automotive OEMs have 1.4 suppliers per component on average. As a matter of fact, many firms are abandoning a single-sourcing strategy (after they experienced supply disruptions) and are shifting back to multi-source practices (Ip, 2001; Latour, 2001; Nishiguchi and Beaudet, 1998; Nishigushi and Brookfield, 1997).

In the fast-paced electronics industry, multi-sourcing seems to be the only conceivable way to ensure a buyer's survival. Wu and Choi described the so-called "30% rule" that one buying company uses in purchasing motherboard components (2002). This policy dictates that the buyer take up no more than 30% of one supplier's production capacity. This rule is needed to hedge against supply risk in both boom and bust economic cycles. If a supplier has a high reliance on the buyer for its business, a

market downturn can drive the supplier out of business. At the same time, in a robust market, where capacity becomes a key driver for growth, the 30% capacity utilization rate still gives the buyer room to expand production with each supplier.

As explained in the previous chapter, supply base consolidation over the last decade have motivated buying companies to look beyond the direct and vertical buyersupplier relationship for answers to improve supply performance. Research on suppliersupplier relationships represents this emergent managerial practice. The next section reviews the research stream.

Supplier-Supplier Relationship

This section first discusses the relational dynamics between suppliers. Then, such relational dynamics are illustrated using four cases from existing studies. The relational dynamics are illustrated using four published cases.

Relational Dynamics between Suppliers

Despite the importance of the relationship among supplies, research on the relationship dynamics among suppliers has been rare in the supply chain management literature. Studies on multi-sourcing and supply networks do capture the supplier-supplier relationship context, but with a different focus. For example, emerging supply network research often takes a bird's eye view of the supply network in analyzing the supply network's structural characteristics and its implications (Choi and Hong, 2002;

Dyer and Nobeoka, 2000); it does not analyze individual suppliers and the relationship dynamics among them. Similarly, studies have documented collaboration among suppliers (Clark, 1989; Dyer, 1996a, b; Fujimoto, 1999; Nishiguchi, 1994; Nishigushi and Brookfield, 1997). Yet information regarding specific supplier-supplier relationship dynamics is anecdotal and sporadic, leaving the gap areas to speculation or theoretical reasoning. In fact, the importance of understanding supplier-supplier relationships and lack of empirically tested theory motivate the researcher to conduct this study.

The limited research on supplier-supplier relationship is either conceptual (Choi et al., 2002) or exploratory (Wu and Choi, 2002). Choi et al.'s conceptual paper proposed three archetypes of relationship between suppliers: cooperative, competitive and co-opetitive supplier-supplier relationships (2002). Co-opetitive relationship, as the next section will explain, refers to the relational dynamics where firms compete and cooperate at the same time. Choi and colleagues argue that each type of supplier-supplier relationship is a function of the nature of the industry, the nature of the information exchanged between the suppliers, the time orientation of the relationship, the buyer's supply management strategy and the supplier's alliances strategy. For example, when suppliers display synergistic activities leading to increased access to resources and market expansion, co-opetitive supplier-supplier relationship can positively affect supplier performance.

Wu and Choi's case study (2002) is an extension of Choi et al.'s conceptual work (2002). It aims to explain the co-opetitive relational dynamics between suppliers. They observed that simultaneous cooperation and competition between the suppliers create a

dynamic relationship balance. It enables the buyer to attain the optimal supply performance outcomes of multi-sourcing strategy (Ansari and Modarress, 1990; Richardson, 1993).

Empirical Evidence of Supplier-Supplier Relational Dynamics

To appreciate the relational dynamics among suppliers, four cases from existing literate are briefly recounted. They bring into focus the supplier-supplier relationship – the relational context of this study. In addition, they also illustrate the buyer's strategic behavior in managing the relationship between the two suppliers within the triad. Cases 2, 3 and 4 are from Wu and Choi's case study (2002). Figure 4 sketches out the supply structure of the three cases. The arrows indicate the direction of material flows. The dotted straight lines indicate information flow. The solid straight line separating the two suppliers indicates a wall or barrier that prevents them from talking with one another.

The first case features Cross's account of British Petroleum (BP)'s IT outsourcing (1996). This case touched upon the co-opetitive relational dynamics among three competing suppliers, who provide turn-key IT service to BP's strategic business units around the world. Specifically, the author pointed out that, despite the successful alliances among the suppliers, they were unwilling to share information and best practices beyond what was required to fulfill the project, because they would compete with each other in future contracts from BP and other buyers. The relational dynamics are depicted as a challenge to the buyer.

The second case illustrates a situation where the buyer tried hard to facilitate collaboration between two competing suppliers. Because of cost pressures and corporate strategy to focus on its core competency, the buyer, a telecommunication equipment company, decided to outsource the complete site material business (e.g., MRO commodities as lamps, ladders, and fiber cable ducts) to two distributors on a turnkey basis. The buyer intended to forge a triadic, three-way strategic alliance with these two distributors so that it could entrust the business completely to the two distributors.

However, despite the buyer's ambitious plan, past rivalry history and present conflicting business interests between the two distributors prevented them from creating such an alliance. Meanwhile, the two distributors were suspicious of the buyer's intention in the beginning, fearing that alliance was another scheme of the buyer to cut price. The suppliers even refused to meet with each other without the presence of the buyer's representatives. As a result, the buyer had to spend numerous resources to coordinate communication and logistics activities between the two suppliers. To engage the suppliers in collaborative interaction, the buyer tried to hold meetings where the suppliers met and discussed common supply issues and problems. After one year of hard work, the buyer observed that the sales representatives of the two distributors became comfortable enough to talk with each other. They began to exchange some information and ideas. The buyer considered this confluence small yet significant progress. In this case, the buyer's strategy was partially fulfilled. Its influence on the suppliers is limited.

A buyer does not always encourage suppliers to collaborate. In the third case, the two suppliers are substrate manufacturers. Substrate is the platform on which microprocessors are

built. The buyer, another telecommunication equipment producer, and two suppliers all reason that any direct interactions and information sharing would simply divulge the suppliers' product cost information. Since the suppliers all use very similar capital equipment made by the same equipment OEMs, they are basically competing on production operations efficiencies in terms of capacity utilization, set-up times reduction, and best work practices, et cetera. A trained eye can easily identify and learn the unique practices on the manufacturing floor and copy them to another plant. Apparently, the two suppliers do not want to reveal their respective internal production know-how. Neither does the buyer want the suppliers to talk with each other because if the suppliers share shop-floor information, they essentially share production costs. As a result, the classic free-market style competition is considered to be the best choice for both buyer and suppliers.

The last case involves the procurement of a set of capital equipment, the tooling system for vehicle door production made up of "a set of 10 workstations." Originally, the buyer, one of the world's largest automotive OEMs, used only one supplier as a "full-service provider" to supply the complete tooling system. To stimulate competition in the tooling supply base, the buyer bid out the ten workstations to six potential tooling suppliers. One of the ten workstations is called a hemmer, which refers to equipment that folds, or "hems" the inner panel of a door into the outer panel. One supplier candidate proposed a tabletop hemmer machine. The buyer liked this idea because the proposed hemmer would reduce set-up time and fit in a flexible manufacturing work environment. As a result, the buyer picked this supplier for the hemmer workstation. Instead of buying the hemmer directly from the new supplier, the buyer requested that this supplier supply the hemmer to the incumbent

supplier, who in turn would integrate the hemmer with the other nine workstations and supply the buyer, as needed. By doing so, the buyer only dealt with one supplier for the complete tooling system. In other words, the buyer was able to use a new supplier without directly managing it.

Through the interactions between these two suppliers, the buyer minimizes supplier development efforts because this task is pushed to the incumbent supplier. In this arrangement, the information exchange between these two suppliers can be best described as being "guarded." One the one hand, both suppliers tried to work in a "collegial" environment. On the other hand, each supplier cautioned its engineers "not to share too much internal information."

In summary, these four cases illustrate the relational dynamics between competing suppliers. The suppliers compete and cooperate at the same time. These four cases also shed light on the buyer's multi-sourcing strategy and associated strategic behavior in managing the interactions between the suppliers.

Other Inter-Organizational Relationship Literature

Research on inter-organizational relationship is not confined to buyer-supplier and supplier-supplier relationship studies in supply chain management literature. Scholars in sociology, psychology, political science, and business strategy, to name a few, have been exploring the same issue over many decades. For example, the idea of co-opetition, one focal concept in this study, originates in early psychology literature and game theory. These studies have had a significant impact on business research. It is necessary to step back and assess important inter-organizational relationship research across various academic disciplines in order to gain a deeper understanding of these fundamental concepts. This section reviews three important topics of inter-organizational relationship that are relevant to this study: inter-organizational relationship characteristics, strategic alliance, and a resource-based perspective of inter-organizational relationship.

Cooperation, Competition and Co-opetition

Researchers generally categorize inter-organizational relationship characteristics in terms of *competition* and *cooperation*. Recently, game theorists proposed a third relationship type: *co-opetition*. The three types of relationship characteristics are reviewed in this section.

Research on competition and cooperation dates back to the early 1900s in psychology, anthropology, sociology and economics. Early studies on cooperation culminated in a report called *Competition and Cooperation* published by the American Social Science Research Council (May and Doob, 1937). Scholars in the early years had been considering cooperation and competition as two extremes of a continuum, pondering philosophical questions (e.g., which of the two represents the fundamental nature of human behaviors at different times or societies?). Here, cooperation and competition are considered as two ends of a continuum. A relationship high on cooperation would signify low on competition and vice versa.
Research on competition and cooperation in psychology dates back to the 1920s. These two concepts are distinguished according to goal structures. For example, Deutsch defined a cooperative situation as one in which individuals' goals are linked together (1949). So an individual attains his/her goal if and only if other participants' goals are attained (Johnson, Maruyama, Johnson and Nelson, 1981). Similarly, sociologist Nisbet understood cooperation as a combination of efforts of two parties toward a specific end (1972). A competitive social situation is one in which an individual attains his/her goal at the sacrifice of other participants (Deutsch, 1949). So competitive behavior is selfcentered rather than reciprocal and results in a win-lose outcome.

Business studies adopted the goal structure concept to define cooperation and competition. Cooperative behavior is collaborative in nature as two business entities seek mutual benefits. It has a long-term relationship orientation and is the basis for alliance (Ganesan, 1994), trust and commitment (Morgan and Hunt, 1994). Cooperative behavior includes information sharing, helping problem solving and joint business action, among others (Heide and Miner, 1992; Noordewier, John and Nevin, 1990).

Following the same logic, competition refers to the endeavor of business firms rivaling for the same business interests such as economic gains or competitive advantage. Classical economics theory considers direct rivalry between competitors as a logical and desirable outcome of a market mechanism (Williamson, 1975). The marketing literature examines the confrontational behavior of firms with incompatible goals in a marketing channel (Day, 1981; Jap, 1999, 2001; Smith, Grimm, and Gannon, 1992; Stern and Reve, 1980; Weitz, 1985). Early strategy research, which is represented by Porter's (1985) five

forces, looked at how market structure and a firm's position in an industry drive competition among firms within that industry (Gomes-Casseres, 1994; Kogut, 2000; Nohria and Garcia-Pont, 1991; Porter, 1985; Smith, Ferrier and Ndofor, 2001: 315-356; Smith, Grimm and Gannon, 1992).

Studies have conceptualized cooperation and competition as two ends of a continuum, or as two distinct constructs. In keeping with the first research on cooperation by May and Doob (1937), marketing scholars Robicheaux and El-Ansary (1976), Gattorna (1978) and Anderson and Narus (1984), and others, treated cooperation as the opposite of competition. These marketing studies sometimes use the term conflict to describe competition.

Recent business research also considers cooperation and competition as two independent constructs. Each is a unique combination of relational characteristics. This perspective offers a richer depiction of inter-firm relationship dynamics because it does not consider competition and cooperation as mutually exclusive. Lado, Boyd, and Hanlon (1997) introduced the notion of syncretic rent-seeking behavior to explain how firms can generate economic rents by combining high levels of cooperative and competitive orientation. Using a numerical taxonomy approach, Cannon and Perreault Jr. (1999) identified nine types of buyer-seller relationships. Here, different levels of cooperation and competition are configured to represent a relational reality. Similarly, Young and Wilkinson developed a typology of relations focusing on the mix of cooperative and competitive elements coexisting in a relationship (1989, 1997).

The sociology and organization theory literature has long argued that competitive and cooperative behaviors are actually indispensable to one another, whether it is an individual, a firm or a tribal society. For one thing, to compete, the individual entities need to work together setting up the rules of the game, or imposing sanctions, otherwise competition would dissolve into open war (Argyle, 1991; Bonta, 1997; Nisbet, 1972).

Psychology studies also contemplate the interplay between cooperation and competition at individual and group levels. Psychologists had long debated opposing views as to which of the two, competition or cooperation, would produce better individual performance (Cosier and Dalton, 1988). On the one hand, advocates of competition argue that a win-lose situation would drive individuals to elevated performance (Michaels, 1977). On the other hand, cooperation advocates point out the possible defeatism of individuals in a competitive situation (Shaw, 1958). Johnson et al.'s meta-analysis of 122 papers concluded that cooperative individuals will perform better than competitive ones especially when they are required to produce a group product (task interdependent) (1981). Tjosvold claims that cooperation among competitors creates the productive tension that yields optimal performance. He argued (1985: 21):

Decision makers involved in a cooperative controversy incorporated opposing ideas ... and developed cohesion and attraction toward one another as persons. Believing that their goals are positively linked, then, greatly helps people realize the potential of controversy.

The same idea of simultaneous cooperation and competition is proposed and tested in game theory. Game theory, the Prisoner's Dilemma in particular, argues that rivals would collaborate if the game has a long duration, because collaboration would bear optimal gains for both sides, assuming the rivaling parties act based on rational calculation of gains (Axelrod, 1984; Luce and Raiffa, 1957). Rapoport and Chammah (1965) find that tit-for-tat strategy, where the second player acts based on the first player's move, turns out to be the winning strategy for every firm or individual involved in long-term interactions.

This notion of simultaneous cooperation and competition has culminated in the idea of "co-opetition" in recent business research. The word "co-opetition" was coined by Ray Noorda, the founder of networking software company Novell Inc. (Davis, 1993) and popularized by Brandenburger and Nalebuff in their best selling book *Co-opetition* (1996). The basic notion of co-opetition is that cooperation and competition are not mutually exclusive and they take place at the same time.

Various business disciplines, such as economics (Kreps, Milgrom, Roberts and Wilson, 1982), marketing (Larsson, Bengtsson, Henriksson and Sparks, 1998; Young and Wilkinson, 1997), strategy (Gnyawali and Madhavan, 2001; Parkhe, 1993), organizational science (Heide and Miner, 1992; Lado, Boyd and Halon, 1989, 1997) and supply chain management (Choi et al., 2002), have explored co-opetitive relational dynamics. For instance, strategy scholars recently found that competition would attenuate if competing firms have multiple interactions (or contacts) across several markets (Barnett, 1993; Barnett and Carroll, 1987; Chen and Hambrick, 1995; Edwards,

1995: 331-352; Gimeno and Woo, 1999; Smith et al., 1992; Weitz, 1985). By doing so, competing firms try to avoid mutually destructive confrontation and retaliation. In this sense, the competing firms are actually exchanging reciprocal treatment with one another. Researchers also observed that business firms in the same industry even form so-called "strategic groups" or "industry clusters" to compete (pie-sharing) and collaborate (pieexpansion) at the same time (Barney and Hoskisson, 1990; Porter, 1998).

In conclusion, the goal structure largely distinguishes cooperation from competition. At the same time, cooperation and competition are not mutually exclusive. A combination of cooperation and competition constitutes the so-called co-opetitive relational dynamics that generate the optimal performance outcome for the participants of a relationship.

Strategic Alliance

Strategic alliance is the voluntary arrangement between firms involving material and/or material exchanges (Gulati, 1998). Kogut highlighted three main motives of forming alliance (1988): reducing transaction cost, enhancing competitive position or market power and seeking information and knowledge from the alliance partner(s). Strategic alliance enables companies to pool different resources together and use them in research and development, production operations and new product development, etc. Here, strategic alliances are the means for firms to harness external resources (Blau, 1964; Das and Teng, 1998; Parkhe, 1993; Gulati, 1998; Powell, Kogut and Smith-Doerr, 1996; Stuart, 2000). In this study, the researcher argues that collaborative supplier-

supplier interactions share similar traits of strategic alliance and can generate positive performance outcome.

Scholars assert that prior relationship history is an important predictor of new alliance creation (Martin, Mitchell and Swaminathan, 1995). The relationship history implies a high level of trust between alliance partners. At the same time, some scholars pointed out that competitive learning is common in strategic alliances (Powell, Kogut and Smith-Doerr, 1996). The implication is that competition and cooperation co-exist in strategic alliance.

Over the past decade, business scholars have embraced the social network perspective to understand strategic alliances by considering collaboration engagement among multiple firms (Anderson, Häkansson and Johanson, 1994; Gimeno and Woo, 1999; Gulati, 1998). The network perspective considers a firm's relationship as its resources.

Relationship as Resource

The social network perspective provides both a theoretical framework and an analytical tool to understand inter-organizational relationships. Examining the overall structure of a relationship network and a firm's position in the network, researchers argue that ties a firm forms with another firm and the overall structure of ties in which the focal firm is embedded determine its ability to access and utilize business information and knowledge (Nahapiet and Ghoshal, 1998; Walker, Kogut and Shan, 1997). Koka and Prescott (2002) measure the information available to a firm in terms of information

volume, diversity and richness. They further argue that the information entitled to a firm is the firm's social capital (Coleman, 1988; Wellman and Berkowitz, 1988: 1-18).

A firm in an embedded network garners in-depth knowledge within the network. Toyota's supplier network epitomizes the strong tie argument. In the network, suppliers engage in voluntary learning and information sharing. They provide advice to each other on cost reduction and continuous improvement activities (Dyer and Nobeoka, 2000). Such activities are exploitative as they are based on existing knowledge.

Two studies consider supply chain as a social network and explore how relational structure among the network members could affect the performance of the buying firm or the individual customer. Specifically, Choi and Hong (2002) compared three supply networks that produce a common personal vehicle system assembly. They found that the extension of contractual linkages a buying firm has in the network affect the stability of the network. Provan and Milward (1995) compared the network structures of four urban health care networks and interpreted how the network structural difference could explain healthcare delivery quality.

The theoretical underpinning of the social network purports the "interconnectedness" nature of inter-organizational relationship. Social scientists have long challenged the ability of a dyadic relational framework in interpreting interorganizational relationship dynamics (Ridley and Avery, 1979: 223-245). Sociologists see systems of ties as the basis of social structure. For instance, Emerson (1962) argues that a dyadic relationship is always embedded in a larger network of relationships. Scholars, taking a resource-based view, consider relational linkages as among a firm's competitive resources that are valuable, rare to come by, imperfectly mobile, not imitable by competitors and not substitutable (Barney, 1996; Peteraf, 1993; Rungtusanatham, forthcoming; Wernerfelt, 1984, 1995). Rungtusanatham et al. (forthcoming) argue that, by creating linkages with suppliers, a buying company gains sustainable competitive advantage by excluding its competitors from forming similar connections.

In summary, this chapter first discussed the basic buyer-supplier relational characteristics. These relational characteristics provide researchers a common language to describe supplier-supplier relationship. Then, a buyer's multi-sourcing strategy is reviewed. It delineated the triadic relational setting pertinent to this study and explicated the notion that a buyer creates the multi-sourcing arrangement to manage supplier-supplier relationship. Next, this chapter explored various academic disciplines to understand the origin and concepts of inter-organizational relationship characteristics. Review of the supplier relational dynamics. Strategic alliance and the resource perspective of inter-organizational relationship accentuate the importance of a firm's relationships linkages with other firms.

Building on the literature review, Chapter 3 will present the theoretical models of the study and associated theoretical justification of the propositions.



Figure 4. Empirical Evidence of Buyer's Supply Management Strategy and Supplier-Supplier Interactions Dynamics (Adapted from Wu and Choi, 2003)

CHAPTER 3

MODEL DEVELOPMENT

This study presents two theoretical models: a moderating model and a mediating model. Associated with the two models are three specific propositions. Applying the existing theoretical arguments in the extant literature to the specified relational context, the researcher exposes the logic behind these two models.

A Moderating Model

Figure 2 presents the moderating model. The focal interest in a moderating model is the moderator. A causal relationship between the independent variable (IV), Supplier-Supplier Interactions and dependent variable (DV), Supply Performance, the main effect, needs to be established first. This study proposes that Supplier-Supplier Interactions has a direct and positive effect on Supply Performance.

The notion of a free-market economy favors competitive relational dynamics between the suppliers. However, the idea of co-opetition suggests a better answer that builds upon the logic of competition and cooperation (Choi et al., 2002). By creating a multi-sourcing relational setting, a buyer can exploit the market forces of supplier competition and at the same time reduce supply risks (Richardson, 1993; Richardson and Roumasset, 1995). That is, if the suppliers are organized to work together, it is possible that the buyer can take advantage of the benefits of both the market forces and relational resources created by supplier-supplier collaboration (Coleman, 1988; Koka and Prescott, 2002; Rungtuthanatham et al., forthcoming; Wellman and Berkowitz, 1988: 1-18).

This study proposes that collaborative interaction between competing suppliers would produce better supply performance than supplier-supplier relationship solely based on competition. As the relationship context of this study specified, the two suppliers supply complementary components to the same end unit or similar components to different end units. In such an arrangement, the buyer actually links the suppliers in task interdependent supply assignment (Deutsch, 1949; Ganesan, 1994; Nisbet, 1972). Under such circumstances, the suppliers cooperate and compete at the same time. Such coopetitive interactions between suppliers could spark synergy in areas such as learning, continuous improvement, innovation, product innovation and product development (Choi et al., 2002).

Collaborative supplier-supplier interactions can accomplish supplier development tasks that are usually carried out by the buyer (Choi, 1999; Hahn, Watts and Kim, 1990; Krause and Ellram, 1997; Krause, Handfield and Scannell, 1998). As a matter of fact, as a buyer tries to outsource its non-core competency, on many occasions the suppliers actually have a stronger expertise on product and process technology than the buyer does (Murphy, 2003). Consequently, instead of having the buyer involved in supplier development, supplier-supplier interactions facilitate supplier development activities such as cost reduction, process reengineering and quality management. This in turn leads to reduced cycle time and productivity improvement (Clark and Fujimoto, 1991; De Meyer and Van Hooland, 1990; Hamel, 1991; Walker and Poppo, 1984).

