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Achieving Build-to-order Supply Chain Capability through Practices Driven by Supplier Alignment and Supplier Empowerment

by

Kun Liao

Submitted as partial fulfillment of the requirements for

the Doctor of Philosophy degree in Manufacturing Management and Engineering

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College of Graduate Studies

The University of Toledo

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An Abstract of

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Build-to-order Supply Chain (BOSC) is viewed by many researchers as an effective way to achieve high customer value because BOSC can fulfill an individual or a group of customers' orders while maintaining low cost, cutting inventory cost, eliminating waste, and achieving short response time through flexible manufacturing and integrated logistics. BOSC is needed to support mass customization, which is the ability to make high variety and low cost products and deliver them quickly to meet the diverging needs of customers. Mass customization can be achieved by implementing modularity-based manufacturing practices, postponing production steps that determine product features and performances, and applying IT to coordinate actions and speed up final production and

delivery. BOSC also emphasizes the importance of partnership with suppliers and customers, web-based technologies, and rapid transport and delivery.

This research proposes that BOSC capability (i.e., cost effectiveness, volume effectiveness, and timely delivery) can be achieved through three dimensions of supply chain practices: modularity, postponement, and partnership.

This study applies social dilemma theory and resource dependency theory to build a model to explore the mechanism of inducing these three dimensions of supply chain practices. Social dilemma theory states that members in an alliance have a higher tendency to defect (e.g., withhold information or not fully participate) rather than to cooperate because members may achieve higher short-term profits through defecting (Dawes, 1980). These defects will cause long-term failure of an alliance, and members will loose their profits in the long run. Resource dependency theory indicates that members in a supply chain should depend and cooperate to move out of the dilemma of defecting to gain higher profits in the long-run instead of competing with one another. The literature suggests two types of solutions to change the views of members in an alliance from a short-term view to a long-term view: structural solutions, which focus on strategy, responsibility and profit allocation, and motivational solutions, which focus on changing partners' perceptions of group identity and self efficacy. This research applies social dilemma theory and resource dependency theory in buyer-supplier links in the supply chain context. A buyer's structural solutions (i.e., supplier alignment) perceived by the supplier and the supplier's motivational solutions (i.e., supplier empowerment) can increase the frequency and range of partnership practices, modularity practices, and postponement practices.

Partnership strategy (i.e., trust, commitment, and shared vision between the buyer and the supplier) established in the supply chain induces supplier alignment and supplier empowerment. Partner relationship has positive influences upon supplier alignment and supplier empowerment.

The data used in this study were collected from tier 1 and tier 2 suppliers in North America and China. Structural Equation Model is used to analyze those data. Of eleven hypotheses, seven are significant.

This research has three significant contributions to supply chain management literature. First, it has developed several valid and reliable measures (e.g., supplier alignment, supplier empowerment, and supplier partnership practices) for supply chain management research. Second, it has verified valuable practices (i.e., modularity supply chain practices and supplier partnership practices) for achieving BOSC capability. Third, it has also identified strategy (i.e., partner relationship) and drivers (i.e., supplier alignment and supplier empowerment) for the supply chain practices.

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CHAPTER 1: INTRODUCTION

With intensive global competition, technological change, and demanding customers, the environment for businesses becomes more complex and uncertain (Skinner, 1985; Doll and Vonderembse, 1991; Wang et al., 2006). This environmental uncertainty calls for customer-oriented strategies that require all members within a supply chain to understand and meet the needs of their direct customers and to satisfy the ultimate customers of the supply chain (Day, 1995). This requires supply chain participants to achieve flexibility and continuous and innovative responsiveness (Doll and Vonderembse, 1991; Koufteros et al., 2005; Zhang et al., 2006a). Flexibility is the adaptability of a system to internal and external influences in order to achieve desired outcomes (Zhang et al., 2003; Zhang et al., 2006b). "Responsiveness is the ability to react purposefully and within an appropriate time-scale to customer demand or changes in the marketplace, to bring about or maintain competitive advantage" (Holweg, 2005, p. 605). "Companies rely on strategic alliances based on core competencies and information technologies to achieve flexibility and responsiveness" (Gunasekaran and Ngai, 2005, p. 424). Two primary strategies that help firms to achieve flexibility and responsiveness are supply chain management (SCM) and mass customization (MC).

Supply chain management strategies have been recognized by both researchers and industries as keys to establishing a competitive edge in highly competitive markets (Choi and Hartley, 1996; Handfield et al., 1997; Chen and Paulraj, 2004; Kaufmann and

Carter, 2006; Li et al., 2006). Supply chain is a governing strategy that creates values for customers, and it is defined as a system, which integrates suppliers, manufacturers, distributors, and customers in terms of material, financial, and information flows (Fiala, 2005). Supply chain management focuses on building integrated networks, and its practices are defined to cover dimensions of upstream and downstream, information and material flows (Li et al., 2006; Donlon, 1996; Tan et al., 2002).

Mass customization targets customer values and has become a major trend in today's business because of its responsiveness and cost effectiveness (Pine, 1993; Tu et al., 2004). Mass customization capability is "the ability to produce varieties of customized products quickly, on a large scale and at a cost comparable to mass-production through technical and managerial innovations" (Tu et al., 2004, p. 152). It is commonly agreed among researchers that mass customization can be achieved through practices that are related to modularity (Pine, 1993; Tu et al., 2004), postponement (Feitzinger and Lee, 1997; Van Hoek et al., 1999; Li et al., 2006), and information sharing (Gunasekaran and Ngai, 2005).

Firms are now utilizing build-to-order supply chain (BOSC) practices to deploy both supply chain management strategy and mass customization strategy to build up responsiveness and flexibility, which enables companies to deliver products that customers have ordered (Tu et al., 2004; Gunasekaran and Ngai, 2005). From the strategy perspective, BOSC can be defined as ''the value chain that manufactures quality products or services based on the requirements of an individual customer or a group of customers at competitive prices, within a short span of time by leveraging the core competencies of

partnering firms or suppliers and information technologies such as the Internet and WWW to integrate such a value chain'' (Gunasekaran and Ngai, 2005, p. 425).

BOSC is viewed by researchers as the 21st century supply chain strategy (Gunasekaran, 2005). Among firms, Dell is utilizing BOSC strategy to become an operational leader in computer industry (Gunasekaran and Ngai, 2005). BOSC strategy has been realized and utilized as an effective competitive weapon by companies in other industries; BMW uses BOSC in its Z3 cars to allow customers to place orders and change orders (Gunasekaran and Ngai, 2005); VOLVO is also using build-to-order strategies in its Swedish production practices (Frederiksson and Gadde, 2005).

1.1 Problem Statement

According to a literature review on BOSC (Gunasekaran and Ngai, 2005), BOSC literature can be classified as four categories: BOSC and organizational competitiveness, developing and implementing BOSC, operations of BOSC, and BOSC and information technology. BOSC and organizational competitiveness include economic factors, market forces, and competitive factors (Porter, 1980; Daugherty and Pittman, 1995; Holweg and Miemczyk, 2003). Developing and implementing BOSC includes design and procurement, partnership and virtual supply chain, logistics, and implementation (Lee, 1996; Bowersox et al., 1999; Hsu and Wang, 2004). Operations of BOSC include planning, forecasting, coordinating, and monitoring (Glasserman and Wang, 1998; Krause et al., 1998; Biswas and Narahari, 2004). BOSC and information technology include internet, e-commerce, ERP technology, and radio frequency identification (Chang, 2002; Steger-Jensen and Svensson, 2004; Teich et al., 2004).

However, Gunasekaran and Ngai (2005) also point out gaps in the BOSC literature including defining and specifying the content domain of the BOSC construct, developing an integrated model for business strategy and operations strategy, economic factors, market factors, and competitive factors, and defining measures of performance. In order to fill some of the above research gaps, this study addresses the following questions:

1) What are BOSC capabilities?
2) What practices constitute BOSC practices?
3) What are the relationships between BOSC practices and BOSC capabilities?

The current study explores BOSC practices and BOSC capabilities and measures them based on mass customization and supply chain management strategies: mass customization considers both demand satisfaction and supply efficiency and effectiveness; supply chain strategy emphasizes integration of members in the supply side; and BOSC utilizes mass customization as a linkage between a supply chain and its customers. Mass customization practices include modularity product design and postponement process design (Tu et al., 2004). Supply chains also require frequent and intense interactions between buyers and suppliers to respond to the fast changing environment (Fine, 2005; Gunasekaran and Ngai, 2005). Therefore, this study identifies three major types of build-to-order supply chain practices: (1) supplier modularity practices, which view supply chain from design architecture perspective, (2) supplier postponement practices, which originate from process optimization, and (3) supplier partnership practices, which are based on supply network integration. This study also develops an integrated model to illustrate the causal relationship between BOSC practices and BOSC capabilities.

The three practices described above cannot be implemented by supply chain members (i.e., buyers and suppliers) automatically unless a mechanism exists to stimulate suppliers by the buyer in order to guide all members in a supply chain to utilize these three practices. However, the interaction mechanism, which is between a buyer and its suppliers to pursue the three practices, has not been clearly explored and empirically tested (McCutcheon and Stuart, 2000; Goffin et al., 2006). Therefore, this study addresses the fourth research question: What is the interaction mechanism between buyers and suppliers that pursue BOSC practices and how can the constructs in the mechanism be measured?

The partner practice generating mechanism involves both the buyer and the supplier to interact with each other driven by a supply chain strategy (i.e., partner relationship). In this study, the construct of partner relationship is proposed to measure the buyer's trust, commitment, and sharing vision with suppliers (Li et al., 2006). The strategy of partner relationship can influence the buyer-supplier structure mainly in two ways according to social dilemma theory and resource dependency theory (Zeng and Chen, 2003): (1) the reciprocity payoff structure between buyer and supplier (i.e., Supplier Alignment) and (2) supplier's feeling of group identity and self-efficacy (i.e., supplier empowerment). Supplier Alignment strongly binds buyers and suppliers along three dimensions: operations strategy (i.e., relative strategic importance of cost, quality, delivery, and flexibility), responsibilities (i.e., responsibility allocations), and financial benefits (i.e., sharing costs, risks, and benefits). Therefore, Supplier Alignment leads to effective and efficient activities of partner practices, modularity-based practices, and postponement

practices. Empowered suppliers enjoy working closely with the buyer to actively participate in the three supply chain practices (Lee, 2004; Li et al., 2006).

1.2 Research Objective and Contributions

Although this study identifies the model built on social dilemma theory and resource dependency theory, it would be very valuable to test this model through a large-Scale empirical study to allow this model to have a theoretical foundation as well as empirical evidence. Additionally, this study is the first to systematically identify key BOSC practices and BOSC capability according to mass customization strategy and supply chain management strategy; it also would be very beneficial to researchers and practitioners should BOSC practices empirically supported have direct effects on BOSC capabilities. Therefore, the main objectives of this research are to explore: (1) the direct effects of partner relationship on supplier alignment, (2) the direct effects of partner relationship on supplier empowerment, (3) the direct effects of supplier alignment on supplier partnership practices, (4) the direct effects of supplier alignment on supplier modularity practices, (5) the direct effects of supplier alignment on supplier postponement practices, (6) the direct effects of supplier empowerment on supplier partnership practices, (7) the direct effects of supplier empowerment on supplier modularity practices, (8) the direct effects of supplier empowerment on supplier postponement practices, (9) the direct effects of supplier partnership practices on build-to-order supply chain capability, (10) the direct effects of supplier modularity practices on build-to-order supply chain capability, and (11) the direct effects of supplier postponement practices on build-to-order supply chain capability.

This study has both academic and practical values. By using social dilemma and resource dependency theory, this study has developed a theoretical model of driver - activity - capability in BOSC. This study is thus one of the first large-scale empirical studies to address relationships among supplier alignment, supplier partnership, supplier empowerment, and BOSC practices. This study also identifies key practices contributing to the BOSC capabilities. Finally, another main contribution of this research is the development of valid and reliable measurement instruments for (1) supplier alignment, (2) supplier empowerment, (3) supplier partnership practices, and (4) BOSC capability.

From a practitioner' perspective, this study guides firms to systematically establish a build-to-order supply chain through supplier modularity practices, supplier postponement practices, and supplier partnership practices. The results of this study can also help understand the mechanism for buyer and supplier to be actively involved in joint operation practices and information sharing.

This study collected data in North America and China. Few researches in the past have collected data from the Chinese auto supply chain. One contribution of the study is helping researchers to understand the Chinese auto market and China suppliers. In 2006, China became the second largest auto market in the world (*People's Daily*, 2006). Companies such as GM and Ford, who lose money in North America, gain huge profits in the Chinese auto market (*China Daily*, 2006; *The Indianapolis Star*, 2007). Even Chrysler announced the outsourcing of the assembly of its subcompact cars to a Chinese automaker in 2007 (*MSN Money*, 2006). However, the current understanding of Chinese auto suppliers and automakers is very limited. The data collected from suppliers in the

Chinese auto industry will help researchers understand the status of the Chinese auto industry and the viewpoints of Chinese auto suppliers concerning BOSC.

Chapter 2 builds a theoretical framework for a build-to-order supply chain including defining constructs and developing hypotheses. Instruments are developed through a pilot study described in Chapter 3 and through a large-scale survey in Chapter 4. Chapter 5 discusses structural equation modeling and hypothesis testing. Conclusions and future research directions are provided in Chapter 6.

CHAPTER 2: THEORETICAL FRAMEWORK AND HYPOTHESES

The Council of Logistics Management (CLM, 2000) defines supply chain management (SCM) as "the systemic, strategic coordination of the traditional business functions and tactics across business functions within a particular organization and across businesses within the supply chain for the purposes of improving the long-term performance of the individual organizations and the supply chain as a whole." Supply chain is viewed as an effective competitive weapon because it focuses on integrating both information flow and material flow across the supply chain to achieve global optimizations and improve long-term performance (Childhouse and Towill, 2003; Feldmann and Müller, 2003).

Supply chain practices have attracted many researchers because of the characteristic of integration in a supply chain. Since supply chain research evolves from different disciplines such as purchasing, logistics, operations management and marketing, there is no consensus about supply chain practices. One of the key components of supply chain practices is the buyer-supplier linkage, which is a traditional topic in purchasing research: Donlon (1996) focuses more on purchasing to include practices of supplier partnership and outsourcing; Chen and Paulraj (2004) develop purchasing measures such as supplier base reduction, long-term relationships, communication, cross-functional teams and supplier involvement from the buyer's view. Some measures include manufacturer-customer links as well as manufacturer-supplier links in the model of

supply chain practices: Tan et al. (1998) consider both practices of supplier relationships and customer relationships. Another view of supply chain practices in material flow is from a logistics perspective; Tan et al. (2002) identify constructs of geographical proximity and JIT capability as logistics issues in a supply chain.

In addition to the material flow practices within a supply chain, information flow practices are also critical to supply chain: Alvarado and Kotzab (2001) include practices of inter-organizational information systems in their model; and Tan et al. (2002) identify practices of information sharing in supply chain management.

Some researchers identify supply chain practices from the complete chain perspective rather than from a link perspective. For example, Min and Mentzer (2004) focus on supply chain relationships and identify supply chain practices including practices of the agreed vision and goals, information sharing, risk and award sharing, cooperation, process integration, long-term relationship, and agreed supply chain leadership. In sum, researchers zoom in and zoom out to view the supply chain and define the supply chain practices based on their research purposes and research experiences.

Researchers measure supply chain practices at the corporation (i.e., a member in a supply chain) level because it is difficult to define and measure supply chain practices from the perspective of the whole chain and hard to obtain responses for the whole chain; Li et al. (2005, 2006) define supply chain management practices as a set of activities undertaken in an organization to promote effective management of its supply chain. They define supply chain management practices to cover main dimensions of those practices of upstream (e.g., strategic supplier partnership), downstream (e.g., customer relationship),

information flow (e.g., level of information sharing and quality of information sharing), and material flow (e.g., postponement).

Since supply chain practices are broad and there is no consensus among researchers, a valuable way to define and measure supply chain practices to benefit researchers and practitioners is to define supply chain practices to target a specific supply chain strategy. Build-to-order supply chain strategy is a state-of-the-art supply chain strategy because it focuses on a supply chain's responsiveness toward customers and its own efficiency and effectiveness. Build-to-order Supply Chain (BOSC) is a fast, reliable, and low-inventory system, and it is the next step in the evolution of supply chain management. Which practices should be viewed as critical BOSC practices is a valuable question that attracts interests of researchers and supply chain managers. In addition, how to coordinate supply chain members to actively participate into BOSC is also a valuable topic, which deserves to be explored more deeply (Gunasekaran and Ngai, 2005).

Following the above discussion, a research model is built on theories of mass customization, three dimension (3D) concurrent engineering, social dilemma, and resource dependency, as described in Section One. Then, constructs and hypotheses of relationships between these constructs are defined or proposed through the literature review from Section Two through Section Eight.

2.1 Theoretical Model

3D Concurrent Engineering, Mass Customization, and BOSC Practices

As mentioned in Chapter 1, environmental uncertainty includes two main parts: technology changes and demanding customers. Technology changes result in push

strategy of operations or supply chain, while demanding customers result in a pull strategy. Fine (1998) proposes a concept of clockspeed to measure the rate of technology change. A company in an industry with high clockspeed has a high possibility of quickly losing its advantages, resulting in a shorter life for its competitive advantage (Fine et al., 2002). A company's real core competence is its ability to design and redesign its value chain in order to continually seek the maximum advantage (Fine et al., 2002). They provide 3D concurrent engineering practices to respond to the fast rate of technology change. 3D concurrent engineering is used to simultaneously build supply chain practices in three dimensions: product development, process management, and supply and retail management.

Mass customization is a pull strategy to satisfy demanding customers. It utilizes modular product design, postponement process design, and web-based information technology. Modularity product design provides more product varieties for customers. Postponement process design allows companies to meet customer demands quickly while maintaining low operation costs. Web-based information technology, such as B2B, B2C, and RFID, allows (1) demand information to be transferred forward from customer to manufacturer and from manufacturer to supplier, (2) order fulfillment information to be transferred backward from supplier to manufacturer and from manufacturer to customer, and (3) product location information within a supply chain to be tracked easily.

In this study of exploring and defining BOSC supply chain practices, both technology push strategy (e.g., 3D concurrent engineering) and customer pull strategy (e.g., mass customization) are considered. Therefore, based on 3D concurrent engineering (i.e., product development, process, and supply and retail management) and mass

customization (i.e., modularity, postponement, and Web-based IT usage), build-to-order supply chain practices are based on supplier modularity practices, supplier postponement practices, and supplier partnership practices (see Figure 2.1.1).

By definition, modularity allows many varieties of products while maintaining low cost of manufacturing each module. Modularity allows companies to communicate available permutations of products with customers easily and to fulfill orders quickly.

Postponement is a strategy of delaying the final customization of a product as close as possible to customers until an actual order is placed. Postponement allows the whole supply chain to lower total inventories and to maintain few or no final product inventories in the BOSC.

Partnership with suppliers or marketers allows quick information sharing within a supply chain. It increases the scope and frequency of joint problem-solving to improve both products and processes. Partnership also enables fair or healthy information flows within a supply chain.

The three practices described above should be guided by an interaction mechanism to involve both buyers and suppliers with proactive participation because buyer and supplier are different parties in an alliance. However, the interaction mechanism, which is between a buyer and its suppliers to pursue three practices, has not been clearly explored and empirically tested (McCutcheon and Stuart, 2000; Goffin et al., 2006). Previous studies of supply chain practices are mainly from the buyer (i.e. manufacturer) perspective (Hartley et al., 1997; Johnston et al., 2004; Petersen et al., 2005; Krause et al., 2007). This is one of first studies to include a model of supply chain practices from

the supplier perspective. The model is based on social dilemma theory from economics and resource dependency theory from management.

Social Dilemma Theory, Resource Dependency Theory, and the Interaction Mechanism of Buyer and Supplier

Social dilemma theory can be traced back to Deutsch's (1973, 1980) goal theory, which includes three main parts: (1) there are three goals of individuals within a group (i.e., cooperation, competition, and independence); (2) goals determine the interaction of individuals in a group; (3) interactions determine outcomes of the group. Social dilemma theory focuses on the tension between two goals within a social group: competition and cooperation (Dawes, 1980). Social dilemma theory has two main parts: (1) one member in a social group will get higher payoff if the member chooses to defect because this member can get a larger portion of the pie made by the group than the portion that the member deserves to get; (2) if all members choose to cooperate, the pie will become bigger and thus the actual gain of each member will increase although the percentage gained by each member has not changed (Dawes, 1980). When applying social dilemma theory in an alliance context (i.e., a group of several members pursuing common goals and then sharing benefits according to some rules), Zeng and Chen (2003) use a simple decision model to support that a member in an alliance has a tendency to choose defecting to get higher self-interest rather than to choose cooperation to get higher interest for the whole alliance. Social dilemma theory describes the potential short-term decision of a member in an alliance, which will lead to a long-term failure of the whole alliance and thus the failure of the member. In contrast to the social dilemma theory, resource dependency theory focuses on the long-term view of members in an alliance to

emphasize the importance of cooperation in an alliance. “The essence of the resource dependence theory is that in a business relationship, dependencies are created between the exchange partners, and such dependencies often enable the exchange partners to influence each other’s behavior and profitability” (Banerji and Sambharya, 1998, p. 46). In the supply chain context, when manufacturers and suppliers communicate with one another and make joint or related decisions, both can remove part of the environmental uncertainty and have higher benefits (Powell, 1990). Therefore, members in a successful supply chain should have a long-term view to choose cooperation instead of competition.

Researchers have been finding different ways to enable members in an alliance to have a long-term and cooperation view rather than a short-term and competition view. Zeng and Chen (2003) propose a model to drag members in an alliance out of the social dilemmas to enhance partner cooperation. The model uses structural solutions and motivational solutions that were developed by previous researches (Komorita and Parks, 1994; Messick and Brew, 1983; Yamagishi, 1986). Structural solutions focus on reciprocity system building and include changing allocation rules (Chen, 1999; Rapoport and Amaldoss, 1999) and minimizing greed or fear of competition of other parties (Holm et al., 1999; Doz, 1996); motivational solutions focus on increasing self efficacy of members and include two approaches, enhancing communications (Bouas and Komorita, 1996; Chen, 1996; Zeng and Chen, 2003) and establishing long-term goals (Axelrod, 1984; Heide and Miner, 1992; Parkhe, 1993; Zeng and Chen, 2003).

This study adapts the structural solutions and motivational solutions to social dilemmas into supply chain management to facilitate cooperation within a supply chain. Compared to multiple-member alliances, the partner cooperation between buyer and

supplier is a dyadic relationship with its specific characteristics. Operations management researchers have studied the buyer-supplier relationships for a long time and have found some specific characteristics of it through empirical studies (Hartley et al., 1997; McCutcheon and Stuart, 2000; Johnston et al., 2004; Petersen et al., 2005; Krause et al., 2007). McCutcheon and Stuart (2000) explored buyer behaviors and supplier behaviors for pursuing alliance-like relationships through interviews with managers in fifteen manufacturing and service firms in Germany. In their interviews, they found that (1) trust–building actions are mostly initiated by buyers; (2) the supplier's view of potential benefits influences the supplier's partnership behavior; (3) both the buyer's actions and the supplier's actions drive the mutual beneficial alliance.

A research model on a partner practice generating mechanism in BOSC is built in Figure 2.1.1, which is based on structural solutions and motivational solutions to social dilemmas and McCutcheon and Stuart's field research. The model includes three parts: (1) the buyer's partnership strategy has a positive relationship with the buyer's structural initiatives and supplier's motivation; (2) the buyer's structural initiatives and the supplier's motivation increase the buyer's and supplier's participation in three BOSC practices (i.e., supplier partnership practices, supplier modularity practices, and supplier postponement practices). This study then uses the following constructs to measure each of the above concepts:

(1) The construct of partner relationship measures a supply chain strategy promoted by a buyer. In this study, partner relationship is the perception of it by suppliers since respondents are suppliers. Therefore, partner relationship is defined as the degree of a buyer's trust, commitment, and sharing of vision, which is perceived by a supplier. Since

suppliers often fear that they might become useless to buyers if they share some key information or knowledge with the buyer, the buyer's offerings of trust, commitment and sharing of vision can remove part of the supplier's fear. Thus, partner relationship can empower the supplier to cooperate with the buyer. Li (2002) defines a construct of partner relationship including trust, commitment and shared vision between buyers and suppliers. Her partner relationship construct is adopted in this study.

(2) Supplier alignment is defined to measure the buyer's structural initiatives perceived by suppliers. Supplier alignment is the level of agreement within a supply chain regarding the following three aspects: first, the relative strategic importance of cost, quality, delivery, and flexibility, second, responsibility allocations, and third, sharing costs, risks, and benefits. Supplier alignment is highly related to supply chain integration (Das et al., 2006) because the former links members in a supply chain using the dimensions of strategy, tactic, and finance.

Integration has been found to be a critical success strategy for a system under a fast-changing environment (Vonderembse et al., 1997). Without integration, the supply chain cannot achieve the goal of being globally optimal (Tan et al., 1998; Frohlich and Westbrook, 2001). The higher the degree of integration across the supply chain, the better the supply chain's performance (Lee et al., 1997; Johnson and Davis, 1998; Frohlich and Westbrook, 2001).

Supply chain management enables all supply chain members to have a common purpose, conveying values to the customer. The purpose of alignment strategy is to facilitate integration (Lingle and Schiemann, 1996). Supplier alignment is a structural activity to induce more integration activities (i.e., joint operation practices and

extensively information sharing) to maximize a network's profit and then allow supply chain members to share it reasonably through common competitive priority, responsibility allocations, sharing risks, benefits, and costs (Lee, 2004). Narayanan and Raman (2004, p. 96), through their more than 50 case studies, found that misalignment is the reason for poor supply chain performances, which includes "excess inventory, stock-outs, incorrect forecasts, inadequate scales efforts, and even poor customer service."

(3) The supplier empowerment mainly focuses on increasing a supplier's self efficacy. This construct measures a physiological process of the supplier's thinking, which includes four parts; meaningfulness (i.e. value consistency between a supplier's value and the value of offerings from a buyer), potency (i.e., a supplier's capabilities of providing quality products and services to the buyer), autonomy (i.e., a supplier's self determination of its activities), and impact (i.e., the contribution value of a supplier's activities to the success of finial products and to the success of the supplier). It is through this psychological process that a supplier can decide the degree of its desire to participate in a supply chain. Conger and Kanungo (1988) propose that psychological empowerment, which catches the underlying causes of delegation, participation, and resource sharing, can improve organizational performances through its practices. This study proposes that empowerment of suppliers can stimulate supply chain members to be more proactive in achieving higher performances of a supply chain and its members through supply chain practices in the build-to-order supply chain (BOSC) context.

The entire model of this research is shown in Figure 2.1.1. Constructs in this model and major hypotheses are described in following sections. Table 2.1.1 summarizes definitions and relevant literature of those constructs.