Existing studies provide evidence of the co-opetitive dynamics among suppliers. Dyer found that the suppliers in Nissan and Toyota's supply networks have a higher level of human asset and physical asset specialization than that of other automotive OEMs (1996 a, b). Such high-asset specificity safeguards against the hazards of opportunism and generates trust and goodwill among contracting parties, which in turn translates into lower transaction costs for the buyer. In another study, Dyer and Nobeoka (2000) found that knowledge diffusion occurs quickly in Toyota's supply networks.

In the BP case described in the previous chapter, Cross illustrated how three competing IT service providers use their individual expertise to help each other solve technical problems across different BP facilities around the world (1996). In the site material case (Wu and Choi, 2002), the two competing distributors share best practices and capacities, though quite reluctantly, to get up to speed with the sudden business increase after the consolidation. In the automotive capital equipment case, one supplier directly supplies equipment to the incumbent supplier. Through this arrangement, the two competing suppliers have to interact with each other so that tacit knowledge is shared and the new supplier learns how to work with the buyer.

In the relational setting of this study, the linkage between the suppliers is also the unique resource for the focal buyer. Not every buying company can create a co-opetitive relational exchange between suppliers through a parallel sourcing arrangement. The co-opetitive interactions between suppliers are built upon mutual trust and a long-term relationship orientation of each company in the relational triad. As such, this exchange represents a unique resource to the buyer. Research in Japanese manufacturing strategy

explained how such trust is created among the Japanese automotive suppliers (Asanuma 1985, 1989; Clark and Fujimoto, 1991; Richardson, 1993). In his analysis, the buying company gives each supplier a fair opportunity to bid on a new contract when a new vehicle program is initiated. The suppliers that contribute to product design but fail to win the contract are compensated in future business. By creating an equitable relationship environment, the suppliers are more willing to share technical and cost information within the supply network even though they are competing for the same business. Such dynamic relational exchange between suppliers cannot be created simply through the buyer's purchasing leverage. If a buyer simply uses multi-sourcing as a market mechanism to select the lowest bidders, the suppliers are forced into a win-lose situation, where direct competition would be the dominant mode of supplier-supplier engagement.

In summary, this study acknowledges the market efficiency created by market competition. It further argues that collaboration between competing suppliers may yield better performance results. Collaboration creates both market efficiency and synergy from the suppliers. Such synergy in turn leads to better supply performance.

Proposition 1: Supplier-supplier interactions have a direct and positive effect on each supplier's supply performance such that a higher level of supplier-supplier interactions will lead to better supply performance. Supplier-supplier interactions may benefit the suppliers rather than the buyer if the buyer is not monitoring such interactions (Baker and Faulkner, 1993; Choi, et al., 2002; Murphy, 2003). The two suppliers may engage in collusive interaction if the buyer loses monitoring capability. For instance, as a buyer outsources complete assembly and subsystem to a tier-one supplier, the suppliers may know more about the product technology and cost structure than the buyer. Under such circumstances, the buyer loses bargaining power in price negotiation because it does not have the expertise to make price judgment (Murphy, 2003).

Potential collusive behavior can be prevented through close monitoring by the buyer. Yet the buyer does not necessarily need to get involved in supplier-supplier interactions. In Dyer and Nobeoka's description of Toyota's knowledge-sharing network (2000), Toyota, the buying company, creates and maintains the rules for knowledge creation and protection within the network. Such rules stipulate that the knowledge generated within the network belongs to the network. Here, Toyota does not directly tell two suppliers how they should interact with each other. Instead, it closely manages at the macro level by enforcing the rules and network routines and preventing free riders through economic sanctions (e.g., withdrawal of business). Essentially, such rules and network routines elicits a network culture over the years. Suppliers in the network share tacit knowledge as to what behavior is expected and what would be sanctioned. Similarly, in a case study of small apparel firms in New York city, Uzzi also observed that firm's "non-self-interested behavior" is not a directly forced upon by the business

partners (1997). Rather, common experience, shared symbols and collective success motivate firms to cooperate.

The above analysis purports a moderating effect of the Buyer's Influence on the relationship between Supplier-Supplier Interactions and Supply Performance. That is, buyer's influence creates specific rules and routines and relational environment that facilitate desirable behavior of the suppliers and avert their opportunistic pursuit. To wit, a buyer's influence changes the strength and/or direction of the effect of supplier-supplier interactions on supply performance (Baron and Kenny, 1985; James and Brett, 1984).

Proposition 2: A buyer's influence on supplier-supplier interactions moderates the relationship between supplier-supplier interactions and a supplier's supply performance.

A Mediating Model

A buyer can also directly affect the way suppliers engage with one another. Specifically, a buyer creates a multi-sourcing procurement arrangement, through which the buyer directly influences the interactions between the suppliers (Harryson, 1997; Miyashita and Russell, 1994; Richardson, 1993; Richardson and Roumasset, 1995; Wu and Choi, 2002). As argued in the previous section, Supplier-Supplier Interactions have a direct effect on Supply Performance. In other words, the buyer can achieve the desired supply performance *through* the interactions between the suppliers in a multi-sourcing arrangement.

Here, a buyer's ability to influence the supplier's behavior arises from its leverage position as a buyer, its expertise and/or ownership of product technology related to the supplied component, and position in the overall supply network (Anderson and Weitz, 1992; Burt, 1992; Choi and Hong, 2002; Jap, 1999, 2001; Gulati, 1998; Stern and Reve, 1980). In the hemmer procurement case, sheer purchasing power enabled the automotive OEM buyer to compel one supplier to supply the hemmer station to the other supplier. Even though neither supplier was happy with the arrangement, they had to comply lest they lose business with the buyer.

Shared business objectives and mutual trust between a buyer and suppliers also enhance the buyer's influence over the suppliers. For example, in the site material case, the suppliers were reluctant to talk with each other in the beginning until they came to see the buyer's sincerity and mutual benefit of the buyer's proposal (Wu and Choi, 2002). A common goal structure creates a win-win situation for both suppliers (Deutsch, 1949; Ganesan, 1994; Morgan and Hunt, 1994; Nisbet, 1972).

Proposition 3: Supplier-supplier interactions fully mediate the effect of buyer's influence on supply performance. Specifically, a buyer's influence on supplies-supplier interactions has a positive effect on a supplier's supply performance. This effect is enacted by supplier-supplier interactions.

To wit, the connection between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions and between Supplier-Supplier

Interactions and Supply Performance suggests that Supplier-Supplier Interactions becomes a full mediator between Buyer's Influence on Supplier-Supplier Interactions and supplier's Supply Performance (Baron and Kenny, 1986). Referring to Figure 3, this proposed mediating effect suggests that Buyer's Influence on Supplier-Supplier Interactions, the antecedent, is expected to affect the consequence, Supply Performance *through* Supplier-Supplier Interactions. That is, Supplier-Supplier Interactions *"transmits"* the effect of buyer's influence to supply performance (Baron and Kenny, 1985; James and Brett, 1984). The mediator variable serves as a mechanism that allows the buyer's influence to take place and produce the desired supply performance outcome.

CHAPTER 4

RESEARCH METHODS

This chapter discusses the research methodology. First, the research context is delineated. Then, the nominal definitions of the constructs are stated. It is followed by a discussion of the measurement, sampling and data collection method, selection of the buying company and buyer and supplier informants, and data collection. The survey response rate is reported at the end of the chapter. These topics are discussed in a sequence that follows a logical research procedure.

Research Context

The research context entails a situation where two suppliers have similar production and process capability and compete in the same business market. They either supply complementary components that go into the same end item at the buying company or make similar components of the same application used for different end products at the buying company. In this relational context, the suppliers are competitors in terms of their capability and product offering. The buyer's multi-sourcing strategy explained in Chapter 2 creates such a relational context. In a multi-sourcing arrangement, the suppliers supply complementary components to the buyer. Once the suppliers have established supply contracts with the buyer, they work toward a common goal and their success becomes interdependent.

This research context elicits a competitive tension between the suppliers. The buyer can substitute one supplier with the other because of their similar capability and product technology. At the same time, because of the complementary nature of components each supplier supplies, this relational context specification does not rule out the possibility that these two suppliers could engage in collaborative interaction to supply the buyer. In other words, the suppliers can potentially engage in a co-opetitive relational exchange (Choi et al., 2002).

A dual-sourcing strategy would hardly elicit such relational dynamics between suppliers (Richardson and Roumasset, 1995; Sudhindra, 1995). In a dual-sourcing arrangement, two suppliers compete directly for the same business. One supplier's gain is the other's loss (Jap, 1999). Under such circumstances, confrontation dominates the relational dynamics between the suppliers. In other words, a dual-sourcing arrangement does not create a goal structure that facilitates any collaborative interaction between competing suppliers (Deutsch 1949; Ganesan 1994). On the contrary, the multi-sourcing strategy described in Chapter 2 allows collaborative interactions between competing suppliers.

Nominal Definition of the Constructs

The proposed models have three constructs: Buyer's Influence on Supplier-Supplier Interactions, Supplier-Supplier Interactions and Supplier's Supply Performance. Nominal definitions of the three constructs are stated here.

Buyer's Influence on Supplier-Supplier Interactions explores the buyer's supply management strategy. To be specific, the construct focuses on the buyer's strategic behavior of managing the relationship between two suppliers in the buyer-suppliersupplier triad. A Buyer's Influence on Suppler-Supplier Interactions is defined as the behavioral actions that a buyer engages in to influence interactions between two suppliers. Such activities manifest the buyer's supply management strategies. Here, a buyer's influence represents the "realized strategy" rather than "intended plans" (Mintzberg, 1978).

The construct Supplier-Supplier Interactions taps into the behavioral dimension of supplier-supplier relationship. Supplier-Supplier Interactions is defined as the behavioral actions that two suppliers of a given buying company engage in and that affect one or both suppliers in supplying the buying firm. Given the relationship context described above, the two suppliers are competitors in the buyer-supplier-supplier triad. Since this study focuses on the collaborative interaction between competing suppliers, this construct essentially asks to what extent competing suppliers cooperate. It follows that this study considers competition and cooperation as a relational continuum (May and Doob, 1937). The relational continuum is depicted in Figure 5. Supplier-Supplier Interactions measures the level of cooperation between competing suppliers. This conceptualization recognizes that cooperation and competition are not mutually exclusive, echoing the notion of co-opetition: suppliers compete and cooperate at the same time.

The construct Supplier-Supplier Interactions focuses on the behavioral aspect of the supplier-supplier relationship. Such relational behavior is operationalized as

observable production and operations activities. This study forgoes considering the cognitive (i.e., equity, power) and affective (i.e., trust) dimension of inter-organizational relationship, leaving such a holistic conceptualization to future research.

Supplier's Supply Performance is the manifested capability and operations outcome of a supplier in supplying a buyer. It includes a supplier's operations performance such as quality, delivery, cost and service, among others, and the overall satisfaction of the buyer toward the supplier. The nominal and operational definitions of the three constructs are summarized in Table 1.

Measurement

There are three constructs in the study. Existing scales were adapted for Supplier-Supplier Interactions and Supply Performance. Tables 2 and 3 list the existing measurement items of these two constructs, their respective psychometric properties, and the final scales adapted in this study. New measurement items were created for the new construct Buyer's Influence on Supplier-Supplier Interactions. The new scale is listed in Table 4.

Measurement items for Supplier-Supplier Interactions are adapted from two studies by Heide and Miner (1992) and Noordewier et al. (1990). The scales in the existing two studies measure three dimensions of inter-organizational interactions: information exchange, helping and problem solving and joint activities. Since the original scales measure vertical buyer-supplier relationship, modification was made to fit the questionnaire's wording to the supplier-supplier relational context in this study. The modification was kept to a minimum to maintain the integrity of the original scales. In addition, one item in Noordewier et al. (1990) was discarded. This item describes shipment of goods from supplier to buyer, which is irrelevant in this study. Further, a new item was created for this study in order to capture specific interactions on production operations issues.

As Table 3 illustrates, a supplier's Supply Performance is measured using measurement items developed by Cannon and Perreault Jr. (1999). It is measured as operations performance, which includes quality, service support, total value received, overall cost, and responsiveness, and overall satisfaction of a buyer toward a supplier. Two additional items were added. These two items are actually from Cannon and Perreault's original survey questionnaire (unpublished), which was graciously provided by one of the authors.

Scale items were developed for Buyer's Influence on Supplier-Supplier Interactions following the procedures prescribed by DeVellis (1991). Based on the nominal definitions of this construct and existing academic and practitioner literature, ten items were generated. Face validity of the measurement instrument was evaluated to satisfy the assessment of the content validity (Rungtusanatham, 1998). To do so, the measurement items were subjected to expert evaluation. A panel of six faculty members and graduate students were asked to assess face validity of the construct. They were given the nominal and operational definition of this construct and were asked to provide suggestions on semantics changes and recommendations as to which items to include in

the questionnaire. Finally, the scale items were shown to the buyers and commodity managers in the buying firm of this study for suggestions. In the end, six items were selected. Table 4 reports the new scale and measurement items.

Sampling and Data Collection Method

As indicated by the research context in the previous chapter, the unit of analysis of the study is a relationship: the behavioral interactions between two suppliers. These two suppliers and corresponding buyer form a relational triad. Such a buyer-suppliersupplier triad is the unit of reference in this study.

The study is theory testing in nature. In this study, theory testing examines whether the proposed hypothesis can adequately describe the relationships among concepts using empirical data. To accomplish this, a survey-based empirical research method is used in data collection (Babbie, 1998).

Data are collected from a single buying firm and its corresponding suppliers. The reason for focusing on a single buying firm is to control potential firm effect on the constructs of the study. One potential firm effect is the potentially different supply management strategies of buying firms within an industry or across different industries. Different supply management strategies are manifested in different approaches as to how buyers influence the interactions between two suppliers.

The key constructs in this study--Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions--tap into the business behavior of buyer and suppliers. Referring to Figure 1, such behavioral data will be collected from individual buyers and corresponding pairs of suppliers in the triads. Specifically, the buyer will answer questions on Buyer's Influence on Supplier-Supplier Interactions and each supplier's Supply Performance. Each supplier in the triad provides information on its perspective of Supplier-Supplier Interactions. By collecting data on Buyer's Influence and suppliers' Supply Performance from separate sources, this study eliminates the common method problem (Doty and Glick, 1998).

Based on the proposed theory and the triadic relational context, each individual buyer at the supply chain management organization of the buying firm will be asked to identify a purchasing scenario that matches the triadic relational context illustrated in Figure 1. Essentially, this purchasing procurement scenario needs to meet three criteria. First, this buyer must support a critical product at the buying firm. This product is critical because of its overall profit impact, its value/price and product/production technology complexity. This research focuses on the critical products because they elicit the most meaningful and dynamic relationship between the suppliers (Kraljic, 1983; Olsen and Ellram, 1997). Second, there are two suppliers that are supplying different parts that go into a critical product at the buying company. Third, these two suppliers must have similar production and process technologies, but each supplier can supply the other supplier's part. These three criteria create a multi-sourcing relational context where two suppliers may compete and collaborate at the same time.

Selection of Buying Company and Buyer and Supplier Informants

The selected buying company is a Fortune 100 company. To ensure confidentiality, the company name is concealed. The company was contacted in October 2002 for participation in this study. The vice president (VP) of Strategic Supply Chain Management endorsed the study and sent a memo to the Directors of Supply Management at the company's three divisions, encouraging their participation. They all agreed. For confidentiality, the names of the three divisions are coded as Aero-Machining (AMac), Aero-Electronics (ATro) and Industrial Application (IApp).

A brief introduction of the three divisions' major lines of product and critical components they buy will help to understand product technology and the associated purchasing environment of this study. The AMac division produces aircraft engines and landing systems. It purchases high-precision metal machining parts and assemblies. The ATro division produces complete assemblies of avionics products such as cockpit communication system, navigation and collision avoidance system. The division buys custom-designed circuit cards, machined metal parts and electronic assemblies. The IApp division focuses on industrial applications. Its products include sensors, and temperature, air and flow controls. Like the two aerospace divisions, the IApp division also purchases electronic components and machined parts. But the technical specification is geared toward industrial application.

After a non-disclosure agreement between the researcher and the legal office of the buying company was signed, the directors of the three divisions provided the

researcher with complete name lists of the commodity managers and buyers in their respective divisions. The directors also sent out emails to all the people on the lists, notifying them about the study and upcoming phone call from the researcher. The nondisclosure agreement is reproduced in Appendix A.

Before data collection, meetings were held with three people at each division: the director, and two commodity managers or buyers. The purpose was to understand each division's business, purchasing strategies and general supply management practices. These meetings also allowed the researcher to examine whether the research design and data collection method was applicable at this particular buying company.

After a series of discussions with the buyers and commodity managers, the original triadic purchasing context was slightly modified to make it relevant to the specific research site. In the original research design, the conceptualized triadic relational context predicates that the two suppliers' components go into the same end item at the buying firm. The "same-end-item" criterion was created for selecting the two suppliers in a triad. The logic behind this criterion was to ensure that the two suppliers' business interests are tied. They engage with one another in meaningful exchanges, whether confrontational or collaborative. Such consideration is not relevant at this particular buying company. At this buying firm, the buyers are organized according to commodity groups rather than final products (i.e., end items). For instance, a buyer at the AMac division could be responsible for a commodity group such as casting, machined metal parts, or circuit card assemblies. These purchased components in each commodity group

could go into either the same or different final products (i.e., different commercial aircraft models).

Discussion with the division directors, buyers and commodity managers also revealed that the production activities in the three divisions are largely job-shop operations and production coordination is done by the buying company and, as such, the researcher reasoned that a buyer or commodity manager's supply management strategy on supplier-supplier interactions should not be driven by the workflow requirements as those observed in continuous flow and JIT operations in the automotive industry. Because of this, the researcher concluded that whether the two suppliers supply the same end item does not affect how they interact with each other. The directors, commodity managers and buyers corroborated this reasoning during the meetings. As a result, the "same-end-item" criterion was dropped by the time when the buyer interview protocol was finalized.

Another decision made after talking with the commodity managers and the buyers (three people at each division) was to include both commodity managers and buyers at the buying company as telephone survey informants. In the supply chain organization of the buying firm, commodity managers deal with strategic issues such as supplier selection and contract negotiation. The buyers handle daily procurement tasks such as delivery and supply quality management. Despite the different task assignments, both commodity managers and buyers communicate with the suppliers frequently. They both have intimate knowledge of the suppliers' products and supplier's performance. Furthermore, they also discuss purchasing strategy with each other. Hence they are all

competent to answer the survey questions in this study. For the sake of simplicity, the general term "buyer" is used in the following sections to refer to either the buyer or commodity manager informants in the buying firm.

Data Collection

Because the list of names provided by the three divisions contains all buyers and commodity managers in the three divisions, the sampling technique of this study is a population survey. For the buyer telephone interview, an email was sent to each buyer in the name lists soliciting participation. The email explained the research purpose and asked each buyer to schedule an interview. The survey questionnaire was also attached in the email. Two days after sending the email, the researcher called the buyers to set up a specific interview time. Most of the interviews were conducted within two weeks after initial contact was made. During each telephone interview, both the buyer and the researcher had a copy of the survey questions in front of them. The researcher read the interview questions to the buyer and circled the answers in his copy of the interview protocol.

During the telephone interviews, the buyers identified the two suppliers according to the criteria and gave the suppliers' contact information to the researcher. The suppliers are designated as Supplier A and Supplier B, according to the order their names were given by the buyer. Within two days of each interview, the researcher mailed a copy of the survey to both Supplier A and Supplier B together with a self-addressed return envelope. Each survey questionnaire was customized so that the triadic relational framework is accurately presented to the prospective supplier respondents. Each survey questionnaire specified the name of the other supplier, the names and/or part numbers of the components supplied by both suppliers, and the focal end product where the components are used. The Supplier Mail Survey Questionnaire is reproduced as Appendix C.

If the researcher did not receive the survey response back from a supplier in two weeks, this supplier was called and reminded to return the survey. A new copy of the questionnaire was often faxed to the prospective informant at the supplier company. The supplier respondents were usually sales managers in charge of the buying firm's account. In some cases where the supply company is a small manufacturer, respondents were a company president or director of operations.

Table 5 links the informant with each construct in the two data sets. Supplier A Data Set has 68 responses from the suppliers, corresponding with 68 interviews with the buyers. Supplier B Data Set contains 70 responses from the suppliers, corresponding with 70 interviews with the buyers. Details of the survey and interview response are reported in the following section.

Data collection took place between December 5, 2002 and April 30, 2003. Mail surveys from suppliers received after April 30, 2003 were not used in data analysis.

Survey Response

Table 6 tabulates the buyer telephone survey information. A total of 163 buyers' names were obtained from the three divisions. After initial telephone discussion with the buyers, 23 buyers were deemed inappropriate for the study. For example, in the ATro division, seven interview candidates from one facility were removed from the interview. These seven buyers handle government defense contracts. The purchasing contracts mandate signing of a non-disclosure agreement with the suppliers forbidding disclosure of the suppliers' names. In the same division, another seven interview candidates were deemed unsuitable for the study because they used a single source for all of their commodity procurement. In addition, eight buyers were reluctant to be interviewed. Finally, 16 buyers could not be reached by the data collection cutoff time due to a scheduling conflict arising from issues such as business travel, vacations, sick leave, and job transfers. As a result, a total of 123 interviews were conducted with the buyers in three divisions. Among the 123 interviews, six buyers were interviewed twice. Each of the six buyers provided two different data sets involving two relational triads. The interviews were conducted with a one month interval in between. The response rates for the three divisions, IApp, ATro, and AMac are 92.1%, 76.0%, and 84.6%, respectively.

A total of 246 (123 x 2) survey letters were mailed to the suppliers. Detailed information on supplier response is described in Table 7. By April 30, 2003, the data collection cutoff date, 138 valid replies were received from the suppliers. These 138 survey replies from the suppliers match with 95 buyer interviews. In other words, each

of the 95 buyer interviews is paired up with one corresponding supplier survey reply. Out of the 138 supplier survey replies, 68 are from Supplier A and 70 from Supplier B. There are 43 buyer-supplier-supplier triads where data are collected from all three companies in a triad.

The researcher contacted all suppliers who did not reply to the survey. Several suppliers wrote to the researcher or answered the researcher's phone calls, indicating that they were reluctant to participate in the study. Seven suppliers wrote to the researcher, stating that they had no interaction with the other suppliers. Such replies were not included as valid survey replies and were excluded from the total reply count and subsequent data analysis.