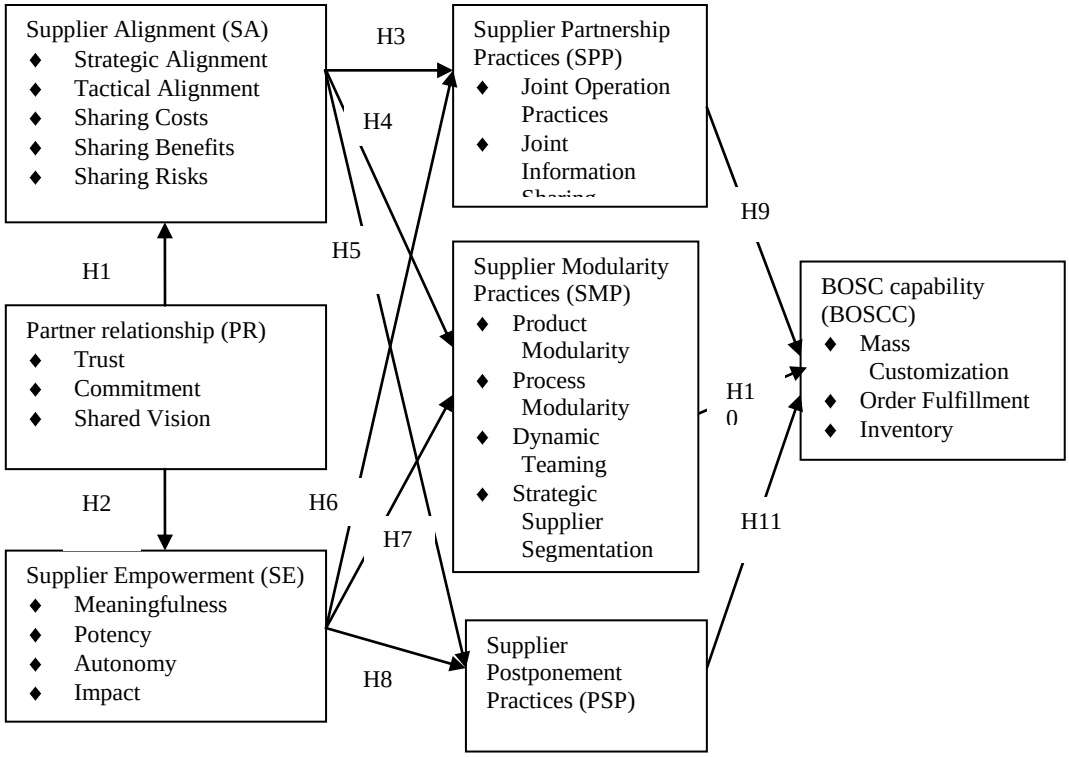


Figure 2.1.1: Theoretical Model

Construct	Definition	Items /Subconstructs	Literature
Partner Relationship	The degree of buyer's trust, commitment, and sharing vision, which is perceived by the supplier	• Trust • Commitment • Shared vision	Li., 2002; Narayanan and Raman, 2004; Liker and Choi, 2004
Supplier Alignment	The level of agreement within an supply chain regarding the relative strategic importance of cost, quality, delivery, and flexibility, responsibility allocation, and sharing costs, risks, and benefits	• Strategic alignment (The level of agreement within a supply chain regarding the relative strategic importance of cost, quality, delivery, and flexibility) • Tactical alignment (The level of agreement within a supply chain regarding responsibility allocations among supply chain members) • Financial alignment-sharing costs (The level of agreement within a supply chain regarding sharing costs between supply chain members) • Financial alignment-sharing	Skinner, 1974; Boyer and McDermott, 1999; Lingle and Schiemann, 1996; Venkatraman and Camillus, 1984; Galbraith and Nathanson, 1978; Lorange and Vancil, 1977; Stonich, 1982; Robinson, 1999; Lindman et al., 2001; Narayanan and Raman, 2004; Lee, 2004; Cao and Dowlatshahi, 2005

		benefits (The level of agreement within a supply chain regarding sharing benefits between supply chain members) • Financial alignment-sharing risks (The level of agreement within a supply chain regarding sharing risks between supply chain members)	
Supplier Empowerment	A process of enhancing feelings of potency of suppliers through identification of the potential value of proactively participating in supply chain practices	• Meaningfulness (The perception of suppliers' values about products and services provided to the buyer) • Potency (supplier's capabilities of providing quality products and services to the buyer) • Autonomy (The degree of the supplier's self determination of its activities) • Impact (the contribution value of the result of activities of the supplier to the success of the finial products and the success of the supplier)	Kirkman and Rosen, 1999 ; Conger and Kanungo, 1988; Thomas and Velthose , 1990; Spreitzer, 1995; Spreitzer, 1996; Spreitzer et al, 1999; Somech, 2005; Kirkman et al., 2004
Supplier Partnership Practices	The degree of joint activities of partners within a supply chain on the information flow and the material flow	Joint operation practices (The degree of joint activities of partners within a supply chain on the material flow) Information sharing practices (The degree of joint activities of partners within a supply chain on the information flow)	Dyer et al., 1998; Daft and Lengel, 1986; Narayanan and Raman, 2004; Liker and Choi, 2004; Lee, 2004; Li, 2002; Lambert and Knemeyer, 2004
Supplier Modularity Practices	Practices of applying modularity in product, process, supply base, and teaming in the supply chain context	• Product modularity • Process modularity • Dynamic teaming • Strategic suppler segmentation	Tu et al., 2004; Krishan and Ulrich, 2001; Pine, 1993; Feitzinger and Lee, 1997; Fine et al., 2005
Supplier Postponement Practices	"the practice of moving forward one or more operations or activities (making, sourcing and delivering) to a much later point in the supply chain"	• Time • Location	Li et al., 2006
Build-to-order Supply chain Capabilities	Ability of a firm to produce varieties of customized products on a large Scale to fulfill customer orders efficiently at a reasonable cost through technical and managerial innovations	• Mass customization • Order fulfillment • Inventory	Pine, 1993; Tu et al., 2004; Gunasekaran and Ngai, 2005

Table 2.1.1: Constructs

2.2 Partner Relationship

Li (2002) defines partner relationship as the degree of trust, commitment, and shared vision between trading partners. Since partner relationship in this research is the perceived motivational activities offered by the buyer, this study modifies her definition as *the degree of buyer's trust, commitment, and shared vision, which are perceived by the supplier.*

This study adopts Li's (2002) three subconstructs,

- Trust
- Commitment
- Shared vision

2.3 Supplier Alignment

Since Skinner (1974) emphasizes the importance of alignment between operations strategy and corporate strategy, alignment has gained the interest of strategic management researchers (Venkatraman and Camillus, 1984) and operation management researchers (Boyer and McDermott, 1999). The purpose of alignment is to facilitate manufacturing integration and to increase manufacturing flexibility (Lingle and Schiemann, 1996). Operations management researchers have extensively explored the definition of alignment and the alignment-performance link.

Boyer and McDermott (1999, p. 290) define alignment as "the level of agreement within an organization regarding the relative importance of cost, quality, delivery, and

flexibility to the organization's operational goals." They focused on the consensus of the priorities of competitive advantages. Alignment has been extensively studied from a system fit perspective within an organization. The alignment of reward systems, information systems, organization cultures, and corporate resources are discussed in earlier researches (Galbraith and Nathanson, 1978; Lorange and Vancil, 1977; Stonich, 1982). However, the alignment-performance link has not been consistently supported in them. Lindman et al. (2001) proposed that the alignment of strategic priorities should go through mediating variables to have effects on performance.

Recently, researchers have paid more interest in alignment between organizations. One type of alignment between firms is "co-opetition", which is the alignment between competitors to cooperate for marketing opportunities (Robinson, 1999). Virtual enterprise is a temporary alliance, which depends on the alignment between or among participating firm members. Cao and Dawlatshahi (2005) empirically support the cause and effect of alignment between virtual enterprise and information technology on business performance.

Supply chain is a specific alliance involving buyers and suppliers. Supplier Alignment is critical to supply chain management. Lee (2004) uses cases of Cisco and Seven-Eleven to emphasize the importance of Supplier Alignment for better performance because buyers and suppliers are in a network cooperating for the purpose of providing products to customers. He describes Supplier Alignment as allocating responsibilities and sharing risk, cost, and profit. Narayanan and Raman (2004, p. 96) contend that the failure of Cisco in 2001 is because "Cisco hadn't stipulated the responsibilities and accountability of its contractors and component suppliers." Cisco ended up with a huge

inventory at that time. “We found, in more than 50 supply chains we studied, the companies often did not act in ways that maximized the network’s profit; consequently, the supply chain performed poorly” (Narayanan and Raman, 2004, p. 96). “Misaligned incentives are often the causes of excess inventory, stock outs, incorrect forecasts, inadequate scales, and poor customer services” (Narayanan and Raman, 2004, p. 96). “All functions and firms must pull in the same direction to ensure that supply chain delivers goods and services quickly and cost-effectively” (Narayanan and Raman, 2004, p. 96). “To induce supply chain partners to behave in ways that are best for everybody, companies have to create or modify monetary incentives. A supply chain works well if its companies’ incentives are aligned; that is, risks, costs, and rewards of doing business are distributed fairly across the network” (Narayanan and Raman, 2004, p. 96). In short, to make the profit pie bigger and then share it with suppliers or marketers are essential aspects of Supplier Alignment.

In order to measure Supplier Alignment, this study, based on the above descriptions, views Supplier Alignment in three dimensions; strategic dimension, tactic dimension, and financial dimension. This study extends Boyer and McDermott’s (1999) within-organization alignment definition to the supply chain context to include financial incentive and responsibility allocation besides the relative importance of cost, quality, delivery, and flexibility. This study defines Supplier Alignment as *the level of agreement within a supply chain regarding the relative strategic importance of cost, quality, delivery, and flexibility, responsibility allocations, and sharing costs, risks, and benefits.* The definition of each of the five dimensions is described as follows:

The strategic dimension of Supplier Alignment is based on the competitive priority, which is defined as *the level of agreement within a supply chain regarding the relative strategic importance of cost, quality, delivery, and flexibility.*

The tactic dimension of Supplier Alignment is based on the responsibility allocation, which is defined as *the level of agreement within a supply chain regarding responsibility allocation among supply chain members.*

The sharing costs dimension of Supplier Alignment is based on the financial allocation, which is defined as *the level of agreement within a supply chain regarding sharing costs between supply chain members*.

The sharing benefits dimension of Supplier Alignment is on the financial allocation, which is defined as *the level of agreement within a supply chain regarding sharing benefits between supply chain members*.

The sharing risks dimension of Supplier Alignment is based on the financial allocation, which is defined as *the level of agreement within a supply chain regarding sharing risks between supply chain members*.

2.3.1 Partner Relationship and Supplier Alignment

Each of the three dimensions of Supplier Alignment (i.e., trust, commitment, and shared vision) can increase Supplier Alignment (i.e., strategic alignment, tactical alignment and sharing costs, benefits and risks). First, trust means that a buyer is honest and reliable (Li, 2002), which renders the buyer initiatives of strategy consistency, tactical allocation, and cost, benefit and risk sharing more easily acceptable by suppliers. Therefore, a reciprocative system in strategy, tactic, and finance (i.e., Supplier Alignment) is well established.

Second, the commitment dimension of partner relationship means that the buyer keeps its promise and even makes sacrifices to the supplier. With the buyer's long-term commitment to contract the supplier, the supplier is willing to keep on being aligned with the buyer even when the strategic priority of the buyer has changed; the tactic allocation in product development, manufacturing process, logistics, and quality improvement will be clear and fair; buyers and suppliers are willing to share costs, benefits, and risks in product development, manufacturing process, logistics, and quality improvement.

Third, shared vision means that a buyer and a supplier share their business policies and rules, aims and objectives of supply chain, importance of collaboration and improvements, and the future of the final products of the supply chain. Through sharing visions in business, the buyer and the supplier can align operations strategy (i.e., strategic alignment) with each other to target the common business strategy (i.e. sharing vision), allocate responsibilities in product development, manufacturing process, logistics, and quality improvement with harmony, and share costs, benefits, and risks easily because the buyer and the supplier have common business goals. Therefore, this study proposes the below hypothesis;

Hypothesis 1: Partner relationship has a positive impact on supplier alignment.

2.4 Supplier Empowerment

Conger and Kanungo (1988) summarize previous management practices on empowerment as effects of delegation (Burke, 1986), employee participation (Likert, 1961; McGregor, 1960), and resource sharing (Burke, 1986). In order to find the real source of empowerment rather than management practices of empowerment identified by

previous research, Conger and Kanungo (1988) argue that empowerment should not be limited to practices of delegation, employee participation, and resource sharing. They propose the motivational view of psychological empowerment, which is defined as "a process of enhancing feelings of self-efficacy among organizational members through identification of conditions that foster powerlessness and through their removal by both formal organizational practices, and informal techniques of providing efficacy information" (Conger and Kanungo, 1988, p. 474).

Physiological empowerment attracts a lot of researchers in theory building, measurements, and applications at the individual level (Conger and Kanungo, 1988; Thomas and Velthose, 1990; Spreitzer, 1995; Spreitzer, 1996; Spreitzer et al, 1999). Thomas and Velthose (1990) define four components of individual empowerment: meaning or inherent value, competence or self-efficacy, self-determination or choice, and impact or perceived consequence. Meaning is the value of a work, which is judged by the individual. Competence is the confidence of skills, which are required by the work. Self-determination is the autonomy of an individual to finish the work in terms of making decisions on the methods, schedules, and other job-related activities. Impact is the importance of the work of the individual to the department or team.

Team empowerment is as important as individual empowerment (Kirkman and Rosen, 1999, 2000). More empowered teams are more productive and proactive than less empowered teams (Kirkman and Rosen, 1999). Here team empowerment can be defined as a process of increasing potency. The four elements of individual empowerment are modified to be used in teams. Team empowerment includes meaningfulness, potency,

autonomy, and impact (Kirkman and Rosen, 1997). Potency at the team level is similar to the competence dimension at the individual level.

Although there is some research on empowerment in different fields at the individual level (Conger and Kanungo, 1988; Thomas and Velthose, 1990; Spreitzer, 1995; Spreitzer, 1996; Spreitzer et al, 1999) and team level (Kirkman et al., 2004), little research has been done on organizational empowerment within a supply chain. This study focuses on supplier empowerment within a supply chain, which is defined as *a process of enhancing feelings of potency of suppliers through identification of the potential value of proactively involving in supply chain practices.* Corresponding to the four dimensions of individual empowerment and group empowerment, supplier empowerment also includes the same four dimensions: meaningfulness, potency, autonomy, and impact. The definition of each dimension is described as following:

- Meaningfulness is defined as the perception of a supplier concerning its own value regarding products and services provided to the buyer.
- Potency is defined as the supplier's capabilities of providing quality products and services to the buyer.
- Autonomy is defined as the supplier's self-determination of its activities.
- Impact is defined as the contribution value of results of activities of the supplier to the success of finial products and the success of the supplier in an industry.

2.4.1 Partner Relationship and Supplier Empowerment

Partner relationship includes three parts: trust, commitment, and shared vision. Each part of supplier alignment can increase supplier empowerment (i.e., the feeling of

potency, meaningfulness, autonomy, and impact). First, trust means that a buyer is honest, reliable, open, and respects the confidentiality of information to a supplier (Li, 2002). These attitudes of the buyer to the supplier allow the supplier to have more freedom of choice in technologies and methods (i.e., autonomy in supplier empowerment) and thus increase the supplier's confidence in providing high quality products (i.e., potency in supplier empowerment). With the high quality products they provide to the buyer and increased trust from the buyer, the supplier can keep a positive and long-term relationship with the buyer to secure and improve its business success (i.e., meaningfulness in supplier empowerment) and have an intention to increase contributions toward the success of the buyer and the supply chain (i.e., impact in supplier empowerment).

Second, the commitment dimension of partner relationship means that the buyer keeps its promise and even makes sacrifices to the supplier. With the buyer's long-term commitment to contracts, the supplier can invest more in product and/or process improvements, which will increase choices of technologies and methods (i.e., autonomy in supplier empowerment) and increase its confidence in providing high quality products (i.e., potency in supplier empowerment). With more knowledge accumulation and higher quality performance, the supplier can increase its sense of company value (i.e., meaningfulness in supplier empowerment) and its sense of value to provide products to the buyer (i.e., impact in supplier empowerment).

Third, shared vision means that a buyer and a supplier share their business policies, objectives of supply chain, and importance of collaboration and improvements. Through sharing visions with the buyer, the supplier can have high confidence in its

capability to provide high quality products to the buyer (i.e., potency in supplier empowerment) because the supplier can understand customer requirements well through keeping its pace with the buyer. The supplier can also identify its own value through serving the considerate buyer (i.e., meaningfulness in supplier empowerment) and have a tendency to contribute high quality products and services to the buyer with a contribution value on consumers and the supply chain (i.e., impact in supplier empowerment).

Liker and Choi (2004) studied supply chains of "The Big Three" and North American Toyota and Honda through interviewing their suppliers. They found that Toyota and Honda shared their visions with their suppliers, trusted their suppliers and committed to their suppliers. Suppliers see benefits to cooperate with Toyota and Honda and have little fear of loosing their business with them. Therefore, suppliers are willing to invest more into their business with Toyota and Honda and have high confidence in their own value and its relation to the success of Toyota or Honda cars. In this case, the partner relationship offered by buyers really empowers suppliers to work with buyers. Therefore, this study proposes the below hypothesis:

Hypothesis 2: Partner relationship has a positive impact on supplier empowerment.

2.5 Supplier Partnership Practices

Partnership is one type of close relationship to ensure two or more companies join together to solve problems. Researchers contend that partnership can increase both buyers' performances and suppliers' performances through joint activities (Liker and Choi, 2004). However, many firms who claimed that they used partnership argued that

their partnership did not improve their performance. In order to find why this happened, this study points out that partnership should be first viewed as two parts: partner relationship (Li, 2002) and partnership practices, and then companies can figure out what is wrong with partner relationship or partnership practices in their failed cases. Dyer et al. (1998) propose the idea of "segmentation" between partnership relationships and arm's length relationships by comparing American, Japanese, and Korean auto manufacturers' supplier management policies and practices. They found that US firms claimed the partnership relationship with suppliers, but the frequency of their interactions with suppliers in actual practice is very low. Their relationship with suppliers is actually like an arm's length relationship. For Korean firms, they also claim that they have partnerships with all suppliers. Although their relationships with suppliers are partnerships, they do not have frequent interactions with suppliers. For Japanese companies, they have very good segmentation between the partnership relationship with some suppliers and the arm's length relationship with other suppliers. They have different frequency of interactions with different types of suppliers; they interact more with partnership suppliers than with arm's length suppliers. Comparing performances of these three groups of auto manufacturers, they have concluded that performances of Japanese firms are the best. So Dyer and his colleagues claim that segmentation is a good way to manage suppliers in terms of both supplier relationships and supplier management practices. They suggest that manufacturers can concentrate more on suppliers who provide important parts to them by using partnership practices for those suppliers only. Their research identifies the direct effect of partnership practices to firm's performances.

This study defines partnership practices and measures it according to previous case research on partnership practices, which mainly include two parts: joint operation activities and joint information activities (Liker and Choi, 2004; Lambert and Knemeyer, 2004; Lee, 2004). Researchers have found that partnership practices, which are viewed as frequent and deep joint problem solving, can improve both manufacturers' and suppliers' performance. Liker and Choi (2004) state that partnership practices encourage extensive knowledge sharing between manufacturers and suppliers and build up "deep supplier relationships". They focus on how manufacturers help their suppliers improve the suppliers' processes. Lambert and Knemeyer (2004) remind firms to identify the true partnerships, which have high trust and highly frequent and deep joint activities, from "so-called partnerships", which have low trust and lowly frequent joint operation practicesactivities. Narayanan and Raman (2004) emphasize the importance of information sharing through failed cases of supply chain management, in which supply chain members hide information for their own purposes. Lee (2004) focuses on information sharing and knowledge transference between suppliers and manufacturers in building up effective and efficient supply chains. Liker and Choi (2004) propose a "supplier-partnering hierarchy" package. They argue that a good way to share information effectively is to share information intensively but selectively. Therefore, partnership practices can be defined as *joint activities within a supply chain on the information flow and the material flow.* This study measures partnership practices using two subconstructs:

(1) The subconstruct of joint information activities is defined as joint *activities of partners within a supply chain on the information flow.*

(2) The subconstruct of joint operation activities is defined as joint *activities of partners within a supply chain on the material flow.*

2.5.1 Supplier Alignment and Supplier Partnership Practices

As described before, Supplier alignment links a supplier and a buyer on the dimensions of strategy, tactics, and finance. When the buyer and the supplier have the same strategic priority of cost, quality, delivery, and flexibility, they should keep on working together and sharing information to have consistency toward the same strategic goals. A clear and fair tactical responsibility allocation between a buyer and a supplier can ensure both parties share information frequently, allowing suppliers to have on-time deliveries. In addition, the buyer utilizes its expertise to help the supplier to improve the quality of its products which meet the specification requirements set by the buyer. When both the buyer and the supplier share their costs, risks, and benefits, based on the resource dependency theory, both of them tend to share their knowledge to solve problems in product designs and process improvements and share information frequently to have efficiency in their operations in order to get more common benefits for both firms (Powell, 1990; Banerji and Sambharya, 1998). Sharing costs, risks, and benefits between a buyer and a supplier in financial alignment can induce both the buyer and the supplier to work in a close friendship to make the profit pie bigger and then share it fairly. In summary, a buyer and a supplier will have more activities of joint operation practices and information sharing when the buyer and the supplier align in dimensions of strategy, tactics, and finance (Liker and Choi, 2004). Goffin et al. (2006) contend that sharing rewards with the supplier can lead to an exchange of resources and integration of logistics in their model. Therefore, this study proposes the following hypothesis;

Hypothesis 3: Supplier alignment has a positive impact on supplier partnership practices.

2.5.2 Supplier Empowerment and Supplier Partnership Practices

Supplier empowerment is a psychological process for a supplier to evaluate the value of providing products to a buyer including its own confidence, freedom, benefits, and its impacts to the buyer. The potential benefit for the supplier is one critical part of supplier empowerment. A supplier's view of potential benefits induce the supplier to display goodwill trust (McCutcheon and Stuart, 2000), which will lead to its proactive participation into solving problems with the buyer and sharing information with the buyer to provide high quality products rather than holding information for its own uses. Therefore, this study proposes the following hypothesis:

Hypothesis 6: Supplier empowerment has a positive impact on supplier partnership practices.

2.6 Supplier Modularity Practices

Product design is a process of selecting ideas based on market requirement and engineering constrains (Krishan and Ulrich, 2001). One critical dimension of product architecture is integral versus modular (Salvador et al., 2002). Modularity can be defined as one component of a family of components that is connected with other component(s) in other families through standardized interfaces (Salvador et al., 2002). Based on this definition, modularity can be measured through two items: the number of different interfaces among component families, and the number of functions performed by each

component family (Fine et al., 2005). Pine (1993) proposes that modularity is a design architecture to meet customers' specific demands and to maintain low cost.

Tu et al. (2004) extend this product design architecture in a manufacturing context and define a construct of Modularity-based Manufacturing Practices (MBMP). MBMP includes: Product Modularity (i.e., "the practice of using standardized product modules so they can be easily reassembled or rearranged into different functional forms, or shared across different product lines"), Process Modularity (i.e., "the practice of standardizing manufacturing process modules so that they can be resequenced easily or new modules can be added quickly in response to changing product requirements"), and Dynamic Teaming (i.e., "the practice of using modular structures to reorganize manufacturing teams quickly and link them to necessary resources in response to product design or manufacturing process changes").

This study extends the construct of MBMP by Tu et al. (2004) in the supply chain context. In such a context, supply base also can be modularized to have both operation efficiency and managerial efficiency since the buyer needs only to deal with limited modulated supplier groups rather than a large number of individual suppliers. In the auto industry, a typical supplier module is the air conditioner module. Normally, one supplier is the air conditioner module leader and acts as the interface to the automaker. This leader ensures different suppliers in the module to coordinate together to ensure the quality of the whole air conditioner system. Therefore, by adding a supply base dimension in modularity, the construct of supplier modularity practices is defined as *practices of applying modularity in product, process, teaming, and supply base in the supply chain context.*

This study proposes that supplier modularity practices include the following four parts:

- Product Modularity
- Process Modularity
- Dynamic Teaming
- Strategic Supplier Segmentation

2.6.1 Supplier Alignment and Supplier Modularity Practices

Supplier Alignment integrates buyer and supplier in strategy, tactic, and finance. The buyer-supplier integration will highly increase the supplier modularity practices in product design, process operation, manufacturing team, and supply base management. In product design, aligned suppliers proactively cooperate with the buyer in design, using their expertise to design modules for the final products. In this way, the total design time becomes shorter and the introduced new products have higher quality.

In the manufacturing process, with the alignment between the buyer and the supplier, suppliers are willing to adapt to the market change of the final products and thus adopt more modular manufacturing process to respond to the fast changed products, which demand flexible manufacturing requirements for suppliers. Flexible manufacturing requirements call for flexible manufacturing teams of suppliers to adapt to the fast changing manufacturing projects and their schedules.

Changing demands of the buyer also requires the supplier to respond quickly not only through the supplier's modular manufacturing process, dynamic team, but also push back the uncertainty to the supplier's supply base management. In supplier management, many companies utilize the method of modular supply base management to focus more

on important suppliers. This is similar to the ABC method in inventory management to invest more time and money in more important suppliers to ensure overall efficiency and effectiveness in supply base management. Therefore, this study proposes the following hypothesis:

Hypothesis 4: Supplier alignment has a positive impact on supplier modularity practices.

2.6.2 Supplier Empowerment and Supplier Modularity Practices

Empowered suppliers, like empowered individuals, are proactive in the alliance with the buyer on supplier modularity practices in product design, process operation, manufacturing team, and supply base management. In product design, empowered suppliers are willing to share their expertise to design modules for the final products. In this way, the introduction period of new product becomes shorter.

In the manufacturing process, empowered suppliers are willing to adapt to the market change of the final products and thus invest more in modular manufacturing processes to respond to the fast changed products, which demand flexible manufacturing requirements for suppliers. Similar to the effect of supplier alignment, flexible manufacturing systems call for flexible manufacturing teams of suppliers to adapt to the fast changing manufacturing projects and their schedules.

Changing demands of the buyer push back the uncertainty to the supplier's supply base management. Empowered suppliers are more likely to utilize the method of modular supply base management (i.e., strategic supplier segmentation) to maximize the utilization of resources in supply base management. Therefore, this study proposes the following hypothesis:

Hypothesis 7: Supplier empowerment has a positive impact on supplier modularity practices.

2.7 Supplier Postponement Practices

Mass customization is referred to as customizing products to satisfy individual customer need at the similar price of mass-produced products (Davis, 1987). There are a wide variety of approaches to achieve mass customization. From the process design perspective, postponement has been considered an important method to contribute to mass customization (Feitzinger and Lee, 1997; Van Hoek et al., 1999). Postponement means that the final assembly or packaging of a product is postponed usually until a company receives customer's orders (Lee and Tang, 1997; Li et al., 2006).

The market uncertainty from the development of technology, increased competition, more demanding consumers, growing product variety and complexity, and shorter product life cycles force companies to adopt postponement more frequently (Bowersox et al. 1999; Yang et al. 2003).

Li et al. (2006, p. 110) define postponement supply chain practice as "the practice of moving forward one or more operations or activities (making, sourcing, and delivering) to a much later point in the supply chain." The definition of postponement in their study is adopted here. The measurement is also adopted with some revisions. The measurement of postponement is in two dimensions:

- Time dimension in postponement
- Location dimension in postponement

2.7.1 Supplier Alignment and Supplier Postponement Practices

Postponement aims at gaining more and more implementations in supply chains because it has the capability to largely eliminate speculative inventories. (Bowersox et al., 1999). Companies, which successfully implement postponement, involve suppliers deeply in postponement practices (van Hoek, 2001). Sometimes, suppliers should sacrifice their own profit by temporarily holding some inventory or stopping assembly lines for the purpose of postponement. Supplier Alignment enables suppliers to have this type of "sacrifice", because suppliers are consistent with the buyer in strategy and operations responsibility. Furthermore, suppliers are willing to get involved into postponement activities in the supply chain because they are confident they will share benefits, as well as sharing costs and risks, with the buyer. Therefore, this study proposes the following hypothesis:

Hypothesis 5: Supplier alignment has a positive impact on supplier postponement practices.

2.7.2 Supplier Empowerment and Supplier Postponement Practices

Empowered suppliers are willing to participate in the postponement practices through temporarily holding inventories or stopping their assembly lines because suppliers, with high confidence in manufacturing, logistics, quality management, and purchasing management (i.e., potency dimension in supplier empowerment) can view (1) the potential extra profits and capability increases in manufacturing, logistics, quality management and purchasing management (i.e., meaningfulness dimension of supplier empowerment) and (2) the benefit of the postponement activities for the supplier in terms of its contributions to the supplier chain, its industry status and reputation (i.e., impact

dimension of supplier empowerment). Therefore, this study proposes the following hypothesis:

Hypothesis 8: Supplier empowerment has a positive impact on supplier postponement practices.

2.8 Build-to-order Supply Chain Capability

Gunasekaran and Ngai (2005, p. 427) define BOSC as ‘‘a value chain that activates the processes of building the products based on individual customer requirements and by leveraging information technology and strategic alliances with partnering firms for required components and support services such as logistics. The aim in BOSC is to meet the demands of individual customers with a short lead time and minimum inventory and production costs along the value chain.’’

BOSC is the advanced stage of mass customization because it considers both mass customization and supply chain. Tu et al. (2001, p. 203) define mass customization (MC) capabilities as “the ability of a firm to produce varieties of customized products on a large scale at a cost comparable to non-customized products through technical and managerial innovations.” The measurement of mass customization capability includes cost effectiveness, volume effectiveness, and responsiveness. “BOSC provides a level of responsiveness, cost effectiveness, and flexibility that enables companies to deliver the products that customers have chosen at the time they requested it” (Gunasekaran and Ngai, 2005, p. 425). The major difference between mass customization capability and BOSC capability is order fulfillment capability and low inventory of the whole supply chain. So, BOSC capability is defined as the ability of a firm to produce varieties of

customized products on a large scale to fulfill customer orders efficiently at a reasonable cost through technical and managerial innovations. This study proposes that BOSC capability includes:

- Mass customization capability
- Order fulfillment
- Low inventory

2.8.1 Supplier Partnership Practices and Build-to-order Supply Chain Capability

Lee (2004) contends that a firm can achieve competitive advantages through exchanging information and knowledge with supply chain members. Joint operation activities (i.e., joint product development, shared planning, integration of logistics and joint problem solving) integrate suppliers and buyers. Joint product development can save a high percentage of the cost of new product development, which is a major proportion of final product costs. Shared planning can optimize productions to achieve the lowest costs of production, which will be transferred to the cost of the final products. Shared planning allows the whole chain to coordinate to fill orders faster. Joint operation practices transfers knowledge to improve supply chain efficiency (Liker and Choi, 2004). Frederiksson and Gadde (2005) introduce the Volvo case using logistics integration and joint planning to achieve high level of BOSC. Therefore, this study proposes the following hypothesis:

Hypothesis 9: Supplier partnership practices have a positive impact on BOSC capabilities.

2.8.2 Supplier Modularity Practices and Build-to-order Supply Chain Capability

Modularity supply chain practices apply modularity architecture to dimensions of product, process, supply base, and teaming. Modularity product design practices allow supply chains to offer customers many combinations, which satisfy different customer groups. Modularized products allow the manufacturer to communicate with customers easier and change modules more quickly to meet the changing demands of customers and still maintain low costs in design, logistics, and manufacturing (Pine, 1993). Modularity processes allow managers to easily manage the process to schedule or reschedule manufacturing processes to meet the changed demands and maintain a low inventory of final products. Dynamic teams are flexible enough to solve problems quickly to increase the efficiency in the supply chain to respond to changing customer demands quickly and thus have few final product inventories.

Tu et al. (2004) show that high Modularity-based Manufacturing Practices (i.e., modularity product design, modularity process, and dynamic teaming) increase Mass Customization Capability (i.e., cost effectiveness, volume effectiveness, and responsiveness), which is a key part of Build-to-order Capability. In supplier modularity practices, the fourth dimension is strategic supplier segmentation. It allows the manufacturer to save a lot of time in managing the supply base through managing modules of suppliers based on the product modules, and to save on the cost of managing suppliers and to respond to changing demands quickly. Therefore, this study proposes the following hypothesis:

Hypothesis 10: Supplier modularity practices have a positive impact on BOSC capabilities.

2.8.3 Supplier Postponement Practices and Build-to-order Supply Chain Capability

Supplier Postponement Practices can delay the time of assembling final products to the latest possible time, even until the order is placed in some cases, to have as few inventories of final products and obsolete inventories as possible. Since obsolete products in inventory increase the average costs of final products dramatically, less obsolete inventory means a lower cost. The goal of operations is to make money, and not carrying inventory is one of key ways of saving money in operations (Goldratt, 1999). Postponement processes can allow supply chains to respond to the customer's needs quickly and to maintain a low inventory level at the same time (Feitzinger and Lee 1997; Van Hoek et al., 1999). So, this study proposes the following hypothesis:

Hypothesis 11: Supplier postponement practices have a positive impact on BOSC capability.

CHAPTER 3: INSTRUMENT DEVELOPMENT (1): ITEM GENERATION, PILOT STUDY, AND LARGE-SCALE ADMINISTRATION

As described in Chapter Two, there are eleven hypotheses to be tested and seven constructs to be developed or adopted from previous research. In this study, there are four stages of construct development: (1) In the first pre-pilot stage, the definition and items of each construct are first generated from a broad literature review; (2) then, the potential items are given to two practitioners and five academicians for a pretest, whose purpose is to clarify the instructions and the questions in the questionnaire; according to their feedback, the items are modified, included, or discarded to ensure the content validity of the instruments; (3) the third stage is the pilot study; in this stage, a small sample of respondents is used to answer the surveys; the reliability and validity of the instruments can be evaluated and then the instruments are refined; (4) the fourth stage is testing validities and reliabilities of all instruments through analyzing large-scale survey data.

This chapter introduces the first three stages of the instrument development, and the next chapter discusses the fourth stage, a large-scale instrument development. Section 3.1 in this chapter describes how items of each construct are generated or adopted from previous research. Section 3.2 introduces the process of questionnaire modifications by the practitioners and academicians, as well as the modified questionnaire. Section 3.3 presents a small- scale survey that is used in the pilot study and a reliability analysis to

evaluate and modify the instruments to be used as the final questionnaire for the large-scale survey.

3.1 Item Generation

Content validity is the first consideration in developing a measurement. In order to ensure content validity, items of a construct should cover the main domains of the construct (Churchill, 1979). It is through a broad literature review and interviews with practitioners and academicians in the research field that items generated in the research can largely be ensured to have content validity. This study generates initial items of each construct through a broad literature review. Items are assigned to groups to measure a specific dimension of a construct. This study develops three new constructs: Supplier Alignment, Supplier Empowerment, and Supplier Partnership Practices; adopts two constructs with major revisions: Supplier Modularity Practices and Build-to-order Supply Chain Capabilities; and adopts two constructs with minor revisions: Partner Relationship and Supplier Postponement Practices. The generation process and literature basis for items are briefly described as follows (see Appendix 1 for the initial items).

Items in **Supplier Alignment** were from operations strategy literature (Skinner, 1974; Boyer and McDermott, 1999; Lingle and Schiemann, 1996; Venkatraman and Camillus, 1984; Galbraith and Nathanson, 1978; Lorange and Vancil, 1977; Stonich, 1982; Robinson, 1999; Lindman et al., 2001) and supply chain management literature (Narayanan and Raman, 2004; Lee, 2004). The item generation process of each dimension of Supplier Alignment is described as follows.

First, previous research on operations strategy uses the Euclidian distance between actual rankings of two parties to measure the alignment (Cao and Dowlatshahi, 2005). This study uses the perceived alignment to measure the strategy alignment between a buyer and a supplier. There are two reasons for choosing this type of measurement: (1) perceived alignments are more suitable for the definition of strategy alignment, which is proposed to have a relationship with the psychological empowerment of suppliers; (2) perceived alignments can catch not only the current alignment but also the past history and future trend of strategic alignment. Four items are used to cover the domain of strategy alignment: (1) the buyer gives its strategic priority to the supplier; (2) the buyer encourages the supplier to have similar strategic priority as the buyer's; (3) the buyer and the supplier do have similar strategic priority in their operations; (4) the buyer and the supplier maintain historical consistency on strategic priority.

Second, for tactical alignment, Lee (2004) emphasizes clear allocations of role, task and responsibility between buyers and suppliers. These perceived fair allocations are viewed as important because unfair responsibility allocations cannot be followed exactly by buyers and suppliers and thus do not reflect the actual tactical alignment. Tactical alignment measures clearness and fairness of responsibility allocations within a supply chain in new product development, process improvements, and logistics.

Third, for financial alignment, literature suggests equitably sharing costs, benefits and risks between buyers and suppliers as the incentive part of Supplier Alignment (Lee, 2004; Narayanan and Raman, 2004). This study measures three types of financial alignment (i.e., sharing costs, sharing risks, and sharing benefits) in three major types of

operations activities: new product development, process improvements, and logistics for nine items used in the measurement of financial alignment.

Items in **Supplier Partnership Practices** are from supply chain management literature (Dyer et al., 1998; Daft and Lengel, 1986; Narayanan and Raman, 2004; Liker and Choi, 2004; Lee, 2004; Li., 2002; Lambert and Knemeyer, 2004). This study focuses on partner practices in supply chain to include two types of practices: Joint Operations Practices and Information Sharing Practices. The former includes seven items covering joint activities in planning, product development, process improvement, quality improvement, logistics, and sending employees to the other party for problem solving. The latter has eight items, including the frequency and the freedom of information sharing in new product development, process, logistics, and finance.

Supplier Modularity Practices are based on three dimensions of Modularity-based Manufacturing Practices (i.e., Product Modularity, Process Modularity and Dynamic Teaming, and a new dimension) by Tu et al. (2004). The items in Modularity-based Manufacturing Practices by Tu et al. (2004) are modified in the supply chain context (Krishan and Ulrich, 2001; Salvador, et al., 2002; Pine, 1993; Feitzinger and Lee, 1997; Fine et al., 2005) to have three corresponding dimensions in Supplier Modularity Practices: Product Modularity (7 items), Process Modularity (6 items), and Dynamic Teaming (7 items). A fourth dimension, Strategic Supplier Segmentation, is added. The six items of Strategic Supplier Segmentation cover both the modularity of a company's supplier base and the modularity of its OEM's supplier base.

Items in **BOSC Capability** are based on definitions of Mass Customization Capability (Tu et al., 2004) and BOSC (Gunasekaran and Ngai, 2005). BOSC

Capabilities include cost effectiveness, volume effectiveness, responsiveness, flexibility, and final product inventory. Items of cost effectiveness, volume effective, flexibility, and responsiveness are adopted from Mass Customization Capability (9 items in Tu et al., 2001). This study identified three items to measure the capability of maintaining low final product inventory, low total inventory cost, and low obsolete product inventory.

Instruments of **Partner Relationship** and **Supplier Postponement Practices** are adopted from Li's (2002) research with minor modifications. The construct of Partnership Relationship includes Trust (4 items), Commitment (6 items), and Shared Vision (4 items). The construct of Supplier Postponement Practices includes four items.

Supplier Empowerment items are modified from items of team empowerment created by Kirkman and Rosen (1999) and elevated to the firm level in the supply chain and as is referred to in other literature on psychological empowerment (Conger and Kanungo, 1988; Thomas and Velthose, 1990 Spreitzer, 1995; Spreitzer, 1996; Spreitzer et al, 1999; Somech, 2005; Kirkman et al., 2004). There are eight items for the dimension of Potency, six items for the dimension of Meaningfulness, six items for the dimension of Autonomy, and six items for the dimension of Impact. There are a total of 111 items in eighteen pools in the revised questionnaire (see Table 3.1.1). The items are listed in Appendix One.

Major Construct	Sub Construct	Number of Items
Supplier Alignment	Strategic Alignment	4
	Tactical Alignment	6
	Financial Alignment	6
Partner Relationship	Trust	4
	Commitment	6
	Shared Vision	4
Supplier Empowerment	Meaningfulness	6
	Potency	8
	Autonomy	6
	Impact	6
Supplier Partnership Practices	Joint Operations Practices	7
	Information Sharing Practices	8
Supplier Modularity Practices	Product Modularity	7
	Process Modularity	6
	Dynamic Teaming	7
	Supply Base Modularity	4
Supplier Postponement Practices		4
BOSC Capability		12
Total		111

Table 3.1.1: Items for Each Construct

3.2 Pre-pilot Study

After the items were generated, the questionnaire was first sent to five academicians and two practitioners to check the consistency of each item with the definition and the content of corresponding constructs as well as the accuracy of the wording in the questionnaire. According to their feedback, items were added, modified and eliminated. The revised questionnaire is listed in Appendix Two.

3.3 Scale Development: The Pilot Survey Method

In order to have preliminary confidence about the reliability and validity of the measurement Scale, a small Scale pilot study was conducted. A questionnaire was sent to five suppliers of Guangzhou Honda Automobile Co. in Guangdong, China and twenty five suppliers of Yuchai Machine (Group) Co. in Guangxi, China. Questionnaires were given to the marketing and sales managers of suppliers through the purchasing managers of those two firms. The questionnaire made it clear that its different parts were expected to be answered by respondents at different management levels of the suppliers, including executives and department heads. The supplier marketing and sales manager coordinated a team to answer the questionnaire and made sure that the most appropriate persons in their company answered relevant parts of the questionnaire. With the top manager support, the response rate is 100%. The sample size of this pilot study is 30. The pilot study results are very valuable for preliminary evaluation of the reliability and convergent validity of the instrument. Due to the small sample size of the pilot study, discriminant validity of each construct cannot be evaluated through the construct-level factor analyses.

The results of statistical analyses also provide directions to clarify and/or modify items in the questionnaire.

One purpose of the pilot data analyses is to ensure instrument reliability. Reliability indicates the degree to which a measurement will have same results when the test is repeated. This study uses a commonly agreed reliability indicator, Cronbach's alpha (Cronbach, 1951). An alpha value higher than 0.7 indicates an acceptable reliability for a measurement (Nunally, 1978). Another index is the Corrected Item-Total Correlation (CITC) of each item in an instrument; CITC measures how well the item contributes to the construct's internal consistency (Kerlinger, 1978). This study uses SPSS 14.0 to compute both Cronbach's alpha and CITC at dimension level. An item with more than 0.5 for CITC will be kept in the dimension. An item with less than 0.5 for CITC will be eliminated from the dimension unless this item is considered very important to the construct. A factor analysis is conducted to split the dimension if the Cronbach's alpha is very low; then the alpha of each subset of items is recalculated.

Another purpose of the pilot data analysis is to ensure convergent validity of each instrument. Convergent validity measures the extent to which each item in one dimension (construct) forms a common dimension. A dimension-level factor analysis is to assure unidimensionality (convergent validity) of each dimension in a construct. This study uses SPSS 14.0 to conduct factor analysis.

3.4 Pilot Study Results and Item Modification

Sections 3.4.1 through 3.4.7 describe the results of reliability and convergent validity of each construct.

3.4.1 Supplier Alignment (SA)

The Supplier Alignment construct includes three dimensions and twenty-six items: Strategic Alignment (SA) (6 items), Tactical Alignment (TA) (8 items), Sharing Costs (SHC) (4 items), Sharing Benefits (SHB) (4 items), and Sharing Risks (SHR) (4 items). The original 26 items and their corresponding code names are listed in Table 3.4.1.1.

Code Names	***Questionnaire Items***
Strategic Alignment (SA)	
SA01	My OEM has given my firm its strategic priorities
SA02	My firm's strategic priority with respect to *cost* is consistent with my OEM's strategic priority
SA03	My firm's strategic priority with respect to *quality* is consistent with my OEM's Strategic priority
SA04	My firm's strategic priority with respect to *delivery* is consistent with my OEM's strategic priority
SA05	My firm's strategic priority with respect to *flexibility* is consistent with my OEM's strategic priority
SA06	My firm can maintain strategic consistency when my OEM's strategic priority has been changed
Tactical Alignment (TA)	
My firm and my OEM have	
TA01	clearly defined responsibilities in product development
TA02	fairly allocated responsibilities in product development
TA03	clearly defined responsibilities in manufacturing processes
TA04	fairly allocated responsibilities in manufacturing processes
TA05	clearly defined responsibilities in logistics
TA06	fairly allocated responsibilities in logistics
TA07	clearly defined responsibilities in quality improvement
TA08	fairly allocated responsibilities in quality improvement
Sharing Costs (SHC)	
My firm and my OEM share	
FA01	the costs of developing products
FA02	the costs of quality improvements
FA03	the costs of manufacturing process improvements

FA04	the costs of logistics improvements
Sharing Benefits (SHB)	
My firm and my OEM share	
FA05	the benefits of new product introductions
FA06	the benefits of quality improvements
FA07	the benefits from manufacturing process improvements
FA08	the benefits of logistics improvements
Sharing Risks (SHR)	
My firm and my OEM share	
FA09	the risks of new product introductions
FA10	the risks of quality improvements
FA11	the risks from manufacturing process improvements
FA12	the risks of logistics improvements

Table 3.4.1.1: Supplier Alignment - Pilot Study Items

Item Purification: For the Strategic Alignment dimension, the CITC scores of SA1 and SA3 are below 0.50 (see Table 3.4.1.2). However, SA3 is considered to be important for this dimension because SA3 covers quality consistency of strategic alignment. One possible reason of low CITC score for SA3 is the small sample size. The SA1 is dropped to increase the reliability from 0.785 to 0.798. For the Tactical Alignment dimension, the CITC scores are all above 0.50. One item is added to the Strategic Alignment dimension to cover overall consistency in strategy. The added item is "my firm's strategic priorities are consistent with my OEM's." All items of Tactical Alignment, Sharing Costs, Sharing Benefits, and Sharing Risks are kept because all CITC scores of them are 0.50 or above. All alphas are higher than 0.7. These indicate a good reliability of Supplier Alignment.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Strategic Alignment (SA)				
SA2	.641	.555	.767	**α=.798**
SA3	.259	.289	.841	
SA4	.750	.758	.701	
SA5	.707	.749	.698	
SA6	.530	.590	.758	
SA1	.358	**Item dropped after purification**		
Tactical Alignment (TA)				
TA1	.650	.650	.650	**α=.837**
TA2	.518	.518	.735	
TA3	.495	.495	.631	
TA4	.558	.558	.793	
TA5	.557	.557	.739	
TA6	.699	.699	.882	
TA7	.609	.609	.712	
TA8	.545	.545	.755	
Sharing Costs (SHC)				
FA1	.721	.721	.853	**α=.880**
FA2	.778	.778	.831	
FA3	.829	.829	.810	
FA4	.649	.649	.880	
Sharing Benefits (SHB)				
FA5	.726	.726	.756	**α=.831**
FA6	.774	.774	.738	
FA7	.610	.610	.810	
FA8	.546	.546	.837	
Sharing Risks (SHR)				
FA9	.623	.623	.857	**α=.862**
FA10	.727	.727	.816	
FA11	.877	.877	.746	
FA12	.635	.635	.853	

Table 3.4.1.2: Supplier Alignment - Item Purification Results

Dimension-Level Factor Analysis: A dimension-level factor analysis is to assure unidimensionality (convergent validity) of each of three dimensions. The factor analysis results are displayed in Table 3.4.1.3. All factor loadings are higher than 0.50 except that of SA3. However, SA3 was kept for large-Scale survey because it is important for the construct. All KMOs are higher than 0.5. These indicate a good convergent validity of each dimension.

Items	***Factor Loadings***
Strategic Alignment (SA) KMO = .699	
SA2	.734
SA3	.399
SA4	.903
SA5	.853
SA6	.784
Tactical Alignment (TA) KMO =.669	
TA1	.783
TA2	.540
TA3	.696
TA4	.618
TA5	.755
TA6	.815
TA7	.672
TA8	.628
Sharing Costs (SHC) KMO = .510	
FA1	.846
FA2	.877
FA3	.914
FA4	.790
Sharing Benefits (SHB) KMO =.785	
FA5	.864
FA6	.892
FA7	.786
FA8	.727

Sharing Risks (SHR) KMO =.730	
FA9	.774
FA10	.852
FA11	.944
FA12	.786

Table 3.4.1.3: Supplier Alignment - Dimension-Level Factor Analysis

3.4.2 Partner Relationship (PR)

The Partner Relationship construct was developed with three dimensions and twenty-two items: Trust (TRT) (6 items), Commitment (COM) (9 items), and Shared Vision (SHV) (7 items). The original 22 items and their corresponding code names are listed in Table 3.4.2.1.

Code Names	***Questionnaire Items***
Trust (TRT)	
TRT1	My OEM has been open and honest in dealing with my firm.
TRT2	My OEM respects the confidentiality of the information they receive from my firm.
TRT3	Our transactions with my OEM do not have to be closely supervised by my OEM.
TRT4	My firm has been open and honest in dealing with my OEM.
TRT5	My firm respects the confidentiality of the information they receive from my OEM.
TRT6	Our transactions with my OEM do not have to be closely supervised by my firm.
Commitment (COM)	
COM1	My OEM has helped my firm in the past.
COM2	My OEM has made sacrifices for my firm in the past.
COM3	My OEM abides by agreements with my firm very well.
COM4	My OEM has invested a lot of efforts in our relationship with my firm.
COM5	My firm has helped my OEM in the past.

COM6	My firm has made sacrifices for my OEM in the past.
COM7	My firm abides by agreements with my OEM very well.
COM8	My firm has invested a lot of efforts in our relationship with my OEM.
COM9	My firm and my OEM always try to keep each others' promises.
Shared Vision (SHV)	
My firm and my OEM have a similar understanding about	
SHV1	the aims and objectives of the supply chain.
SHV2	the importance of collaboration across the supply chain.
SHV3	the importance of improvements that benefit the supply chain as a whole.
SHV4	my OEM will have good scales.
SHV5	my OEM will have good profits.
SHV6	my OEM will have high customer satisfaction.
SHV7	my OEM will have good brand reputation.

Table 3.4.2.1: Partner Relationship - Pilot Study Items

Item Purification: Table 3.4.2.2 below presents the item purification results. All CITC scores are higher than 0.5 for the dimension of Trust. For the dimensions of Commitment, four of eight CITC scores are lower than 0.5. An exploratory factor analysis is conducted for the dimension. Two factors are found in the dimension of Commitment. Reliability is tested for each factor. All CITC scores of the two factors are higher than 0.5 except that of COM1; COM1 is deleted to improve the reliability. For the dimension of Shared Vision, three of seven CITC scores are less than 0.50. Measurement is purified by deleting one item one time; after three rounds of dropping, SHV1 and SHV4 are deleted because they overlap with other items. However, SHV6 is kept because it is very important for the content validity. All alpha values are higher than 0.75. This indicates a good reliability of Partner Relationship.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Trust (TRT)				
TRT1	.606	.606	.793	**α=.824**
TRT2	.740	.740	.762	
TRT3	.532	.532	.807	
TRT4	.582	.582	.799	
TRT5	.575	.575	.799	
TRT6	.547	.547	.810	
Commitment (COM)				
COM2	.632	.586	.798	**α=.803**
COM3	.565	.619	.765	
COM4	.690	.758	.607	
COM1	.290	**Item dropped after purifications**		
COM5	.580	.580	.900	**α=.878**
COM6	.897	.897	.780	
COM7	.802	.802	.817	
COM8	.740	.740	.846	
Shared Vision (SHV)				
SHV2	.653	.538	.751	**α=.782**
SHV3	.638	.597	.727	
SHV5	.712	.632	.715	
SHV6	.292	.347	.798	
SHV7	.743	.688	.698	
SHV1	.057	**Items sequentially dropped after purifications**		
SHV4	.339			

Table 3.4.2.2: Partner Relationship - Item Purification Results

Dimension-Level Factor Analysis: As shown in Table 3.4.2.3 below, all factor loading scores are close to or higher than 0.70. All KMOs are also higher than 0.60. These indicate a good convergent validity of each dimension in Partner Relationship.

Items	*Factor Loadings*	
Trust (TRT) KMO = .515		
TRT1	.743	
TRT2	.840	
TRT3	.704	
TRT4	.722	
TRT5	.708	
TRT6	.683	
Commitment (COM)		
COM2	.801	**KMO =.647**
COM3	.831	
COM4	.910	
COM5	.689	**KMO =.765**
COM6	.888	
COM7	.840	
COM8	856	
Shared Vision (SHV)		
SHV2	.778	**KMO =.713**
SHV3	.838	
SHV5	.819	
SHV7	.805	

Table 3.4.2.3: Partner Relationship - Dimension-Level Factor Analysis

3.4.3 Supplier Empowerment (SE)

The Supplier Empowerment construct includes four dimensions and twenty-three items: Meaningfulness (MN) (6 items), Potency (PT) (7 items), Autonomy (AT) (5 items), and Impact (IP) (5 items). The original 23 items and their corresponding code names are listed in Table 3.4.3.1.

Code Names	*Questionnaire Items*
Meaningfulness (MN) **My company believes that OEM projects are**	
MN1	worthwhile in increasing my company's profits
MN2	significant in increasing my company's design capability
MN3	significant in increasing my company's manufacturing capability
MN4	significant in increasing my company's logistics capability
MN5	significant in increasing my company's quality management capability
MN6	significant in increasing my company's purchasing capability
Potency (PT) **My company**	
PT1	has confidence in its R&D capability
PT2	has confidence in its manufacturing capability
PT3	has confidence in its purchasing capability
PT4	has confidence in its logistics capability
PT5	has confidence in quality management capability
PT6	can get a lot done when it works hard
PT7	believes that it can be very productive
Autonomy (AT) **My company**	
AT1	can select different R&D ways to do OEM's work
AT2	can select different manufacturing ways to do OEM's work
AT3	can select different logistics ways to do OEM's work
AT4	can select different purchasing ways to do OEM's work
AT5	can select different quality management ways to do OEM's work
Impact (IP) **My company's OEM project**	
IP1	has a positive impact on OEM's customers
IP2	provide products that matter to OEM
IP3	makes a difference in OEM supply chain
IP4	has a positive impact on customers other than this OEM
IP5	makes a difference in my firm's industry

Table 3.4.3.1: Supplier Empowerment - Pilot Study Items

Item Purification: As shown in Table 3.4.3.2, for the dimension of Potency, the CITC scores of PT1 and PT4 are lower than 0.50; these two items are sequentially dropped from the dimension; the CITC scores of the rest items in this dimension are all higher than 0.50. For the dimension of Meaningfulness, the CITC scores of MN2 and MN6 are also lower than 0.50; these two items are sequentially dropped from the dimension; the CITC score of each remaining item in this dimension is higher than 0.50. For the dimension of Autonomy, all CITC scores are higher than 0.50. For the dimension of Impact, the CITC scores of IP1 and IP3 are lower than 0.5; these two items are sequentially dropped from the dimension; the CITC scores of the rest items in this dimension are all higher than 0.50.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Potency (PT)				
PT2	.527	.658	.777	α =**.821**
PT3	.557	.514	.813	
PT5	.772	.733	.748	
PT6	.559	.559	.804	
PT7	.588	.635	.780	
PT1	.479	**Items dropped after purifications**		
PT4	.214			
Meaningfulness (MN)				
MN1	.678	.734	.811	α =**. 860**
MN3	.672	.748	.807	
MN4	.593	.537	.885	
MN5	.710	.839	.764	
MN2	.350	**Items dropped after purifications**		
MN6	.388			
Autonomy (AT)				
AT1	.810	.810	.849	α = **.890**
AT2	.567	.567	.899	

AT3	.802	.802	.850	
AT4	.741	.741	.865	
AT5	.762	.762	.859	
Impact (IP)				
IP2	.337	.603	.530	α = **.705**
IP4	.575	.518	.619	
IP5	.417	.524	.658	
IP1	.227	**Items dropped after purifications**		
IP3	.351			

Table 3.4.3.2: Supplier Empowerment - Item Purification Results

Dimension-Level Factor Analysis: The factor analysis results are displayed in Table 3.4.3.3. All loading scores are higher than 0.60. All KMOs are higher than 0.60, which indicate a good convergent validity for each dimension.

Items	***Factor Loadings***
Potency (PT) KMO=.691	
PT2	.800
PT3	.679
PT5	.857
PT6	.715
PT7	.776
Meaningfulness (MN) KMO =.770	
MN1	.858
MN3	.867
MN4	.699
MN5	.927
Autonomy (AT) KMO = .810	
AT1	.782
AT2	.770
AT3	.889

AT4	.784
AT5	.868
Impact (IP) KMO =.635	
IP2	.814
IP4	.872
IP5	.733

Table 3.4.3.3: Supplier Empowerment - Dimension Level Factor Analysis

Item Revisions: In the pilot study, specific attention was also paid to the wording of each item in the questionnaire. IP5 was originally worded "my company's project makes a difference in my firm's industry," but was later rephrased as "my company's project has a positive impact on my firm's reputation in the industry."

3.4.4. Supplier Partnership Practices (SPP)

The Supplier Partnership Practices construct includes two dimensions and fourteen items: Joint Operations Practices (JOP) (6 items) and Information Sharing Practices (ISP) (8 items). The original fourteen items and their corresponding code names are listed in Table 3.4.4.1.

Code Names	*Questionnaire Items*
Joint Operations Practices (JOP)	
JOP1	My firm jointly develops products with my OEM.
JOP2	My firm jointly improves manufacturing processes with my OEM.
JOP3	My firm jointly improves qualities of products with my OEM.
JOP4	My firm coordinates logistics with my OEM.
JOP5	My OEM sends its employees to help my firm solve problems.
JOP6	My firm sends its employees to my OEM to solve problems related to my firm's products.

Information Sharing Practices (ISP) My firm shares	
ISP1	product development information frequently with my OEM
ISP2	product development information freely with my OEM
ISP3	manufacturing process information frequently with my OEM
ISP4	manufacturing process information freely with my OEM
ISP5	logistics information frequently with my OEM
ISP6	logistics information freely with my OEM
ISP7	finance information frequently with my OEM
ISP8	finance information freely with my OEM

Table 3.4.4.1: Supplier Partnership Practices - Pilot Study Items

Item Purification: Table 3.4.4.2 below presents the item purification results. All CITC scores are higher than 0.50 except those of JOP2 and JOP4. These two items are kept because JOP2 and JOP4 cover the joint practices of the supplier and the buyer in manufacturing and logistics, which are very important to the dimension of Joint Operations Practices. Both alphas are high than 0.70, which indicates a good reliability of Supplier Partnership Practices.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Joint Operations Practices (JOP)				
JOP1	.618	.618	.730	**α=.79**
JOP2	.319	.319	.802	
JOP3	.549	.549	.751	
JOP4	.449	.449	.772	
JOP5	.549	.549	.754	
JOP6	.784	.784	.678	
Information Sharing Practices (ISP)				
ISP1	.799	.799	.884	**α =.90**
ISP2	.580	.580	.910	

ISP3	.848	.848	.880	
ISP4	.850	.850	.887	
ISP5	.807	.807	.902	
ISP6	.852	.852	.887	
ISP7	.883	.883	.880	
ISP8	.867	.867	.887	

Table 3.4.4.2: Supplier Partnership Practices - Item Purification Results

Dimension-Level Factor Analysis: The factor analysis results are displayed in Table 3.4.4.3. All factor loading scores are higher than 0.50. Both KMOs are higher than 0.60. These indicate a good convergent validity of each dimension.

Item Revisions: Since quality management plays a critical role in supply chain management and quality information sharing was ignored in the pilot study, two items are added to the Information Sharing Practices dimension to cover the information sharing of quality management: One is "my firm shares quality information frequently with my OEM"; the other is "my firm shares quality information freely with my OEM."

Items	***Factor Loadings***
KMO = .666	
JOP1	.740
JOP2	.512
JOP3	.719
JOP4	.643
JOP5	.734
JOP6	.820
KMO = .696	
ISP1	.767

ISP2	.582
ISP3	.809
ISP4	.715
ISP5	.593
ISP6	.716
ISP7	.866
ISP8	.806

Table 3.4.4.3: Supplier Partnership Practices - Dimension Level Factor Analysis

3.4.5 Supplier Modularity Practices (SMP)

The Supplier Modularity Practices construct includes four dimensions and twenty-three items: Product Modularity (PDM) (5 items), Process Modularity (PSM) (5 items), Dynamic Teaming in Manufacturing (MDT) (5 items), and Strategic Supplier Segmentation (SSM) (8 items). The original twenty-three items and their corresponding code names are listed in Table 3.4.5.1.

Code Names	*Questionnaire Items*
Product Modularity (PDM)	
PDM1	Our products use modularized designs.
PDM2	Our products share common modules.
PDM3	Our product features are designed around a standard base unit.
PDM4	Product modules can be reassembled into different forms.
PDM5	Product feature modules can be added to a standard base unit.
Process Modularity (PSM)	
PSM1	Our production process is designed as adjustable modules.
PSM2	Our production process can be adjusted by adding new process modules.
PSM3	Production process modules can be adjusted for changing production needs.
PSM4	Our production process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units.

PSM5	Production process modules can be re-arranged so that customization sub-processes occur last.
Dynamic Teaming in Manufacturing(DT)	
MDT1	Production teams that can be reorganized are used in our plant.
MDT2	Production teams can be reorganized in response to product / process changes.
MDT3	Production teams can be reassigned to different production tasks.
MDT4	Production team members can be re-assigned to different teams.
MDT5	Production team members are capable of working on different teams.
Strategic Supplier Segmentation (SSM)	
SSM1	My firm classifies its suppliers based on the importance of their parts to my firm's final products.
SSM2	My firm classifies its suppliers based on their ability to customize components for my firm's final products.
SSM3	My firm classifies its suppliers based on the product development interdependency of their parts to my firm's final products.
SSM4	My firm classifies its suppliers based on the level of ownership that my firm has in the supplier.
SSM5	My firm interacts with its suppliers based on the importance of their parts to my firm's final products.
SSM6	My firm interacts with its suppliers based on their ability to customize components for my firm's final products.
SSM7	My firm interacts with its suppliers based on the product development interdependency of their parts to my firm's final products.
SSM8	My firm interacts with its suppliers based on the level of ownership that my firm has in the supplier.