Nominal and Operational Definition of the Constructs

ConstructNominal DefinitionOperational DefinitionSupplier-SupplierThe behavioral actions that two suppliers of a given buying company engage in and that affect one or both suppliers in supplying the buying firm.It is measured as (a) behavioral action that indicates the frequency/extent to which suppliers share information with one another, (b) behavioral actions that indicate the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
DefinitionDefinitionSupplier-SupplierThe behavioral actions that two suppliers of a given buying company engage in and that affect one or both suppliers in supplying the buying firm.It is measured as (a) behavioral action that indicates the frequency/extent to which suppliers share information with one another, (b) behavioral actions that indicate the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
Supplier-SupplierThe behavioral actions that two suppliers of a given buying company engage in and that affect one or both suppliers in supplying the buying firm.It is measured as (a) behavioral action that indicates the frequency/extent to which suppliers share information with one another, (b) behavioral actions that indicate the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that
Interactions suppliers of a given buying company engage in and that affect one or both suppliers in supplying the buying firm. indicates the frequency/extent to which suppliers share information with one another, (b) behavioral actions that indicate the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
company engage in and that affect one or both suppliers in supplying the buying firm. supplying the bu
affect one or both suppliers in supplying the buying firm. another, (b) behavioral actions that indicate the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
supplying the buying firm. the extent to which suppliers help one another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
another to overcome production-related problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
problems and (c) behavioral actions that indicate the extent to which suppliers work together with respect to addressing issues
indicate the extent to which suppliers work
together with respect to addressing issues
OMEDIEL WOULLESDELS OF AUTOENVILVISSUES
and problems of production procurement
and product/process engineering
and product process engineering
Buyer's Influence on The behavioral actions that a It is measured as the extent to which the
Supplier-Supplier buyer engages in to facilitate buyer facilitates collaborations between two
Interactions interactions between two suppliers
suppliers
ouppitoto.
Supplier's Performance The manifested capability and It is measured as the extent to which a
operations outcome of buyer is satisfied with a supplier's (a)
supplying a product to a buyer. product cost, (b) product quality, (c) on-
time delivery. (d) flexibility (e) service and
(f) the overall satisfaction of the huver
toward the supplier in terms of the supply
of a product

Competition Cooperation

Figure 5. Supplier-Supplier Interactions Conceptualization

Supplier-Supplier	Existing	Psychometric	Final Scales
Interactions	Scale Items	Property	Adapted
Supplier-Supplier Interactions 1. Information exchange. Existing scales from Heide and Miner (1992) defined as the degree to which each party discloses information that may facilitate the other party's activities, as opposed to keeping all information proprietary.	 Existing Scale Items 1. In this relationship, it is expected that any information that might help the other party will be provided to them. √^a 2. Exchange of information in this relationship takes place frequently and informally and not only according to a pre-specified agreement. √ 3. It is expected that the parties will provide proprietary information if it can help the other party. √ 4. It is expected that we keep each other informed about events or changes that may affect the other party. √ 	Psychometric Property Existing items in the original study. Survey instrument pre-tested. Scales purified using item-to-total correlations, factor analysis. Cronbach alpha level for all 23 scales of 6 constructs in the study except three exceeds 0.7; these three scales only exceed 0.6 - which 3 not mentioned (Heide and Miner 1992)	 Final Scales Adapted For each statement below, circle the number that best describes how your firm interacts with []. 7- point scales, completely (in)accurate description. 1. In this relationship with [_], it is expected that any information that might help the other party will be provided to them. 2. Exchange of information between our two companies takes places frequently. 3. Exchange of information between our two companies takes places informally. 4. It is expected that [_] and we will provide proprietary information if it can help the other party. 5. It is expected that our
			two companies keep each other informed
			about events or
			changes that may affect

Existing Scales Adapted for Supplier-Supplier Interactions

^aA check mark $\sqrt{}$ indicates an item in original study is used in this study.

Continued

	<u></u>		
Supplier-supplier	Existing	Psychometric	Final Scales
Interactions	Scale Items	Property	Adapted
(continued)			
2. Problem solving	1. In most aspects of	Existing items in the	Circle the number that
and joint activities	this relationship, the	original study. Survey	best describes how your
2	parties are jointly	instrument was pre-	firm interacts with [].
Existing scales from	responsible for	tested. Scales	7-point scales, completely
Heide and Miner	getting things done.	purified using item-	(in)accurate description
(1992). It is	√ √	to-total correlations	()
measured as the	2 Problems that arise	and factor analysis	6 [] and we are jointly
degree to which the	in the course of this		responsible for getting
narties share the	relationship are	Cronbach alpha level	things done
responsibility for	treated by the parties	for all 23 scales of 6	7 Problems that arise in
maintaining the	as joint rather than	constructs in the	the course of our
relationship itself and	individual	study except three	relationship with []
for problems that arise		study except three	
for problems that arise	2 The mention in this	three conles only	are treated by our two
as times goes on.	5. The parties in this	unee scales only	companies as joint
	relationship do not	exceed 0.6 -which 3	rather than individual
	mind owing each	not mentioned (Heide	responsibilities.
	other favors. \vee	and Miner 1992)	8. Our two companies do
	4. The responsibility		not mind owing each
	for making sure that		other favors.
	the relationship		9. The responsibility for
	works for both us		making sure that the
	and this supplier is		relationship works for
	shared jointly. $$		our two companies is
			shared jointly.
			10.Our two companies
			work together on many
			cases (e.g., purchasing,
			product/process
			engineering, material
			management,
			production planning
			and scheduling, etc.).
			(Item developed for
			this study)

^aItem 3 and 6 are from Cannon & Perreault Jr.'s original questionnaire. They were dropped in their published study (1990).

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Continued

Interactions (continued)Scale ItemsPropertyAdapted3. Helping1. Supplier calls in advance to advise us of shipment (delivery) problems.Measurement and structural relationship is molded using LISREL. Parameter estimates an effort to help us during emergencies. \sqrt For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with [_]. 7- point scales, strongly (dis)agree3. Helping1. Supplier necommends structural relationship is defined as the position suppliers take toward assisting the buyer in a relationshipSupplier necommends stock substitutes when delivery trouble develops.Measurement and structural relationship is molded using LISREL. Parameter construct is 0.74.For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with [_]. 7- point scales, strongly (dis)agree emergencies.4. Supplier recommends buyer in a relationship3. Supplier necommends stock substitutes when delivery trouble develops.Supplier helps us in value analysis, ideas, cost reductions, problem solving, etc.5. Supplier advises us of potential problems in meeting our needs. $$ 11.[_] and we help each other in ideas, cost reductions, and problem solving, etc.13. [_] and we advise each other of any potential problems in meeting the buyer's reads.13. [_] and we advise each other of any potential problems in meeting the buyer's reads.	Supplier-supplier	Existing	Psychometric	Final Scales
InteractionsJocate refinsTropertyReapted3. Helping1. Supplier calls in advance to advise us of shipment (delivery) problems.Measurement and structural relationship is molded using LISREL. Parameter estimates and fit statistics are reported. Jöreskog reliability of the second-order the second-orderFor each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with [_]. 7- point scales, strongly (dis)agree3. Helping1. Supplier necommends stock substitutes when delivery trouble develops.Measurement and structural relationship is molded using LISREL. Parameter estimates and fit statistics are reported. Jöreskog reliability of the second-orderFor each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with [_]. 7- point scales, strongly (dis)agree3. Supplier recommends buyer in a relationship3. Supplier recommends stock substitutes when delivery trouble develops.Jöreskog reliability of the second-order to net acts with [_]. 7- point scales, strongly (dis)agree4. Supplier helps us in value analysis, ideas, cost reductions, problem solving, etc.11.[_] and we make an effort to help each other in ideas, cost reductions, and problems sin meeting our needs. $$ 5. Supplier advises us of potential problems in meeting our needs. $$ 13.[_] and we advise each other of any potential problems in meeting the buyer's protential problems in meeting the buyer's	Interactions	Scale Items	Property	Adapted
3. Helping3. HelpingExisting scales from Noordewier et al. (1990). It was called supplier assistance. In a buyer-supplier relationships context, it is defined as the position suppliers take toward assisting the buyer in a relationship1. Supplier calls in advance to advise us of shipment (delivery) problems.Measurement and structural relationship is molded using LISREL. Parameter estimates and fit statistics are reported. Jöreskog reliability of the second-order construct is 0.74.For each statement below, circle the number that indicates your agreement in describing how your firm interacts with [_]. 7- point scales, strongly (dis)agree3. Supplier necommends stock substitutes when delivery trouble develops.3. Supplier necommends stock substitutes when delivery trouble develops.Measurement and structural relationship to help us during emergencies. $$ 4. Supplier helps us in value analysis, ideas, cost reductions, problem solving, etc. $$ Measurement and structural relationship to statistics are reported. Jöreskog reliability of the second-order construct is 0.74.II.[_] and we make an effort to help each other during emergencies.4. Supplier advises us of potential problems in meeting our needs. $$ Supplier advises us of potential problems in meeting our needs. $$	(acentinued)	Seale Hellis	roperty	Adapted
 3. Helping a. Supplier calls in advance to advise us of shipment (delivery) problems. 1. Supplier calls in advance to advise us of shipment (delivery) problems. 2. Supplier makes an effort to help us during emergencies. √ 3. Supplier recommends stock substitutes when delivery trouble develops. 4. Supplier helps us in value analysis, ideas, cost reductions, problem solving, etc. √ 5. Supplier advises us of potential problems in meeting our needs. √ 	(continuea)		······································	
HEEUS.	3. Helping Existing scales from Noordewier et al. (1990). It was called supplier assistance. In a buyer-supplier relationships context, it is defined as the position suppliers take toward assisting the buyer in a relationship	 Supplier calls in advance to advise us of shipment (delivery) problems. Supplier makes an effort to help us during emergencies. √ Supplier recommends stock substitutes when delivery trouble develops. Supplier helps us in value analysis, ideas, cost reductions, problem solving, etc. √ Supplier advises us of potential problems in meeting our needs. √ 	Measurement and structural relationship is molded using LISREL. Parameter estimates and fit statistics are reported. Jöreskog reliability of the second-order construct is 0.74.	 For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with []. 7-point scales, strongly (dis)agree 11.[] and we make an effort to help each other during emergencies. 12.[_] and we help each other during, emergencies. 13.[_] and we advise each other of any potential problems in meeting the buyer's needs.

Existing Scales Adapted for Supplier's Supply Performance

Supplier-supplier	Existing	Psychometric	Final Scales
Interactions	Scale Items	Property	Adapted
(continued)			
Existing scales from	Operations performance	Literature review	For each aspect of supplier
Cannon & Perreault	(Cannon & Perreault Jr.,	and interviews with	performance below, please
Jr. (1999) are used,	1999)	marketing and	circle the number that
plus one item from		purchasing	indicates how well []
Noordewier et al.	1. Product quality $$	personnel to get	performed compared with
1990, and one item	2. Delivery performance	initial pools of	your firm's experience with
created for this study.	V	scales. Coefficient	other suppliers. 7-point
	3. Sales, service and/or	alpha is 0.85.	scales, needs improvement-
	technical support v	Average variance	about average-superior
	4. Total value received N	extracted, adjusted	performance
		item-to-total	1 D. 1
		correlation and	1. Product quality
	Company & Democult In	and an and a second	2. Derivery performance
Existing cooles from	(Californi & Ferreault Jr.,	reported	5. Responsiveness to
Cannon & Perregult	strongly disagree)	Discriminant and	$(N_{aw} item)^{a}$
Ir (1000) are used	subligity disagice)	convergent validity	4 Sales service and/or
JI. (1999) are used.	1 Our firm regrets the	examined	technical support
	decision to do business	CAutilitied.	5 Total value received
	with this supplier	As above	6 Overall cost performance
	Reverse Coded $$	Coefficient alpha is	(New item)
	2. Overall we are very	0.84.	(1.01) 10010
	satisfied with this		For each statement below,
	supplier. $$		circle the number that
	3. We are very pleased		indicates your agreement or
	with what this supplier		disagreement in describing
	does for us. $$		how your firm feels about
	4. Our firm is not		[]. 7 point scales,
	completely happy with		strongly (dis)agree
	this supplier. (Reverse		
	Coded) $$		7. Our firm regrets the
	5. If we had to do this all		decision to do business
	over again, we would		with this supplier.
	still choose to use this		8. Overall, we are very
	supplier. v		Satisfied with [].
			what [] does for us
			10 Our firm is not
			completely hanny with
			this supplier
			11. It we had to do it all over
			again, we would still
			choose to use this
	·		supplier.
News Scales Created for a New Construct Buyer's Influence on Supplier-Supplier

Interactions

Buyer's Influence on	Scales in
Supplier-Supplier	the Dissertation
Interactions	
No existing scales available from existing literature. New scales are developed based on existing literature	Circle the number that indicates your agreement or disagreement with each statement's description of how you manage the interactions between these two suppliers. 7-point scales, strongly (dis)agree
and the author's previous research on this topic.	1. We provide occasions (e.g., social settings, meetings, forums and conferences, etc.) where SUPPLIER A and SUPPLIER B can meet and talk.
	 We encourage SUPPLIER A and SUPPLIER B to work on operations issues (i.e., quality, delivery, forecast, process engineering, etc.) together. SUPPLIER A and SUPPLIER B's ability to work as a team is an important supplier evaluation/selection criterion.
	4. Our contractual agreements with SUPPLIER A and SUPPLIER B promote collaboration between them.
	5. We encourage SUPPLIER A and SUPPLIER B to help each other out if they encounter production problems.
	6. We encourage SUPPLIER A and SUPPLIER B to coordinate their activities without our direct involvement.

Table 5

Two Data Sets and Corresponding Constructs and Informants

Two Data Sets	Corresponding Informants
Supplier A Data Set (N=68)	
Buyer's Influence on Supplier-Supplier Interactions	Buyer
Supplier A Performance	Buyer
Supplier A's Interactions with Supplier B	Supplier A
Supplier B Data Set (N=70)	
Buyer's Influence on Supplier-Supplier Interactions	Buyer
Supplier B Performance	Buyer
Supplier B's Interactions with Supplier A	Supplier B

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Division	Original Informant	Interviews Conducted	Informants without	Interview Candidates	Interview Candidates	Response Rate ^b
	Population	&	Suitable	Reluctant to	Unreachable	
		Number of	Relational	Participate	by the Data	
		Informants ^a	Context for		Collection	
			the Study		Cutoff Date	
IApp	39	36 (35)	1	2	- 1	92.1%
AMac	53	48 (44)	1	0	9	84.6%
ATro	71	39 (38)	21	6	6	76.0%
Total	163	123 (117)	23	8	16	N.A.

Summary of Telephone Interview at the Buying Firm

¹ 1 respondent at IApp, 1 respondent at ATro, 5 respondents at AMac provided two cases in separate interviews. So the corresponding number of effective respondents, the number in the bracket, at IApp, ATro, and AMac are 36 minus 1, 39 minus 1 and 48 minus 4, respectively.

^b Number of Informants/(Original Informant Population – Informants Without Suitable Context for the Study). For example, in AMac division, the response rate is (44)/(53-1)=84.6%

Table 7

Summary of Mail Survey from the Suppliers

Division	Total Number of Survey Letters Sent to Suppliers	Replies Received from Supplier A	Replies Received from Supplier B	Pairs of Replies from Both Supplier A & Supplier B ^a	Response Rate ^b
IApp	36 X 2	19	15	10	47.2%
AMac	48 X 2	27	29	19	58.3%
ATro	39 X 2	22	26	14	61.5%
Total	246	68	70	43	N.A.

^a The number is included in the total number of replies from Supplier A and Supplier B in the left two columns. For example, in the IApp division, 10 pairs of replies are part of 31 total replies (19+15).

^b (Replies Received from Supplier A + Replies Received from Supplier B)/Total Number of Survey

Letters Sent to Suppliers. For example, in the IApp division, the response rate is (19+15)/(36x2)=47.2%.

CHAPTER 5

DATA ANALYSIS

In this study, ordinary least squares multiple regression method is used in model testing. This chapter will first discuss the residual assumptions, diagnosis of outliers and associated remedies in multiple regressions analysis. Then, the methods for examining the psychometric property of the constructs are reported. It is followed by a detailed description of the multiple regression procedure for testing the proposed moderating and mediating models.

Multiple Regression Method

Ordinary least squares regression analysis is conducted to test both moderating and mediating models. SAS is used for statistical analysis (SAS Institute Inc., 1985). As the Model Testing Procedure section will explain, the moderating model is tested following two-step logic and the mediating model is tested using a series of regression models. Each model is tested independently using Supplier A Data Set and Supplier B Data Set.

Two important issues associated with linear multiple regression method are residual assumptions and outliers. These two issues and corresponding remedial measures are discussed in the following two subsections.

Residual Assumptions in Multiple Regression

There are three basic assumptions on residuals in linear regression. Violations of the assumptions raise concerns as to whether the estimates of regression coefficients and their standard error are correct (Cohen, Cohen, West and Aiken, 2003: 117). Three basic assumptions on residuals are to be examined. The first assumption is that the residuals should have constant variance. This is also called *homoscedasticity* of residuals. The second assumption is independence of residuals. That is, there should be no relationships among the residuals. Both non-constant residuals variance and correlated residuals lead to incorrect standard error estimates and significance tests. The third assumption is that the residuals should have a normal distribution. Non-normality of residuals is often an important signal of model misspecification. Table 8 summarizes the visual and statistical methods to examine these three assumptions.

If the assumptions are met, statistical results will be analyzed and reported. If the assumptions are violated, remedial measures will be taken to address this problem in the following post hoc data analysis. The remedial measures are taken in post hoc data analysis. Cohen et al. suggested three remedial methods: data transformation, removal of outliers and robust approach (2003). Data transformation can accomplish three objectives: (1) simplify the relationship, (2) eliminate non-constant residual variance and (3) normalize residuals. Outliers are removed if the outlier(s) represent contaminated observation or rare cases. Robust approach is used when residual normality assumption is violated (Cohen et al., 2003: 221-222, 412-413, 417-418).

The researcher decided to avoid data transformation simply for the purpose of finding a statistically significant relationship between two variables. Although data transformation can "*create more conceptually meaningful units*" (Cohen et al., 2003: 221), it is difficult to interpret the statistical relationship among the variables.

The second objective is irrelevant in this study. As the next chapter will report, all residual variances are constant in this study.

In this study, residual normality was violated in the first mediator regression model using Supplier A Data Set. The researcher decided to use the Robust Approach, M-estimate, over outlier removal and data transformation approaches, to address the residual normality issue. The reasons are two-fold. First, the outliers were identified based on the statistical properties of the data. The researcher tried not to delete any outliers because there is no convincing reason to believe the outliers are contaminated data. Second, as explained above, it is difficult to interpret the statistical relationship among the variables after the data are transformed. The rationale behind using an Mestimate will be explained when it is applied.

Diagnosis and Treatment of Outliers

To diagnose outliers, Cohen et al. suggest that visual inspection be supplemented with regression diagnostics. Outliers have three characteristics: leverage, discrepancy and influence. Leverage examines how unusual a case is in terms of its value on the independent variable(s). Index plot is a convenient method displaying the value of case number and leverage value (h_{ii}). Discrepancy measures the distance between the

predicted and observed value on a dependent variable. Externally studentized residual is one measure of discrepancy. It considers what would happen if the outlying case were deleted from the data set. It identifies cases whose dependent variable value is highly discrepant from its predicted values. Influence estimates how the regression equation would change if one case were removed from the data set. Global measures of influence are DIFFITS and Cook's D. Specific measures of influence (DFBETAS) provide information about how a case affects each individual regression coefficient (β). These regression diagnostics are all deletion statistics. That is, they provide information about how deletion of a case affects overall characteristics of the regression equation. The outlier diagnostics index is summarized in Table 9.

Examination of the Psychometric Properties of the

Scales for the Three Constructs

In this study, reliability and unidimensionality of the three constructs were examined.

Reliability is defined as " [t]he extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials..." (Carmines and Zeller, 1979). In this study, reliability is operationalized as Internal Consistency. The Internal Consistency Method assesses the degree of inter-relatedness or homogeneity among measurement items used to operationalize a construct (Cortina, 1993: 100; Green, Lissitz and Mulaik, 1997). The researcher used one common technique of the Internal

Consistency Method, the reliability coefficient estimate given by Cronbach alpha (Cronbach, 1951).

Factor analysis is conducted to examine construct validity. Construct validity refers to the consistency of a set of operational indicators (i.e., the measurement items) on a latent factor, namely, the construct. Specifically, exploratory factor analysis is applied to examine the unidimensionality of each of the three constructs. Exploratory factor analysis is an appropriate method to identify the number and nature of the underlying factor structure of a set of indicators (Hatcher, 1994). If the indicators, or measurement items in the questionnaire, load highly on the same factor, it can be said that these indicators are consistent in sharing common variance. Consequently, the measurement items comprising these indicators can be said to be unidimensional and measuring the same construct. Principal factor analysis with varimax rotation was conducted on the data for each of the three constructs.

Convergent validity and discriminant validity of a construct cannot be assessed because only one method of measurement (interview and postal survey) is employed in data collection.

Model Testing and Procedure

Both the moderating model and mediating model are tested using multiple regression analysis. Using a series of regression models, Baron and Kelly (1986: 1177)

suggested procedures to test moderating and mediating models. The multiple regression procedures are explained in this section.

A moderator is a variable that affects the direction or strength of the relationship between an independent variable and a dependent variable (Baron and Kenny, 1986). This definition presumes an *a priori* "causal" relationship between the independent variable and the dependent variable. That is, in the proposed moderating model as an example, a causal relationship between Supplier-Supplier Interactions and Supplier Performance is assumed. What we are interested in studying is how the moderator, Buyer's Influence on Supplier-Supplier Interactions, would affect the direction and/or strength of the effect of Supplier-Supplier Interactions on a supplier's Supply Performance. Based on this logic, testing the moderating effect involves two steps. The first step is to establish an *a priori* linear causal relationship between the independent variable and dependent variable. This causal relationship is the main effect. It is expressed as

$$Z = \beta_0 + \beta_{xx} X + e$$

Equation 1

where, X is the independent variable Supplier-Supplier Interactions Z is the dependent variable Supply Performance

The second step tests the moderating effect. Mathematically, a linear hypothesis of the moderating effect is tested by adding a product of the moderator and the

independent variable to the main effect equation. The mathematical equivalence of the moderating effect is depicted in Figure 6.