Table 3.4.5.1: Supplier Modularity Practices- Pilot Study Items

Item Purification: As shown in Table 3.4.5.2., CITC scores of PDM3, PSM3, MDT4 and MDT5 of the dimensions of Product Modularity, Process Modularity and Dynamic Teaming in Manufacturing are lower than 0.50. However, these items are kept since they were validated in the large-scale by Tu et al. (2004). All CITCs for the dimension of Strategic Supplier Segmentation are higher than 0.50. All alphas are higher than 0.70. These indicate a good reliability of each dimension.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Product Modularity (PDM)				
PDM1	.647	.647	.799	**α=.835**
PDM2	.606	.606	.811	
PDM3	.484	.484	.840	
PDM4	.818	.818	.745	
PDM5	.647	.647	.798	
Process Modularity (PSM)				
PSM1	.621	.621	.826	**α=.848**
PSM2	.814	.814	.783	
PSM3	.470	.470	.859	
PSM4	.807	.807	.772	
PSM5	.644	.644	.831	
Dynamic Teaming in Manufacturing (MDT)				
MDT1	.571	.571	.668	**α=.740**
MDT2	.709	.709	.605	
MDT3	.571	.571	.668	
MDT4	.325	.325	.760	
MDT5	.386	.386	.738	
Strategic Supplier Segmentation (SSM)				
SSM1	.719	.719	.945	**α=.947**
SSM2	.815	.815	.939	
SSM3	.779	.779	.941	
SSM4	.834	.834	.938	
SSM5	.867	.867	.935	
SSM6	.799	.799	.940	
SSM7	.894	.894	.933	
SSM8	.765	.765	.943	

Table 3.4.5.2: Supplier Modularity Practices- Item Purification Results

Items	*Factor Loadings*
Product Modularity (PDM) KMO = .72	
PDM1	.780
PDM2	.736
PDM3	.595
PDM4	.896
PDM5	.729
Process Modularity (PSM) KMO =.81	
PSM1	.788
PSM2	.826
PSM3	.581
PSM4	.905
PSM5	.743
Dynamic Teaming in Manufacturing(MDT) KMO = .75	
MDT1	.792
MDT2	.709
MDT3	.824
MDT4	.461
MDT5	.730
Strategic Supplier Segmentation (SSM) KMO = .85	
SSM1	.608
SSM2	.581
SSM3	.630
SSM4	.603
SSM5	.763
SSM6	.687
SSM7	.735
SSM8	.640

Table 3.4.5.3: Supplier Modularity Practices- Dimension-Level Factor Analysis

Dimension-Level Factor Analysis: The factor analysis results are displayed in Table 3.4.5.3. All factor loading scores are higher than 0.50 except that of MDT4. All

KMOs are higher than 0.60. This indicates a good convergent validity for each dimension.

3.4.6 Supplier Postponement Practices (PSP)

The Supplier Postponement Practices construct includes one dimension and seven items. The original seven items and their corresponding code names are listed in Table 3.4.6.1.

Until customer orders have been received,

Code Names	*Questionnaire Items*
PSP1	My firm postpones product designs.
PSP2	My firm postpones production.
PSP3	My firm postpones final product assembly activities.
PSP4	My firm postpones final product labeling activities.
PSP5	My firm postpones final packaging activities.
PSP6	My firm postpones the forward movement of goods.
PSP7	Our goods are kept in storage at central location.

Table 3.4.6.1: Supplier Postponement Practices – Pilot Study Items

Item Purification: Table 3.4.6.2 presents the item purification results. All CITC scores are higher than 0.80. Alpha is higher than 0.70. These indicate a good reliability of Supplier Postponement Practices.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
PSP1	.895	.895	.977	
PSP2	.930	.930	.974	
PSP3	.951	.951	.973	
PSP4	.964	.964	.972	**α=.98**
PSP5	.905	.905	.976	
PSP6	.933	.933	.974	
PSP7	.865	.865	.979	

Table 3.4.6.2: Supplier Postponement Practices - Item Purification Results

Dimension-Level Factor Analysis: All factor loading scores are higher than 0.80. The KMO is higher than 0.80. These figures are presented in Table 3.4.6.3. They indicate a very good convergent validity for each dimension.

Items	***Factor Loadings***
KMO =.870	
PSP1	.884
PSP2	.913
PSP3	.950
PSP4	.957
PSP5	.899
PSP6	.930
PSP7	.851

Table 3.4.6.3: Supplier Postponement Practices - Dimension Level Factor Analysis

3.4.7 Build-to-order Supply Chain Capability (BOSCC)

The Build-to-order Supply Chain Capability construct includes one dimension and ten items. The original ten items and their corresponding code names are listed in Table 3.4.7.1.

Until customer orders have been received,

Code Names	*Questionnaire Items*
BOC1	my firm can customize products on a large Scale
BOC2	my firm can add product variety without increasing cost
BOC3	my firm can customize products while maintaining high production
BOC4	my firm is capable of low cost set-up
BOC5	my firm can customize product features quickly
BOC6	my firm can add product variety without sacrificing overall production efficiency
BOC7	my firm fulfills orders (products & volume) completely
BOC8	my firm fulfills orders timely
BOC9	my firm maintains low work-in-process inventory
BOC10	my firm maintains low finished goods inventory

Table 3.4.7.1: Build-to-order Supply Chain Capability – Pilot Study Items

Item Purification: Initial reliability is tested and presented in Table 3.4.7.2. CITC scores of BOC7, BOC8, and BOC10 are lower than 0.5. An exploratory factor analysis is conducted, and three factors matching the sources of literature are identified, which are Mass Customization (BOC1 to BOC6), Order Fulfillment (BOC7 and BOC8), and Low Inventory (BOC9 and BOC10) respectively.

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
BOC1	.710	.710	.851	
BOC2	.743	.743	.848	
BOC3	.753	.753	.847	
BOC4	.642	.642	.857	
BOC5	.721	.721	.850	**α=.873**
BOC6	.600	.600	.860	
BOC7	.454	.454	.871	
BOC8	.353	.353	.876	
BOC9	.500	.500	.868	
BOC10	.416	.416	.873	

Table 3.4.7.2: Build-to-order Supply Chain Capability - Item Purification Results

Dimension-Level Factor Analysis: As seen from Table 3.4.7.3., all factor loading scores are higher than 0.70. KMOs are higher than 0.50. These indicate a good convergent validity of each dimension.

Item Revisions: In order to cover major aspects of order fulfillment, one item is added to the Order Fulfillment dimension. The item added is "my firm can deliver the products to the customer at the assigned location." In order to cover major aspects of low inventory, one item is added to the Inventory dimension. The item added is "my firm maintains low raw material inventory."

The modified questionnaire is presented in Appendix Three. This questionnaire is used for the large-Scale survey.

Items	*Factor Loadings*
Mass Customization KMO =.718	
BOC1	.792
BOC2	.777
BOC3	.824
BOC4	.814
BOC5	.880
BOC6	.771
Order Fulfillment KMO =.500	
BOC7	.849
BOC8	.849
Inventory KMO=.500	
BOC9	.933
BOC10	.933

Table 3.4.7.3: Build-to-order Supply Chain Capability - Dimension Level Factor Analysis

3.5 Sampling Plan and Sampling Design

After the modification of the instruments, a large-Scale survey was conducted to have a sample of data for the instrument validation and the hypothesis testing. Sections 3.5 and 3.6 discuss the administration of the large-Scale survey.

Sampling is a process of selecting members from a population of interest to conduct studies on and reach a conclusion; the conclusions made from the sample may be generalized back to the population if the sample is representative.

This study focuses on suppliers' perceptions toward their customers. Suppliers of all industries in the world can be viewed as the population. Suppliers in motor vehicle

industry were chosen as respondents in this study, and they were chosen for several reasons. First, the motor vehicle industry sector is import and typical in many countries: the U.S. auto production accounts for more than 5% of the U.S. private sector GDP (Auto Industry BERA, 2004). Second, it is easy for researchers to reach a big sample of respondents of suppliers (Droge et al., 2004). The Auto industry has more suppliers than many other industries; each auto maker has more than 100 first-tier suppliers and more than 1,000 second-tier suppliers according to a conversation with a senior supply chain manager in auto industry by the author. Third, auto suppliers are more suitable for this survey because this survey includes many questions of product design, process management, and supply chain management, which most auto suppliers have experienced.

This study collected data from auto suppliers in both China and North America to make it a multinational study because of the importance of these two areas/regions' auto industries in the world: the U.S. is the largest producer and consumer of motor vehicles in the world (Auto Industry BERA, 2004), and in 2006, China became the second largest auto market and the third largest auto maker in the world (*People's Daily*, 2006).

The sample of suppliers was chosen differently in North America and China respectively because of the different supply chain characteristic in each region. In North America, many suppliers work with several auto makers; all suppliers in North America industries are treated as the supplier sample in this study. In China, the majority of suppliers for an auto maker are exclusive for the supply chain of the auto maker only; major auto makers have their own supply networks with a little overlap. There are three major types of automakers in China: Japanese brand automakers, Western (i.e., North

America and European) brand automakers, and Chinese brand automakers. In this study, the Chinese supplier sample includes these three subsets of suppliers for each type of automakers.

Another consideration in this study is tiers. Since this study is about buyer-supplier relationship, major relationships in auto supply chain include relationships between automakers and first-tier suppliers and relationships between first-tier suppliers and second-tier suppliers. The sample in this study includes both first-tier suppliers and second-tier suppliers.

According to the above considerations of country/region and tier as well as available networks and resources, this study has a sample of suppliers located in North America and China (see Table 3.5.1). In North America, all the first-tier suppliers of all North America motor vehicle makers were included in the sample; suppliers of the first-tier suppliers in North America were chosen as a sample of second-tier suppliers. In China, the sample also includes first-tier suppliers and second-tier suppliers: (1) the sample of first-tier suppliers includes first-tier suppliers of Japanese brand automakers and those of western brand automakers; (2) suppliers of the first-tier suppliers of Japanese brand automaker are chosen in a sample of second-tier suppliers of Chinese automakers; suppliers of major Chinese auto makers were chosen as the sample of second-tier suppliers of Chinese automakers. In summary, factors of locations of country (i.e., North America vs. China) and tiers (first-tier vs. second-tier) were carefully considered in designing the sample of this research. Therefore, the sample of the auto supply chains in this study is generalizable (Droge et al., 2004). Table 3.5.1 below summaries the sample of suppliers described above.

Country or Region of Supplier Location	Sample: Suppliers of_____		Tier of Suppliers in the Sample
North America	All North America motor vehicle makers		first
	One first-tier supplier of North America motor vehicle makers		second
China	Japanese Brand	Joint ventures of Japanese automakers	first
		first-tier suppliers of a joint venture of a Japanese automaker	second
	Western Brand	Joint ventures of Western automakers	first
		first-tier suppliers of a joint venture of a Western automaker	second
	Chinese Brand	Chinese automakers	first
		first-tier suppliers of Chinese brand automakers	second

Table 3.5.1 Sample of Suppliers

3.6 The Large-Scale Data Collection

3.6.1 Questionnaire Translation

The questionnaire was originally written in English. The Chinese-version questionnaire was done through a four-stage process. In the first stage, the English version was translated into Chinese by the author, who is fluent in English and Chinese and has both academic training and work experience in supply chain management. In the second stage, the Chinese questionnaire was translated back to English by a supply chain researcher, who is fluent at both Chinese and English. In the third stage, the author and the researcher checked each item of the questionnaire to make sure of the accuracy of translation; several minor changes were made for the Chinese version. In the fourth stage,

the questionnaire was sent to a senior supply chain manger and a vice president in Chinese auto industry respectively; two phone calls were made by the author to listen to the feedback of each executive; the questionnaire was understood well and no changes were suggested.

3.6.2 Data Collection Method

This study adopted an "expanding network" data collection method. The basic idea of the "expanding network" is that the focal company (the automaker to the first-tier suppliers or the first-tier suppliers to the second-tier suppliers) helps researchers to identify supplier respondents by sending the request to suppliers and encouraging them to participate in this research; the company may also collect responses on behalf of the researcher. In summary, the focal company strongly supported this research and played a pivotal role in the data collection process. Through one focal company, researchers could easily reach 10+ or even 100+ suppliers. The "expanding network" data collection method was partially (Dyer et al., 1998) or fully (Malhotra et al., 2005) used by researchers in their supply chain studies.

The "expanding network" data collection method has several advantages in supply chain research. First, it matches the expanding characteristic of supply chain growing: supply chain is an expanding network on both the supply side and the demand side of a manufacturing company (e.g., an auto maker); the easiest way of reaching a large number of members in the supply chain is through the manufacturer or focal company. Second, it is suitable for the situation when the contact information of suppliers is confidential. When the questionnaire is sent through the purchasing manager to their suppliers, researchers do not need contact information of suppliers. Third, it is easier to

get a higher response rate than simply mailing the survey to companies in a commercial mailing list because suppliers are more responsive to the survey requested from their customers. Fourth, it is suitable for a long survey; it takes 30 to 40 minutes to answer 165 questions in the survey in this study; industry employees are tired of answering many surveys, especially long ones; without the support of network members, fewer and fewer of them intent to answer the survey. There are a couple of examples of recent OM/SC survey research. One researcher hired students to make more than 1,600 calls to collect data. One researcher hired a graduate assistant to call respondents to answer the survey and got 10 more after calling for a whole summer. Fifth, this method allows researchers to expand the study: getting responses of buyers can expand this study to include perceptions of both sides of buyer-supplier links.

Another issue in data collection is to identify key informants to be core respondents for the survey to minimize key-informant bias. In this study, purchasing managers of the buying companies identified the key informants, such as the supplier's scales vice-presidents, scales managers, and scales account managers. These types of informants are also identified in other similar studies (Dyer et al., 1998). For this study, questionnaires were sent to these key informants identified by the purchasing manager.

3.6.3 Data Collection Process

The five-stage data collection process started in May 2007 and ended in February 2008. In the first stage, key executives (purchasing managers, supply chain mangers, vice presidents of manufacturing or purchasing) were contacted through telephone calls or emails by the author or author's industry connections to inquire about the possibility of sending this survey to their suppliers. In North America, three purchasing managers for

motor vehicle makers and one purchasing manager for a first-tier supplier for all North America auto makers were contacted, all of which agreed to send the questionnaires to their suppliers. In China, three executives for Japanese brand auto makers and one executive for a first-tier supplier of Japanese brand auto makers were contacted, and all agreed to participate in this study except one executive for a Japanese brand auto maker. Two managers of western brand auto makers in China were contacted; one agreed to participate in this study. One executive of a Chinese brand auto maker and one executive of a first-tier supplier of Chinese brand auto makers were contacted; only the executive of the first-tier supplier agreed to participate in this research.

In the second stage, an email was sent to each of the key executives who agreed to participate and send the questionnaire to their suppliers; this email offered two options of their answering the survey: the Word/PDF version and the on-line version. Then, the executives sent emails to request their suppliers answer this survey. Table 3.6.3.1 lists the number of questionnaires sent by each manager who agreed to participate in this study.

In the third stage, suppliers submitted on-line answers or sent the completed survey to the executive through mail or email. Responses received in this stage are called first-wave responses. The number of first-wave responses from each supply chain is listed in Table 3.6.3.1, too.

In the fourth stage, executives sent emails again or called suppliers who did not complete the survey. Responses received in this stage are called second-wave responses. The numbers of second-wave responses from each supply chain are also listed in Table 3.6.3.1. Of 480 mailed or emailed questionnaires, 24 didn't reach the targeted responses because of wrong addresses or names. The number who received the questionnaire is

456. The number of complete and usable responses was 208, resulting in a response rate of 45.6% (calculated as 208/ (480-24)). There are 160 responses from the first wave and 48 responses from the second wave. Table 3.6.3.1 lists the details of numbers of questionnaires sent, first-wave responses, second-wave responses, and total responses received for each supply chain as well as response rate for each supply chain.

Country/ Region	**Sample**		**Questionnaires Sent**	**First Wave**	**Second Wave**	**Total Received**	**Response rate**
North America	first-tier suppliers		49	23	11	34	69.4%
	second-tier suppliers		30	6	0	6	20%
China	Japanese Brand	first-tier suppliers	52	25	18	43	82.7%
		second-tier suppliers	20	17	3	20	100%
	Western Brand	first-tier suppliers	47	33	8	41	87.2%
	Chinese Brand	second-tier suppliers	258	56	8	64	24.8%
Total			**456**	**160**	**48**	**208**	**45.6%**

Table 3.6.3.1 Response of Each Supply Chain

3.7 Sample Characteristics

This section falls into two subsections. Subsection 3.7.1 describes sample characteristics of the respondents (job title, job function, and years with the organization) while Section 3.7.2 describes organization-related information (employment size, annual scales, supply chain implementation, percentage of transactions with customers, percentage of transactions with suppliers, location of country and tier level).

3.7.1 Sample Characteristics of the Respondents (Also see Table 3.7.1 in Appendix 4)

Job Title: 35.1% of the respondents are CEO/President, 25.0% of them are directors, 5.3% are titled managers. 17.3% are assigned to the "other" category, and 17.3% are unidentified.

Job Function: The majority of the responses (54.3%) identified their job function as scales (40.4%) or corporate executive (13.9%). 6.7% of the respondents are in purchasing departments, 8.7% are from research and design departments, 1.0% from manufacturing departments, 4.3% from distribution and transportation department. 5.3% respondents from other functions. There are 19.7% respondents who did not identify their job functions.

Years at the Organization: 7.7% of the respondents have been in their companies for less than two years. 23.1% respondents reported that they had been in the company between 2-5 years, 11.1% between 6 and 10 years, and 10.1% for more than 10 years. 48.1% respondents did not answer this question.

3.7.2 Sample Characteristics of Surveyed Organization (See Table 3.7.2 in Appendix 4)

Number of Employees: 10.1% of the organizations have fewer than 50 employees. 10.6% of the organizations have between 51 and 100 employees, 13.9% between 101 and 250 employees, 23.6% between 251 and 500 employees, 14.9% between 501 and 1000 employees, and 21.2% over 1000 employees. There are 5.8% respondents who did not identify the number of employees in their firms.

Annual Scales: 8.2% of the organizations have scales volumes less than 5 millions. 6.7% of the organizations have scales volumes between 5 and 10 millions, 11.5% between 10 and 25 millions, 8.7% between 25 and 50 millions, 12.0% between 50 and 100 millions, and 44.2% over 100 millions. 8.7% of the organization did not indicate their scales volume.

Supply Chain Implementation: 38.4% of the organizations implemented supply chain management, while 53.4% of them did not implement supply chain management. Only 8.2% of the organizations did not identify whether they implemented supply chain management.

Percentage of Transactions with Customers: 10.1% of the organizations indicated that they had done less than 10% of their business transactions electronically with customers, 6.7% of them have done 10% to 30%, 10.6% of them have done 30% to 50%, 17.3% of them have done 50% to 80%, and 42.8% of them have done more than 80%. There are 12.5% of the organizations did not identify the percentage of transactions with customers.

Percentage of Transactions with Suppliers: 12.5% of the organizations indicated that they had done less than 10% of their business transactions electronically with suppliers, 17.3% of them have done 10% to 30%, 18.3% of them have done 30% to 50%, 19.7% of them have done 50% to 80%, and 17.3% of them have done more than 80%. There are 14.9% of organizations who did not identify the percentage of transactions with suppliers.

Location of Country: 16.8% of the organizations are located in North America, and 83.2% of them are located in China.

Tier Level: 71.2% of the organizations are first-tier suppliers in auto industries while 28.8% of the organizations are second-tier suppliers.

3.8 Test of Non-response Bias

Non-response bias may lower the validity of responses. Non-response bias is generally viewed by researchers as a continuum, which manages from fast responders to slow responders. A common way of analyzing non-response bias is a Chi-square test with an assumption that the second-wave responses can be treated as non-responses for the first wave (Jitpaiboon, 2005). Table 3.8 shows the process and the results of this Chi-square test; there is no difference between these two groups because the p-values are all higher than 0.05. Therefore, the respondents represent an unbiased sample.

Variables	First Wave	Second Wave	Second Wave	Chi-square Test
	Frequency (%)	Expected Freq. (%)	Observed Freq. (%)	
Number of Employees				
1-50	15	5	6	$\chi 2 = 7.47$ df = 6 p > 0.10
51-100	21	6	1	
101-250	21	6	8	
251-500	35	11	13	
501-1000	26	8	5	
Over 1000	33	10	11	
Unidentified	9	3	4	
Scales Volume in Millions				
<5	12	4	5	$\chi 2 = 12.10$ df = 6 p > 0.05
5 to <10	13	4	1	
10 to <25	22	7	2	
25 to <50	16	5	2	
50 to <100	16	5	9	
Over 100	68	20	24	
Unidentified	13	4	5	
Job Title				
CEO/President	62	19	11	$\chi 2 = 8.11$ df = 4 p > 0.05
Director	35	11	17	
Manager	8	2	3	
Others	29	9	7	
Unidentified	26	8	10	

Table 3.8: Test of Non-response Bias

CHAPTER 4: INTRUMENT DEVELOPMENT (2): LARGE-SCALE INSTRUMENT VALIDATION

After the large-Scale survey is conducted, a sample of data is ready for the instrument validation and the hypothesis testing. This chapter discusses the large-Scale instrument validation. The large-Scale instrument assessment methodology is in Section One. Instrument validation is presented in Section Two. Chapter Five focuses on hypothesis testing.

4.1 Large-Scale Instrument Assessment Methodology

The large-Scale instrument development in this study includes reliability and validity assessment, using the 208 responses. Reliability measures the consistency of an instrument; if the same respondents retake the test under the same conditions, they will provide identical results. The validity measures the degree to which the instrument tests the "true" concept the designer wants. Reliability shows the precision of a construct, while validity measures the accuracy of a construct. A construct cannot be valid if it is not reliable; a construct can be reliable even if it is not valid. Validity includes content validity, unidimentionality (convergent validity), discriminant validity, and validation of the second-order construct.

Reliability indicates the degree to which a measurement can have same results when the test is repeated. This study uses a commonly agreed reliability indicator, Cronbach's alpha (Cronbach, 1951). An alpha value of 0.7 or above indicates a good measurement (Nunally, 1978). In addition, the Corrected Item-Total Correlation (CITC) of each item in an instrument measures how well the item contributes to the construct's internal consistency (Kerlinger, 1978). This study uses SPSS 15.0 to compute both Cronbach's alpha and CITC at the dimension level. An item with more than 0.5 for CITC will be kept in the dimension. An item with less than 0.5 for CITC will be eliminated from the dimension except that this item is considered very important to the construct.

Content validity measures the representativeness of each item to the construct. A construct has content validity if the items in the construct adequately cover the domain of the construct (Kerlinger, 1978). The content validity can be evaluated through one or all of procedures listed below: (1) a comprehensive review of the literature (Nunnaly, 1978), (2) an evaluation of the generated items by other researchers and/or professionals, and (3) a pilot study with a small sample from the population and/or a Q-sort process. This study used all three procedures described in Chapter Two and Chapter Three to ensure the content validity.

Convergent validity measures the extent to which the items in one construct (dimension) form a common dimension. This study uses confirmatory factor analysis (CFA) in AMOS to test and modify the measurement model. Goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square residual (RMR) of each dimension in one construct are provided for the initial model and the final model. Models with GFI and AGFI scores between 0.80 and 0.90 are considered as a reasonable model

fit; models with scores of 0.90 or above are considered a good model fit (Joreskog and Sorbom, 1989).

Discriminant validity measures the independence of each dimension in a construct (Bagozzi and Philips, 1982). Disciminant validity is tested through a three-step pair-wise comparison process using structural equation modeling: (1) two dimensions in one construct form a correlated model, and χ^2 of this two-factor model is recorded; (2) a single factor model with all items in those two dimensions is tested, and χ^2 of this one-factor model is recorded; (3) the disciminant validity is supported if the difference of the two χ^2 scores (df = 1) is significant at $p < 0.05$ level (Joreskog, 1971). The critical χ^2 value for $p < 0.05$ is 3.84.

Validation of the second-order construct measures the degree of existence of a second-order model. The test is a three-step process: (1) a first-order CFA model of one construct is tested, and the $\chi 2$ value is recorded; (2) a second-order CFA model of the construct is tested, and the $\chi 2$ value is also recorded; (3) the T-coefficient (i.e., the ratio of the chi-square score of the first-order CFA model to the second-order CFA model) of 0.80 or above validates the existence of the second-order construct. However, T-coefficient method is valid only for a construct with four or more dimensions. When a construct has less than 4 dimensions, if each dimension has the factor loading of 0.5 or above to the construct, it confirms a second-order construct.

4.2 Large-Scale Measurement Results

The results of the assessment process of each of seven constructs in this study will be shown in subsections 4.2.1 through 4.2.7.

4.2.1 Supplier Alignment (SA)

Convergent validity: The twenty-two items and their corresponding codes are listed in Table 4.2.1.2. Items are sequentially deleted in the CFA using AMOS to improve convergent validity while maintaining content validity; SA05 is deleted to improve model fit because it overlaps with SA01, SA02, SA03, and SA04. The initial model fit indexes and final model fit indexes for convergent validity are also listed in the table. The scores of GFI, AGFI, and RMR for the final model indicate a very good convergent validity for each dimension.

Code Names	***Questionnaire Items***	***Initial Model Fit***	***Final Model Fit***
Strategic Alignment (SA)			
SA01	My firm's strategic priority with respect to *cost* is consistent with strategic priority of my OEM.	**GFI=.937 AGFI=.854 RMR=.039**	**GFI=.954 AGFI=.863 RMR=.037 (SA05 deleted)**
SA02	My firm's strategic priority with respect to *quality* is consistent with strategic priority of my OEM.		
SA03	My firm's strategic priority with respect to *delivery* is consistent with strategic priority of my OEM.		
SA04	My firm's strategic priority with respect to *flexibility* is consistent with strategic priority of my OEM.		
***SA05**	My firm's strategic priorities are consistent with my OEM's.		
SA06	My firm can maintain strategic consistency with my OEM when my OEM's strategic priority has been changed.		
Tactical Alignment (TA) My firm and my OEM have			
TA01	clearly defined responsibilities in product development.	**GFI=.989 AGFI=.943 RMR=.011**	**GFI=.989 AGFI=.943 RMR=.011**
TA03	clearly defined responsibilities in manufacturing processes.		
TA05	clearly defined responsibilities in logistics.		
TA07	clearly defined responsibilities in quality improvement.		
Sharing Cost (SHC) My firm and my OEM share			
FA01	the costs of developing products.	**GFI=.960 AGFI=.802 RMR=.026**	**GFI=.960 AGFI=.802 RMR=.026**
FA02	the costs of quality improvements.		
FA03	the costs of manufacturing process improvements.		
FA04	the costs of logistics improvements.		

Sharing Benefit (SHB)			
My firm and my OEM share			
FA05	the benefits of new product introductions.	**GFI=.976 AGFI=.881 RMR=.016**	**GFI=.976 AGFI=.881 RMR=.016**
FA06	the benefits of quality improvements.		
FA07	the benefits from manufacturing process improvements.		
FA08	the benefits of logistics improvements.		
Sharing Risk (SHR)			
My firm and my OEM share			
FA09	the risks of new product introductions.	**GFI=.969 AGFI=.844 RMR=.016**	**GFI=.969 AGFI=.844 RMR=.016**
FA10	the risks of quality improvements.		
FA11	the risks from manufacturing process improvements.		
FA12	the risks of logistics improvements.		

*Item deleted

Table 4.2.1.1: Supplier Alignment – Convergent Validity

Discriminant validity: Table 4.2.1.2 shows the results of discriminant validity. The differences of chi-square values of each pair of dimensions are all significant at 0.001 level (df = 1, critical value = 10.83). The results indicate a disciminant validity of the construct of Supplier Alignment.

	TA			**SHC**			**SHB**			**SHR**		
	Cor.	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**
SA	73.8	136.0	***62.2***	85.6	191.2	***105.6***	66.4	153.2	***86.8***	64.1	172.1	***108.0***
TA				70.0	311.4	***241.4***	49.7	236.6	***186.9***	46.8	294.2	***247.4***
SHC							88.6	292.3	***203.7***	96.0	304.4	***208.4***
SHB										132.6	357.0	***224.4***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.1.2: Supplier Alignment – Discriminant Validity Assessment

(Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.1.1) and the second-order CFA model (Figure 4.2.1.2) are tested. Results of indexes

are showed in Table 4.2.1.3. The T-coefficient of 0.937 indicates the existence of the second-order construct.