Here, the moderating effect is represented by the cross product of the moderator and the independent variable. The interaction variable specifies the condition as to how the independent variable affects the dependent variable. The moderating model is expressed as

$$Z = \beta_0 + \beta_{z x/y} X + \beta_{z y/x} Y + \beta_{z x, y} XY + e$$
 Equation 2

where, X is the independent variable Supplier-Supplier Interactions Y is the moderator Buyer's Influence on Supplier-Supplier Interactions

Z is the dependent variable Supply Performance

The moderating effect is supported if the path coefficient $\beta_{zx, y}$ of the cross product variable is statistically significant.

A mediator is the mechanism through which an independent variable works on the dependent variable (Baron and Kenny, 1986: 1176). This study proposes a full mediating model. Referring to Figure 3 in the first Chaper, Supplier-Supplier Interactions, the mediator intervenes between Buyer's Influence on Supplier-Supplier Interactions and Supply Performance. Simply speaking, a buyer has to instigate suppliers to interact with each other in order to attain a certain desired supply performance.

Judd and Kenny recommended estimation of a series of regression equations to test the mediating effect (1981). The first mediator testing equation (Equation 3) is to regress the mediator on the independent variable and estimate the path coefficient, which

is β_{xy} . The regression is expressed as

$$\mathbf{X} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_{xv} \mathbf{Y} + \boldsymbol{e}$$

Equation 3

where, Y is the independent variable Buyer's Influence on Supplier-Supplier Interactions

X is the mediator Supplier-Supplier Interactions

The second mediator testing equation (Equation 4) is to regress the dependent variable on the independent variable and estimate the path coefficient β_{zy} .

 $Z = \beta_0 + \beta_{zy} Y + e$

Equation 4

where, Y is the independent variable Buyer's Influence on Supplier-

Supplier Interactions

Z is the dependent variable Supply Performance

The last equation (Equation 5) is graphically depicted in Figure 7. Three coefficients, β_{xy} , $\beta_{z x/y}$, and $\beta_{z y/x}$, are estimated.

$$Z = \beta_0 + \beta_z x/v X + \beta_z v/x Y + \beta_{xv} Y + e$$

Equation 5

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where, X is the mediator Supplier-Supplier Interactions

- Y is the independent variable Buyer's Influence on Supplier-
- Supplier Interactions
- Z is the dependent variable Supply Performance

To establish the mediation effect, β_{xy} , β_{zy} , and $\beta_{z x/y}$ must be significant, β_{xy} in equation 5 must be smaller than β_{zy} , and finally, $\beta_{z y/x}$ must be insignificant. In Figure 7, the dotted arrow indicates that $\beta_{z y/x}$ needs to be insignificant.

Exploration of the Least Squares Regression Assumptions

Residuals Assumptions	Examination Methods
Constant Variance	Scatter plot of residuals against each of the independent variables and predicted Dependent Variable White Test (P value>0.05 indicates homogeneity of residual variance)
Independence	Index plot (i.e., case-wise plot)
Normality	Normality (Q-Q) plot. Lilliefors' Statistic (P value>0.05 indicates Normality)

Table 9

Regression Diagnostics for Individual Outliers (adapted from Cohen et al., 2003: 410)

Diagnostic Index	Measures
Leverage	Extremity on independent variables
Externally Studentized Residuals	Discrepancy of Y_i from regression line excluding the case
DFFITS	Influence: change in predicted Y if case omitted from estimate
Cook's D	Influence measured as aggregate change in set of B_is if case omitted from estimate
DEBETAS	Influence measured as change in set of <i>B_is</i> if case omitted from estimate



Figure 6. Mathematical Equivalence of the Moderating Effect (Equation 2)



Figure 7. Mediating Effect Testing (Equation 5)

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CHAPTER 6

RESULTS

The chapter first reports preliminary data analysis to understand the characteristics of the data. It is followed by testing of the two proposed models and post hoc data analysis. Post hoc data analysis is based on the model testing results and contextual information garnered during and after the telephone interview and postal survey. It also includes a new model and comparison of the buyer's influence behavior across the three divisions.

Preliminary Data Analysis

First of all, reliability and validity of the three constructs are reported. Then, the statistical characteristics of the data are examined to answer two questions-- (1) Is there any statistical difference between Supplier-Supplier Interactions data in Supplier A Data Set and Supplier B Data Set statistically? (2) Are there any statistical differences among the data collected from the three divisions of the buying company and corresponding suppliers? The rationale and answers to these two questions are also reported in this section.

Psychometric Properties of the Constructs

The reliability of Buyer's Influence on Supplier-Supplier Interactions is examined using the buyer interview data. The sample size is 95. Reliabilities on Supplier Performance and Supplier-Supplier Interactions are examined separately using two data sets: Supplier A Data Set and Supplier B Data Set. The sample size of Buyer's Influence for Supplier A is 95 and Supplier B 94. One set of data from Supplier B was not used in the calculation because of missing values. The sample size of Supplier-Supplier Interactions for Supplier A is 68 and Supplier B 70. Table 10 tabulates the Internal Consistency reliability scores for the three constructs. The reliability of the measurement items for Buyer's Influence on Supplier-Supplier Interactions is high considering it is a new construct.

Principal factor analysis with varimax rotation was conducted on the data for each of the three constructs. Again, since there are two sets of data for Supplier A and Supplier B on Supply Performance and Supplier-Supplier Interactions, the analysis is conducted on each set of data independently. For each construct, the results turn out to be the same for both data sets: As reported in Table 11, exploratory factor analysis indicates that each of the three constructs is unidimensional. One factor is extracted based on the minimum eigenvalue-one criterion.

Tables 12, 13 and 14 report the factor loading result of principal factor analysis. The factor loading for each measurement item is between 0.58 and 0.87 for the new construct, Buyer's Influence on Supplier-Supplier Interactions. All the measurement items are acceptable considering that they are created to measure a new construct. The

factor loadings of the existing measurement items for the other two constructs are higher. Convergent validity and discriminant validity of a construct cannot be assessed because only one method of measurement (interview and postal survey) is employed in data collection.

Statistical Characteristics of the Data

That is, it is expected that there is no statistical difference between Supplier A Data Set and Supplier B Data Set on the construct Supplier-Supplier Interactions. As explained in the Research Design and Data Collection Method section in the previous chapter, the suppliers are designated as Supplier A and Supplier B in the order their names were given by the buyer during the telephone interview. Because of this, the researcher assumes that suppliers are assigned randomly as Supplier A or Supplier B. Consequently, there is no conceivable reason why the two data sets are systematically different. Furthermore, the researcher assumes that the supplier-supplier interactions as a "*homogeneous whole*" (Klein, Palmer and Conn, 2000). Interaction between the suppliers is a mutual experience to both suppliers, and it is measured as observable behavior and activities taking place between them. Informant's perceptual bias should be minimal.

This premise is supported by the paired t-test of the 43 pairs of supplier survey responses on this construct. Table 15 summarizes the result. The perception of paired suppliers is similar. The null hypothesis that the two population means are equal is not refuted. The p-value for the two-tailed t-test is 0.806. The correlation of Supplier A and

Supplier B on Supplier-Supplier Interactions is 0.765. This result indicates that the paired suppliers have consistent perception of their interactions (Jones, Johnson, Butler and Main, 1993; Kumar, Stern and Anderson, 1993).

As introduced in Chapter 4, the buying company's three divisions produce different end products and have independent supply chain organizations. It is likely that each division takes a different approach to managing the relationship between the suppliers. If so, Buyer's Influence on Supplier-Supplier Interactions, the manifested supply management strategy, could be different in the three divisions.

To examine potential divisional differences on the construct Buyer's Influence on Supplier-Supplier Interactions, one-way ANOVA analysis was conducted using both the Supplier A Data Set and Supplier B Data Set. SPSS is used for ANOVA statistical analysis (SPSS Inc., 2001). The One-Way ANOVA procedure compares the group (i.e., division) means, a method known as pair-wise multiple comparisons. In the One-way ANOVA procedure used in this study, the null hypothesis says that average scores of Buyer's Influence on Supplier-Supplier Interactions are statistically the same across the three divisions. Rejection of the hypothesis would indicate that at least one division differs from the other in the way the buyers manage supplier-supplier interactions.

For the Supplier A Data Set, ANOVA F statistics indicate that the means of at least two divisions on Supplier-Supplier Interactions are statistically different. However, the Levene test for homogeneity of variances shows that the variances of the scores are different across the three divisions. The F test may give incorrect results when the sample sizes are not equal, which is the case in this study, and when the variances of the scores across the divisions are different. Because of this, robust tests were conducted. The test statistics of robust tests--Welch statistics and Brown-Forsythe statistics-are both statistically significant. Thus the null hypothesis is rejected. Tables 16, 17, and 18 summarize the One-Way ANOVA statistics for Supplier A Data Set.

The same One-Way ANOVA procedure was applied to Supplier B Data Set. The same statistical conclusion was drawn. The F-test and consequently two robust tests all indicate that at least two divisions have different approaches in influencing supplier-supplier interactions. Tables 19, 20 and 21 summarize the statistical results of One-Way ANOVA analysis using Supplier B Data Set.

Because of the divisional differences, data for all three constructs were standardized according to division. The standardized data were used in the following model testing and post hoc data analysis. The post hoc data analysis will further examine how the three divisions differ in terms of Buyer's Influence on Supplier-Supplier Interactions.

Model Testing

The moderating model and mediating model testing results are reported in this section.

Moderating Model Testing

The main effect of the moderating model was tested first. The original two data sets were entered separately into Equation 1, the main effect model. The main effect model turned out to be insignificant for both data sets. The model statistics for the two data sets are presented in Tables 22 and 23. The three regression assumptions are checked. For both Supplier A and Supplier B data sets, the scatter plots of residuals against the independent variables (i.e., Supplier-Supplier Interactions) and predicted dependent variables (i.e., Supplier Performance) do not show any pattern, as presented in Appendices D, E, F and G. Also, referring to Table 24, the White Test indicates that the residual variance is constant (UCLA Academic Technology Services, 2003).

The index plots for both data sets do not appear to show any residual patterns or clusters, indicating residual independency. The index plots for both data sets are illustrated in Appendices H and I. The normality plots presented in Appendices J and K indicate that the residual normality assumption is satisfied for both data sets. The respective p-values of Lilliefors' Statistic value are 0.934 and 0.0879 for Supplier A and Supplier B data sets, supporting the normality plots conclusion.

Because the main effect (Equation 1) is not established, further model testing for moderating effect is halted.

Examination of the regression diagnostics and scatter plot of residuals against the independent variables and dependent variables indicate presence of outliers in both data sets. In the following post hoc exploratory data analysis, the outliers were analyzed and remedial actions were taken. The moderating model is reexamined using the same two-step procedure if the residual assumptions are met. For now, in terms of theory testing, the hypothesis on moderating effect is not supported using the full data sets.

Mediating Model Testing

To test the mediating model, three regression models need to be estimated (i.e., Equations 3, 4 and 5). Again, the models are tested separately using Supplier A Data Set and Supplier B Data Set.

The first model (Equation 3) tests the relationship between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions. For Supplier A Data Set, the model is significant. The model statistics are reported in Table 25. Checking the three residual assumptions, the normality assumption is not met. The p-value of Lilliefors' statistic is 0.2141, which is larger than 0.05. The null hypothesis that the residuals are normal is rejected. The normality plot, which is illustrated in Appendix L, provides the same conclusion. Cohen et al. pointed out that nonnormal residuals do not lead to serious problems in the interpretation of the significant tests or confidence interval, yet they often signal other problems in the regression model such as model misspecification (Cohen et al., 2003: 126). Violation of normality will be addressed in the post hoc analysis.

The second model (Equation 4) examines the relationship between Supply Performance and Buyer's Influence on Supplier-Supplier Interactions. This relationship was not found with Supplier A Data Set. The model statistics are reported in Table 26. The residual assumptions are all met. But outliers were identified. In the following post hoc analysis, the outliers were analyzed and corresponding remedial actions taken.

For Supplier B Data Set, the relationship between Buyer's Influence and Supplier-Supplier Interactions (Equation 3) is *barely* significant (p=0.0735). All three residuals assumptions are met. The model statistics are reported in Table 27.

The relationship between Supply Performance and Buyer's Influence on Supplier-Supplier Interactions (Equation 4) was also examined using Supplier B Data Set. This relationship is not statistically significant. The result is reported in Table 28. Again, outliers are found. The outliers will be analyzed in post hoc exploratory analysis.

Because the estimates of Equation 4 did not produce significant statistical results for both data sets, mediating model testing was halted.

In summary, this section tells us that, with the two complete data sets, neither the moderating nor the mediating model is supported. The statistically significant relationship that was found is the positive relationship between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions in both Supplier A Data Set and Supplier B Data Set. In the next section, post hoc exploratory data analysis is conducted.

Post Hoc Data Analysis

The post hoc data analysis is exploratory by nature for two reasons. First, further testing of the proposed two models involved removal of outliers. The decision to remove an outlier was based on the statistical characteristics of the empirical data. Determining an outlier also involves subjective judgment. Second, the new models proposed in this section were induced based on the model testing results in the previous section. The new models were to explain and interpret the statistical result. In other words, the proposed new models were not based on *a priori* theory.

Post Hoc Analysis of the Moderating Model

As indicated in the moderating model testing section, outliers are observed in the main effect model (Equation 1) for both Supplier A Data Set and Supplier B Data Set. Using the regression diagnostics index (Cohen et al., 2003: 410), four outliers were removed from Supplier A Data Set. At this time, the Supplier A Data Set, the main effect model (Equation 1) becomes significant. A negative relationship between Supplier-Supplier Interactions and Supply Performance was found. The model statistics are summarized in Table 29. The three residual assumption requirements are all met.

Since the main effect (Equation 1) is established using Supplier A Data Set, the moderating model (Equation 2) was tested. The overall model is significant. However, close examination of the statistical result indicates that only Supplier-Supplier Interactions and Buyer's Influence on Supplier-Supplier Interactions are significant. The

regression coefficient of the cross product, $\beta_{Z,XY}$, is not significant. Thus, the moderating model is still not supported. The model statistics are reported in Table 30.

For the Supplier B Data Set, five outliers were identified using regression diagnosis. After the five outliers are removed, the main effect model is significant. Here, the statistical conclusion is the same as that found using Supplier A Data Set. There is a negative relationship between Supplier-Supplier Interactions and Supply Performance. The model statistics are reported in Table 31.

The moderating model (Equation 2) does not yield a statistically significant result with Supplier B Data Set. The result is reported in Table 32.

In conclusion, the Post Hoc exploratory analysis did not support the moderating model. After the outliers were removed from Supplier A Data Set and Supplier B Data set, a negative relationship between Supplier-Supplier Interactions and Supply Performance was found. This finding will be discussed in Chapter 6.

Post Hoc Analysis of the Mediating Model

As indicated in the Mediating Model Testing section, although the first regression model (Equation 3) is significant, the residual normality assumption is violated. Following Cohen et al.'s recommendation, robust approaches were used as alternatives to the ordinary least squares method to estimate the regression coefficient: *"Ideally, robust approach should perform better than ordinary least squares method when there are outlier or the residual have a non-normal distribution with extreme residuals in the tails."* One robust approach, M-estimation, was used. This method is based on the idea of minimizing squared residuals using iteratively reweighed least squares (Schumacker, Monahan and Mount, 2002).

Robust methods are currently only available in the S-PLUS statistical package (Mathsoft, Inc., 1999). With the M-estimation method, the first model (Equation 3) turned out to be significant again for Supplier A Data Set: Buyer's Influence on Supplier-Supplier Interactions has a positive relationship with Supplier-Supplier Interactions. The results are reported in Table 33.

After outliers are removed from both Supplier A Data Set and Supplier B Data Set, the second model in mediating effect testing (Equation 4) still cannot establish a mediating effect. Thus the mediating effect still cannot be established with the Supplier A Data Set.

Table 34 summarizes all tests conducted in model testing in the previous section and post hoc exploratory model testing in this section. The testing results are also summarized.

Post Hoc Analysis of a New Model

In the above post hoc exploratory data analysis, for both Supplier A Data Set and Supplier B Data set, the relationship between Supply Performance and Supplier-Supplier Interactions is negative, the opposite of the proposed relationship. To understand this outcome, survey data, together with the brief notes taken during the interviews and voluntary comments some suppliers wrote on the returned survey, were reviewed. Follow-up phone calls were made to the buyers and the corresponding pairs of suppliers, where the buyer interview and supplier survey data clearly indicated a high level of interaction and low level of performance. Many suppliers commented that they usually worked with each other when quality or delivery problems occurred or when the buyers required one to help the other. The buyers largely concurred with the suppliers' comments. It appears that supplier-supplier interactions took place only to address immediate problems. If this is the case, then the negative relationship between Supply Performance and Supplier-Supplier Interaction really means that it is the Supply Performance that drives Supplier-Supplier Interactions, not the other way around. That is, the interactions between suppliers are issue-specific and problem-driven.

To test this interpretation, the researcher examined the statistical relationship between the difference of Supply Performance of the pairs of suppliers and Supplier-Supplier Interactions. Here, the researcher surmised that if a buyer gave different ratings on supply performance, the buyer then took note of the performance gap between these two suppliers. Based on the explanation from the buyers and suppliers in the previous paragraph, the researcher inferred that the buyers might require the supplier with a better performance rating to help the other supplier with a lower performance rating to close the performance gap.

To examine whether difference in Supply Performance and Buyer's Influence on Supplier-Supplier Interaction leads to Supplier-Supplier Interactions, a new regression model was specified. This new model is illustrated in Figure 8. It is expressed as

$$Z = \beta_0 + \beta_{z,d/y} D + \beta_{z,y/d} Y + e$$
 Equation 6

where, D is the independent variable Difference in Supply Performance Y is the independent variable Buyer's Influence on Supplier-Supplier Interactions

Z is the dependent variable Supplier-Supplier Interactions

Buyer's Influence on Supplier-Supplier Interactions was also included in the model. The relationship between this variable and Supplier-Supplier Interactions had been tested to be significant in the first mediating model equation (see Tables 25, 27 and 33). Inclusion of Buyer's Influence on Supplier-Supplier Interactions in the new model is to identify all possible antecedents of Supplier-Supplier Interactions.

In the collected data, there are 95 pairs of Supplier Performance data from Supplier A and Supplier B. Referring to Table 7, each of the 95 pairs of performance data has at least one corresponding survey data on Supplier-Supplier Interactions. Fortythree out of 95 pairs have corresponding data on Supplier-Supplier Interactions from both Supplier A and Supplier B. The remaining 52 data on Supplier-Supplier Interactions are collected from either Supplier A or Supplier B. Each of 43 pairs was averaged to represent the overall level of Supplier-Supplier Interactions for that pair. The rationale of using the average is that suppliers in each pair have similar perception on Supplier-Supplier Interactions based on the paired T-test. Each of the remaining 52 data on Supplier-Supplier Interactions was used directly to represent the level of interactions for each pair. The model turns out to be significant. Supplier-Supplier Interactions is positively related with the Difference in Supply Performance. A statistically significant relationship was found between Supplier-Supplier Interaction and Buyer's Influence on Supplier-Supplier Interactions, a result found in the first mediating model (Equation 3) for both Supplier A and Supplier B Data Sets. The model statistics are reported in Table 35. The three residual assumptions are also met.

The researcher also checked the correlation between the two independent variables in the second new model, Difference in Supply Performance and Buyer's Influence on Supplier-Supplier Interactions. The correlation is not significant at the p-value of 0.05. The interpretation and implications of this observation are discussed in the next chapter.

Post Hoc Analysis of the Divisional Differences in Buyer's Influence

In the preliminary data analysis, the divisional differences in Buyer's Influence on Supplier-Supplier Interactions were found. How the three divisions differ in terms of Buyer's Influence on Supplier-Supplier Interactions was analyzed. For both Supplier A Data Set and Supplier B Data Set, Tukey's Honestly Significant Difference (HSD) Test of multiple group comparison indicates the means are statistically different between the AMac division and the IApp division and between the AMac division and Atro division. There is no statistical difference between the IApp division and ATro division. Tukey's

HSD test is a more conservative test based on experimentwise Type I error rates (Kuehl, 1994: 98). The Tukey HSD multiple comparisons outcome is illustrated in Tables 36 and 37. This finding is interesting because ATro, an aerospace division, has a similar supply management strategy to that of IApp, a division that manufactures industrial products. This finding seems counterintuitive. It is expected that the aerospace industry has a very different production flow, demand pattern and product quality/technology requirement from that of industrial products. This finding will be interpreted in the following chapter.