	$\chi 2$	**$\chi 2$/df**	**GFI**	**AGFI**	**NFI**	**CFI**
First-order CFA	504.0	2.82	.804	.747	.826	.879
Second-order CFA	538.1	2.92	.789	.735	.815	.868
T-coefficient ($\chi 2$ of First-order/ $\chi 2$ of Second-order)	93.7%					

Table 4.2.1.3: Supplier Alignment – Validation of the Second-order Construct

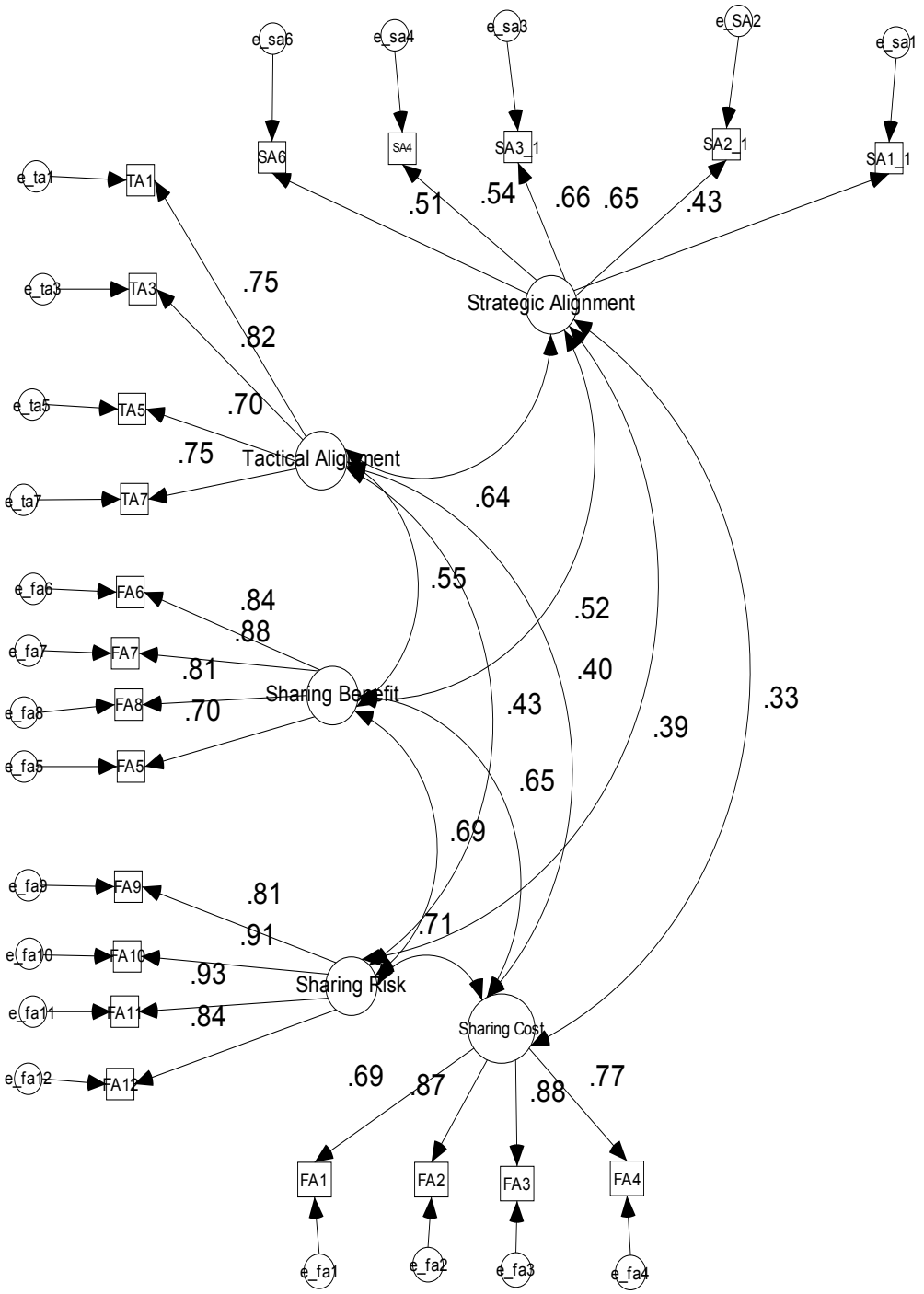


Figure 4.2.1.1: The Results of First-order CFA Model for Supplier Alignment

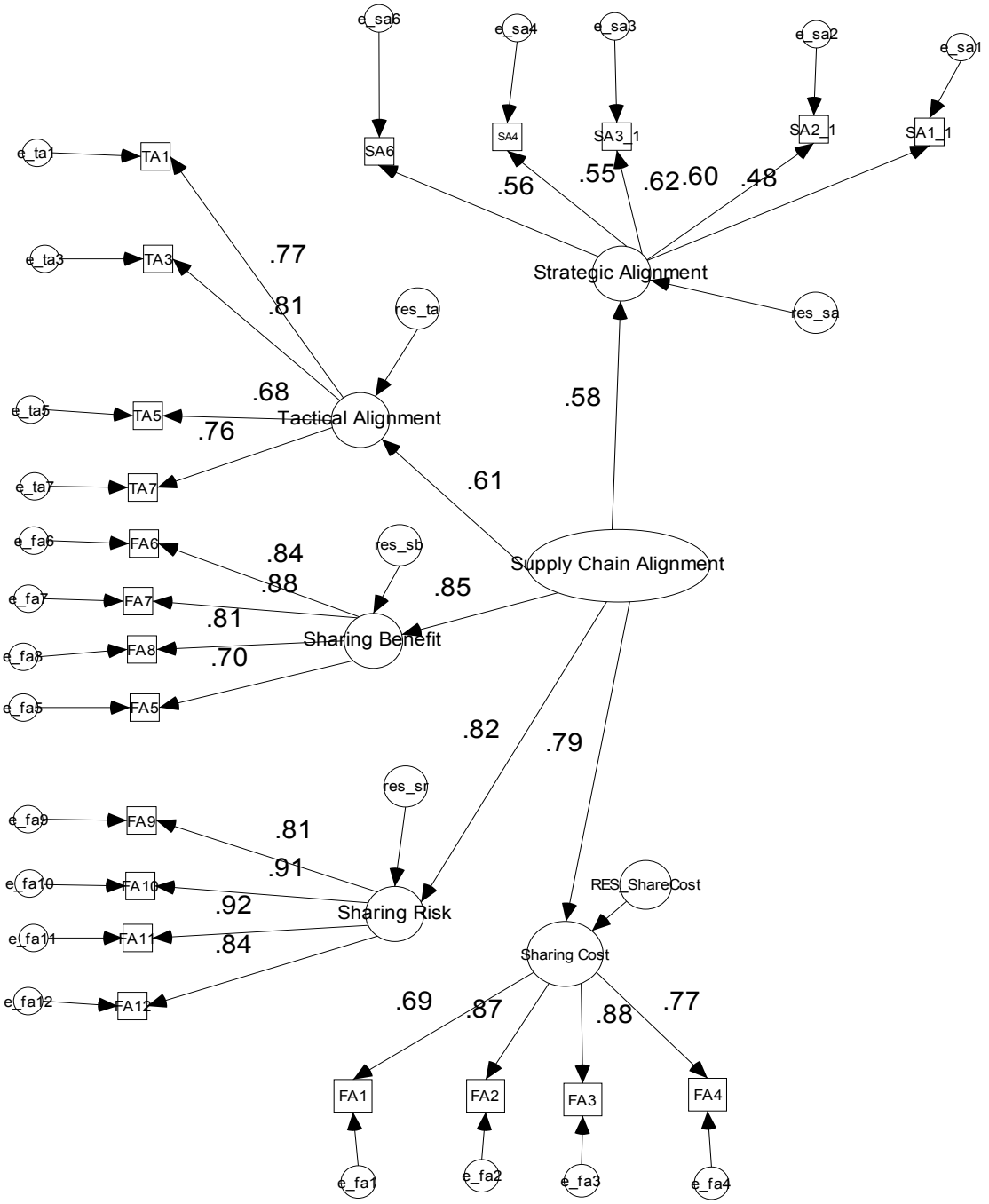


Figure 4.2.1.2: The Results of Second-order CFA Model for Supplier Alignment

4.2.2 Partner Relationship (PR)

Convergent validity: The eighteen items and their corresponding codes are listed in Table 4.2.2.1. Items are sequentially deleted in the CFA using AMOS to improve convergent validity while maintaining content validity; TRT3 is deleted because it overlaps with TRT1; TRT6 is also deleted because it overlaps with TRT4; COM4 is deleted because it overlaps with COM3; COM2 is deleted because it overlaps with COM3. The initial model fit indexes and final model fit indexes for convergent validity are also listed in the table. The scores of GFI, AGFI, and RMR for the final models indicate a very good convergent validity for each dimension.

Code Names	***Questionnaire Items***	***Initial Model Fit***	***Final Model Fit***
Trust (TRT)			
TRT1	My OEM has been open and honest in dealing with my firm.	**GFI=.845 AGFI=.638 RMR=.170**	**GFI=.977 AGFI=.887 RMR=.025 (TRT3 and TRT6 deleted)**
TRT2	My OEM respects the confidentiality of the information they receive from my firm.		
*TRT3	Our transactions with my OEM do not have to be closely supervised by my OEM.		
TRT4	My firm has been open and honest in dealing with my OEM.		
TRT5	My firm respects the confidentiality of the information they receive from my OEM.		
*TRT6	Our transactions with my OEM do not have to be closely supervised by my firm.		
Commitment (COM)			
*COM2	My OEM has made sacrifices for my firm in the past.	**GFI=.757 AGFI=.515 RMR=.112**	**GFI=.944 AGFI=.833 RMR=.040 (COM2 and COM4 deleted)**
COM3	My OEM abides by agreements with my firm very well.		
*COM4	My OEM has invested a lot of efforts in our relationship.		
COM5	My firm has been helped my OEM in the past.		
COM6	My firm has made sacrifices for my OEM in the past.		
COM7	My firm abides by agreements with my OEM very well.		
COM8	My firm has invested a lot of efforts in our relationship.		
Shared Vision (SHV) **My firm and my customers have a similar understanding about**			
*SHV2	the importance of collaboration across the supply chain.	**GFI=.896 AGFI=.688 RMR=.040**	**GFI=.996 AGFI=.960 RMR=.005 (SHV2 deleted)**
SHV3	the importance of improvements that benefit the supply chain as a whole.		
SHV5	my OEM's profits.		

SHV6	my OEM's customer satisfaction.		
SHV7	my OEM's brand reputation.		

*Item deleted

Table 4.2.2.1: Partner Relationship - Convergent Validity

Discriminant validity: Table 4.2.2.2 shows the results of discriminant validity. The differences of chi-square values of each pair of dimensions are all significant at 0.005 level (df = 1, critical value = 7.88). The results indicate a disciminant validity of the construct of Partner Relationship.

	COM			SHV		
	Cor.	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**
TRT	114.7	141.5	***26.8***	47.6	89.1	***41.5***
COM				96.7	256.9	***160.2***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.2.2: Partner Relationship – Discriminant Validity Assessment

(Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.2.1) and the second-order CFA model (Figure 4.2.2.2) are tested. Results of indexes are showed in Table 4.2.2.3. Since the number of dimensions is less than 4, loadings of each dimension to the construct are checked. All loadings of each dimension to the construct are higher than 0.70. This indicates the existence of the second-order construct.

	$\chi 2$	$\chi 2$/df	GFI	AGFI	NFI	CFI
First-order CFA	245.8	3.96	.833	.755	.818	.855
Second-order CFA	245.8	3.96	.833	.755	.818	.855

Table 4.2.2.3: Partner Relationship – Validation of the Second-order Construct

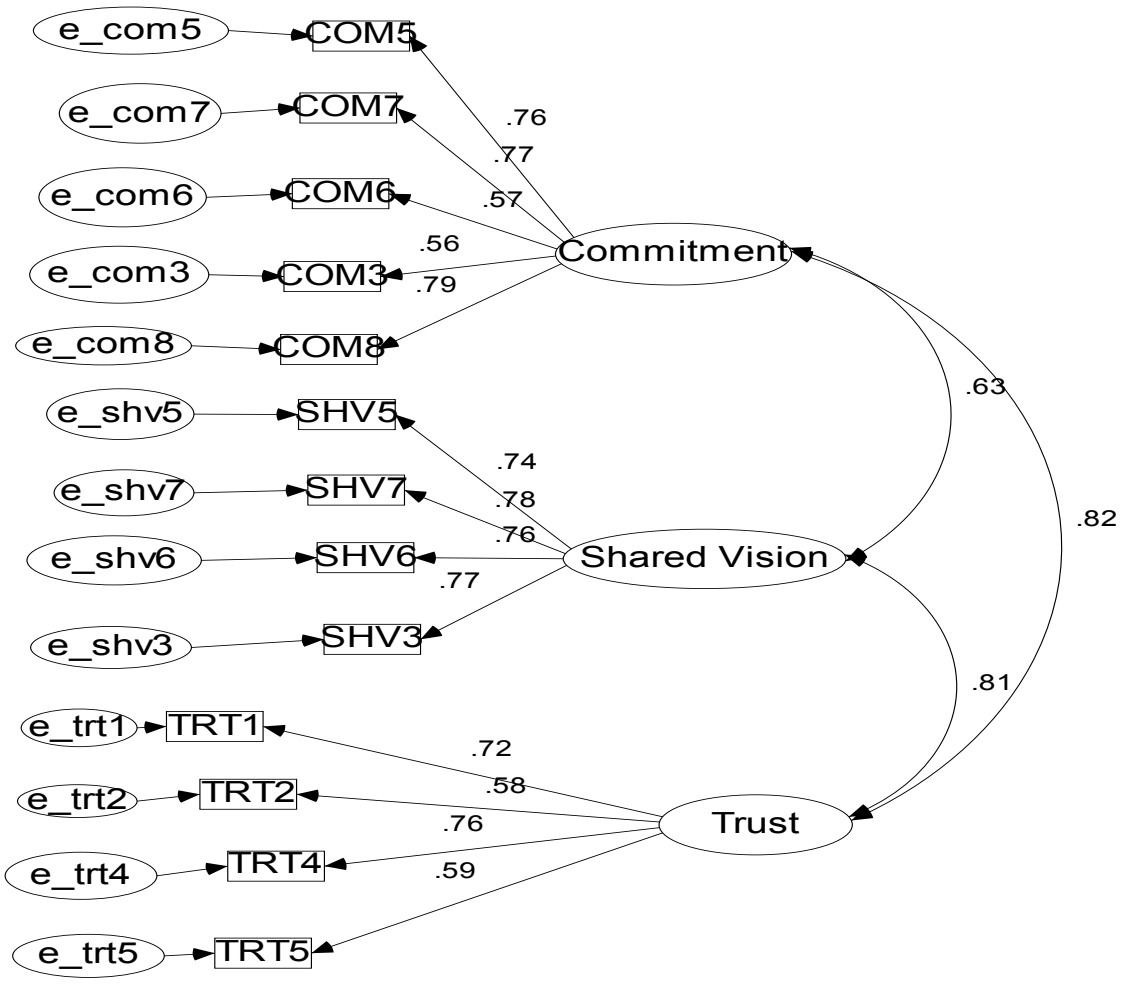


Figure 4.2.2.1: The Results of First-order CFA Model for Partner Relationship

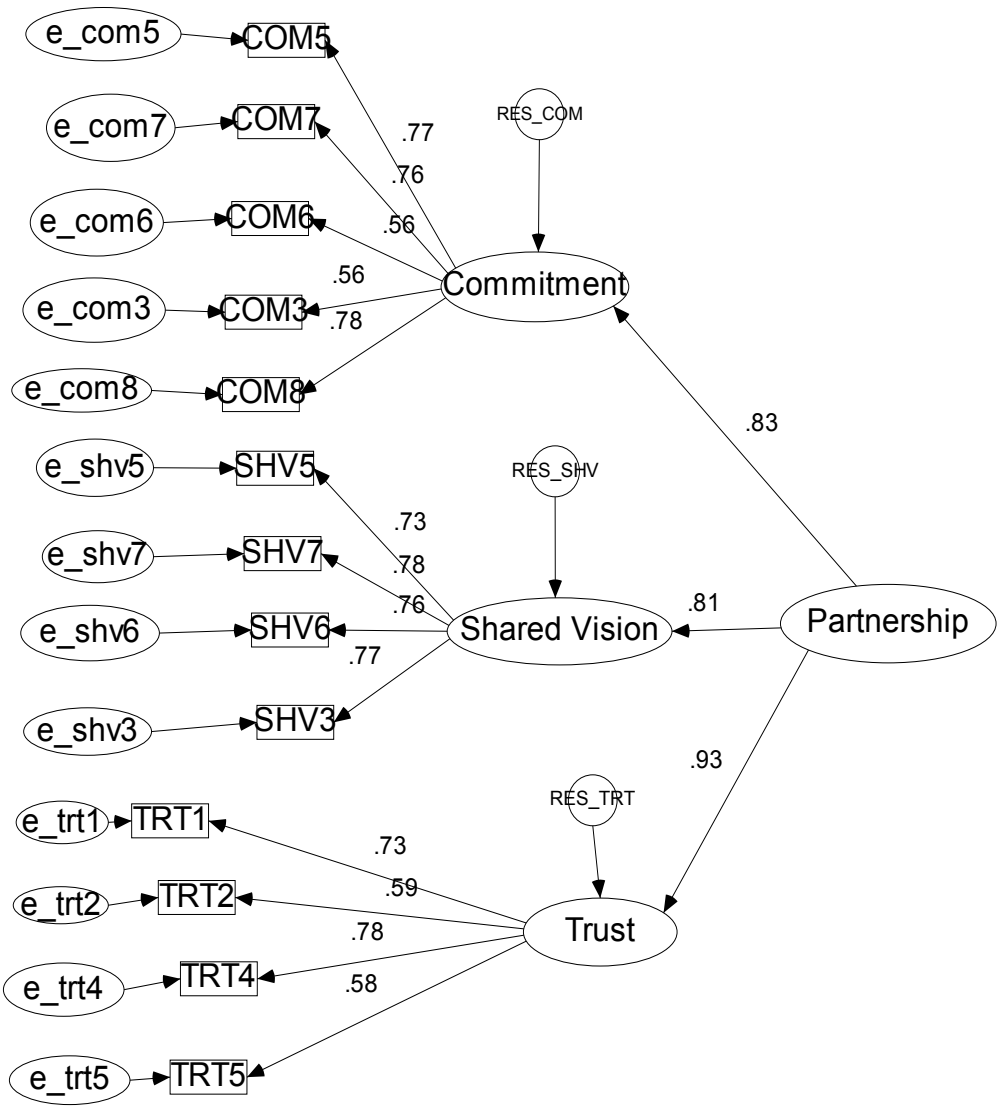


Figure 4.2.2.2: The Results of Second-order CFA Model for Partner Relationship

4.2.3 Supplier Empowerment (SE)

Convergent validity: The seventeen items and their corresponding codes are listed in Table 4.2.3.1. The initial and final model fit indexes for convergent validity are also listed in the table. Items are sequentially deleted in the CFA using AMOS to increase convergent validity while maintaining content validity; PT6 is deleted because it overlaps

with PT7. The scores of GFI, AGFI, and RMR for the final models indicate a very good convergent validity for each dimension.

Code Names	*Questionnaire Items*	*Initial Model Fit*	*Final Model Fit*
Meaningfulness (MN) **My company believes that projects with the OEM are**			
MN1	worthwhile in increasing my company's profits.	**GFI=.996** **AGFI=.978** **RMR=.007**	**GFI=.996** **AGFI=.978** **RMR=.007**
MN3	significant in increasing my company's manufacturing capability.		
MN4	significant in increasing my company's logistics capability.		
MN5	significant in increasing my company's quality management capability.		
Potency (PT) **My company**			
PT2	has confidence in its manufacturing capability.	**GFI=.924** **AGFI=.772** **RMR=.020**	**GFI=.985** **AGFI=.923** **RMR=.009** (PT6 deleted)
PT3	has confidence in its purchasing capability.		
PT5	has confidence in its quality management capability.		
***PT6**	can get a lot done when it works hard .		
PT7	believes that it can be very productive.		
Autonomy (AT) **My company**			
AT1	can select different R&D ways to do my OEM's work.	**GFI=.982** **AGFI=.947** **RMR=.018**	**GFI=.982** **AGFI=.947** **RMR=.018**
AT2	can select different manufacturing ways to do my OEM's work.		
AT3	can select different logistics ways to do my OEM's work.		
AT4	can select different purchasing ways to do my OEM's work.		
AT5	can select different quality management ways to do my OEM's work.		
Impact (IP) **My company's projects with the OEM**			
IP2	provide products that matter to my OEM.	**GFI=.968**** **AGFI=.930** **RMR=.019**	**GFI=.968**** **AGFI=.930** **RMR=.019**
IP4	have a positive impact on customers other than my OEM.		
IP5	make a difference in my firm's industry.		

*Item deleted

** The overall model fit indexes are from the correlated model including this dimension and the dimension of Meaningfulness; the loading for each of the three items is significant at 0.001 level.

Table 4.2.3.1: Supplier Empowerment - Convergent Validity

Discriminant validity: Table 4.2.3.2 shows the results of discriminant validity. The differences of chi-square values of each pair of dimensions are all significant at 0.001 level (df = 1, critical value = 10.83). The results indicate disciminant validity of the construct of Supplier Empowerment.

	PT			AT			IP		
	Cor.	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**
MN	38.9	206.3	***167.4***	54.9	264.6	***209.7***	23.7	115.1	***91.4***
PT				55.2	365.2	***310.0***	42.7	91.5	***48.8***
AT							47.7	141.9	***94.2***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.3.2: Supplier Empowerment – Discriminant Validity Assessment

(Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.3.1) and the second-order CFA model (Figure 4.2.3.2) are tested. The results of indexes are shown in Table 4.2.3.3. The T-coefficient of 0.994 indicates the existence of the second-order construct.

	$\chi 2$	$\chi 2$/df	GFI	AGFI	NFI	CFI
First-order CFA	216.1	2.21	.880	.834	.883	.932
Second-order CFA	217.3	2.17	.880	.834	.883	.932
T-coefficient ($\chi 2$ of First-order/ $\chi 2$ of Second-order)	99.4%					

Table 4.2.3.3: Supplier Empowerment – Validation of the Second-order Construct

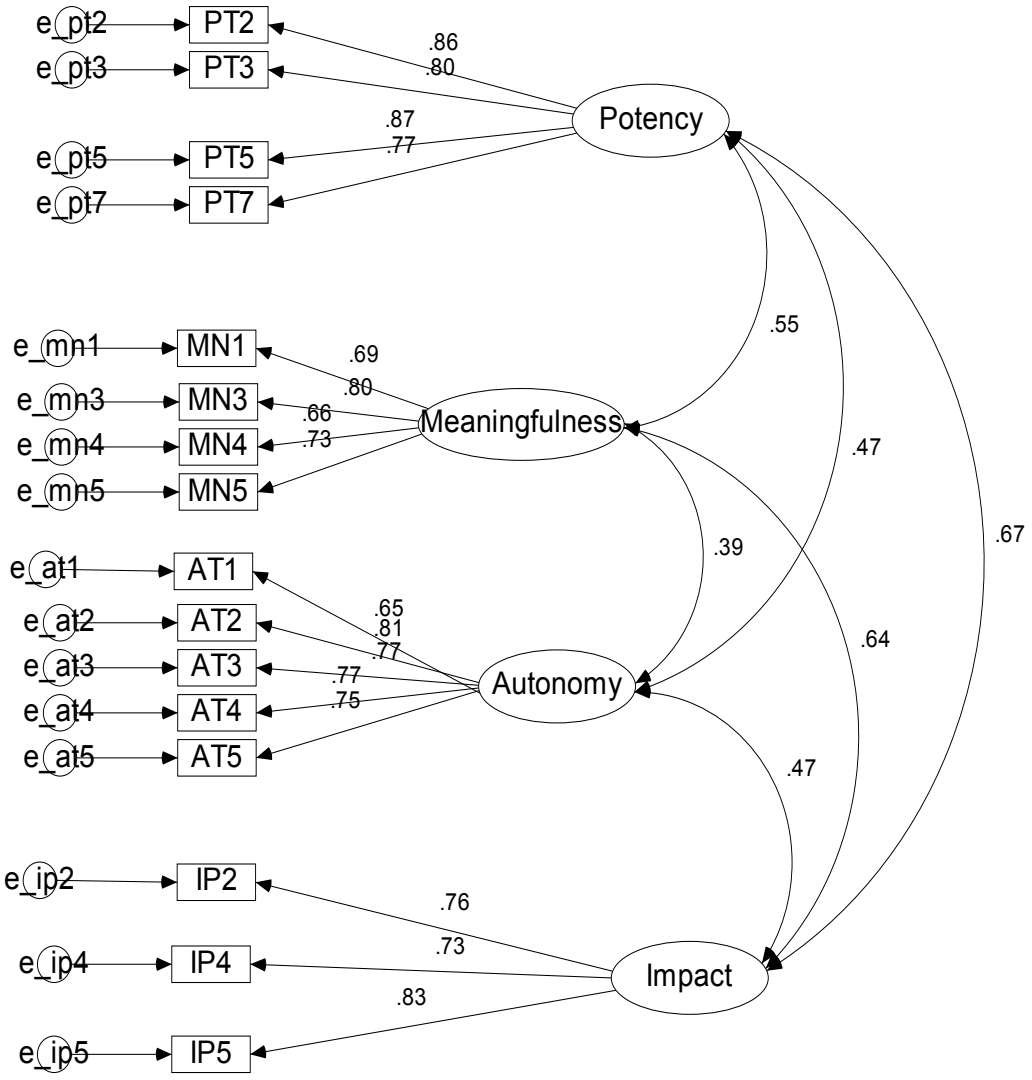


Figure 4.2.3.1: The Results of First-order CFA Model for Supplier Empowerment

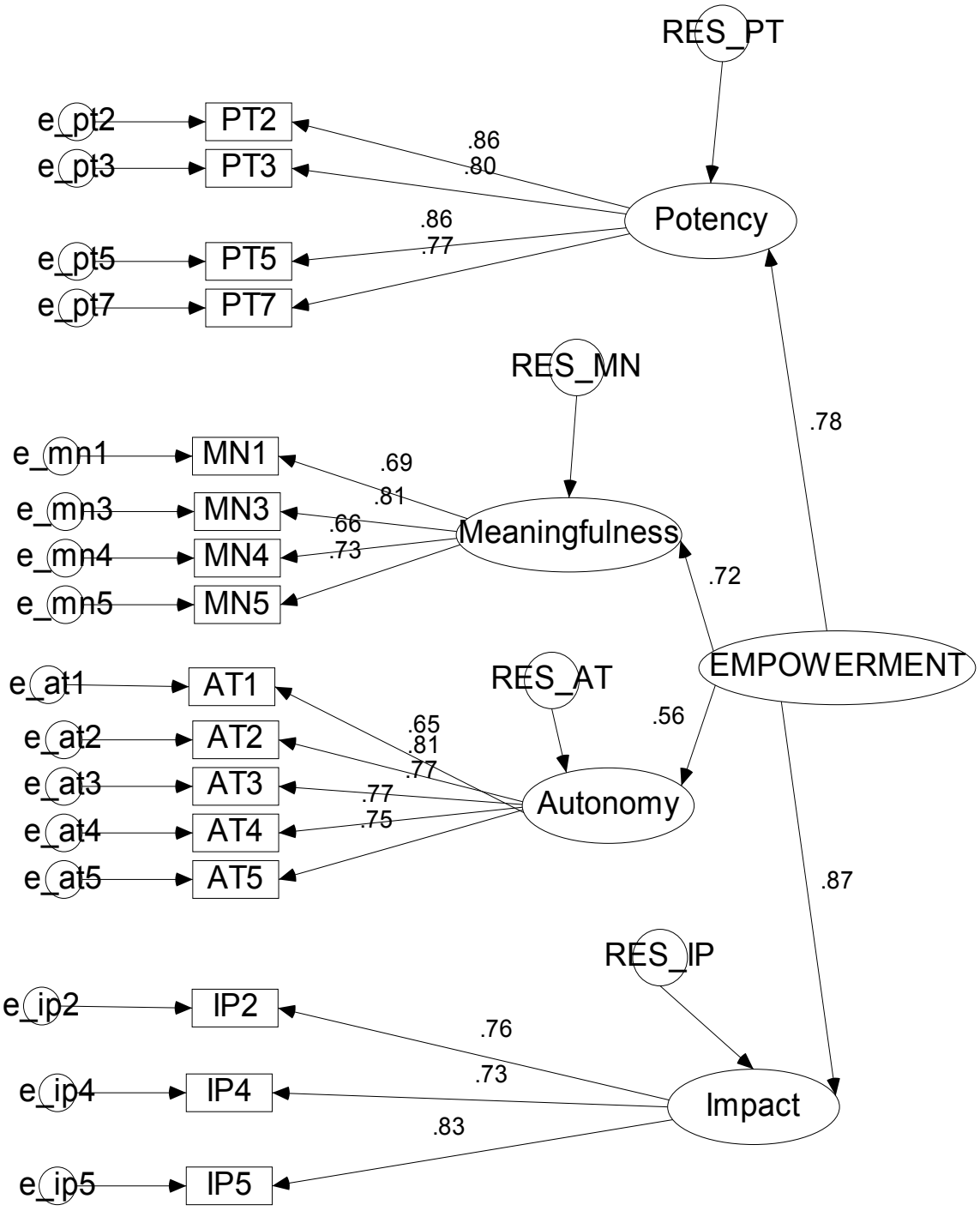


Figure 4.2.3.2: The Results of Second-order CFA Model for Supplier Empowerment

4.2.4 Supplier Partnership Practices (SPP)

Convergent Validity: The sixteen items and their corresponding codes are listed in Table 4.2.4.1. Items are sequentially deleted in the CFA using AMOS to increase convergent validity while maintaining content validity; JOP5 and JOP6 are deleted because each of them overlaps with JOP1, JOP2, JOP3, and JOP4; ISP10, ISP4, ISP6, ISP8 and ISP2 are sequentially deleted because they overlap with ISP9, ISP3, ISP5, ISP7, and ISP1 respectively; ISP7 is deleted to improve convergent validity because it overlaps with ISP1 and ISP3. The initial and final model fit indexes for convergent validity are also listed in the table in respective columns. The scores of GFI, AGFI, and RMR for the final model indicate a very good convergent validity for each dimension.