Construct Reliability Assessment

Construct	Reliability	
	Cronbach α	
Buyer's Influence on Supplier-Supplier		
Interactions (5 items) (N=95)	0.89	
Supplier-Supplier Interactions (13 items)		
Data from Supplier A (N=68)		
Data from Supplier B (N=70)	0.97	
	0.96	
Supplier Performance (11 items)		
Data from Supplier A (N=95)		
Data from Supplier B (N=94 ^a)	0.93	
	0.93	

^a1 data point deleted due to missing value

Table 11

Summary of Unidimensionality Assessment Using Principal Factor Analysis

Constructs	Construct Validity Unidimensional?
Buyer's Influence on Supplier-Supplier Interactions (5 items, N=95)	YES
Supplier-Supplier Interactions (13 items)	
Data from Supplier A (N=68)	YES
Data from Supplier B (N=70)	YES
Supplier Performance (11 items)	
	YES
Data from Supplier A (N=95)	YES
Data from Supplier B (N=94)	

Principal Factor Analysis for the Construct Buyer's Influence on Supplier-Supplier

Interactions

Construct	Factor Loading
Buyer's Influence on Supplier-Supplier Interactions	
N = 95, Communality = 3.53	
Item 1	0.58
Item 2	0.71
Item 3	0.87
Item 4	0.77
Item 5	0.78
Item 6	0.86

Table 13

Principal Factor Analysis of the Construct Supplier-Supplier Interactions

Construct	Factor Loa	ding
Supplier-Supplier Interactions	Data from Supplier A N = 68 Communality = 10.21	Data from Supplier B N = 70 Communality = 8.89
Item 1	0.93	0.86
Item 2	0.86	0.76
Item 3	0.83	0.85
Item 4	0.80	0.71
Item 5	0.95	0.87
Item 6	0.90	0.75
Item 7	0.89	0.91
Item 8	0.88	0.88
Item 9	0.95	0.90
Item 10	0.82	0.84
Item 11	0.92	0.82
Item 12	0.87	0.75
Item 13	0.93	0.84

Construct	Fact Load	or ing
Supply Performance	Data from Supplier A	Data from Supplier F
	N = 95	N = 94
	Communality = 5.56	Communality = 6.57
Item 1	0.63	0.63
Item 2	0.65	0.63
Item 3	0.72	0.68
Item 4	0.75	0.68
Item 5	0.87	0.92
Item 6	0.66	0.70
Item 7	0.79	0.79
Item 8	0.92	0.94
Item 9	0.94	0.91
Item 10	0.77	0.72
Item 11	0.73	0.81

Principal Factor Analysis for Construct Supply Performance

Table 15

Paired T-Test of Suppliers' Perception on Supplier-Supplier Interactions

Paired Supplier Group	Correlation	Paired Differences			t	df	P-Value
N=43		Mean	Std. Deviation	95% C.I. of the Difference			
Supplier A		2.337	1.698				
Supplier B		2.293	1.758				
Supplier A-Supplier B	0.765	0.044	1.185	-0.320~ 0.40	0.247	2	0.806 (2 tailed)

Descriptive Statistics of the Supplier A Data Set on Buyer's Influence on Supplier-

Division	Sample Size	Mean	Std. Dev	Std. Error	95% C. I. for Mean		
					Lower Bound	Upper Bound	
IApp	19	1.8858	1.40341	0.32197	1.2094	2.5622	
ATro	22	1.9623	1.27702	0.27226	1.3961	2.5285	
AMac	27	3.0678	1.82372	0.35098	2.3463	3.7892	
Total	68	2.3799	1.62731	0.19734	1.9860	2.7737	

Supplier Interactions

Table 17

One-Way ANOVA Test of Divisional Difference in Buyer's Influence on Supplier-

Supplier Interactions Using Supplier A Data Set

<u>anninin an ann an ann ann ann ann ann an</u>	Sum of Squares	df	Mean Square	F	P-value
Between Groups	21.252	2	10.626	4.422	0.016
Within Groups		65	2.403		
Total		67	Poperananananananananananananananananananan		

Table 18

Homogeneity of Variance Test and Robust Tests for Equality of Means

<u> </u>	Statistic	df1	df2	P-value
Levene Test	4.095	2	65	0.021
Welch	3.843	2	42.319	0.029
Brown-Forsythe	4.694	2	63.171	0.013

Descriptive Statistics of the Supplier B Data Set on Buyer's Influence on Supplier-

Division	Sample Size	Mean	Std. Deviation	Std. Error	95% Lower Bound	C. I. Upper Bound
IApp	15	1.2453	0.24325	0.06281	1.1106	1.3800
ATro	26	1.8208	1.22751	0.24073	1.3250	2.3166
AMac	29	3.0000	1.69701	.31513	2.3545	3.6455
Total	70	2.1860	1.49923	.17919	1.8285	2.5435

Supplier Interactions

Table 20

One-Way ANOVA Test of Divisional Difference in Buyer's Influence on Supplier-

	Sum of Squares	df	Mean Square	F	P-value
Between Groups	35.956	2	17.978	10.111	0.000
Within Groups	119.134	67	1.778		
Total	155.090	69			

Supplier Interactions Using Supplier B Data Set

Table 21

Homogeneity of Variance Test and Robust Tests for Equality of Means

	Statistic	dfl	df2	P-value
Levene Test	14.471	2	67	0.000
Walah	16 714	2	20 505	0.000
weich	10./14	2	38.383	0.000
Brown-Forsythe	13.415	2	52.194	0.000

Regression Statistics of Moderating Effect ((Equation 1) Using Supplier A Data Set
--	--

			Analysis	of Variance				
	Source	DF	Sum Square	of Mea es Squa	an are F	Value	Pr > F	
	Model Error Corrected Total	1 66 67	1.329 63.617 64.946	39 1.32 29 0.96 69	2939 5390	1.38	0.2445	
	Root M Depende Coeff V	SE ent Mea ar	0.981 an -0.000441 -2225	78 R-Se 18 Adj 38	quare 0.0 R-Sq 0.0	0205 0056		
Parameter Estimates								
	Variable	DF	Parameter Estimate	Standard Error	t Valu	e $\Pr > t $	Standardized Estimate	
	Intercept S-S Interactions	1 ^a 1	-0.00054630 -0.14297	0.11906 0.12174	-0.00 -1.17	0.9964 0.2445	0 -0.14307	
Parameter Estimates								
	Variable		DF	95% Confide	nce Limits			
	Intercept S-S Intera	actions	1 1	-0.23825 -0.38602	0.23716 0.10009			
	Depende Coeff V Variable Intercept S-S Interactions Variable Intercept S-S Intercept	ent Mea ar DF 1 a 1	an -0.000441 -2225 Parameter Estimate -0.00054630 -0.14297 Paramete DF 1 1	18 Adj 18 Adj 38 r Estimates Standard Error 0.11906 0.12174 r Estimates 95% Confide -0.23825 -0.38602	t Valu -0.00 -1.17 ence Limits 0.23716 0.10009	e $\Pr > t $ 0.9964 0.2445	Standardized Estimate 0 -0.14307	

Dependent Variable: Supply Performance ^a Supplier-Supplier Interactions

		Analysis o	f Variance			
Source	DF	Sum of Squares	N Sq	lean uare	F Valu	e Pr > F
Model Error Corrected Total	1 68 69	1.30383 65.56266 66.86650	1. 0.9	30383 96416	1.35	0.2489
Root MS Depender Coeff Va	E nt Mean r	0.9819 -0.0001428 -687340	1 R-Sq 6 Adj I 0	juare R-Sq	0.0195 0.0051	
		Parameter	Estimates			
Variable	DF 1	Parameter Estimate	Standard Error	t Valu	the $\Pr > t $	Standardized Estimate
Intercept S-S Interactions	1	0.00005664 -0.13965	0.11736 0.12009	0.00 -1.1	0.9996 6 0.2489	0 -0.13964
		Parameter	Estimates			
Variab	le	DF	95% Confi	dence Li	imits	
Interce	pt	1 -	0.23413	0.2342	5	

Regression Statistics of Moderating Effect (Equation 1) Using Supplier B Data Set

Dependent Variable: Supply Performance

Table 24 White-Test for Variance Constancy/Homoscedasticity

Data Sets DF Chi-Sq. P-Value					
	Data Sets	DF	Chi-Sq.	P-Value	
Supplier A Data Set 2 1.68 0.4315	Supplier A Data Set	2	1.68	0.4315	
Supplier B Data Set 2 1.67 0.4330	Supplier B Data Set	2	1.67	0.4330	

allu de la construction de la construction de la construcción de la construcción de la construcción de la const	Mirendinanontanaan dagaa morraniyaa caga tarayoo waxaa ay		Analysis of	Variance	*****		**************************************
	Source I	OF	Sum of Squares	Mean Square	F	Value	$P_T > F$
	Model Error Corrected Total	1 66 67	9.60748 55.43298 65.04046	9.60748 0.83989		11.44	0.0012
	Root MSE Dependent M Coeff Var	lean	0.916 -0.000735 -1246	46 29 38	R-Square Adj R-Sq	0.1477 0.1348	
			Parameter I	Estimates			
	Variable D	P DF	arameter Estimate	Standard Error	t Value	e Pr>	Standardized t Estimate
	Intercept Buyer Influence ^a	1 1	-0.00096150 0.38454	0.11114 0.11370	-0.01 3.38	0.99 0.00	031 0 012 0.38434
			Parameter I	Estimates			
	Variable		DF 95%	% Confidence	Limits		
	Intercept Buyer Influer	nce	1 -0 1 -	.222285 0.15754	0.22093 0.61155		

Regression Statistics of Mediating Effect (Equation 3) Using Supplier A Data Set

Dependent Variable: Supplier-Supplier Interactions ^a Buyer's Influence on Supplier-Supplier Interactions
1-27-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2		*****					
		A	analysis of Vari	ance			
	Source	DF	Sum of Squares	Mean Square	F Va	alue	Pr > F
	Model Error Corrected Total	1 66 67	0.95138 63.99531 64.94669	0.95138 0.96963	0.9	98	0.3255
	Root MSE Dependent M Coeff Var	lean	0.98470 -0.00044118 -223198	R-Square Adj R-Sq	0.0146 -0.0003		
		P	arameter Estim	nates			
	Parameter Variable	DF	Standard Estimate	Error	t Value	$\Pr > t $	Standardized Estimate
	Intercept Buyer Influence	1 1	-0.00051236 0.12101	0.11941 0.12216	-0.00 0.99	0.9966 0.3255	0 0.12103
		F	arameter Estim	nates			
	Variable	Γ	DF 959	% Confidence	Limits		
	Intercept Buyer Influe	1 nce 1	-0 -0	0.23893 0.3 0.12290 0.3	23790 36492		
Dependent Variab	le: Supply Perform	ance					

Regression Statistics of Mediating Effect (Equation 4) Using Supplier A Data Set

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		Analysis of	Variance			
Source	DF	Sum of Squares	Mean Squar	e F	Value	Pr > F
Model Error Corrected Total	1 68 69	3.09818 63.75987 66.85806	3.09818 0.93765	3	3.30	0.0735
Root MSE Dependent Mea Coeff Var	an	0.96832 0.00143 67782	R-Square Adj R-Sq	0.046 0.032	3	
		Parameter E	stimates			
Variable DF	.]	Parameter Estimate	Standard Error	t Value	Pr > t	Standardized Estimate
Intercept 1 Buyer Influence 1		0.00134 0.21504	0.11574 0.11830	0.01 1.82	0.9908 0.0735	0 0.21527
		Parameter E	stimates			
Variable	D	F 95%	Confidence	e Limits		
Intercept Buyer Influenc	1 xe 1	-0.2296 -0.0210	51 0.232 92 0.451	28 10		

Regression Statistics of Mediating Effect (Equation 3) Using Supplier B Data Set

Dependent Variable: Supplier-Supplier Interactions

			Analysis o	f Variance				
			Sum of	Mean				
Sour	ce	DF	Squares	Square	I	F Value	Pr > F	
Mod	el	- 1	0.30729	0.30729		0.31	0.5771	
Erro	r .	68	66.55921	0.97881				
Corr	ected Total	69	66.86650					
	Root MS	SE	0.989	935	R-Square	e 0.0046		
	Depende	ent Mea	n -0.000142	286	Adj R-So	-0.0100		
	Coeff Va	ar	-6925	;44				
			Demension	P -4				
			Parameter	Estimates				
		Param	eter Stan	dard			Standardiz	ed
Variable	DF	Estin	nate Err	or	t Value	$\Pr > t $	Estima	ate
variable						, ,		
Intercept	1	-0.0001	1383 0.1	1825	-0.00	0.9992		0
Intercept Buyer Influe	1 ·	-0.0001 -0.0	1383 0.1 6772 0.12	1825 2087	-0.00 -0.56	0.9992 0.5771	-0.0671	0 79
Intercept Buyer Influe	1 ence	-0.0001 -0.0	1383 0.1 5772 0.12	1825 2087	-0.00 -0.56	0.9992 0.5771	-0.067	0 79
Intercept Buyer Influe	1 ence	-0.0001 -0.0	1383 0.1 5772 0.12 Parameter	1825 2087 Estimates	-0.00 -0.56	0.9992 0.5771	-0.067	0 79
Intercept Buyer Influe	1 ence Variable	-0.0001 -0.00	1383 0.1 5772 0.12 Parameter DF 95% (1825 2087 Estimates Confidence	-0.00 -0.56 Limits	0.9992 0.5771	-0.067	0 79
Intercept Buyer Influe	1 ence Variable Intercept	-0.0001 -0.0	1383 0.1 5772 0.12 Parameter DF 95% (1 -0.236)	1825 2087 Estimates Confidence 08 0.23	-0.00 -0.56 Limits	0.9992 0.5771	-0.067′	0 79

Regression Statistics of Mediating Effect (Equation 4) Using Supplier B Data Set

Dependent Variable: Supply Performance

Regression Statistics of Post Hoc Moderating Effect (Equation 1) Using Supplier A Data

Set

<u>, , , , , , , , , , , , , , , , , , , </u>	anna ann an Allan Charles ann an Allan Bhaile	**********************	Analysis of V	ariance	an a sun dan su an		
	-	_	Sum of	Mean			-
	Source	D	F Squares	Square	e F	Value	Pr > F
	Model	1	3.07502	2. 3.0750	2	4.12	0.0467
	Error	62	46.30356	0.7468	3		
	Corrected Total	63	49.37857	, .			
	Root MSE		0.86419	R-Square	0.0623		
	Dependent Me	an	0.10438	Adj R-So	0.0471		
	Coeff Var		827.97049	•			
			Parameter Est	imates			
			Parameter	Standard			Standardized
	Variable	DF	Estimate	Error	t Value	$\Pr > t $	Estimate
	Intercept	1	0.10261	0.10803	0.95	0.3459	0
	S-S Interactions	1	-0.23026	0.11348	-2.03	0.0467	-0.24955
			Parameter Est	imates			
	Variable		DF 95%	6 Confidence	Limits		
	Intercept		1 -0.1	1333 0.31	856		
	S-S Interact	ions	1 -0.4	45710 -0.00)342		
Dependent Variab	le: Supply Perfor	mance	e				

Regression Statistics of Post Hoc Moderating Effect (Equation 2) Using Supplier A Data

Set

ad a for a factor of a construction of the second	Analysis of Variance									
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F					
Model	3	6.35482	2.11827	2.95	0.0396					
Error	60	43.02376	0.71706							
Corrected Total	63	49.37857								
Root MSE		0.84680	R-Square	0.1287						
Dependent N	l ean	0.10438	Adj R-Sq	0.0851						
Coeff Var		811.30106								

Parameter Estimates

		Parameter	Standard		5	Standardized
Variable	DF	Estimate	Error	t Value	$\Pr > t $	Estimate
Intercept	1	0.08978	0.11240	0.80	0.4276	0
S-S Interactions	1	-0.30146	0.11653	-2.59	0.0121	-0.32671
Buyer Influence	1	0.25605	0.12640	2.03	0.0473	0.25583
Interactions * Influe	nce ^a 1	0.10612	0.14846	0.71	0.4775	0.08615

Parameter Estimates

Variable	DF	95% Confidence Limit			
Intercept	1	-0.13505	0.31462		
S-S Interactions	1	-0.53456	-0.06837		
Buyer Influence	1	0.00320	0.50889		
Interactions * Influence	: 1	-0.19085	0.40308		

Dependent Variable: Supply Performance

^a The cross product of Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions

Regression Statistics of Post Hoc Moderating Effect (Equation 1) Using Supplier B Data

Set

<u>ar an </u>	Ana	alysis of	Varian	ce	anadaand di karaan di saraji		
Source	DF	Sum Squa	of tres	Mean Squar	e	F Value	Pr > F
Model Error Corrected Totz	1 63 1 64	3.708 48.109 51.817	862 901 762	3.7080 0.7630	52 54	4.86	0.0312
Root MSE Dependent Coeff Var	Mean 13	0.8738 0.0649 345.9961	86 92 9	R- A	-Square dj R-Sq	0.0716 0.0568	
	Par	ameter E	Estimate	es			
Variable DF	Paran Estin	neter nate	Standa Error	rd	t Value	$\Pr > t $	Standardized Estimate
Intercept 1 Interactions 1	0.03 -0.27	937 405	0.109 0.124	01 36	0.36 -2.20	0.7192 0.0312	0 -0.26753
	Par	ameter E	Estimate	es			
Variable	DF	95% C	onfider	ice Lim	its		
Intercept Interactions	1 1	-0.178 -0.522	346 255	0.2572 -0.0255	1		

Dependent Variable: Supply Performance

Regression Statistics of Post Hoc Moderating Effect (Equation 2) Using Supplier B Data

Set

	An	alysis of Variar	nce			
Source	DF	Sum of	Me	an	E Volue	$\mathbf{D}_r \sim \mathbf{E}$
Source	Dr	Squares	Square		r value	rı > r
Model	3	3.85636	1.28	3545	1.63	0.1906
Error	61	47.96126	0.78	3625		
Corrected Total	64	51.81762				
Root MSE		0.88671	R	-Square	0.0744	
Dependent M	lean	0.06492	A	dj R-Sq	0.0289	
Coeff Var	1	365.78173				
	Par	ameter Estimat	tes			
		Parameter	Standard			Standardized
Variable	DF	Estimate	Error	t Value	$\Pr > t $	Estimate
Intercept	1	0.04149	0.11469	0.36	0.7188	0
Interactions	1	-0.25987	0.13433	-1.93	0.0577	-0.25368
Buyer Influence	1	-0.04900	0.11313	-0.43	0.6665	-0.05529
Interactions * Influence	e 1	0.00109	0.12113	0.01	0.9928	0.00115
	Par	rameter Estimat	tes			
Variable	DF	95% Confid	ence Limi	ts		
Intercept	1	-0.18785	0.27084			
Interactions	1	-0.52848	0.00875			
Buyer Influence	1	-0.27522	0.17722			

-0.24113

0.24331

Dependent Variable: Supply Performance

Interactions * Influence 1

Robust Method Regression of Mediating Effect (Equation 3) Using Supplier A Data Set

9-9-00-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0,000-0		R	Robust M	M Linear	Regression	ı		
	Residuals: Min -0.3527	1Q -0.0775		Median 0.1914	3Q 1.4	N 3.	Лах .563	
	Coefficients:							
		Value	Std. Err	or	t value	Pr(> t)		
	(Intercept)	-0.6762	0.038	9 -	17.4028	0.0000		
	C1	0.0880	0.043	31	2.0398	0.0454		
	Residual scale	e estimate: 0.	.4867 on	66 degree	es of freedo	m		
	Proportion of	variation in	response	explained	l by model	: 0.07086		
	Test for Bias							
		Statistic	s P-	value				
	M-estimate	9.13	0.0	0104				
	LS-estimate	3.79	0.	1503				
Dependent	Variable: Supp	lier-Supplier	Interacti	ons				

Summary of Model Testing and Post Hoc Exploratory Model Testing Results

Models	Supplier A Data Set	Supplier B Data Set
· · · · · · · · · · · · · · · · · · ·	Testea? Significant?	Testea? Significant?
Moderating Model Testing	N=68	N=70
Equation 1	Yes, Non-Significant	Yes, Non-Significant
Equation 2	Not Tested	Not Tested
Post Hoc Moderating Model Testing	N=64	N=65
Equation 1	Yes, Significant ^a	Yes, Significant ^a
Equation 2	Yes, Significant ^b	Yes, Non-Significant
Mediating Model Testing	N=68	N=70
Equation 3	Yes, Significant	Yes, Significant
Equation 4	Yes, Non-Significant	Yes, Non-Significant
Equation 5	Not Tested	Not Tested
Post Hoc Mediating Model Testing	N=64	<i>N=65</i>
Equation 3	Yes, Significant	Not Tested
Equation 4	Yes, Non-Significant	Yes, Non-Significant
Equation 5	Not Tested	Not Tested

^a The model is significant, yet the sign of the coefficient is the opposite of what is proposed. ^b The overall model is significant, but the cross product (i.e., the moderating effect) is not significant.

Analysis of Variance Sum of Mean Source DF Squares Square F Value Pr > FModel 2 15.76486 7.88243 9.52 0.0002 Error 92 76.14463 0.82766 Corrected Total 94 91.90949 Root MSE 0.90976 **R-Square** 0.1715 Dependent Mean 0.00105 Adj R-Sq 0.1535 Coeff Var 86427 Parameter Estimates Standardized Parameter Standard Variable DF Estimate Error t Value $\Pr > |t|$ Estimate Intercept 1 0.00132 0.09334 0.01 0.9887 0 Buyer Influence 0.37111 0.09480 3.91 0.0002 0.37151 1 PerfDif 1 0.18373 0.09484 1.94 0.0558 0.18384 **Parameter Estimates** Variable DF 95% Confidence Limits Intercept 1 -0.18406 0.18670 **Buyer** Influence 0.18284 0.55939 1 PerfDif -0.00462 1 0.37208

Post Hoc Analysis of a New Model Using Combined Data

Dependent Variable: Supplier-Supplier Interactions

^a Difference in Supplier Performance

Multiple Comparisons of Divisional Difference in Buyer's Influence on Supplier-

Division	VS.	Division	Mean	Std.	Sig.	95%	C. I.
			Difference	Error		Lower Bound	Upper Bound
IApp	·	ATro	-0.0765	0.48546	0.986	-1.2409	1.0879
		AMac	-1.1820	0.46416	0.035	-2.2953	-0.0687
ATro		IApp	0.765*	0.48546	0.986	-1.0879	1.2409
		AMac	-1.1055*	0.44520	0.041	-2.1733	-0.0377
AMac		IApp	1.1820*	0.46416	0.035	0.0687	2.2953
		ATro	1.1055*	0.44520	0.041	0.0377	2.1733

Supplier Interactions (Tukey HSD) Using Supplier A Data Set

Table 37

Multiple Comparisons of Divisional Difference in Buyer's Influence on Supplier-

Supplier Interactions (Tukey HSD) Using Supplier B Data Set

Division	vs.	Division	Mean	Std.	Sig.	95% C. I.	
			Difference	Error		Lower Bound	Upper Bound
IApp		ATro	-0.5754	0.43232	0.383	-1.6117	0.460
		AMac	-1.7547*	0.42409	0.000	-2.7712	-0.738
ATro		IApp	0.5754	0.43235	0.383	-0.4609	1.611
		AMac	-1.1792*	0.36014	0.005	-2.0425	-0.316
AMac		IApp	1.7547*	0.42409	0.000	0.7382	2.771
		ATro		0.36014	0.005	0.3160	2.042

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CHAPTER 7 DISCUSSION

This study is the first empirical study that operationalized the supplier-supplier relationship as a construct and correlated it with supply performance. Granted, the proposed two models were not supported; however, the study yielded key findings that contribute to the development of supplier-supplier relationship theory. This chapter first recapitulates and interprets the findings of this study. Then the findings are discussed in a broad context of the inter-organizational relationships, supply chain management and the focal company that supplied the data for this study.

Interpretation of Research Findings

There are three interesting findings drawn from the data analysis. These three findings, whether statistically significant or insignificant, are discussed in this section. Their theoretical implications will be discussed in the following section.