Code Names	***Questionnaire Items***	***Initial Model Fit***	***Final Model Fit***
Joint Operations Practices (JOP)			
JOP1	My firm jointly develops products with my OEM.	**GFI=.911 AGFI=.791 RMR=.070**	**GFI=.999 AGFI=.995 RMR=.006** (JOP5 & JOP6 deleted)
JOP2	My firm jointly improves manufacturing processes with my OEM.		
JOP3	My firm jointly improves qualities of products with my OEM.		
JOP4	My firm coordinates logistics with my OEM.		
***JOP5**	My OEM sends its employees to help my firm solve problems.		
***JOP6**	My firm sends its employees to my OEM to solve problems related to my firm's products.		
Information Sharing Practices (ISP) **My firm shares**			
ISP1	product development information frequently with my OEM.	**GFI=.754 AGFI=.613 RMR=.084**	**GFI=.998 AGFI=.987 RMR=.007** (ISP7 deleted)
***ISP2**	product development information freely with my OEM.		
ISP3	manufacturing process information frequently with my OEM.		
***ISP4**	manufacturing process information freely with my OEM.		
ISP5	logistics information frequently with my OEM.		
***ISP6**	logistics information freely with my OEM.		
***ISP7**	quality information frequently with my OEM.		

***ISP8**	quality information freely with my OEM.		
ISP9	finance information frequently with my OEM.		
***ISP10**	finance information freely with my OEM.		

*Item deleted

Table 4.2.4.1: Supplier Partnership Practices - Convergent Validity

Discriminant validity: Table 4.2.4.2 shows the results of the discriminant validity analysis. The differences of chi-square values of each pair of dimensions are all significant at 0.001 level (df = 1, critical value = 10.83). The results indicate a disciminant validity of the construct of Supplier Partnership Practices.

	JOP		
	Cor.	**Sin.**	**Dif.**
ISP	94.7	187.3	***92.6***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.4.2: Supplier Partnership Practices – Discriminant Validity Assessment

(Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.4.1) and the second-order CFA model (Figure 4.2.4.2) are tested. Results of indexes are showed in Table 4.2.4.3. The T-coefficient method is not applicable for this construct because the number of dimensions of this construct is less than 4. All factor loading scores are above 0.50. This indicates the existence of a second-order construct.

	$\chi 2$	$\chi 2$/df	GFI	AGFI	NFI	CFI
First-order CFA	94.7	4.99	905	820	821	849
Second-order CFA	94.7	4.99	905	820	821	849

Table 4.2.4.3: Supplier Partnership Practices – Validation of the Second-order Construct

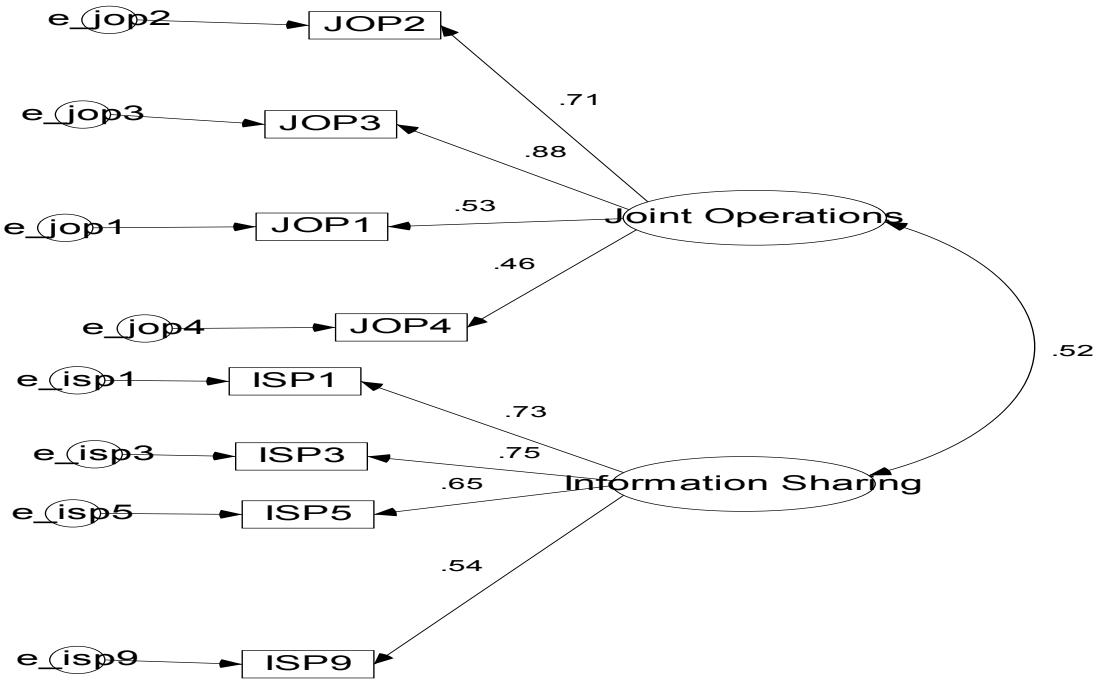


Figure 4.2.4.1: The Results of First-order CFA Model for Supplier Partnership Practices

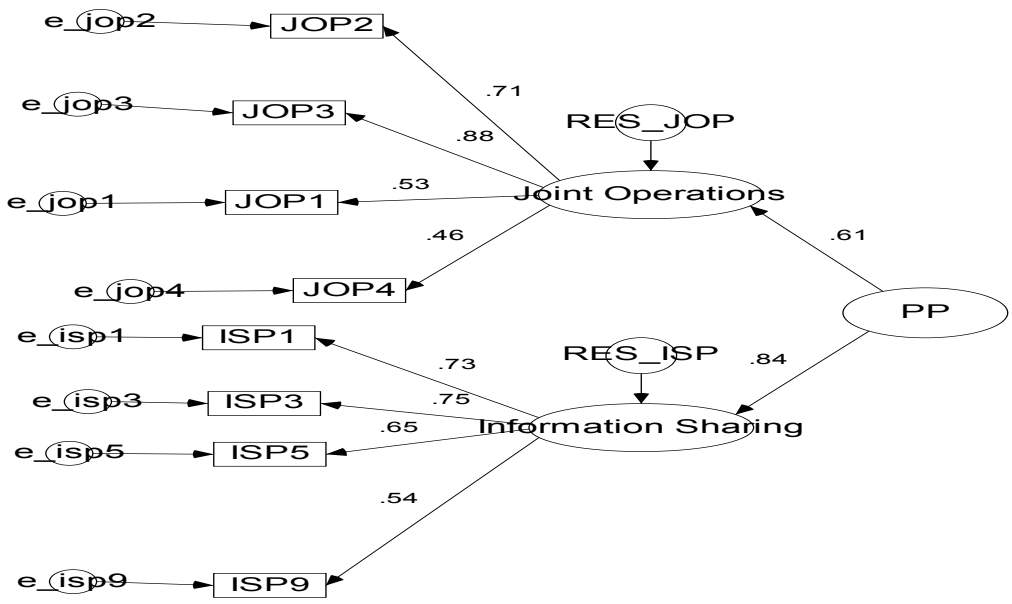


Figure 4.2.4.2: The Results of Second-order CFA Model for Supplier Partnership Practices

4.2.5 Supplier Modularity Practices (SMP)

Convergent Validity: The twenty-three items and their corresponding codes are listed in Table 4.2.5.1. Items are sequentially deleted in the CFA using AMOS while maintaining content validity; MDT1 is deleted because it overlaps with MDT2, MDT3, and MDT4; SSM4, SSM8, and SSM2 are sequentially deleted to improve convergent validity because they overlap with other items. The initial and final model fit indexes for convergent validity are also listed in the table. The scores of GFI, AGFI, and RMR for the final model indicate a very good convergent validity for each dimension.

Code Names	*Questionnaire Items*	*Initial Model Fit*	*Final Model Fit*
Product Modularity (PDM)			
PDM1	Our products use modularized design.	**GFI=.944 AGFI=.832 RMR=.025**	**GFI=.944 AGFI=.832 RMR=.025**
PDM2	Our products share common modules.		
PDM3	Our product features are designed around a standard base unit.		
PDM4	Product modules can be reassembled into different forms.		
PDM5	Product feature modules can be added to a standard base unit.		
Process Modularity (PSM)			
PSM1	Our production process is designed as adjustable modules.	**GFI=.955 AGFI=.865 RMR=.022**	**GFI=.955 AGFI=.865 RMR=.022**
PSM2	Our production process can be adjusted by adding new process modules.		
PSM3	Production process modules can be adjusted for changing production needs.		
PSM4	Our production process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units.		
PSM5	Production process modules can be rearranged so that customization sub-processes occur last.		
Dynamic Teaming in Manufacturing (MDT)			
***MDT1**	Production teams that can be reorganized are used in our plant.	**GFI=.796 AGFI=.386 RMR=.043**	**GFI=959 AGFI=.796 RMR=.025** (MDT1 deleted)
MDT2	Production teams can be reorganized in response to product / process changes.		
MDT3	Production teams can be reassigned to different production tasks.		
MDT4	Production team members can be reassigned to different teams.		
MDT5	Production team members are capable of working on different teams.		
Strategic Supplier Segmentation (SSM)			
SSM1	My firm classifies with its suppliers based on the importance of their parts to my firm's final products.	**GFI=.805 AGFI=.650 RMR=.064**	**GFI=.934 AGFI=.803 RMR=.039** (SSM2, SSM4, and SSM8 deleted)
***SSM2**	My firm classifies its suppliers based on their ability to customize components for my firm's final products.		
SSM3	My firm classifies its suppliers based on the product development interdependency of their parts to my firm's final products.		
***SSM4**	My firm classifies its suppliers based on the level of ownership that my firm has in the supplier.		

SSM5	My firm interacts with its suppliers based on the importance of their parts to my firm's final products.		
SSM6	My firm interacts with its suppliers based on their ability to customize components for my firm's final products.		
SSM7	My firm interacts with its suppliers based on the product development interdependency of their parts to my firm's final products.		
***SSM8**	My firm interacts with its suppliers based on the level of ownership that my firm has in the supplier.		

*Item deleted

Table 4.2.5.1: Supplier Modularity Practices- Convergent Validity

Discriminant validity: Table 4.2.5.2 below shows the results of discriminant validity. The differences of chi-square values for each pair of dimensions are all significant at 0.001 level (df = 1, critical value = 10.83). The results indicate a disciminant validity of the construct of Supplier modularityPractices.

	PSM			**MDT**			**SSM**		
	Cor.	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**
PDM	119.3	386.8	***267.5***	94.4	444.2	***349.8***	88.2	487.3	***399.1***
PSM				101.0	407.3	***306.3***	111.1	474.6	***363.5***
MDT							86.8	422.8	***336.0***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.5.2: Supplier Modularity Practices– Discriminant Validity Assessment (Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.5.1) and the second-order CFA model (Figure 4.2.5.2) are tested. The results of indexes are shown in Table 4.2.5.3. The T-coefficient of 0.975 indicates the existence of the second-order construct.

	χ2	**χ2/df**	**GFI**	**AGFI**	**NFI**	**CFI**
First-order CFA	381.7	2.61	.845	.798	.840	.893
Second-order CFA	391.4	2.64	.841	.795	.836	.890
T-coefficient (χ2 of First-order/ χ2 of Second-order)	97.5%					

Table 4.2.5.3: Supplier Modularity Practices– Validation of the Second-order Construct

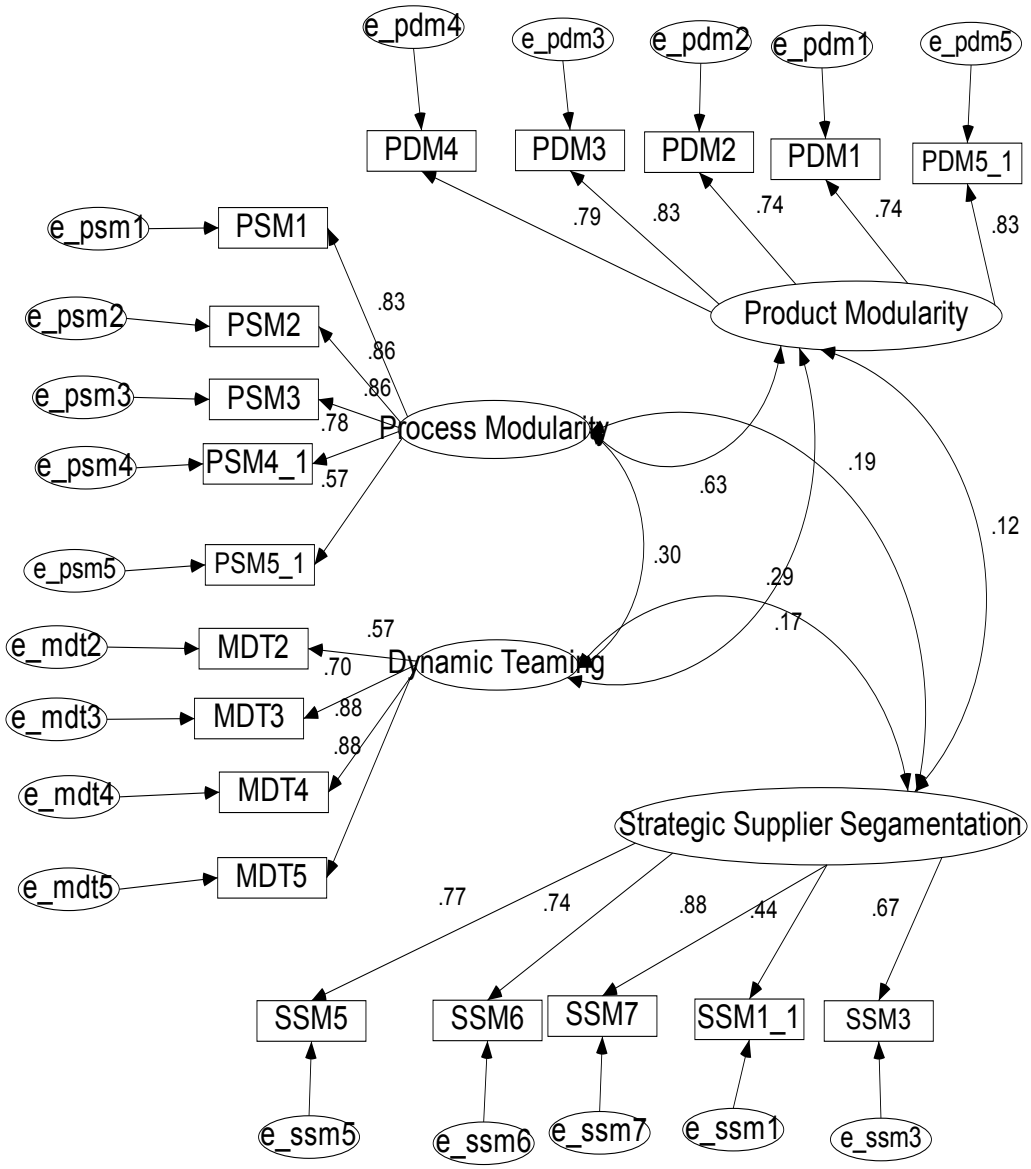


Figure 4.2.5.1: The Results of First-order CFA Model for Supplier Modularity Practices

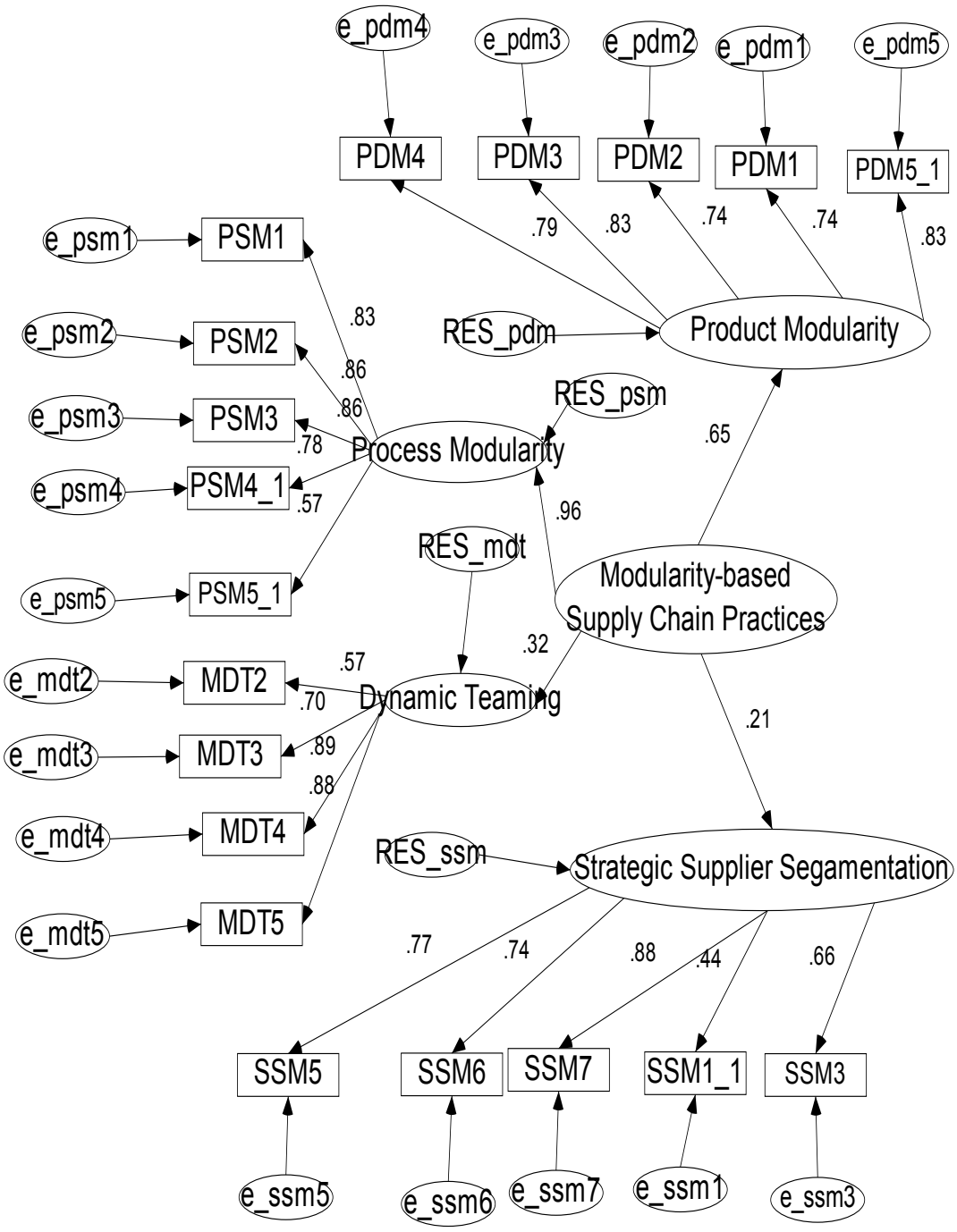


Figure 4.2.5.2: The Results of Second-order CFA Model for Supplier Modularity Practices

4.2.6 Supplier Postponement Practices (PSP)

Convergent Validity: The six items and their corresponding codes are listed in Table 4.2.6. Items are sequentially deleted in the CFA using AMOS while maintaining the content validity. PSP2 and PSP7 are deleted to improve the convergent validity because they overlap with other items. The initial and final model fit indexes for convergent validity are also listed in the table in two respective columns. The scores of GFI, AGFI, and RMR for the final model indicate a good convergent validity for each dimension.

Until customer orders have been received,

Code Names	*Questionnaire Items*	*Initial Model Fit*	*Final Model Fit*
***PSP2**	My firm postpones production.	**GFI=.862** **AGFI=.678** **RMR=.065**	**GFI=.981** **AGFI=.903** **RMR=.018** (PSP2 and PSP7 deleted)
PSP3	My firm postpones final product assembly activities.		
PSP4	My firm postpones final product labeling activities.		
PSP5	My firm postpones final packaging activities.		
PSP6	My firm postpones the forward movement of goods.		
***PSP7**	Our goods are kept in storage at central location.		

*Item deleted

Table 4.2.6: Supplier Postponement Practices – Convergent Validity

4.2.7 Build-to-order Supply Chain Capability (BOSCC)

Convergent Validity: The twelve items and their corresponding codes are listed in Table 4.2.7.1 below. Items are sequentially deleted in the CFA using AMOS. The initial model fit indexes and final model fit indexes for convergent validity are also listed in the table. BOC1 is deleted to improve the convergent validity. The scores of GFI, AGFI, and RMR for the final model indicate a very good convergent validity for each dimension.

Until customer orders have been received,

Code Names	*Questionnaire Items*	*Initial Model Fit*	*Final Model Fit*
Mass Customization (MC)			
BOC1	My firm can customize products on a large Scale.		
BOC2	My firm can add product variety without increasing cost.		
BOC3	My firm can customize products while maintaining high production.	**GFI=.944**	**GFI=.944**
BOC4	My firm is capable of low cost set-up.	**AGFI=.869**	**AGFI=.869**
BOC5	My firm can customize product features quickly.	**RMR=.032**	**RMR=.032**
BOC6	My firm can add product variety without sacrificing overall production efficiency.		
Order Fulfillment (ORD)			
BOC7	My firm fulfill orders (products & volume)completely.	**GFI=.959****	**GFI=.959****
BOC8	My firm fulfill orders timely.	**AGFI=.922**	**AGFI=.922**
BOC9	My firm can deliver products to the assigned location by customers.	**RMR=.033**	**RMR=.033**
Inventory (INV)			
BOC10	My firm maintains a low raw material Inventory.	**GFI=.956****	**GFI=.956****
BOC11	My firm maintains a low work-in-process inventory.	**AGFI=.917**	**AGFI=.917**
BOC12	My firm maintains a low finished goods inventory.	**RMR=.033**	**RMR=.031**

*Item deleted

** The overall model fit indexes are from the correlated model including this dimension and the dimension of Mass Customization; the loading for each of the three items is significant at 0.001 level.

Table 4.2.7.1: Build-to-order Supply Chain Capability – Convergent Validity

Discriminant validity: Table 4.2.7.2 below shows the results of discriminant validity. The differences of chi-square values of each pair of dimensions are all significant at 0.001 level (df = 1, critical value = 10.83). The results indicate a disciminant validity of the construct of Build-to-order Supply Chain Capability.

	ORD			INV		
	Cor.	**Sin.**	**Dif.**	**Cor.**	**Sin.**	**Dif.**
MC	67.8	299.1	***231.3***	72.9	352.8	***279.9***
ORD				9.9	203.8	***193.9***

Cor. = Correlated Model; Sin. = Single Factor Model;
Dif. = Difference between Correlated Model and Single Factor Model

Table 4.2.7.2: Build-to-order Supply Chain Capability – Discriminant Validity Assessment (Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 4.2.7.1) and the second-order CFA model (Figure 4.2.7.2) are tested. The results of indexes are showed in Table 4.2.7.3. All loadings are above 0.50. This indicates the existence of a second-order construct.

	$\chi 2$	$\chi 2$/df	GFI	AGFI	NFI	CFI
First-order CFA	110.5	2.17	.919	.875	.925	.958
Second-order CFA	110.5	2.17	.919	.875	.925	.958

Table 4.2.7.3: Build-to-order Supply Chain Capability – Validation of the Second-order Construct

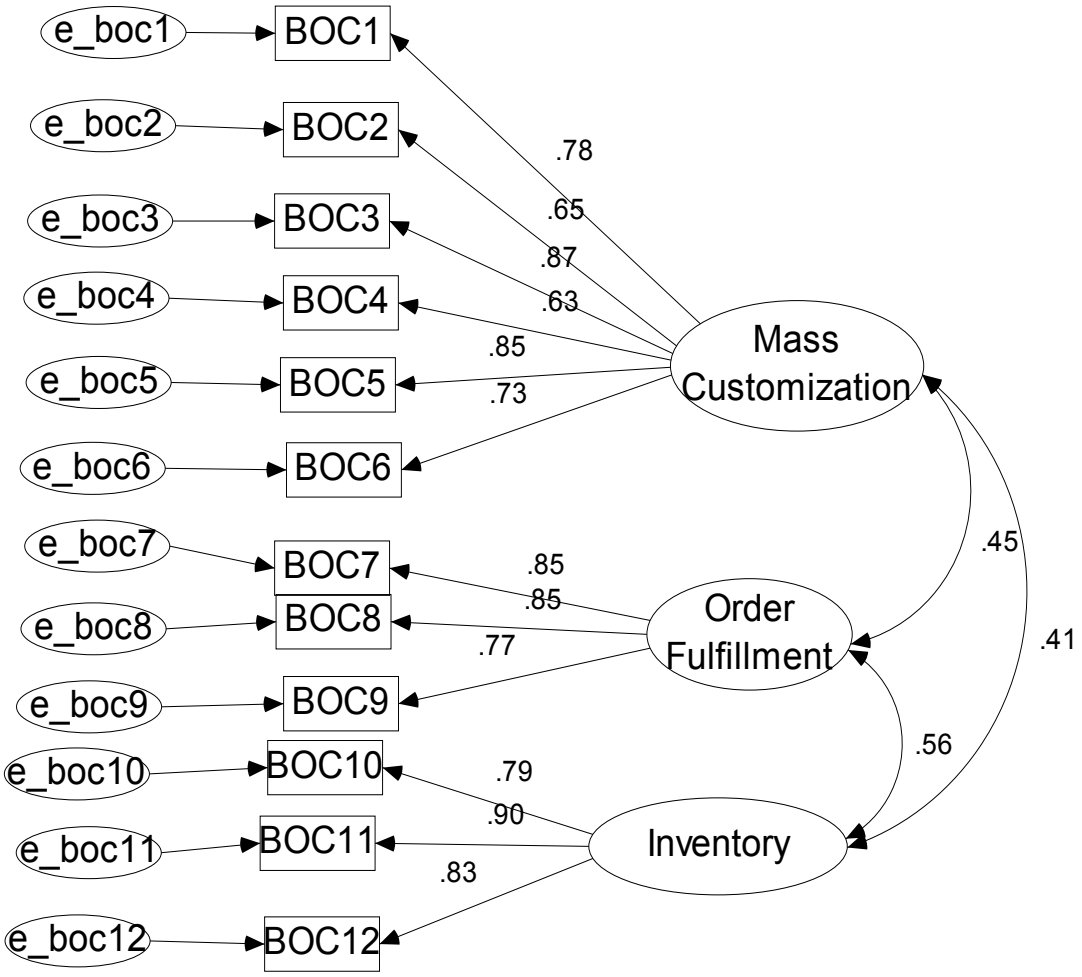


Figure 4.2.7.1: The Results of First-order CFA Model for Build-to-order Supply Chain Capability

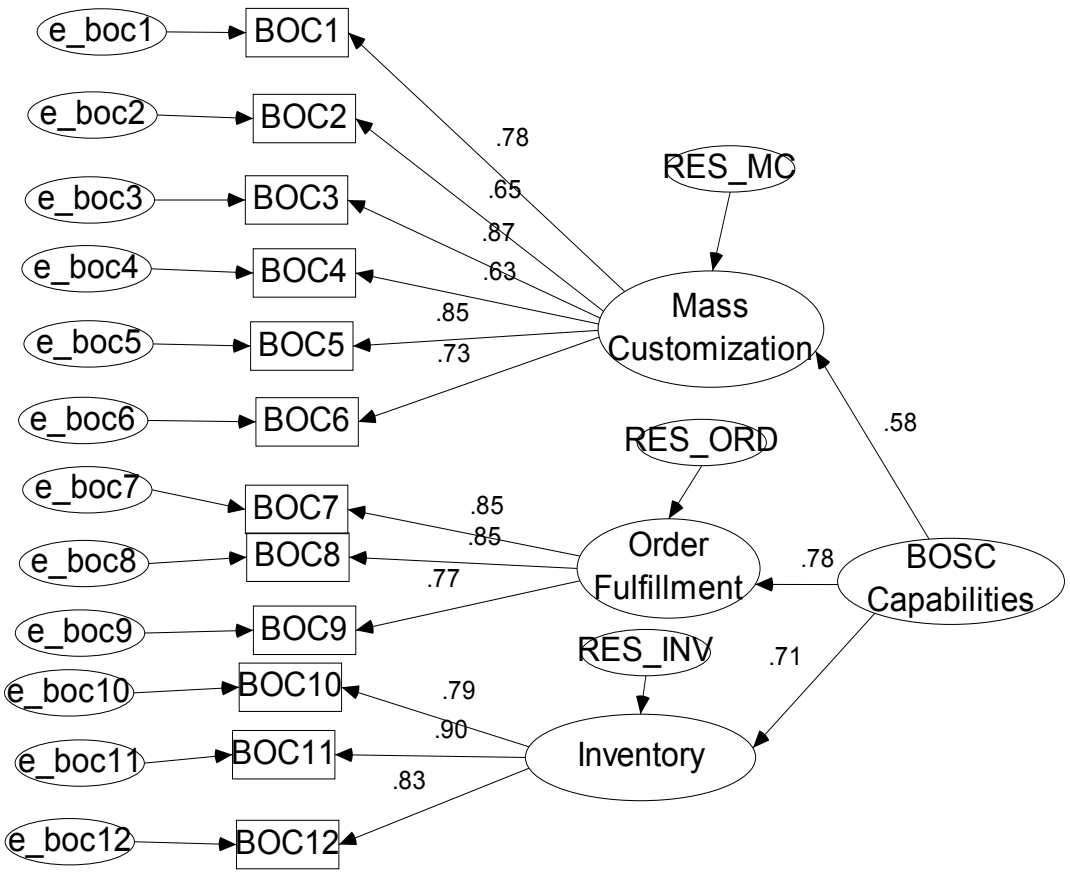


Figure 4.2.7.2: The Results of Second-order CFA Model for Build-to-order Supply Chain Capability

In sum, each of the seven constructs in this study has good reliability and validity including content validity, convergent validity, discriminant validity, and validation of the second-order construct.