The first finding is the positive relationship between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions. Supplier A Data Set strongly supports this finding (see Table 25, p=0.012). Although the p-value for Supplier B Data Set is a little higher than 0.05 (see Table 27, p=0.0735), this relationship is still supported. The interpretation follows that when the buyers initiate the interactions between suppliers, the suppliers comply with the buyers' requirements. And this is certainly good news for the buying company. Being a Fortune 100 company, the buying company has the leverage to dictate to the suppliers what to do and the suppliers comply with the buyers' requirement. As was briefly explained in the previous chapter, buyers may require the suppliers to work together to address production or delivery problems. The suppliers also corroborated that they work together only at the buyers' requests.

The second finding comes from the post hoc exploratory data analysis. With both Supplier A Data Set and Supplier B Data Set, a relationship was established between a supplier's Supply Performance and Supplier-Supplier Interactions, albeit negative. Clearly, interactions between suppliers affect their supply performance. It is just that in this study, the effect happened to be negative. What could be causing this negative relationship?

According to the theoretical argument laid out in Chapter 3, a negative relationship between Supplier-Supplier Interactions and Supply Performance could perhaps point to the potential for collusive behavior between and among suppliers. Simply put, when suppliers interact closely, it is conceivable that they collude against the buyer in terms of pricing and such. However, this theoretical possibility is disputed upon a close examination of the buyer interview notes, the suppliers' comments in their returned mail survey, and the follow-up interviews with the buyers and suppliers. In the follow-up interviews, the researcher identified, based on the survey responses, twelve cases where supplier-supplier interactions are high while the supply performance of the corresponding suppliers are low. The goal here was to obtain alternate explanation to the

collusion argument for the negative correlation. From this follow-up study, a logical, alternate explanation for the negative relationship emerged.

What eventually became clear was that the suppliers were working together to solve temporal problems when they interacted. Couple this situation with the likely fact that they had temporal problems because they were not performing well from the buyer's perspective. As has been briefly explained in Chapter 5, Supplier-Supplier Interactions in this research setting were largely initiated to solve immediate production or delivery– related problems. Several suppliers commented that they only worked together to help the buyers out. In both the ATro and IApp divisions, for example, the electronics assembly suppliers were used to filling each other's inventory shortages when the buyers required immediate delivery on short notice. Such reciprocal assistance between the suppliers was expected by the buyer to ensure on-time delivery. Some suppliers could even look into each other's information system to check inventory status and place an order when they did not have available on-hand inventory. Yet the suppliers were unwilling to go beyond such issue-specific assistance. Several suppliers remarked that they would "never share any company information with the competitors."

The buyers also offered corroborating explanations. Some buyers explained that they only required the suppliers to work together when one supplier had a quality or production problem and/or it could not solve the problem on its own. For example, in the AMac division, the buyers sometimes moved parts production from one supplier to the other for costs or production capacity reasons. During the parts transition period, the new suppliers often had to go through a learning curve and encountered delivery and/or

quality problems. To overcome such problems, the buyers usually nudged the two suppliers to work together. The new suppliers tried to talk with the incumbent suppliers to learn "tribal knowledge" such as how to use the machine tool and how to reduce set-up time. Of course, the incumbent suppliers might not be willing to help the competitor who could potentially take its business away. Under such circumstances, the buyers might step in and force the exchanges between the suppliers.

Post hoc exploratory data analysis supported this interpretation. The positive relationship between the Difference in Supplier Performance and Supplier-Supplier Interactions indicated that the wider the suppliers' performance gap, the higher the level of interactions they were engaged in. One could imagine in this case where one supplier is working with the other supplier to solve problems and the intensity of working together intensifies with the increasing performance gap between the two suppliers.

It is interesting to note that in this post-hoc analysis Buyer's Influence on Supplier-Supplier Interactions does not correlate with the Difference in Supply Performance. One would think that to be consistent with earlier findings there should be a correlation. Therefore, if the Difference in Supply Performance is an adequate proxy of performance gaps, the implication is that the buyers could have other priorities in mind besides solving immediate problems when they facilitate supplier-supplier interactions.

Examination of the measurement items of the Buyer's Influence on Supplier-Supplier Interactions supports this interpretation. Out of the six measurement items of Buyer's Influence on Supplier-Supplier Interactions, only the fifth statement taps into the issue of "helping" or "problem-solving" between the suppliers. The other five

measurement items point to a much broader scope of interactions behavior according to the proposed theory. That is, the measurement items include potential supplier-supplier interactions in terms of joint exploitative and exploratory activities in learning and information sharing. In other words, narrowing the performance gap between the suppliers represents one aspect of buyer's influence intention. To wit, wherein the researcher concludes that issues associated with the measurement scale could account for the result, there is no statistical relationship between Difference in Supply Performance and Buyer's Influence on Supplier-Supplier Interactions.

The last finding is the ambivalent relationship between Buyer's Influence on Supplier-Supplier Interaction and Supply Performance. Although a significant relationship between these two constructs was found in the post hoc analysis using Supplier A Data Set (see Table 30), the result is not conclusive because the relationship was not found in Supplier B Data Set (see Table 32), and neither was the relationship found in the second model when the mediating effect was tested (see Table 26, 28).

There are two possible explanations for this result. The first explanation is straightforward: namely, there is inconclusive relationship between these two constructs. The second explanation concerns the level of Buyer's Influence on Supplier-Supplier Interactions and the level of Supplier-Supplier Interactions in the collected data. Referring to the Appendices B and C, on a Likert scale of 1 to 7, the mean scores of these two constructs are below 3 in both Supplier A and Supplier B data sets across three divisions. That is, the intensity of the buyer's influence and the intensity of suppliersupplier interactions are low. As the following section will explain, the business

environment of this research setting and the buyers' price reduction tactics largely preclude the buyers from engaging the suppliers in collaborative interaction. As a result, the data collected for the Supplier-Supplier Interactions were skewed toward competitive end of the continuum. Thus, to test the relationship between these two constructs fully one would have to address this inherent characteristic of the present data further. This point will be further discussed in the next section.

Overcoming the Gap between the Theory and the Reality

In essence, the theory included the whole spectrum of collaborative relationships (e.g., cooperation and competition); however, the relational dynamics in this study tuned out to be predominantly competitive. Post hoc investigation, as explained in the following paragraphs, demonstrated that both industry and firm-specific factors created the predominantly competitive inter-organizational relationship in this study.

In the aerospace and electronics industries--where the three divisions of the buying firm operate--competition, rather than cooperation, is the dominating theme of inter-organizational relationships. In the aerospace industry, the traditional arm's length relationship is still prevalent thanks to government regulation. The aerospace industry had less exposure to the movement toward a collaborative buyer-supplier in the 1980s and 1990s when many US industries were learning Japanese manufacturing practices; whereas in the electronics industry, overseas competition, product standardization and shorter product life cycles force the suppliers into price wars. The buying company's supply chain management strategy also drives a competitive relationship between the suppliers. Considering Buyer's Influence on Supplier-Supplier Interactions as the manifested supply management strategy, Tables 36 and 37 reveal that the aerospace division ATro shares the same supply management strategy with the industrial division IApp. This observation seems to be counter-intuitive. We generally consider that aerospace manufacturing involves procurement of highly engineered products from the suppliers and, consequently, that the inter-organizational relationship should have been based on alliances and collaboration (Kraljic, 1983). However, pressure for price reductions and product standardization are forcing the industry to approximate the form of a "commodity market" where competition becomes the dominant theme of inter-organizational relationships. Discussion with the buyers revealed that the ATro division tries to use standardized components so as to achieve scale economies. Discussion with the buyers at AMac division indicated that they constantly look for alternative suppliers in low cost regions and this division expects to outsource most of its manufacturing activities overseas in five years.

The competitive relationship found in this research setting is also a result of strategy shifts at the buying company. Follow-up study revealed that a well-intentioned supply management strategy of the buying firm went awry. Since the early 1990s, the buying company, like many other US companies, started to consolidate its supply base. The initial strategic thinking was to create strategic alliances with a smaller group of capable suppliers. By doing so, the buying company could focus its supply management efforts on consolidated suppliers. At the same time, by giving these suppliers larger

contracts, the buying company expected to receive better product quality and lower prices from the suppliers. However, what happened was that short-term price reduction goals undercut the long-term strategy of the buying company. The long-term strategic alliance and short-term cost-cutting tactics take different approaches to accomplishing price reduction. The long-term strategic alliance thinking expects cost reduction through continuous improvement and better product quality, whereas the short-term price cutting tactics involve simply forcing annual price reduction goals onto the suppliers.

Indeed, the short-term price reduction tactics had an adverse effect on the buyersupplier and supplier-supplier relationships. Since one important performance evaluation criterion for buyers is to achieve a price reduction target, the buyers had to constantly look for cheaper supply alternatives. As a result, they were unable to commit to a longterm contract with the suppliers. In the aerospace industry where lead-time is long and future demand is difficult to predict, it was difficult for the suppliers to make capital equipment and raw materials investment. The buyer's short-term tactics worsened the situation. For instance, in the AMac division, a buyer established a blanket order with a supplier with a projection of purchasing quantity in the next three years. While the price is set based on the projected demand, the real market demand in the next three years remains uncertain and the buyer is only legally responsible for purchasing the quantity released for the next 12 months. When the buyer cancels a portion of the blanket order, the supplier will be left with unused materials that were ordered months earlier. Naturally, the suppliers are skeptical of the buyers' promises. To make matter worse, a buyer sometimes moved parts supply among suppliers in an attempt to achieve better

scale economies. However, such actions often created equity issues and distrust among buying firm and the suppliers and animosity among the suppliers themselves. The incumbent suppliers always are wary of being "optimized" out of the business. Furthermore, part transition might not help the buyer in cost saving at all because the new supplier has to go through a learning curve to master production.

Clearly, buyer's price-cutting tactics led to a predominantly competitive business environment. This relationship dynamic is akin to the "close but adversarial" buyersupplier relationship described by Mudambi and Helper (1998). The difference is that the same relational dynamic extends to a broader context that encompasses relationships between suppliers. In conclusion, the highly competitive relational setting of this study precludes the buyer and suppliers from engaging in proactive collaboration in learning and open-information sharing. There is a lack of trust among buyers and the suppliers and among the suppliers. Unlike the participants in Toyota's learning network, suppliers in this research could not benefit from collaborative interaction with each other.

CHAPTER 8 CONCLUSION

This chapter discusses the limitations of the research, future research and research contributions. In the Limitations section, the researcher tries to focus on specific issues in this current study and provides suggestions for new directions in future research. Future Research will first point out the four specific research ideas and three methodological and theoretical issues in inter-organizational relationship research. Contributions of the research will be discussed in terms of theory development and supply chain management practice.

Limitations of the Research

There are four major limitations in this research. The first limitation concerns relational settings of the study. As was elaborated extensively in the previous chapter, supplier-supplier interactions in the study are largely competitive. This relational setting does not capture the long-term-oriented and collaborative relational context subsumed in the theory. As a result, the proposed models, as they were developed, remain yet to be fully tested.

The second limitation is the relatively small sample size of the collected data. A small sample size could produce unstable statistical results. On several occasions, Supplier A Data Set and Supplier B Data Set yield different results (see Table 34). We

cannot make conclusive assertions of a relationship when the two data sets are not in agreement. The statistical results need to be confirmed with new data.

The issue of small sample size also imposes a challenge as to how to deal with the outliers. The outlier data points, the so-called rare cases, may provide important insights into the relationship between the independent variable(s) and dependent variable (Cohen et al., 2003: 413). With a small sample size, even if we can ascertain why the informants answer the survey questionnaires the way they did, it is difficult to determine whether an "outlier" represents a contaminated observation or represents important information about the proposed theory. Removal of the outliers from a small sample creates the lose of important information in the data. Because of this, outliers were only removed in the post hoc exploratory data analysis. Again the research finding should be interpreted only as an exploratory investigation for the purpose of theory development.

The third limitation is the potential lag effect between Supply Performance and the other two variables, Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions. The negative relationship between Supplier-Supplier Interactions and Supply Performance in the current study could be attributed to the potential lag effect. As explained in the previous chapter, Supplier-Supplier Interactions in the study are primarily problem-driven. It may be possible that the poor Supply Performance data reported by the buyers corresponds with the time frame when the problems were being addressed. If Supply Performance data were collected after the problems have been addressed, the research finding could be different. Future research should consider the lag effect and collect longitudinal data so that the potential lag effect issue can be addressed.

Finally, the measurement items of Supplier-Supplier Interactions overemphasized "helping behavior." Out of the 13 measurement items, six are concerned with to "assistance" and/or "problems." The other seven items taps into joint action in production and operations and information sharing. In hindsight, the measurement items are appropriate in this research context because these measurement items are relevant to the manufacturing setting. Yet, if future studies look at supplier-supplier interactions in research and development (R&D), measurement items may also include learning and various aspects of information exchange. Researchers may consider creating new scales instead of using the existing ones.

Future Research

Based on the research findings, limitations of this research, and rich contextual information garnered during this study, seven future research ideas are identified.

First, the proposed two models remain to be tested. The most critical task is to identify research settings that include both competitive and cooperative supplier-supplier interactions as the one laid out in the proposed theory. The supply networks describe by Dyer and Nobeoka (2000) and Uzzi (1997) seem to present the ideal relational setting where the suppliers go beyond helping each other to solve tactical and temporal problems. They engage in continuous learning and information sharing to attain overall betterment of business performance for both buyer and suppliers.

Comparing the relational setting of this study with the "ideal" relational setting in the proposed models, the researcher identifies seven factors leading to competitive supplier-supplier engagement and seven competing factors leading to collaborative suppliers-supplier interactions. These factors are illustrated in Figures 9 and 10. Essentially Figure 9 describes the relational context of this study, where competition predominates the relationship between the suppliers. Figure 10 describes the relational context that needs to be included in future research.

Second, this study only looks at the behavioral dimension of supplier-supplier relationship. To fully understand supplier-supplier relationship, future research should also consider affective and cognitive dimensions of the relationship. As the Toyota learning network example indicates, trust, an affective relational characteristic, is a critical factor leading to co-opetitive interactions between the suppliers (Dyer and Nobeoka, 2000). Further, cognitive complexity is predicated on a supplier's ability to handle cooperation and competition at the same time (Streufert and Streufert, 1978). By considering all three relational dimensions, we are truly exploring a theory of suppliersupplier relationship.

An associated theoretical question is how the three dimensions fit together to describe a relationship type. For instance, in a co-opetitive relationship, two firms may have a high level of collaborative behavioral engagement but a low level of trust; whereas in a cooperative inter-firm relationship, the behavioral and affective dimensions may converge and point to the same direction. A typological approach can be applied in

future research to examine how the three relational dimensions fit together (Doty and Glick, 1994).

Third, this study looks at the relational dynamics between two suppliers in the same tier of a supply chain. Clearly, a supply chain involves multiple tiers. Future research should consider relational settings that encompass suppliers across different tiers. The opportunistic behavior of vertical integration described in transaction cost economics (Coase, 1937) vividly captures the co-opetitive relational dynamics between suppliers in different tiers of a supply chain. Undoubtedly, power plays an important role in the relational dynamics among suppliers across tiers. For instance, a downstream supplier company may have leverage power because of its control of demand information and purchasing leverage. The upstream supply company may also have the leverage power due to its expertise in product technology of the components it supplies. The interplay of power between suppliers in different tiers would affect each supplier's supply performance and the relationship balance between the buyer and suppliers (Heider, 1958).

Fourth, future study should integrate buyer-supplier literature and the manufacturing strategy literature to more deeply understand the firm's competitive advantage. The previous chapter elaborated extensively the dilemma faced by the buying company. On the one hand, the buying company has a long-term objective of creating strategic alliances with the suppliers. On the other hand, this strategic objective was always undercut by short-term price reduction goals. What is interesting is that it explains how changing a firm's strategic priorities leads to changes in its supply

relationships and, consequently, in the firm's ability to access and utilize external resources.

Fifth, the researcher observed a positive correlation between supplier location proximity and supplier-supplier interactions, thereby reaffirming existing theoretical claims in the theory of transaction cost of economics (Williamson, 1987) and social network theory (Wasserman and Faust, 1994). For example, Dyer (1996b) considered the distance between a buyer and a supplier as an indicator of asset-specific investment and collaborative relationship (Dyer, 1996b). Choi and Hong (2002) used distance between two firms as a measure of network complexity. Future research on suppliersupplier interactions should consider controlling the effect of location proximity on the level of supplier-supplier interactions.

Sixth, future research should explore the level of analysis issue. In this study, the unit of analysis is a relationship: the behavioral interactions between two suppliers. The relationship is represented by the procurement of suppliers' components to support a critical product at the buying company. As explained in the Preliminary Data Analysis section, this study assumes that the supplier-supplier dyad is a "*homogeneous whole*" regarding the suppliers' perception of the interactions between them (Klein, Palmer and Conn, 2000). The assumption of homogeneity may not hold. Individuals at different levels of the supplier organization may perceive the relationship differently. If the assumption of homogeneity is relaxed, a multi-level study could reveal interesting dynamics of co-opetition.

Finally, supply performance measurement warrants a different consideration. In this study, supply performance is measured as the comparative performance of the focal supplier against all other suppliers a buyer manages. If the reference point of performance measurement is an industry benchmark or the best of the kind in the industry, the performance data may be very different. For example, a supplier's performance could be good relative to its peers in a buying company's supply base. Yet, this supplier's relative performance could be below average if it is compared with the best performer in the industry. Future research needs to examine the implication of using different performance reference based on the proposed theory.

Contributions of the Research

This study empirically ascertained that there is a statistical relationship between Supplier-Supplier Interactions and Supply Performance. The theoretical significance of this finding is that a buyer's performance is related to indirect relational linkages of this focal buyer. It attests to the notion of "interconnectedness" of inter-organizational relationships. At the same time, it supports the idea that the multitude of interorganizational relationships where a firm is embedded represents part of that firm's unique resources.

Further, this study also ascertained that there is a statistical relationship between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions. The implication of this finding is two-fold. First, a buyer does try to influence the

relationship between the suppliers. Second, a buyer is able to influence the suppliers' relationships.

In terms of supply chain management practices, the following can be learned from this study. First, a buyer needs to manage not only the relationships with its immediate suppliers, but also the relationships among the suppliers themselves. Second, this study suggests how buyers can facilitate collaborations between competing suppliers. As the relational framework of this study indicates, a buyer may award complementary components to the suppliers and link them together through joint project and/or production operations. More importantly, a buyer should build trusting and equitable business environment to make sure the suppliers benefit from participating in collaborative interactions.

Overall Summary of the Dissertation

This study empirically ascertained the relationship between Supplier-Supplier Interactions and Supply Performance. It also identified a positive relationship between Buyer's Influence on Supplier-Supplier Interactions and Supplier-Supplier Interactions. This study also points out that one important task of future researchers is to identify collaborative relational contexts so that the proposed theory can be fully tested. The practical implication of this research finding is that a buyer should manage not just for temporal problems between suppliers but also for long-term strategic relationships between them that can potentially pool resources to realize the sort of benefits that many strategic alliance literature promises.

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Supplier-Supplier Engagement

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Figure 10. Factors Leading to Collaborative

Supplier-Supplier Interactions

^a Multi-sourcing is described in this study in Chapter 2.

BIBLIOGRAPHY

- Anderson, J.C., H. Håkansson and J. Johanson. "Dyadic Business Relationships within a Business Network Context." *Journal of Marketing* 58, no.4 (1994): 1-15.
- Anderson, J.C. and J.A. Narus. "A Model of Distributor Firm and Manufacturer Firm Working Relationships." *Journal of Marketing* 54, no. 1 (1990): 42-58.
- Anderson, E. and B. Weitz. "The Use of Pledges to Build and Sustain Commitment in Distribution Channels." *Journal of Marketing Research* 29, no. 1 (1992): 18-34.
- Ansari, A. and B. Modarress. Just-In-Time Purchasing. New York: The Free Press, 1990.
- Argyle, M. Cooperation: The Basis of Sociability. London: Routledge, 1991.
- Asanuma, B. "The Contractual Framework for Parts Supply in the Japanese Automotive Industry." *Japanese Economic Studies* 13, no. 4 (1985): 54-78.
- Asanuma, B. "Manufacturer-Supplier Relationships in Japan and the Concept of Relation-Specific Skill." *Journal of Japanese and International Economics* 3 (1989): 1-30.
- Axelrod, R. The Evolution of Cooperation. New York: Basic Books, 1984.
- Babbie, E. *The Practice of Social Research*. 8th ed. Belmont, CA.: Wadsworth Publishing Company, 1998.
- Baker, W.E. and R.R. Faulkner. "The Social Organization of Conspiracy: Illegal Networks in the Heavy Electrical Equipment Industry." *American Sociological Review* 58, no. 6 (1993): 837-860.
- Barnett, W.P. "Strategic Deterrence among Multipoint Competitors." *Industrial and Corporate Change* 2, no. 2 (1993): 249-278.
- Barnett, W.P. and G.R. Carroll. "Competition and Mutualism among Early Telephone Companies." *Administrative Science Quarterly* 32, no.3 (1987): 400-421.
- Barney, J. "The Resource-Based Theory of the Firm." Organization Science 7, no.5 (1996): 469–476.
- Barney, J.B. and R.E. Hoskisson. "Strategic Groups: Untested Assertions and Research Proposals." *Managerial and Decision Economics* 11, no. 3 (1990): 187-198.

Baron, R.M. and D.A. Kenny. "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic and Statistical Considerations." *Journal of Personality and Social Psychology* 51, no. 6 (1986): 1173-1182.

Blau, P.M. Exchange and Power in Social Life. New York: John Wiley, 1964.

Bonta, B. "Cooperation and Competition in Peaceful Societies." *Psychological Bulletin* 121, no. 2 (1997): 299-320.

Brandenburger, A.M. and B.J. Nalebuff. Co-opetition. New York: Doubleday, 1996.

- Buchen, I.H. "The Collaborative Customer: The Benefits of 'Coopetition."" *Telemarketing Magazine* 13, no. 5 (1994): 45-46.
- Burt, R.S. *Structural Holes: the Social Structure of Competition*. Cambridge, MA.: Harvard University Press, 1992.
- Cannon J.P. and W.D. Perreault Jr. "Buyer-Supplier Relationships in Business Markets." Journal of Marketing Research 36, no.4 (1999): 439-460.
- Carmines, E.G. and R.A. Zeller. *Reliability and Validity Assessment*. Sage University Paper Series on Quantitative Applications in the Social Sciences. Newbury Park, CA.: Sage Publications, 1979.
- Chen, M.J. and D.C. Hambrick. "Speed, Stealth, and Selective Attack: How Small Firms Differ from Large Firms in Competitive Behavior." *Academy of Management Journal* 38, no. 2 (1995): 453-482.
- Choi, T., 1999. "Reverse Marketing in Asia: A Korean Experience." *Business Horizons* 42, no.5. (1999): 34-40.
- Choi, T.Y. and J.L. Hartley. "An Exploration of Supplier Selection Practices across the Supply Chain." *Journal of Operations Management* 14, no. 4 (1996): 333-343.
- Choi, T.Y. and Y. Hong. "Unveiling the Structure of Supply Networks: Case Studies in Honda, Acura, and DaimlerChrysler." *Journal of Operations Management* 20, no. 5 (2002): 469-493.
- Choi, T.Y., Z. Wu, L.M. Ellram and B. Koka. "Supplier-Supplier Relationships and Their Implications for Buyer-Supplier Relationships." *IEEE Transactions on Engineering Management* 42, no. 2 (2002): 119-130.

- Clark, K.B., 1989. "Project Scope and Project Performance: The Effect of Parts Strategy and Supplier Involvement on Product Development." *Management Science* 35, no. 10 (1989): 1247-1263.
- Clark, K.B. and T. Fujimoto. Product Development Performance: Strategy, Organization and Management in the Word Auto Industry. Boston, MA: Harvard Business School Press, 1991.
- Coase, R.D. "The Nature of the Firm." Economica 4 (1937): 386-405.
- Cohen J., P. Cohen, S.G. West and L.S. Aiken. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed., Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 2003.
- Coleman, J.S. "Social Capital in the Creation of Human Capital." *American Journal of* Sociology 94, (1988): S95-S120.
- Cortina, J.M. "What is Coefficient Alpha? An Examination of Theory and Application." Journal of Applied Psychology 78, no. 1 (1993): 98-104.
- Cosier, R.A. and D.R. Dalton. "Competition and Cooperation: Effects of Value Dissensus and Predisposition to Help." *Human Relations* 41, no. 11 (1988): 823-839.
- Cronbach, L.J., 1951. "Coefficient Alpha and the Internal Structure of Tests." *Psychometrika* 16, no. 4 (1951): 297-334.
- Cross, J., 1995. "IT Outsourcing: British Petroleum's Competitive Approach." *Harvard Business Review* 73, no. 3 (1995): 94-102.
- Cusumano, M.A. and A. Takeishi. "Supplier Relations and Management: A Survey of Japanese, Japanese-Transplant, and U.S. Auto Plants." *Strategic Management Journal* 12, no. 8 (1991): 563-588.
- Das, T.K. and B. Teng. "Resource and Risk Management in the Strategic Alliance Making Process." *Journal of Management* 24, no. 1 (1998): 21-42.
- Davis, D.B. "Noorda: Leaving When Times Get Tough." *Electronic Business Buyer* 19, no. 12 (1993): 50-56, 58.
- Day, G. "Strategic Market Analysis and Definition: An Integrated Approach." *Strategic Management Journal* 2, no. 3 (1981): 281-299.

- De Meyer, A. and B. Van Hooland. "The Contribution of Manufacturing to Shortening Design Cycle Times." *Research and Development Management* 20, no. 3 (1990): 229-239.
- Deutsch, M. "An Experimental Study of the Effects of Cooperation and Competition upon Group Process." *Human Relations* 2 (1949): 199-231.
- DeVellis, R.F. Scale Development: Theory and Applications. Newbury Park, CA: Sage Publications, 1991.
- Doty, D.H. and W.H. Glick. "Typologies as a Unique Form of Theory Building: Toward Improved Understanding and Modeling." Academy of Management Review. 19, no. 2 (1994): 230-251.
- Doty, D.H. and W.H. Glick. "Common Method Bias: Does Common Methods Variance Really Bias Results?" *Organizational Research Methods*. 1, no. 4 (1998): 374-406.
- Dwyer, F.R. and S. Oh. "A Transaction Cost Perspective on Vertical Contractual Structure and Interchannel Competitive Strategies." *Journal of Marketing* 52, no. 2 (1988): 21-34.
- Dyer, J.H. "Specialized Supplier Networks as a Source of Competitive Advantage: Evidence from the Auto Industry." *Strategic Management Journal* 17, no. 4 (1996a): 271-291.
- Dyer, J.H. "Does Governance Matter? Keiretsu Alliances and Asset Specificity as Sources of Japanese Competitive Advantage." Organization Science 7, no. 6 (1996b): 649-666.
- Dyer J.H. and K. Nobeoka. "Creating and Managing a High-Performance Knowledge-Sharing Network: The Toyota Case." *Strategic Management Journal* 21, no. 3 (2000): 345-367.
- Dyer, J.H. and H. Singh. "The Relational View: Corporate Strategy and Sources of Interorganizational Competitive Advantage." Academy of Management Review 23, no. 4 (1998): 660-679.
- Edwards, C.D. Conglomerate Bigness as a Source of Power: Business Concentration and Price Theory. Princeton, NJ: Princeton University Press, 1995.
- Ellram, L.M. "The Supplier Selection Decision in Strategic Partnerships." Journal of Purchasing and Materials Managemen 26, no. 4 (1990): 8-14.
- Ellram, L.M. "Partnering Pitfalls and Success Factors." International Journal of Purchasing and Materials Management 31, no. 2 (1995): 36-44.
- Ellram, L.M. and O.R-V. Edis. "A Case Study of Successful Partnering Implementation." *International Journal of Purchasing and Materials Management 32*, no. 4 (1996): 20-28.
- Emerson, R.M. "Power-Dependence Relations." *American Sociological Review* 27, no. 1 (1962): 31-41.
- Fujimoto, T. The Evolution of a Manufacturing System at Toyota. Oxford: Oxford University Press, 1999.
- Ganesan, S. "Determinants of Long-term Orientation in Buyer-Seller Relationships." Journal of Marketing 58, no. 2 (1994): 1-19.
- Gattorna, J. "Channels of Distribution Conceptualizations: A State-of-the-Art Review." *European Journal of Marketing* 12, no. 9 (1978): 471-512.
- Gimeno, J. and C.Y. Woo. "Mutimarket Contact, Economies of Scope and Firm Performance." *Academy of Management Journal* 43, no. 3 (1999): 239-259.
- Gnyawali, D. and R. Madhavan. "Cooperative Networks and Competitive Dynamics: A Structural Embeddedness Perspective." Academy of Management Review 26, no. 3 (2001): 431-445.
- Gomes-Casseres, B. "Group versus Group: How Alliance Networks Compete." *Harvard Business Review* 72, no. 4 (1994): 62-74.
- Green, S.B., R.W. Lissitz and S.A. Mulaik. "Limitations of Coefficient Alpha as an Index of Test Unidimensionality." *Educational and Psychological Measurement* 37, no. 4 (1977): 827-838.
- Gulati, R. "Alliances and Networks." *Strategic Management Journal* 19, no. 4 (1998): 293-317.
- Hahn, C.K., C.A. Watts and K.Y. Kim. "The Supplier Development Program: A Conceptual Model." *Journal of Purchasing and Materials Management* 26, no. 2 (1990): 2-7.
- Hamel, G. "Competition for Competence and Inter-Partner Learning within International Strategic Alliances." *Strategic Management Journal* 12, no. 5 (1991): 83-103.

- Harryson, S.J. "How Canon and Sony Drive Product Innovation Through Networking and Application-Focused R&D." *Product Innovation Management* 14, no. 4 (1997): 288-295.
- Hartley, J.L., and T. Choi. "Supplier Development: Customers as a Catalyst of Process Change." *Business Horizon* 39, no. 4 (1996): 37-44.
- Hartley, J.L., J.R. Meredith, D. McCutcheon and R.R. Kamath. "Suppliers' Contributions to Product Development: An Exploratory Study." *IEEE Transactions on Engineering Management* 44, no. 3 (1997): 258-267.
- Hatcher, L. A Step-by-Step Approach to Using the SAS Systems for Factor Analysis and Structural Equation Modeling. Cary, NC: SAS Institute Inc., 1994.
- Heide, J.B. and A.S. Miner. "The Shadow of the Future: Effects of Anticipated Interaction and Frequency of Contract on Buyer-Seller Cooperation." Academy of Management Journal 35, no. 2 (1992): 265-291.
- Heider, F. The Psychology of Interpersonal Relations. New York: John Wiley and Sons, Inc., 1958.
- Helper, S. "Strategy and Irreversibility in Supplier Relations: The Case of the U.S. Automobile Industry." *Business History Review* 65, no. 4 (1991a): 781-824.
- Helper, S. "How Much Has Really Changed between U.S. Automakers and Their Suppliers?" *Sloan Management Review* 32, no. 4 (1991b): 15-28.
- Hill, C.W. "Cooperation, Opportunism, and the Invisible Hand: Implication for Transaction Cost Theory." *Academy of Management Review* 15, no. 3 (1990): 500-513.
- Hirschman, A.O. Exit, Voice and Loyalty: Response to Decline in Firms, Organizations and States. Cambridge, MA: Harvard University Press, 1970.
- Ip, G. "Companies are Seeing Efficiencies Erode as Securities Worries Drag on Productivity." *The Wall Street Journal* 24 October 2001, A1.
- James, L.R. and J.M. Brett. "Mediators, Moderators, and Tests for Mediation." *Journal* of Applied Psychology 69, no. 2 (1984): 307-321.
- Jap, S.D. "Pie-Expansion Efforts: Collaboration Process in Buyer-Supplier Relationships." *Journal of Marketing* 36, no. 4 (1999): 461-475.

- Jap, S.D. "Pie-Sharing in Complex Collaboration Contexts." Journal of Marketing Research 38, no. 1 (2001): 86-99.
- Johnson, D.W., G. Maruyama, R. Johnson and D. Nelson. "Effects of Cooperative, Competitive, and Individualistic Goal Structures on Achievement: A Meta-Analysis." *Psychological Bulletin* 89, no. 1 (1981): 47-62.
- Jones, A.P., L.A. Johnson, M.B. Butler and D.S. Main. "Apples and Oranges: An Empirical Comparison of Commonly Used Indices of Interrater Agreement." *Academy of Management Journal* 26, no. 3 (1993): 507-519.
- Judd C.M. and D.A. Kenny. *Estimating the Effects of Social Interventions*. New York: Cambridge University Press, 1981.
- Kamath, R.R. and J.K. Liker. "A Second Look at Japanese Product Development." *Harvard Business Review* 72, no. 6 (1994): 154-158.
- Klein, B., R.G. Crawford and A.A. Alchian. "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process." *Journal of Law and Economics* 21, no. 2 (1978): 297-326.
- Klein, K.J., S.L. Palmer and A.B. Conn. "Interorganizational Relationships: A Multi-Level Perspective." in Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions and New Directions, ed. Klein, K.J. and S.J. Kozlowski, 267-307, San Francisco: Jossey-Bass, 2000.
- Kogut, B. "Joint Ventures: Theoretical and Empirical Perspectives." *Strategic Management Journal* 9 no. 4 (1988): 319-332.
- Kogut, B. "The Network as Knowledge: Generative Rules and the Emergence of Structure." *Strategic Management Journal* 21, no. 3 (2000): 405-425.
- Koka, B.R. and J. Prescott. Strategic Alliances as Social Capital: A Multi-dimensional View. *Strategic Management Journal* 23, no. 9 (2002): 795-816.
- Kraljic, P. "Purchasing Must Become Supply Management." *Harvard Business Review* 61, no. 5 (1983): 109-117.
- Krause D.R. and L.M. Ellram. "Critical Elements of Supplier Development: the Buying Firm Perspective." *European Journal of Purchasing and Supply Management* 3, no. 1 (1997): 21-32.

- Krause, D.R., R.B. Handfield and T.V. Scannell. "An Empirical Investigation of Supplier Development: Reactive and Strategic Processes." *Journal of Operations Management* 17, no. 1 (1998): 39-58.
- Kreps, D.M, P. Milgrom, J. Roberts and R. Wilson. "Rational Cooperation in the Finitely Repeated Prisoners' Dilemma." *Journal of Economic Theory* 27, no. 2 (1982): 245-252.
- Kuehl, R.O. Statistical Principles of Research Design and Analysis. Belmont, CA: Duxbury Press, 1994.
- Kumar, N., L.W. Stern and J.C. Anderson. "Conducting Interorganizational Research Using Key Informants." Academy of Management Journal 36, no. 6 (1993): 1633-1651.
- Lado, A.A., N.G. Boyd and S.C. Hanlon. "Competition, Cooperation and the Search of Economic Rents: A Syncretic Model." *Academy of Management Review* 22, no. 1 (1997): 110-141.
- Larsson, R., T. Bengtsson, K. Henriksson and J. Sparks. "The Interorganizational Learning Dilemma: Collective Knowledge Development in Strategic Alliance." Organization Science 9, no. 3 (1998): 285-305.
- Latour, A. "A Fire at Albuquerque Sparks Crisis for European Cell-Phone Giants." *The Wall Street Journal* 29 January 2001, A1.
- Lorenzoni, G. and A. Lipparini. "The Leveraging of Interfirm Relationships as a Distinctive Organizational Capability: A Longitudinal Study." *Strategic Management Journal* 20, no. 4 (1999): 317-338.

Luce, R.D. and H. Raiffa. Games and Decisions. New York: Wiley, 1957.

- Macneil, I.. "The Many Futures of Contract." University of South California Law Review 61 (1974): 691-816.
- Martin, X., W. Mitchell and A. Swaminathan. "Recreating and Extending Japanese Automobile Buyer-Supplier Links in North America." *Strategic Management Journal* 16, no. 8 (1995): 589-619.

Mathsoft, Inc. S-PLUS 2000: Guide to Statistics. Seattle, Washington, 1999

May, M.A. and L.W. Doob. *Competition and Cooperation: A Report.* Bulletin No. 25, New York, American Social Science Research Council, 1937.

- McMillan, J. "Managing Suppliers: Incentive Systems in Japanese and United States Industry." *California Management Review* 32, no. 4 (1990): 38-55.
- Michaels, J. "Classroom Reward Structures and Academic Performance." *Review of Education Research* 47 (1977): 87-99.
- Mintzberg, H. "Patterns in Strategy Formation." *Management Science* 24, no. 9 (1978): 934-948.
- Miyashita, K. and D.W. Russell. *Keiretsu: Inside the Hidden Japanese Conglomerates*. New York: McGraw-Hill, 1994.
- Mudambi, R. and S. Helper. "The 'Close but Adversarial' Model of Supplier Relations in the U.S. Auto Industry." *Strategic Management Journal* 19 (1998): 775-792.
- Morgan, R.M. and S.D. Hunt. "The Commitment-Trust Theory of Relationship Marketing." *Journal of Marketing* 58, no. 3 (1994): 20-38.

Murphy, T. "Insourcing." Ward's Auto World 39, no. 4 (2003): 44-48.

- Nahapiet, J. and S. Ghoshal. "Social Capital, Intellectual Capital, and the Organizational Advantage." *Academy of Management Review* 23, no. 2 (1998): 242-266.
- Nisbet, R.A. International Encyclopedia of the Social Sciences. New York: Free Press, 1972.
- Nishiguchi, T. Strategic Industrial Outsourcing: The Japanese Advantage. Oxford: Oxford University Press, 1994.
- Nishiguchi, T. and A. Beaudet. "The Toyota Group and Aisin Fire." *Sloan Management Review* 40, no. 1 (1998): 49-59.
- Nishigushi, T. and J. Brookfield. "The Evolution of Japanese Subcontracting." *Sloan Management Review* 39, no. 1 (1997): 89-101.
- Nohria, N. and C. Garcia-Pont. "Global Strategic Linkages and Industry Structure." *Strategic Management Journal* 12 (1991): S105-S124.
- Noodewier, T.G., G. John and J.R. Nevin. "Performance on Outcomes of Purchasing Arrangements in Industrial Buyer-Vendor Relationships." *Journal of Marketing* 54, no. 4 (1990): 80-93.
- Olsen, R.F. and L.M. Ellram. "A Portfolio Approach to Supplier Relationships." Industrial Marketing Management 26, no. 2 (1997): 101-113.

- Parkhe, A. "Strategic Alliance Structuring: A Game Theoretic and Transaction Cost Examination of Interfirm Cooperation." *Academy of Management Journal* 36, no. 4 (1993): 794-829.
- Peteraf, M.A. "The Cornerstones of Competitive Advantage: A Reource-Based View." *Strategic Management Journal* 14 (1993): 179-191.
- Porter, M.E. Competitive Advantage: Creating and Sustaining Superior Performance. New York: The Free Press, 1985.
- Porter, M.E. "Clusters and the New Economics of Competition." *Harvard Business Review* 76, no. 6 (1998): 77-90.
- Powell, W.W., 1990. "Neither Market nor Hierarchy: Network Forms of Organization." Research in Organizational Behavior 12: 295-336.
- Powell, W.W., K.W. Koput and L. Smith-Doerr. "Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology." *Administrative Science Quarterly* 41, no. 1 (1996): 116-145.
- Provan K. and B. Milward. "A Preliminary Theory of Interorganizational Network Effectiveness: A Comparative Study of Four Community Mental Health Systems." *Administrative Science Quarterly* 40, no. 1 (1995): 1-33.
- Rapoport, A. and A. Chammah. *Prisoner's Dilemma*. Ann Arbor, MI: University of Michigan Press, 1965.
- Richardson, J. "Parallel Sourcing and Supplier Performance in the Japanese Automobile Industry." *Strategic Management Journal* 14, no. 5 (1993): 339-350.
- Richardson, J. and J. Roumasset. "Sole Sourcing, Competitive Sourcing, Parallel Sourcing: Mechanism for Supplier Performance." *Managerial and Decision Economics* 16, no. 1 (1995): 71-84.
- Ridley, C.A. and A.W. Avery. "Social Network Influence on the Dyadic Relationship." in Social Exchange in Developing Relationships, ed. Burges, R.L. and T.L. Huston, 223-245, New York: Academic Press, 1979.
- Robicheaux, R.A. and A.I. El-Ansary. "A General Model for Understanding Channel Member Behavior." *Journal of Retailing* 52, no. 4 (1976): 13-30, 93-94.
- Rungtusanatham, M.J. "Let's Not Overlook Content Validity." *Decision Line* 29, no. 4 (1998): 10-13.

- Rungtusanatham, M.J, T.Y. Choi, D.G. Hollingsworth, Z. Wu and F. Cipriano. "Survey Research in Production/Operations Management: Historical Analyses and Opportunities for Improvement." *Journal of Operations Management* 21, no. 4 (2003): 476-488.
- Rungtusanatham, M.J, F. Cipriano, F. Salvador and T.Y. Choi. "Supply Chain Linkages and Operational Performance: A Resource-Based View Perspective." forthcoming.

SAS Institute Inc. SAS User's Guide: Basics, Version 5 Edition. Cary, 1985.

- Schumacker, R.E., M.P. Monahan and R.E. Mount. "A Comparison of OLS to LTS and MM Robust Regression in S-PLUS." Southwest Educational Research Association 25th Annual Meeting, Austin, TX, 2002.
- Shaw, M.E. "Some Motivational Factors in Cooperation and Competition." *Journal of Personality* 6, no. 2 (1958): 155-169.
- Smith, K.G., W.J. Ferrier and H. Ndofor. "Competitive Dynamics Research: Critique and Future Directions." in *The Blackwell Handbook of Strategic Management*. ed. Hitt M.A., R.E. Freeman and J.S. Harrison, 315-356. Oxford: Blackwell Publishers Inc., 2001.
- Smith, K.G., C.M. Grimm and M.J. Gannon. *Dynamics of Competitive Strategy*. Newbury Park, CA: Sage Publications, 1992.

SPSS Inc. SPSS Base 11.0 for Windows Users Guide. Chicago, 2001.

- Stern, L.W. and T. Reve. "Distribution Channels as Political Economies: A Framework for Comparative Analysis." *Journal of Marketing* 44, no. 3 (1980): 52-64.
- Streufert, S. and S.C. Streufert. *Behavior in the Complex Environment*. Washington, D. C.: V. H. Winston & Sons, 1978.
- Stuart, T. "Interorganizational Alliances and the Performance of Firms: A Study of Growth and Innovation Rates in a High Technology Industry." *Strategic Management Journal* 21, no. 8 (2000): 791-811.

Sudhindra, S. "Bidding for Contests." Management Science 41, no. 4 (1995): 561-576.

Tjosvold, D., 1985. "Implications of Controversy Research for Management." *Journal* of Management 11: 21-37.

- Treleven, M. and S.B. Schweikhart. "A Risk/Benefit Analysis of Sourcing Strategies: Single vs. Multiple Sourcing." *Journal of Operations Management* 7, no. 4 (1988): 93-114.
- UCLA Academic Technology Services. Available from http://www.ats.ucla.edu/stat/sas/webbooks/reg/chapter2/sasreg2.htm; accessed 7 July 2003.
- Uzzi, B. "Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness." *Administrative Science Quarterly* 4, no. 2 (1997): 35-67.
- Walker, G., B. Kogut and W. Shan. "Social Capital, Structural Holes and the Formation of an Industry Network." *Organization Science* 8, no. 2 (1997): 109-125.
- Walker, G. and L. Poppo. "Profit Centers, Single-Source Suppliers, and Transaction Costs." *Administrative Science Quarterly* 36, no. 1 (1991): 66-87.
- Walker, G. and D.W. Weber. "A Transaction Cost Approach to Make-or-Buy Decisions." *Administrative Science Quarterly* 29, no. 3 (1984): 373-391.
- Wasserman, S. and K. Faust. Social Network Analysis: Methods and Applications. New York: Cambridge University Press, 1994.
- Weitz, B.A. "Introduction to Special Issue on Competition." *Journal of Marketing Research* 22, no. 3 (1985): 229-236.
- Wellman, B. and S.D. Berkowitz. "Studying Social Structures." in Social Structures: A Network Approach. ed. Wellman, B. and S.D. Berkowitz, 1-18. Cambridge, MA: Cambridge University Press, 1988.
- Wernerfelt, B. "A Resource-Based View of the Firm." *Strategic Management Journal* 5 (1984):171-180.
- Wernerfelt, B. "The Resource-Based View of the Firm: Ten Yeas After." *Strategic Management Journal* 16, no. 3 (1995): 171-174.
- Williamson, O.E. Markets and Hierarchies, Analysis and Antitrust Implications: A study in the Economics of Internal Organization. New York: Free Press, 1975.
- Williamson, O.E. "Transaction Cost Economics: The Governance of Contractual Relations." *Journal of Law and Economics* 22, no. 2 (1979): 3-61.
- Williamson, O.E. "The Economics of Organization: The Transaction Cost Approach." *American Journal of Sociology* 87, no. 3 (1987): 548-577.