CHAPTER 5: STRUCTURAL EQUATION MODELING AND HYPOTHESIS TESTING

This chapter introduces model testing in a multivariate way using structural equation modeling (SEM), which is considered more rigorous than the Pearson correlation used in testing predictive validity (Joreskog, 1970).

SEM has two origins, factor analysis and simultaneous equations (Kaplane and Elliot, 1997) and, therefore, has two parts, the measurement model and the structural model. This study has already used the measurement model in Chapter Four to ensure the reliability of validity of each construct. This chapter introduces path analysis (i.e., structural model) using the AMOS 16 structural model by James L. Arbuckle. The proposed structural model is reviewed in Section 5.1. Structural equation modeling methodology is introduced in Section 5.2, and the testing results are presented in Section 5.3 and discussed in Section 5.4. In order to further explore information in the model, nonsignificant paths are discussed in Section 5.5, the revised model is tested in Section 5.6, and the summary of the results are given in Section 5.7.

5.1 Initial Model

For the convenience of readers, Figure 5.1.1 repeats the theoretical model in Figure 2.1.1. There are seven constructs in the model: Partner Relationship (PR), Supplier Alignment (SA), Supplier Empowerment (SE), Supplier Partnership Practices (SPP),

Modularity Supply Chain Practices (SMP), Supplier Postponement Practices (SPP), and Build-to-order Supply Chain Capability (BOSCC).

There are eleven hypotheses proposed in Chapter 2 and shown in Figure 5.1.1. Hypothesis 1 is the causal relationship of PR → SA; Hypothesis 2 is the causal relationship of PR → SE; Hypothesis 3 is the causal relationship of SA → SPP; Hypothesis 4 is the causal relationship of SA → SMP; Hypothesis 5 is the causal relationship of SA → SPP; Hypothesis 6 is the causal relationship of SE → SPP; Hypothesis 7 is the causal relationship of SE → SMP; Hypothesis 8 is the causal relationship of SE → SPP; Hypothesis 9 is the causal relationship of SPP → BOSCC; Hypothesis 10 is the causal relationship of SPP → BOSCC; and Hypothesis 11 is the causal relationship of SPP → BOSCC.

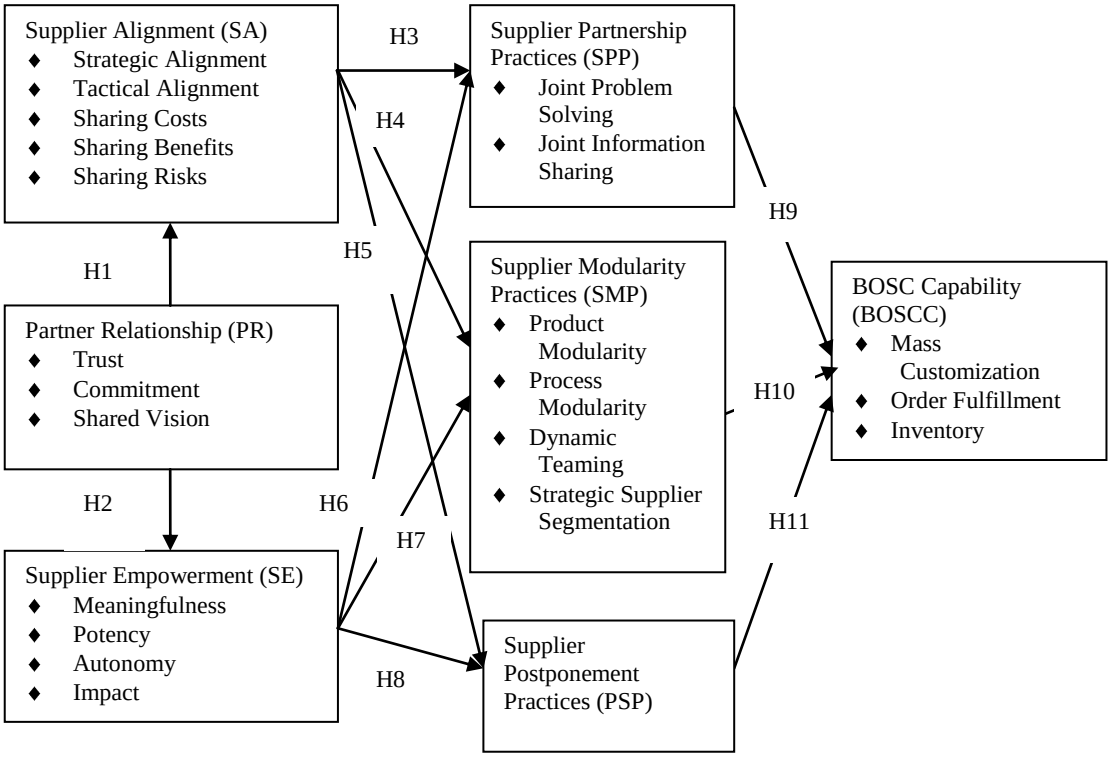


Figure 5.1.1 Theoretical Model

5.2 Structural Equation Modeling Methodology

This section introduces the structural equation modeling (SEM) methodology and its associated model evaluation indexes. SEM has an advantage of simultaneously evaluating all relationships in a research model compared with regression methodology, which can only check one relationship at a time. AMOS is widely used SEM software developed by James L. Arbuckle and released by SPSS. AMOS has the advantage of easy use with the characteristic of graphical presentation. It also provides modification indices for researchers to improve the model. However, researchers should always be cautious in modifying the model because the modifications should have theoretical justifications (Hair et al., 1998).

SEM has two parts: Measurement Model and Structural Model. This study has already described the process and results of the measurement model in Chapter Four, and the results of the structural model are discussed in this chapter, which include: (1) overall fit measures, (2) individual path significance, and (3) the effect size of each path.

5.2.1 Overall Fit Measure

The traditional overall fit index in statistics is the χ^2 value and its significance level. The value of χ^2 less than the critical value at the 0.05 significance level indicates that there is no significant difference between the actual and the predicted input matrices. In this situation, the model is claimed to have a good fit. The χ^2 value has a disadvantage of over sensitivity to sample size, especially when the sample size is higher than 200 (Hair et al., 1998, p.490). Due to the disadvantage of χ^2 indexes, researchers have developed three groups of indexes of overall model fit, including (1) absolute fit, (2) incremental fit, and (3) parsimonious fit (Hair et al., 1998, p.640). The AMOS algorithm provides some statistics of each group.

Absolute Fit Measures: Absolute Fit Measures are on the overall model fit. Two frequently used overall fit measures provided by AMOS are used in this study: (1) Goodness-of-fit index (GFI) and (2) Mean Square Residual (RMSR). GFI represents the squared residuals from prediction to the actual data. It has a range of 0 to 1; the higher the GFI value, the better the model fit; the critical value of GFI is 0.90 (Segars and Grover, 1993). RMSR shows the average of the residuals between observed and estimated input matrices. The smaller the RMSR, the better a model fit; the critical value of RMSR is claimed as 0.1 (Chau, 1997) or 0.05 (Joreskog and Sorbom, 1984).

Comparative Fit Measures: Comparative Fit Measures compare the proposed model to a baseline model (null model). One of the most frequently used comparative fit measures is the Normed Fit Index (NFI). Its range is from 0 to 1; the higher the NFI, the better a model fit; the critical value of NFI is claimed as 0.90 (Hair et al., 1998).

Parsimonious Fit Measures: Parsimonious Fit Measures compare the goodness-of-fit of the model to the number of estimated coefficients. One of the most frequently used parsimonious fit measures is the Adjusted Goodness-of-Fit Index (AGFI). AGFI adjusts degrees of freedom for the proposed model to the degrees of freedom. Its range is from 0 to 1; the higher the AGFI, the better model fit; the critical value of AGFI is claimed as 0.80 (Segars and Grover, 1993).

5.2.2 Significance and Effect Size

AMOS reports the t-value, the significance level, and the standardized regression weight for each causal relationship in the model. The t-value and significance level allow researchers to identify whether the relationship is significant and at what level, while the standardized regression weight, which is called effect size, shows what the coefficient between the independent variable and the dependent variable in a causal relationship. Cohen (1990, p. 1309) classifies effect size into three types: (1) large with effect size of 0.371 or above, (2) medium or meaningful with effect size between 0.148 and 0.371, and (3) small with the effect size of lower than 0.148. In sum, a path with effect size of 0.148 and above is considered valuable.

5.3 Structural Model Testing Results

There are four groups of suppliers (i.e., North America [1], Japanese Brand in China [2], Western Brand in China [3], and Chinese Brand in China [4]) in the dataset. Analyses of the mean differences of the four groups of suppliers and correlations for the seven constructs were conducted before structural model testing.

5.3.1 Mean Differences among the Four Groups of Suppliers

A two-step analysis of mean differences was conducted for each of the seven constructs. First, the mean of each group for each construct is listed in Table 5.3.1.

Group*	PR	SCA	SE	SPP	MBSCP	PSP	BOSCC
1	4.13	3.69	4.17	3.71	3.82	3.30	4.03
2	4.35	3.82	4.12	3.81	3.66	2.75	3.91
3	3.86	3.60	4.03	3.69	3.62	3.06	3.55
4	4.31	3.96	4.27	3.85	3.83	3.02	3.93
Total	4.20	3.80	4.16	3.78	3.74	3.00	3.87

* North America [1], Japanese Brand in China [2], Western Brand in China [3], and Chinese Brand in China [4]

Table 5.3.1: Mean of Each of Four Groups for Seven Constructs

Second, ANOVA was conducted for each of the seven constructs for the four groups. There are mixed results:

- Two constructs (i.e., Supplier Empowerment and Supplier Partnership Practices) have no significant differences among the four groups at 0.05 levels.
- Five constructs (i.e., Partner Relationship, Supplier Alignment, Supplier Modularity Practices, Supplier Postponement Practices, and Build-to-order Supply Chain Capabilities) have significant differences among the four groups at 0.05 levels.

Even though the means of the five groups have some statistically significant differences, the differences do not appear to be material.

5.3.2 Bivariate Correlations of Seven Constructs

Bivariate correlations of the seven constructs are presented in Table 5.3.2.1 through Table 5.3.2.5 for each of the four groups and their overall respondents. They indicate that there is no big difference among the four groups in terms of correlations of the seven constructs.

	PR	SCA	SE	SPP	MBSCP	PSP	BOSCC
PR	1						
SCA	.524(**)	1					
SE	.752(**)	.358(*)	1				
SPP	.386(*)	.416(**)	.351(*)	1			
MBSCP	.259	.418(**)	.425(**)	.470(**)	1		
PSP	.384(*)	.253	.254	.086	-.004	1	
BOSCC	.555(**)	.364(*)	.615(**)	.307	.366(*)	.467(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 5.3.2.1: Construct Correlations for Group 1 Suppliers

	PR	SCA	SE	SPP	MBSCP	PSP	BOSCC
PR	1						
SCA	.599(**)	1					
SE	.737(**)	.636(**)	1				
SPP	.518(**)	.554(**)	.531(**)	1			
MBSCP	.476(**)	.477(**)	.554(**)	.624(**)	1		
PSP	-.031	.002	-.077	.070	.128	1	
BOSCC	.710(**)	.538(**)	.669(**)	.501(**)	.572(**)	.001	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.3.2.2: Construct Correlations for Group 2 Suppliers

	PR	SCA	SE	SPP	MBSCP	PSP	BOSCC
PR	1						
SCA	.748(**)	1					
SE	.850(**)	.703(**)	1				
SPP	.710(**)	.681(**)	.631(**)	1			
MBSCP	.686(**)	.665(**)	.699(**)	.556(**)	1		
PSP	.318(*)	.170	.354(*)	.300	.466(**)	1	
BOSCC	.631(**)	.720(**)	.638(**)	.655(**)	.715(**)	.325(*)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 5.3.2.3: Construct Correlations for Group 3 Suppliers

	PR	SCA	SE	SPP	PSP	MBSCP	BOSCC
PR	1						
SCA	.589(**)	1					
SE	.736(**)	.595(**)	1				
SPP	.651(**)	.698(**)	.622(**)	1			
PSP	-.202	.065	-.077	.043	1		
MBSCP	.607(**)	.637(**)	.686(**)	.673(**)	.092	1	
BOSCC	.539(**)	.599(**)	.494(**)	.528(**)	-.140	.604(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.3.2.4: Construct Correlations for Group 4 Suppliers

	PR	SCA	SE	SPP	PSP	MBSCP	BOSCC
PR	1						
SCA	.627(**)	1					
SE	.749(**)	.589(**)	1				
SPP	.575(**)	.592(**)	.562(**)	1			
PSP	.082	.087	.116	.116	1		
MBSCP	.505(**)	.546(**)	.624(**)	.580(**)	.216(**)	1	
BOSCC	.620(**)	.552(**)	.608(**)	.518(**)	.170(*)	.598(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 5.3.2.5: Construct Correlations for All Suppliers

5.3.3 Initial Structural Modeling Results

In the structural modeling testing, the composite score (i.e., mean of all items in one dimension) for each dimension is the input of AMOS confirmatory structural equation model.

Figure 5.3.3.1 below shows the structural model, while Figure 5.3.3.2 displays the results of path analysis. Table 5.3.1 that follows summarizes detailed results including overall fit measures, significance levels, and effect sizes.

In Table 5.3.3, the initial model fit measures are: GFI = 0.932, RMSR = 0.028, NFI = 0.931, and AGFI = 0.893. GFI is higher than the recommended minimum value of 0.90; RMSR is lower than the recommended maximum value of 0.05; NFI is higher than the recommended minimum value of 0.90; AGFI is higher than the recommended minimum value of 0.80. In sum, measures of fit of model to the data indicate an acceptable level.

Meanwhile, seven out of eleven proposed hypotheses in Table 5.3.3 are significant. Hypotheses 1, 2, and 10 are significant at 0.001 levels; Hypotheses 4 and 7 are significant at 0.01 levels; Hypotheses 3 and 6 are significant at 0.05 levels. The t-value for Hypotheses 5, 8, 9, and 11 are 1.60, -0.87, -0.30, and 1.30 respectively, which are not significant at 0.05 levels. All seven supported relationships have large effect size. Therefore, the supported relationships have both statistical and practical significance, and these seven relationships have both theoretical and managerial implications. The implications of the four insignificant relationships will be addressed later in this chapter.

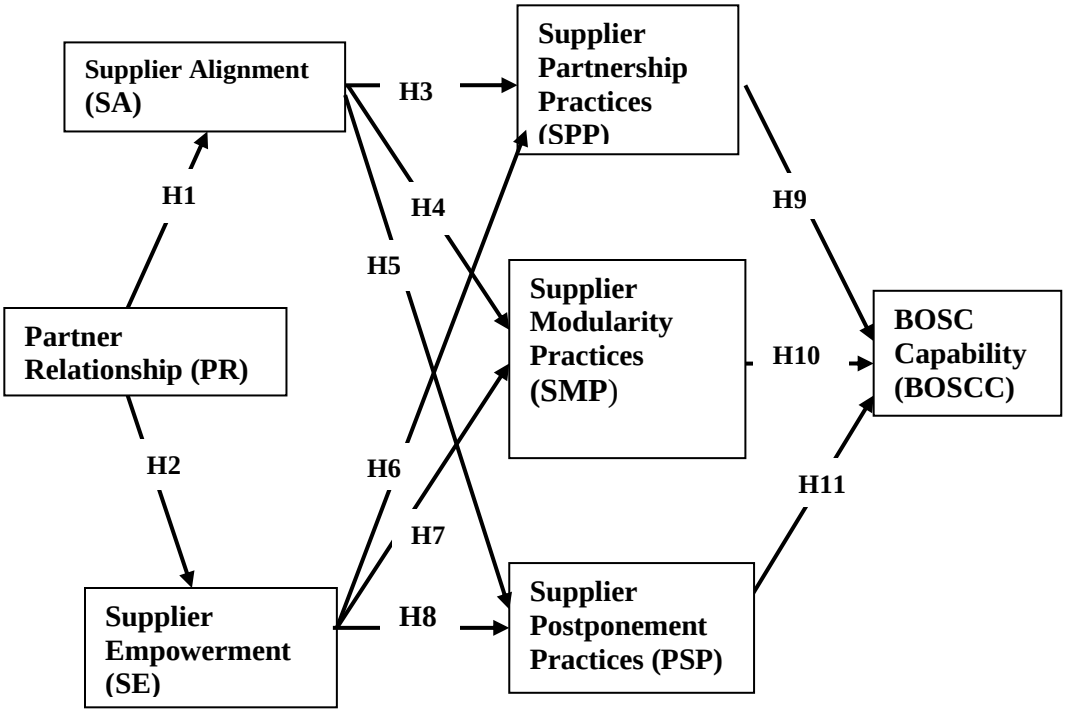
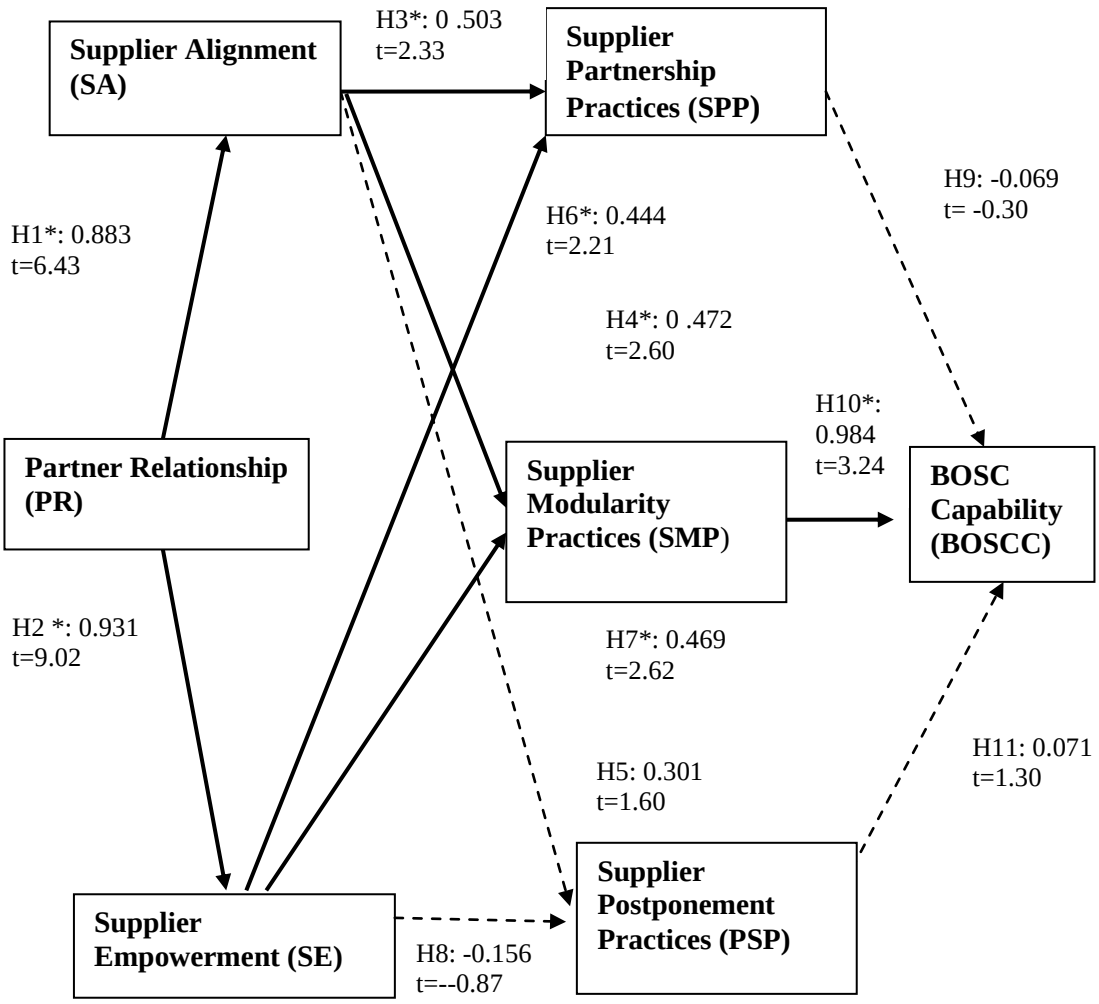


Figure 5.3.3.1: Structural Model for BOSC Capabilities



χ2 /df =0.992; GFI =0.932; RMSR =0.028; NFI =0.931; AGFI =0.893

***Significant Hypothesis**

Figure 5.3.3.2: Path Analysis Results for BOSC Capabilities

Hypotheses	Relationship	Coefficients	Effect Size	t-value	Significant?
H1	PR→ SA	0.883	Large	6.43	Yes****
H2	PR→ SE	0.931	Large	9.02	Yes****
H3	SA→ SPP	0.503	Large	2.33	Yes*
H4	SA → SMP	0.472	Large	2.60	Yes**
H5	SA→ PSP	0.301	Medium	1.60	No
H6	SE→ SPP	0.444	Large	2.21	Yes*
H7	SE → SMP	0.469	Large	2.62	Yes**
H8	SE → PSP	-0.156	Small	-0.87	No
H9	SPP → BOSCC	-0.069	Small	-0.30	No
H10	SMP→ BOSCC	0.984	Large	3.24	Yes****
H11	PSP→ BOSCC	0.071	Small	1.30	No
$\chi 2$ /df =0.992; GFI =0.932; RMSR =0.028; NFI =0.931; AGFI =0.893					

**** p <0.001; *** p<0.005; ** p <0.01; * p <0.05

Table 5.3.3: Initial Structural Modeling Results

5.4 Discussions of Structural Modeling and Hypotheses Testing Results

The proposed model has seven significant hypotheses (i.e., Hypotheses 1, 2, 3, 4, 6, 7, and 10) and four non-significant hypotheses (i.e., Hypotheses 5, 8, 9 and 11). The model also shows a very good fit to the data. The model fit and the significant hypotheses have great values to business researchers and practitioners; researchers can use these newly developed instruments for further studies and can expand the exploration of new hypotheses; the supported hypotheses can help business practitioners to make decisions more effectively and efficiently. The implications of the results of each hypothesis in this

study are discussed below. This section begins with the first two hypotheses, which are reproduced here:

Hypothesis 1: *Partner relationship has a positive impact on supplier alignment.*

Hypothesis 2*: Partner relationship has a positive impact on supplier empowerment.*

Hypotheses 1 and 2 were found to be significant with large effect sizes. This indicates that partner relationship has direct positive impacts on Supplier Alignment and supply chain empowerment. Partner relationship is the degree of trust, commitment, and shared vision between buyer and supplier. When there exist trust, commitment, and shared vision, the two sides are open and honest; they respect the confidentiality of each other's information; transactions are not so strictly supervised. This type of close relationship has both structural and emotional influences in a buyer-supplier alliance.

From a structural perspective, with the partner relationship, buyer and supplier would have further alignment actions in strategy, tactic, and finance: (1) strategic alignment includes supplier having strategic priorities (i.e., cost, quality, delivery, and flexibility) with buyer and maintaining the strategic priority consistency in the future; (2) tactical alignment includes clearly and fairly defined responsibilities of buyer and supplier in product development, manufacturing process, logistics, and quality improvement; (3) financial alignment includes sharing costs, benefits, and risks in new product development, manufacturing process, quality improvement, and logistics improvement. In sum, the closer the relationship between buyer and supplier, the easier both parties can work toward some goals, help each other, and even sacrifice self benefit for each other.

The emotional influence of partner relationship between buyer and supplier results in an empowered supplier. Like human beings in close relationship with friends, the close relationship will make the supplier feel empowered through a logic process comprising (1) confidence in manufacturing, quality management, and purchasing, (2) the meaningful results of the project with the buyer including increasing capabilities and profits, (3) the autonomy in choosing manufacturing process, logistics, and quality management, and (4) the impacts to the buyer and other customers in the industry. It is through the logic reasoning process that the supplier is stimulated and full of ambition because of the partner relationship built with the buyer.

In their case study, Liker and Choi (2004) compared the feelings of the same suppliers for two groups of auto makers of the U.S. companies (i.e., The Big Three) and Japanese Companies (i.e., Toyota and Honda). The suppliers felt that Japanese auto makers are friendlier in dealing with them; the suppliers share costs, benefits, and risks with the Japanese automakers; the suppliers felt empowered to do business with Japanese even though the Japanese automakers also put cost cutting pressure on them as did The Big Three. For practitioners, building partnership in a supply chain is a valuable starting point in supply chain management, which guides the meaningful establishment of Supplier Alignment and empowers suppliers.

Now, we discuss the implication of the results of the next three hypotheses:

Hypothesis 3: *Supplier alignment has a positive impact on supplier partnership practices.*

Hypothesis 4: *Supplier alignment has a positive impact on supplier modularity practices.*

Hypothesis 5: *Supplier alignment has a positive impact on supplier postponement practices.*

Hypotheses 3 and 4 are significant, while Hypothesis 5 is not significant. The effect sizes for the relationships in Hypotheses 3 and 4 are large. This indicates that Supplier Alignment has a large effect on supplier partnership practices and supplier modularity practices. Supplier Alignment links buyer and supplier in strategy, tactics, and finance. All activities in Supplier Alignment encourage further joint activities of buyer and supplier in operations and information sharing in product development, manufacturing process, quality improvement, and logistics. Supplier Alignment unites buyer and supplier harmoniously, so buyer and supplier can work closely in operations and share information frequently and freely. Dyer et al. (1998) observed the higher frequency of sending employees to the other party's facilities between buyer and supplier with high alignment, which is a key indicator of joint operations and information sharing.

Supplier Alignment also has a high and positive impact on supplier modularity practices. Aligned supplier and buyer can work together to decide how to modulate the whole product, modulate the manufacturing process, form a dynamic team, and manage suppliers through modularity more effectively and efficiently because modularity requires careful considerations of capabilities, investment requirements, and financial gains and risks of each side.

Hypothesis 5 is not significant. Since none of the relationships with Supplier Postponement Practices is significant in this study, a specific discussion on Supplier Postponement Practices and its associated hypotheses is in given Section 5.5.

Below is a discussion of the implication of the results of Hypotheses 6, 7, and 8, which are also reproduced here:

Hypothesis 6: *Supplier empowerment has a positive impact on supplier partnership practices.*

Hypothesis 7: *Supplier empowerment has a positive impact on supplier modularity practices.*

Hypothesis 8: *Supplier empowerment has a positive impact on supplier postponement practices.*

Hypotheses 6 and 7 are significant, while Hypothesis 8 is not. The effect sizes for the relationships in Hypotheses 6 and 7 are large. These indicate that supplier empowerment has a large effect on supplier partnership practices and supplier modularity practices. Supplier empowerment evaluates the passion of the supplier in the alliance. Highly motivated suppliers have an intention to join with the buyer in operations and information sharing in product development, manufacturing process, quality improvement, and logistics. Supplier empowerment has a power which highly elevates the desire for the supplier to work for the buyer, so buyer and supplier can work closely in operations and share information frequently and freely. Liker and Choi (2004) observed through interviews with auto suppliers that empowered suppliers worked with the buyer in operations and shared information with the buyer.

Supplier empowerment also has a high and positive impact on supplier modularity practices. Empowered suppliers are willing to modulate their components and manufacturing processes, to form a dynamic team, and to manage suppliers more

efficiently because suppliers can have higher potential for operational and financial gains and impact on their customers and their industry.

Hypothesis H8 is not significant. A specific discussion on Supplier Postponement Practices and its associated hypotheses is placed in Section 5.5.

Now, we discuss the last three hypotheses, as reproduced below:

Hypothesis 9: *Supplier partnership practices have a positive impact on BOSC capability.*

Hypothesis 10: *Supplier modularity practices have a positive impact on BOSC capability.*

Hypothesis 11: *Supplier postponement practices have a positive impact on BOSC capability.*

Hypothesis 10 is significant, while Hypotheses 9 and 11 are not. The effect size for the relationship in Hypothesis 10 is large. That indicates that supplier modularity practices have a large effect on build-to-order supply chain capabilities. The application of modularity in areas of product design, manufacturing process, manufacturing team, and supplier management allows the company to have more flexibility in these areas while not increasing costs. These can increase the build-to-order capabilities of the supplier and then the whole supply chain, which are high mass customization and order fulfillment capabilities as well as low inventories of raw material, work-in-process components, and finished products. Tu et al. (2004) empirically supports the finding that higher modularity-based manufacturing practices have a positive impact on mass customization capabilities. This study supports their finding in the supply chain context.

Hypotheses 9 and 11 are not significant, so specific discussions on Supplier Postponement Practices and their associated hypotheses are also given in Section 5.5.

5.5 Discussions of Nonsignificant Paths

The four nonsignificant hypotheses identified in the previous section are classified into two discussion issues: (1) Hypotheses 5, 8, and 11 are all related to the construct of Supplier Postponement Practices; in Section 5.5.1 below, a detailed literature review and two follow-up interviews were conducted to explain the nonsignificance of these three hypotheses. (2) Hypothesis 9 is not significant in SEM, so Section 5.5.2 explains the nonsignificance of it.

5.5.1 Reevaluating the Construct of Supplier Postponement Practices (PSP)

In order to find why Hypotheses 5, 8, and 11 are not significant, a detailed literature review on postponement usage within a supply chain was conducted, and new information was found. Through literature review, van Hoek (2001) found that the successful mass customization cases have characteristics of upstream mass manufacturing and intermediate or down-stream postponed manufacturing and services. "Those activities that are not postponed (for example, up-stream activities) can be run (like a flow shop) in a mass production environment, thereby maintaining efficiency" (p.162). Theoretically, OEMs are facing independent demands while suppliers are under dependent demand; postponement is a more suitable strategy to react to independent demands.