- Williamson, O.E. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives." *Administrative Science Quarterly* 26, no. 2 (1991): 269-296.
- Wu, Z. and T.Y. Choi. Supplier-Supplier Relationships in the Buyer-Supplier Triad: Building Theories from Seven Case Studies. Decision Sciences Institute 2002 Proceedings (2002): 2021-2026.
- Young, L.C. and I.F. Wilkinson. "The Role of Trust and Co-operation in Marketing Channels: A Preliminary Study." *European Journal of Marketing* 23, no. 2 (1989): 109-122.
- Young, L.C. and I.F. Wilkinson. "The Space Between: Towards a Typology of Interfirm Relations." *Journal of Business-to-Business Marketing* 4, no. 2 (1997): 53-97.

APPENDIX A

NON-DISCLOSURE AGREEMENT WITH THE BUYING COMPANY

Mutual Exchange of Proprietary Information Agreement No:

Disclosure Period: <u>5</u> years Proprietary Period: <u>5</u> years

PROPRIETARY INFORMATION EXCHANGE AGREEMENT

This Proprietary Information Exchange Agreement (this "Agreement") is made and entered into as of November 3, 2002 by and between [BUYING COMPANY] acting through [DIVISION] with its primary office at [ADDRESS] and <u>Zhaohui Wu</u>, with its primary office at Department of Supply Chain Management, W. P. Carey College of Business, Arizona State University, Tempe, Arizona 85287-4706 ("ASU").

RECITALS

A. Each of the parties possesses, or may possess, certain Proprietary Information related to <u>Study of Supplier Relationship Management and Supply Management Strategy</u> ("Program ") which the other party may wish to review.

B. The parties recognize that the Proprietary Information is a valuable asset of the disclosing party, and that misuse or unauthorized disclosure will substantially impair the value of the Proprietary Information.

C. Each party acknowledges that the other party may not sell, or have under development, products which are competitive with those of the other party.

AGREEMENT

NOW THEREFORE, the parties agree as follows:

1.

DEFINITION OF PROPRIETARY INFORMATION

"Proprietary Information" means any information, technical data or know-how in whatever form, including, but not limited to, documented information, machine readable or interpreted information, information contained in physical components, maskworks and artwork, which are clearly identified as being confidential or proprietary. Information transmitted orally or visually shall be considered to be Proprietary Information provided such Proprietary Information is identified by the disclosing party prior to disclosure, reduced to written summary form, and marked as being confidential or proprietary by the transmitting party, and transmitted to the recipient within thirty (30) days after such oral or visual transmission. During this thirty (30) day period, such oral or visual information so disclosed shall be provided the same protection as provided Proprietary Information as set forth below.

2. INFORMATION NOT CONSIDERED PROPRIETARY

Proprietary Information does not include information which is: (a) developed by the receiving party independently of the disclosing party as supported by the receiving party's written records; (b) rightfully obtained without restriction by the receiving party from a third party; (c) publicly available other than through the fault or negligence of the receiving party; (d) released without restriction by the disclosing party to anyone including the U.S. Government as supported

by the receiving party's written records; or (e) known to the receiving party at the time of its disclosure.

3. DERIVATIVE AND INDEPENDENTLY DEVELOPED INFORMATION.

3.1 Information, inventions, data, and ideas specifically developed by Supplier using any Proprietary Information to perform, any purchase order for goods or services to [BUYING COMPANY] and required for the design definition, unique production requirements, or unique repair schemes, improvements, or modifications of such goods or services shall be owned by and disclosed to [BUYING COMPANY] at [BUYING COMPANY]'s direction, and shall be treated as Proprietary Information in accordance with this Agreement. Further, all information, inventions, data and ideas derived by Supplier through the use of Proprietary Information shall be owned by [BUYING COMPANY]. Such information includes without limitation designs, unique processes, drawings, prints, unique specifications, reports, test data, and other technical information, regardless of form, and all unique equipment, tools, gauges, patterns, process sheets or work instructions.

3.2 Supplier information, inventions, data and ideas independently developed from Proprietary Information shall be owned by Supplier subject to Supplier maintaining reasonable documentation supporting such independently developed information, inventions, data, and ideas. Such Supplier developed information includes without limitation designs, unique processes, drawings, prints, unique specifications, reports, test data, and other technical information, regardless of form, and all unique equipment, tools, gauges, patterns, process sheets or work instructions.

4. MARKING OF PROPRIETARY INFORMATION

Any Proprietary Information exchanged by the parties and entitled to protection hereunder shall be identified as such by an appropriate stamp or marking on each document exchanged designating that the Proprietary Information is "Proprietary" or "Highly Proprietary".

5. **PROTECTION**

The receiving party shall hold each item of Proprietary Information so received in confidence until <u>5</u> years after the expiration of this Agreement (the "Proprietary Period").

6. ALLOWABLE USES

During the Proprietary Period the receiving party shall use the Proprietary Information for the following purposes only with respect to the Program: <u>Study of Supplier Relationship</u> <u>Management and Supply Management Strategy.</u>

7. IMPERMISSIBLE USES, NO RIGHTS GRANTED

A. Neither party hereto shall, without the prior written consent of the other, (i) disclose such Proprietary Information during the Proprietary Period in whole or in part; or (ii) use in whole or in part, Proprietary Information disclosed by the other to manufacture or enable manufacture by itself or third parties of the disclosing party's products, products similar thereto, or products derived therefrom.

B. The receiving party may not use the Proprietary Information to reproduce, redesign, reverse engineer or manufacture any products or equipment of the disclosing party. The receiving party may not use the Proprietary Information to perform any services relating to the products or equipment of the disclosing party.

C. Proprietary Information shall remain the property of the disclosing party. Nothing in this Agreement shall be construed as granting or conferring any rights on the part of any party by license or otherwise, expressly or implied, to any invention or discovery, or to any patent covering such invention or discovery.

8. PERMITTED DISCLOSURES

A. The receiving party shall make the Proprietary Information available only to its employees, contract employees, and other parties working on the Program within the receiving party's facility and having a "need to know" with respect to said purpose. In connection therewith the parties shall advise each such employee, contract employee, or other party of its obligations under this Agreement.

B. If authorized in writing by the disclosing party, the receiving party may disclose Proprietary Information of the disclosing party to a third party; provided that the receiving party requires the third party to enter into a proprietary information exchange agreement with similar terms and conditions to this Agreement and such agreement is provided to the disclosing party within fifteen (15) days after the date on which it was entered into.

C. Except when authorized in writing by the disclosing party, the receiving party shall not otherwise disclose such Proprietary Information during the Proprietary Period.

9. RETURN OR DESTRUCTION OF PROPRIETARY INFORMATION

Upon written request of the disclosing party, the disclosed Proprietary Information and all copies thereof shall, upon the expiration or termination of this Agreement, be returned to the disclosing party, or be "destroyed" and a written certificate of destruction shall be provided to the disclosing party.

10. LEGAL ACTIONS AND GOVERNMENT REGULATIONS

Should the receiving party be faced with legal action or a requirement under U.S. or foreign government regulations to disclose Proprietary Information received hereunder, the receiving party shall forthwith notify the disclosing party, and upon the request of the latter, the receiving party shall cooperate in contesting such disclosure. Except in connection with a failure to discharge the responsibilities set forth in the preceding sentence, neither party shall be liable in any way for any disclosures made pursuant to judicial action or U.S. or foreign government regulations.

In addition, neither party shall be liable in any way for any inadvertent disclosure or use where the customary degree of care has been exercised by the receiving party as it normally uses to protect its own Proprietary Information; provided that upon discovery of such inadvertent disclosure or use, the receiving party shall notify the original disclosing party immediately, and shall endeavor to prevent any further inadvertent disclosure or use.

11. RELATIONSHIP BETWEEN THE PARTIES

A. This Agreement does not create a teaming agreement, joint venture, partnership or other such arrangement; rather, the parties expressly agree that this Agreement is solely for the purpose of disclosing and protecting Proprietary Information.

B. Neither party promises to provide the other party with Proprietary Information. The decision to provide any Proprietary Information is within the sole discretion of the party originally possessing the Proprietary Information.

C. Except as provided in Section 15 herein, each party shall bear its own costs and expenses incurred under or in connection with this Agreement.

12. RELEASE OF INFORMATION TO PUBLIC

Receiving Party shall not, without the prior written consent of [BUYING COMPANY], make any release of information concerning this study (other than to employees and subcontractors that is required for the performance of their duties), including providing copies of this study except as may be necessary to comply with a subpoena or other proper mandatory legal demand.

13. EXCLUSIVE CONTACTS

The following persons will, on behalf of the respective parties, be the sole individuals authorized to receive and or transmit written Proprietary Information:

[BUYING COMPANY]. <u>Various Buyers</u> Arizona State University: Zhaohui Wu

Additional	Contacts:		
Name	Title	Signature	Date
	Research Associate		

Graduate Research Assistant

Either party may change the exclusive contact by written notice.

14. TERM OF AGREEMENT

This Agreement shall expire <u>5</u> year(s) after the date first written above (the "Disclosure Period") except that it may be terminated earlier by thirty (30) days prior written notification by either party to the other or extended by mutual written agreement. The provisions of Sections 4, 5,6,7, 8 and 13 shall survive such expiration or termination.

15. DISPUTE RESOLUTION

A. Before the parties resort to litigation to solve any dispute, the parties agree to

schedule a mandatory meeting at a mutually agreeable location, which meeting will be attended by at least one senior manager from each party. At that meeting, each side will present its dispute and the senior managers will enter into good faith negotiations in an attempt to resolve the dispute.

B. In the event the dispute is not resolved, the parties retain all applicable remedies available in law or equity.

C. Notwithstanding any other rights of either party, eitherparty may seek injunctive relief in any court of competent jurisdiction against improper use or disclosure of Proprietary Information.

16. EXPORT OF PROPRIETARY INFORMATION

The receiving party represents and warrants that no technical data furnished by the disclosing party shall be exported from the United States without rust complying with all requirements of the International Traffic in Arms regulations and the Export Administration Act and regulations issued thereunder, including the requirement for obtaining any export license, if applicable. The receiving party shall first obtain the written consent of the disclosing party prior to submitting any request for authority to export any such technical data. The receiving party will assume its full responsibility for all claims, demands, damages, costs, fines, penalties, attorneys' fees and all other expenses to the extent permitted by law, arising from the failure of the receiving party to comply with this clause or the International Traffic in Arms regulations and the Export administration Act and applicable regulations.

17. MISCELLANEOUS

A. Except as to a sale or transfer of the business to which this Agreement relates, the rights of the parties under this Agreement may not be assigned or transferred to any person, firm or corporation without the express prior written consent of the other party, which consent will not be unreasonably withheld.

B. This Agreement may be signed in one or more counterparts (including faxed copies), each of which shall be deemed one and the same original.

C. This Agreement constitutes the entire agreement between the parties with respect to the subject matter hereof. The terms of this Agreement may not be superseded by any specific legends or statements associated with any Proprietary Information, and may not be amended except by written document signed by duly authorized representatives of each of the parties.

IN WITNESS WHEREOF, the parties have entered into this Agreement as of the date first written above.

Arizona State University By: [SIGNATURE] Name: Zhaohui Wu Title: PH.D. Candidate Date: February. 4 2003 [BUYING COMPANY] [SIGNATURE] Name: Title: Compliance Officer Date: February. 4 2003

APPENDIX B

BUYER TELEPHONE SURVEY QUESTIONNAIRE

Research Background.

Thank you for agreeing to the interview. This interview is part of my dissertation research. This interview will take about 20 minutes. Your answers will be kept in strict confidence. Only aggregated results will be disclosed. If you are interested, I will provide you a summary of the research findings after the study is completed.

The purpose of this study is to understand how you manage the *interactions* between two suppliers. Most supply chain management studies investigate how a buyer, like [BUYING COMPANY], manages and works with a supplier through supplier development to improve supply and supplier performance. However, it remains unclear how the interactions between suppliers will affect supply performance. My dissertation tries to answer this question. In this survey, I am asking about how you, as a buyer, manage the interactions between two suppliers and the supply performance of each supplier.

Please think of a critical product that you support at [BUYING COMPANY]. This product is critical because of its overall profit impact, its value/price, and/or product/production technology complexity.

Now think of two suppliers, SUPPLIER A and SUPPLIER B. For this study these two suppliers must meet three <u>criteria</u>. First, they have similar production and process technology. Second, currently they are supplying different parts that go into critical product(s) at [BUYING COMPANY], but each supplier can supply the other supplier's part. Finally, I must be able to survey these two suppliers.

Section 1: General Information.

1. What is the name of product that you support at [BUYING COMPANY]?

2. Please provide the contact information of these two suppliers.

SUPPLIER A:

Contact name: Company name: Phone number: Postal address:

SUPPLIER B:

Contact name: Company name: Phone number: Postal address:

3. What is the name and number of the part supplied by

SUPPLIER A? [____]

SUPPLIER B? [_____

Section 2: Buyer's Influence on the Interactions between Two Suppliers.

The following statements pertain to sourcing of PART X from SUPPLIER A and PART Y from SUPPLIER B. Circle the number that indicates your agreement or disagreement with each statement's description of how you manage the interactions between these two suppliers.

			strong disagi	gly ree					stron agre	gly ee	
1.	We provide occasions (e.g., social settings, meetings, forums and conferences, etc.) where SUPPLIER A and SUPPLIER B can meet and talk.			2	3	4	5	6	7		
2.	We encourage SUPPLIER A and SUPPLIER F to work on operations issues (i.e., quality, delivery, forecast, process engineering, etc.) together.	нона 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1	2	3	4	5	6	7		
3.	SUPPLIER A and SUPPLIER B's ability to work as a team is an important supplier evaluation/selection criterion.		1	2	3	4	5	6	7		
4.	Our contractual agreements with SUPPLIER A and SUPPLIER B promote collaboration between them.	•	1	2	3	4	5	6 	7		
5.	We encourage SUPPLIER A and SUPPLIER E help each other out if they encounter production problems.	b to	1	2	3	4	5	6	7		
6.	We encourage SUPPLIER A and SUPPLIER E coordinate their activities without our direct involvement.	B to t	1	2	3	4	5	6	7		

Section 3: Evaluating SUPPLIER A.

SUPPLIER A's Performance. For each aspect of supplier performance below, please circle the number that indicates how well SUPPLIER A performed compared with your firm's experience with other suppliers.

Compared to other suppliers, how well does SUPPLIER A perform?

Aspects of Supplier Performance		Needs Impro	Needs Improvement			ıt ge	superior performance		
1.	Product quality	1	2	3	4	5	6	7	
2.	Delivery performance	1	2	3	4	5	6	7	
3.	Responsiveness to requests for changes	1	2	3	4	5	6	7 . , , , , , , , , , , , , , , , , , , ,	
4.	Sales, service, and/or technical support	1	2	3	4	5	6	7	
5.	Total value received	1	2	3	4	5	6	7	
6.	Overall cost performance	1	2	3	4	5	6	7	

Your Firm's Attitudes Toward SUPPLIER A. For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm feels about SUPPLIER A.

		strong disagi		strongly agree				
7.	Our firm regrets the decision to do business with SUPPLIER A.	1	2	3	4	5	6	7
8.	Overall, we are very satisfied with SUPPLIER A.	1	2	3	4	5	6	77
9.	We are very pleased with what SUPPLIER A does for us.	1	2	3	4	5	6	7
10.	Our firm is not completely happy with SUPPLIER A.	1	. 2	3	4	5	6	7
11.	If we had to do it all over again, we would still choose to use SUPPLIER A.	1	2	3	4	5	6	77

Section 4: Evaluating SUPPLIER B.

SUPPLIER B's Performance. For each aspect of supplier performance below, please circle the number that indicates how well SUPPLIER B performed compared with your firm's experience with other suppliers.

Compared to other suppliers,	
how well does SUPPLIER B perform.	?

Aspects of Supplier Performance		N Ir	leeds nprov	veme	nt a	abou veraz	t ge	su perj	perior formance	
1. Product quality			1	2	3	4	5	6	7	
2. Delivery performance			1	2	3	4	5	6	7	
3. Responsiveness to requests for o	changes		1	2	3	4	5	6	7	
4. Sales, service, and/or technical	support		1	2	3	4	5	6	7	
5. Total value received			1	2	3	4	5	6	7	
6. Overall cost performance		- '* ';	1	2	3	4	5	6	7	

Your Firm's Attitudes Toward SUPPLIER B. For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm feels about SUPPLIER B.

				sti di	rong sagr	ly ee				strc ag	ngly ree
. 7	. Our firm regrets the de SUPPLIER B.	cision to do business wi	th		1	2	3	4	5	6	7
8.	Overall, we are very sa	tisfied with SUPPLIER	B.		1	2	3	4	5	6	7
9.	We are very pleased windoes for us.	th what SUPPLIER B			1	2	3	4	5	6	7
10.	Our firm is not complet SUPPLIER B.	ely happy with			1	2	3	4	5	6	7
11.	If we had to do it all ov choose to use SUPP	er again, we would still LIER B.			1	2	3	4	5	6	7
	Would you want a copy	of the research result?	Pleas	se c	ircle	you	r cho	ice:		YES	

THANK YOU AGAIN FOR YOUR PARTICIPATION!

NO

APPENDIX C

SUPPLIER MAIL SURVEY QUESTIONNAIRE

[Arizona State University] [Department Letterhead]

[Date] [Name] [Address]

Dear [salutation]:

I am a Ph.D. student at Arizona State University. I am conducting my dissertation research, and I am seeking your help by asking you to complete this short survey.

Your name was given by PERSON X at [BUYING COMPANY]. PERSON X also informed me that your company is supplying PART X to [BUYING COMPANY]. Person X also informed me that COMPANY Y is supplying PART Y to Honeywell.

In the following pages, there are several questions regarding your company's interactions with Company Y. There are no right or wrong answers. You may or may not have any direct contractual relationships with COMPANY Y. The questions only ask to what extent your company interacts with this company. Your response will be kept in strict confidence, and only aggregated data will be disclosed in this research. Please return your answer directly to me using the enclosed self-addressed envelope, or you may fax your responses to me at 480-965-8629.

Thank you in advance for your participation. If you have any questions, please don't hesitate to call or email me.

Sincerely,

Zhaohui Wu

Ph.D. Candidate Supply Chain Management Department P.O. Box: 874706 Main Campus Arizona State University Tempe, AZ 85287-4706 Phone: 480-727-6191 Fax: 480-965-8629 Email: <u>zhaohui.wu@asu.edu</u>

		completely inaccurate description		completely inaccurate description					cc a de	ompletely accurate escription
1.	In our relationship with COMPANY Y, it is expected that any information that might help the other party will be provided to them.	1	2	3	4	5	б	7		
2.	Exchange of information between our two companies takes place frequently.	1	2	3	4	5	6	7		
3.	Exchange of information between our two companies takes place informally.	1	2	3	4	5	6	7		
4.	It is expected that COMPANY Y and we will provide proprietary information to one another if it can help the other party.	1	2	3	4	5	6	7		
5.	It is expected that our two companies keep each other informed about events or changes that may affect the other party.	1	2	3	4	5	6	7		
6.	COMPANY Y and we are jointly responsible for getting things done.	1	2	3	4	5	6	7		
7.	Problems that arise in the course of our relationship with COMPANY Y are treated by our two companies as joint rather than individual responsibilities.	1	2	3	4	5	6	7		
8.	Our two companies do not mind owing each other favors.	1	2	3	4	5	6	7,		
- 9 .	The responsibility for making sure that the relationship works for our two companies is shared jointly.	I ,,	2	3	4	5	6	7		
10.	Our two companies work together on many cases (e.g., purchasing, product/process engineering, material management, production planning and scheduling, etc)	1	2	3	4	5, 1	6	7		

For each statement below, circle the number that best describes how your firm interacts with COMPANY Y.

		strong disagr	ly ee				strongly agree
11.	COMPANY Y and we make an effort to help each other during emergencies.	.1	2	3	4	5	6 7
12.	COMPANY Y and we help each other in ideas, cost reductions, and problem solving, etc.	1	2	3	4	5	6 7
13.	COMPANY Y and we advise each other of any potential problems in meeting Honeywell's needs.	1	2	3	4	5	6 7

For each statement below, circle the number that indicates your agreement or disagreement in describing how your firm interacts with COMPANY Y.

Would you want a copy of the research results?

YES

Please circle your choice:

NO

THANK YOU AGAIN FOR YOUR PARTICIPATION!

APPENDIX D

SCATTER PLOT OF RESIDUALS

AGAINST SUPPLIER-SUPPLIER INTERACTIONS

SUPPLIER A DATA SET, MODERATING MODEL, EQUATION 1



APPENDIX E

SCATTER PLOT OF RESIDUALS

AGAINST PREDICTED SUPPLY PERFORMANCE

SUPPLIER A DATA SET, MODERATING MODEL, EQUATION 1



APPENDIX F

SCATTER PLOT OF RESIDUALS AGAINST

SUPPLIER-SUPPLIER INTERACTIONS

SUPPLIER B DATA SET, MODERATING MODEL, EQUATION 1



APPENDIX G

SCATTER PLOT OF RESIDUALS

AGAINST PREDICTED SUPPLY PERFORMANCE

SUPPLIER B DATA SET, MODERATING MODEL, EQUATION 1



APPENDIX H

INDEX PLOT OF RESIDUALS

SUPPLIER A DATA SET, MODERATING MODEL, EQUATION 1



APPENDIX I

INDEX PLOT OF RESIDUALS

SUPPLIER B DATA SET, MODERATING MODEL, EQUATION 1


APPENDIX J

NORMALITY PLOT

SUPPLIER A DATA SET, MODERATING MODEL, EQUATION 1

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APPENDIX K

NORMALITY PLOT

SUPPLIER B DATA SET, MODERATING MODEL, EQUATION 1

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APPENDIX L

NORMALITY PLOT EXAMINING

SUPPLIER A DATA SET, MEDIATING MODEL EQUATION 3

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