Two interviews were conducted on the usage of postponement in supply chain management with one Vice President of a first-tier supplier and one Senior Supply Chain

Manager of an auto manufacturer in China, whose suppliers constitute about half of the respondents in this study. They thought postponement might be useful for OEM, while suppliers, who are under JIT requirements and high penalties of delay, would not use it to a high degree; OEMs even do not care about whether suppliers use postponement.

The Construct of Supplier Postponement Practices in this study designed and proposed by Li (2002) is based on the final product postponement. This may explain why all postponement-related hypotheses are not significant. This finding also brings about an interesting research question: How to measure Supplier Postponement Practices for manufacturing suppliers?

5.5.2 Nonsignificance of Hypothesis 9

Hypothesis 9 is not significant in SEM. From the statistics perspective, the possible reason is that the relationship between Supplier Modularity Practicesand build-to-order supply chain capabilities is much stronger than that between supplier partnership practices and build-to-order supply chain practices, "hiding" the significance of Hypothesis 9.

5.6 The Revised Model

The previous discussions of the non-significant hypotheses inspire the author to rethink the supplier practices constructs. The previous model focuses on applying three different supply chain strategies (i.e., partnership, modularity, and postponement) in supplier's practices. Another view of supplier practices could be from the supply chain network perspective.

There are some supply chain networks proposed by different supply chain research groups. Lambert et al. (1998) present a supply chain network structure. It includes six nodes, which are tier 2 suppler, tier 1 supplier, manufacturer, customer, consumer/end-customer; each of tier 2 supplier, tier 1 supplier and manufacturer has six functions, namely, purchasing, production, logistics, R&D, marketing & scales, and finance. Two flows, product flow and information flow, link the six nodes from the beginning to the end of the supply chain. The 21st Century Logistics framework, developed at Michigan State University, includes three main parts, which are material and service supplier, internal operations, and customers; this framework has four flows, product-service value flow, market accommodation flow, information flow, and cash flow (Closs and Mollenkopf, 2004).

The supply chain network approach is also empirically supported by research. Li et al. (2005) define and empirically validate the construct of supply chain management practices, which covers three main parts of a manufacturer's practices (i.e., upstream, downstream, and internal supply chain processes) in a supply chain.

This study redefines supplier practices from a supply chain network strategy perspective. Suppliers (first tier suppliers and second tier suppliers) in this study have similar structures to a manufacturer within the supply chain network. The structure of a supplier in a supply chain network includes three main parts: upstream relation, internal processes, and downstream relation. The upstream relation is the management and relationship with the supplier's suppliers. The internal processes mainly include the supplier's processes within the functions of product design, purchasing, production,

marketing, and finance. The downstream processes are the practices for the flows of product and information with the customer.

Therefore, a new construct of supply chain practices is proposed from a supply chain network perspective. This construct includes six dimensions in Supplier Partnership Practices and Supplier modularity Practices to cover three main parts of supply chain practices: upstream relation (strategic supplier segmentation), internal processes (product modularity, process modularity, and dynamic teaming), and downstream relation (joint operation practices and information sharing practices). A revised model (Figure 5.5.2) excludes Supplier Postponement Practices and combines the dimensions of Supplier Partnership Practices and Supplier Modularity Practices into a construct called Supply Chain Practices. Model testing results are presented in the next section.

Because there is a new construct of Supply Chain Practices in the revised model, this section includes two parts: Section 5.6.1 tests the measurement of Supply Chain Practices, and Section 5.6.2 the revised model.

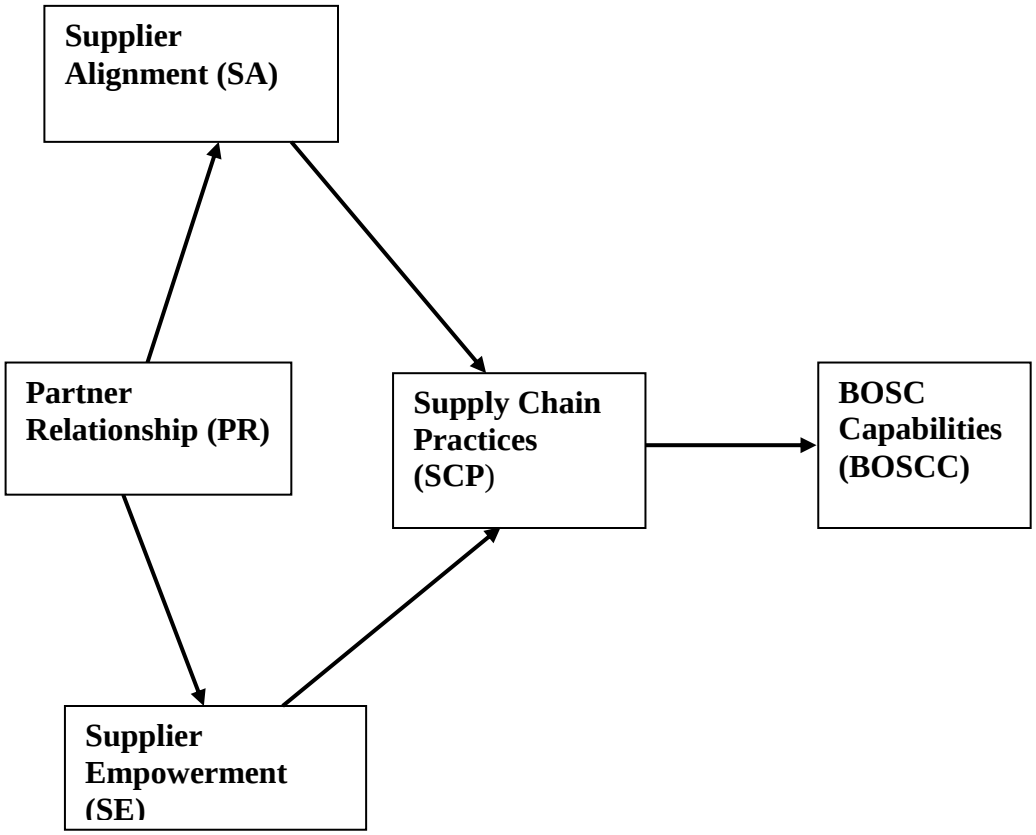


Figure 5.5.2: The Revised Model

5.6.1 Measurement Model of Supply Chain Practices

The proposed measure of Supply Chain Practices includes two dimensions of Supplier Partnership Practices (i.e., joint operation practices and information sharing practices) and four dimensions of Supplier Modularity Practices. The convergent validity of each dimension has been tested in Section 4.2.4 and Section 4.2.5; each dimension has a good convergent validity. This section shows the results of disciminant validity and validation of the second-order construct for Supply Chain Practices.

Discriminant validity: Table 5.6.1.1 below shows the results of discriminant validity. The differences of chi-square values for each pair of dimensions are all

significant at 0.001 level (df = 1, critical value = 10.83). The results indicate a disciminant validity of the construct of Supplier Alignment.

	ISP			PDM			PSM			MDT			SSM		
	Co.	**Si.**	**Di.**	**Co.**	**Si.**	**Di.**	**Co.**	**Si.**	**Di.**	**Co.**	**Si.**	**Di.**	**Co.**	**Si.**	**Di.**
JOP	95	187	***93***	94	268	***175***	68	222	***155***	48	207	***159***	98	230	***133***
ISP				120	289	***169***	80	195	***116***	46	223	***177***	90	234	***144***
PDM							119	387	***268***	94	444	***350***	88	487	***399***
PSM										101	407	***306***	111	475	***364***
MDT													87	423	***336***

Co. = Correlated Model; Si. = Single Factor Model;
Di. = Difference between Correlated Model and Single Factor Model

Table 5.6.1.1: Supply Chain Practices – Discriminant Validity Assessment (Pairwise comparison of $\chi 2$ values)

Validation of the second-order construct: The first-order CFA model (Figure 5.6.1.1) and the second-order CFA model (Figure 5.6.1.2) below are tested. Results of indexes are shown in Table 5.6.1.2. The T-coefficient of 0.935 indicates the existence of the second-order construct.

	$\chi 2$	**$\chi 2$/df**	**GFI**	**AGFI**	**NFI**	**CFI**
First-order CFA	815.2	2.64	.775	.725	.757	.831
Second-order CFA	872.0	2.74	.761	.716	.740	.815
T-coefficient ($\chi 2$ of First-order/ $\chi 2$ of Second-order)	93.5%					

Table 5.6.1.2: Supply Chain Practices – Validation of the Second-order Construct

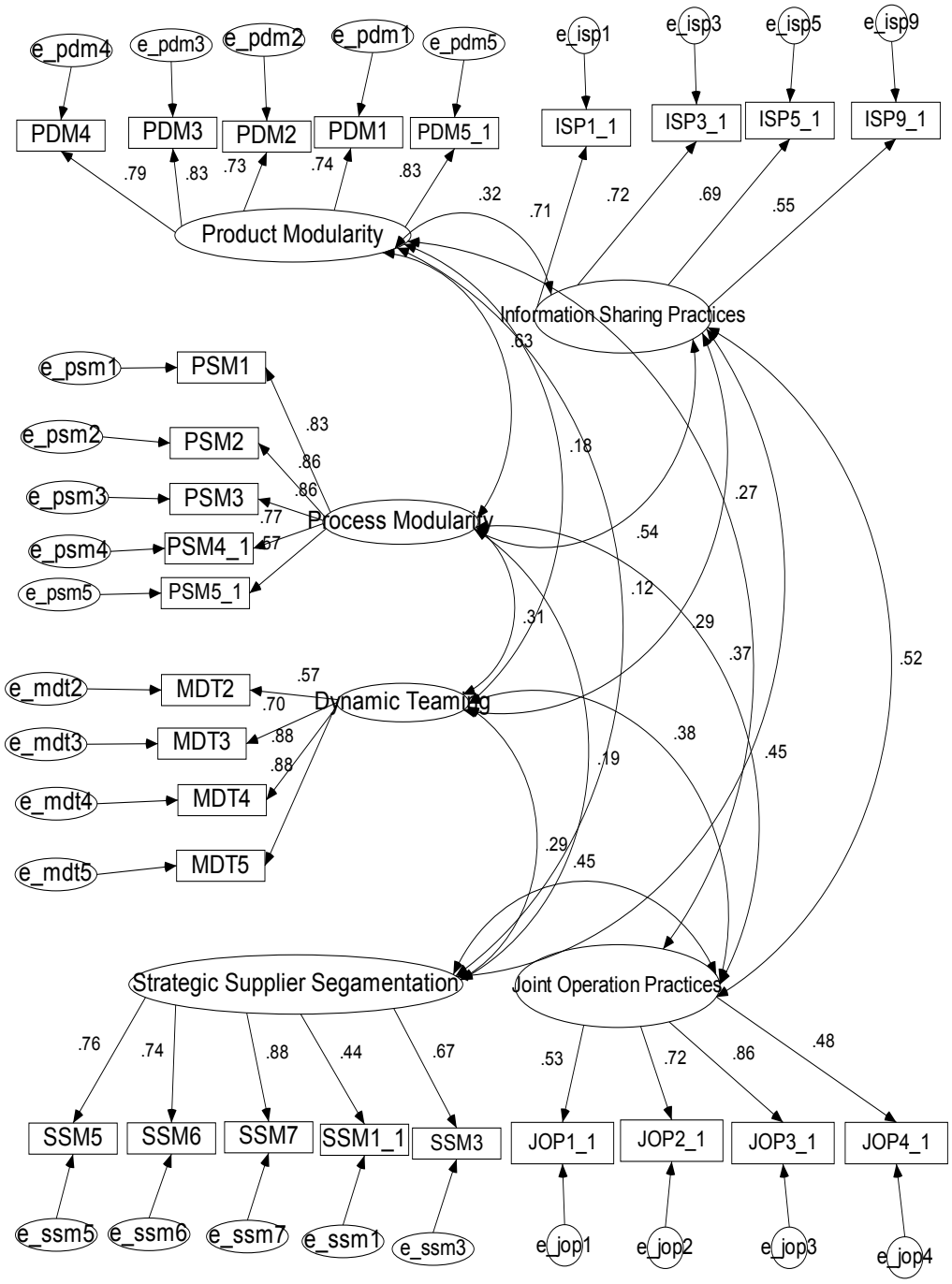


Figure 5.6.1.1: The Results of First-order CFA Model for Supply Chain Practices

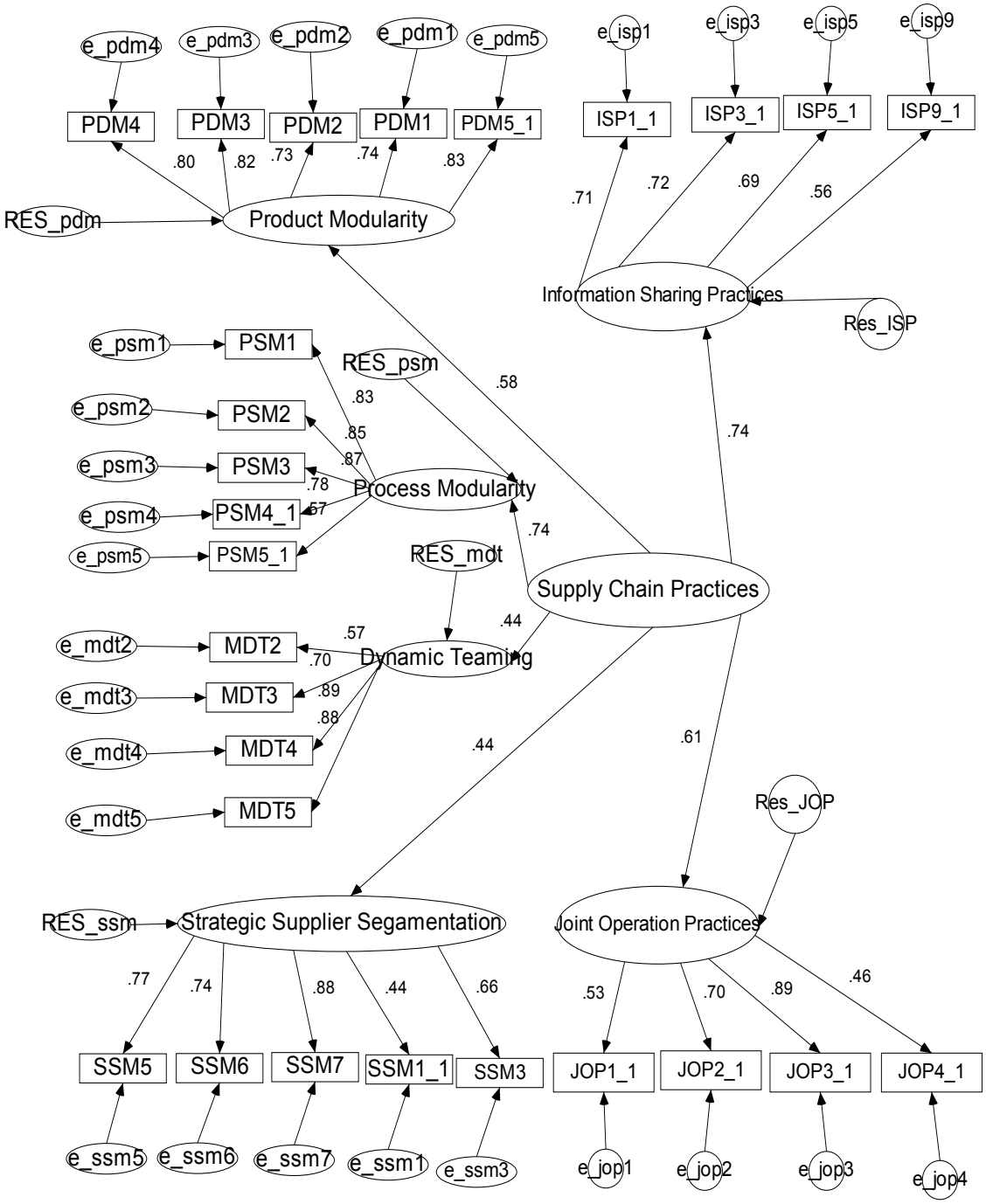


Figure 5.6.1.2: The Results of Second-order CFA Model for Supply Chain Practices

5.6.2 Bivariate Correlations of the Five Constructs

Bivariate correlations of the five constructs are presented in Table 5.6.2.1 through Table 5.6.2.5 for each of the four groups and the overall respondents. All correlations are significant. These tables show that there is no big difference among the four groups in terms of the correlations of the five constructs.

	PR	SA	SE	SCP	BOSCC
PR	1				
SA	.524(**)	1			
SE	.752(**)	.358(*)	1		
SCP	.347(*)	.478(**)	.458(**)	1	
BOSCC	.555(**)	.364(*)	.615(**)	.396(*)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 5.6.2.1: Construct Correlations of the Revised Model for Group 1 Suppliers

	PR	SA	SE	SCP	BOSCC
PR	1				
SA	.599(**)	1			
SE	.737(**)	.636(**)	1		
SCP	.543(**)	.558(**)	.602(**)	1	
BOSCC	.710(**)	.538(**)	.669(**)	.601(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.6.2.2: Construct Correlations of the Revised Model for Group 2 Suppliers

	PR	SA	SE	SCP	BOSCC
PR	1				
SA	.748(**)	1			
SE	.850(**)	.703(**)	1		
SCP	.782(**)	.755(**)	.757(**)	1	
BOSCC	.631(**)	.720(**)	.638(**)	.779(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.6.2.3: Construct Correlations of the Revised Model for Group 3 Suppliers

	PR	SA	SE	SCP	BOSCC
PR	1				
SA	.589(**)	1			
SE	.736(**)	.595(**)	1		
SCP	.679(**)	.719(**)	.719(**)	1	
BOSCC	.539(**)	.599(**)	.494(**)	.625(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.6.2.4: Construct Correlations of the Revised Model for Group 4 Suppliers

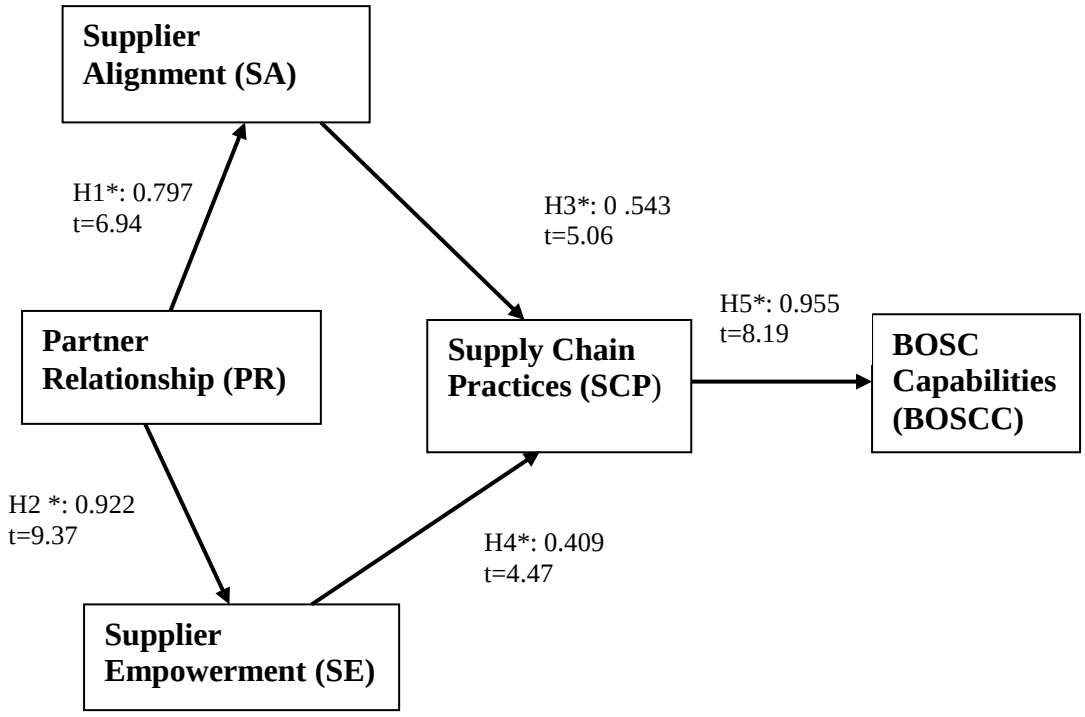
	PR	SA	SE	SCP	BOSCC
PR	1				
SA	.627(**)	1			
SE	.749(**)	.589(**)	1		
SCP	.593(**)	.629(**)	.670(**)	1	
BOSCC	.620(**)	.552(**)	.608(**)	.633(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.6.2.5: Construct Correlations of the Revised Model for All Suppliers

5.6.3 Testing Results of Revised Structural Model

The revised structural model is tested using AMOS. Figure 5.6.2 and Table 5.6.2 below show the testing results. In Table 5.6.2, the revised model fit measures are: GFI = 0.922, RMSR = 0.019, NFI = 0.917, and AGFI = 0.884. GFI is higher than the recommended minimum value of 0.90; RMSR is lower than the recommended maximum value of 0.05; NFI is higher than the recommended minimum value of 0.90; AGFI is higher than the recommended minimum value of 0.80. In sum, all model-fit indexes of the revised model are at acceptable levels. All five hypotheses are significant at 0.001 levels. All the relationships in this model have high effect sizes.



χ2 /df =1.18; GFI =0.922; RMSR =0.019; NFI =0.917; AGFI =0.884

***Significant**

Figure 5.6.3: Path Analysis Results for the Revised Model

Hypotheses	Relationship	Coefficients	Effect Size	t-value	Significant?
H1	PR→ SA	0.797	Large	6.94	Yes****
H2	PR→ SE	0.922	Large	9.37	Yes****
H3	SA→ SCP	0.543	Large	5.06	Yes****
H4	SE→ SCP	0.409	Large	4.47	Yes****
H5	SCP→ BOSCC	0.955	Large	8.19	Yes****
χ2 /df =1.18; GFI =0.922; RMSR =0.019; NFI =0.917; AGFI =0.884					

**** p <0.001; *** p<0.005; ** p <0.01; * p <0.05

Table 5.6.3: Revised Structural Modeling Results

5.7 Summary of Results

Overall, the results indicate that high levels of partner relationship will lead to high levels of supplier alignment and empower suppliers, high levels of Supplier Alignment and supplier empowerment will enhance supplier partnership practices and supplier modularity practices, and both types of supply chain practices will lead to high build-to-order supply chain capabilities. With the large effect sizes of all significant hypotheses, this study has implementation values for supply chain managers.

The next chapter will include the conclusions, contributions, implementations for managers and researchers, limitations of the research, and possible future researches.

CHAPTER 6: SUMMARY, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

This chapter includes (1) a summary of research findings and contributions in Section 6.1, (2) implications for practitioners in Section 6.2, (3) implications for researchers in Section 6.3, (4) limitations of the research in Section 6.4, and (5) recommendations for future research in Section 6.5.

6.1 Summary

This research is one of the first large-scale empirical studies to confirm the relationship between build-to-order supply chain practices and build-to-order supply chain capabilities and to explore and empirically confirm the interaction mechanism between buyer and supplier, which brings about build-to-order supply chain practices. It answers the following research questions: (1) what are BOSC capabilities? (2) what practices constitute BOSC practices? (3) what are the relationships between BOSC practices and BOSC capabilities? and (4) what is the interaction mechanism between buyers and suppliers who pursue BOSC practices and how can the constructs in the mechanism be measured?

As mentioned in the introduction, the majority of researchers of build-to-order supply chain focus on practices, while few researchers built up a mechanism (e.g., Supplier alignment and supplier empowerment in this study) to lead to the build-to-order supply chain practices. Furthermore, there is no clear definition of conceptual

frameworks and constructs of Supplier Alignment and supplier empowerment in most recent studies; the most current literature focuses on the managerial practices of Supplier Alignment, and little research has paid attention to the importance of supplier empowerment. This research provides comprehensive measurements of Supplier Alignment and supplier empowerment to systematically cover both structural and emotional parts of the BOSC practice-triggering mechanism. Both measurements are from suppliers' perspectives. Based on the data from 208 respondents, most of whom are executives in suppliers, the constructs and models are tested using the confirmative structural equation modeling methodology. As such, this study contributes to the understandings of the driving mechanisms of BOSC practices in several ways.

First, this study provides a theoretical framework including the detailed dimensions of partner relationship, Supplier Alignment, supplier empowerment, supplier partner practices, supplier modularity practices, and build-to-order supply chain capabilities. This framework lays a firm foundation for future research to add new constructs to provide a deeper and/or a broader understanding of build-to-order supply chain.

Second, this research offers valid and reliable instruments. These new instruments include: (1) Supplier alignment, (2) supplier empowerment, (3) supplier partnership practices, (4) supplier modularity practices, and (5) build-to-order supply chain capabilities. All measurements have been tested through a rigorous statistics process, which includes steps of pilot test, confirmative factor analysis, reliability, convergent validity, discriminant validity, and validation of second-order construct. All measurements satisfied the requirements of both validity and reliability; therefore, it is

valuable and can be used in future studies. These measurements are "blocks" for researchers to build their own research "houses" in supply chain management.

Third, this study empirically supports the description in the literature regarding the positive relationship between supplier partner practices and build-to-order supply chain practices as well as the positive relationship between supplier modularity practices and build-to-order supply chain practices. This study also empirically supports the direct causal relationship between Supplier Alignment and supplier empowerment to build-to-order supply chain practices, supplier partnership practices and supplier modularity practices. In addition, this study empirically supports the direct effects of partner relationship between buyer and supplier on both Supplier Alignment and supplier empowerment.

Fourth, this research theoretically reveals and statistically confirms a sequential process to achieve high build-to-order supply chain capabilities. The process starts from closer partner relationship, through tighter Supplier alignment and supplier empowerment, and triggers more frequent positive supplier partnership practices and more usages of modularity in supply chain, which will result in higher build-to-order supply chain capabilities.

Fifth, the results show and uphold the pivotal roles of Supplier Alignment, as has been described by other supply chain researchers, as well as of supplier empowerment, which has largely been ignored by previous research. Stimulating a high level of supplier empowerment is as important as establishing alignments in strategy, tactic, and finance between buyer and supplier in a supply chain.

6.2 Implications for Practitioners

There are several implications for practitioners according to the results of this study. First, the evaluation of one company's build-to-order capabilities should be conducted from different perspectives including (1) mass customization, which focuses on responding to the fast changing and diversified customer preferences in the current post-industrial era, (2) order fulfillment, which evaluates the capability of finishing orders in right quantity, right quality, right time, and right location, and (3) inventory, which indirectly measures the cost associated with build-to-order supply chain. Companies which can maintain high capabilities in these three aspects can claim to have high build-to-order supply chain capabilities.

Second, in order to have high build-to-order supply chain capabilities, suppliers should have intensive joint operation practices and information sharing activities: the results in this study encourage buyers and suppliers (1) to systematically partake in joint activities and (2) at the same time to share information freely and frequently concerning new product designs, manufacturing process improvement, quality management, logistics, and finance. Joint operations activities and information sharing activities decrease conflicts within cross-organizational projects by supplier and buyer and integrate supplier and buyer to customized final products, fulfill orders efficiently, and lower inventories.

Third, to achieve high build-to-order supply chain capabilities, it is also important for firms to utilize modularity architecture not only in product designs but also in manufacturing process, working teams, and supplier management. The modularity allows firms to have high flexibility to respond to changing environment while maintaining as

low cost as in mass production environment: (1) product modularity can satisfy more customers by changing customized modules to reduce the time of new product introduction while a lot of modules do not need to be redesigned; (2) manufacturing process modularity can quickly change processes to make newly designed products and quickly respond to the changing demands of customers by adjust manufacturing modules; (3) dynamic teaming is capable of serving different projects and teaming members are also dynamic to finish different jobs with diversified skills and knowledge; (4) strategic supplier segmentation focuses on the modularity of supply base and interacts differently with different types of supply modules; strategic supplier segmentation allows buyer to save time and costs in managing suppliers. Furthermore, the advantage of flexibility for modularity allows firms to update some modules, resulting in largely saving updating cost.

Fourth, establishing partnership with suppliers is a key strategy in supply chain management for buyers because partnership can empower suppliers and induce cost, benefit, and risk sharing between buyer and supplier. Partnership can be established through trust-building initiatives, committing to suppliers, and sharing visions with suppliers. In order to have trust, buyer and supplier should be open and honest toward each other and respect confidentiality of the information from each other. Commitment between buyer and supplier is kept through abiding agreements, helping each other and even sacrificing for each other. Sharing visions includes a similar understanding about the importance of improvements that benefit the supply chain as a whole and the buyer's brand reputation, customer satisfaction, and profits which highly influence suppliers' scales and profit.

Fifth, buyers should empower suppliers to proactively participate in supply chain activities such as joint activities, sharing information, and build modules in products, processes, teams, and supplier bases. In order to empower suppliers, it is not enough to just have some management practices, such as delegations; the empowerment building should be achieved through a psychological process by the supplier, which includes meaningfulness, potency, autonomy, and impact. The logic process starts at the usefulness of the project to the supplier in terms of increasing its profitability and its capabilities in manufacturing, logistics, and quality. Then, suppliers would think about whether it has confidence in its capabilities. Suppliers would also think about the freedom in selecting ways in R & D, manufacturing, logistics, purchasing, and quality management. Finally, suppliers would consider the impact of the project results on all its customers and its reputation in industries. In order to empower suppliers, buyers should consider the four psychological thinking steps when awarding projects to supplier.

Sixth, with a close relationship, buyers and suppliers could align together to have common manufacturing strategies and clearly allocated responsibilities while sharing costs, benefits, and risks for the following reasons. First, it takes time for the buyer to instruct its suppliers to have common strategic priority; the instruction process includes a lot of conflicts between buyer and supplier; however, with the partnership, the two sides will eventually have consistent supply chain strategic priority and works like a company. Second, it makes the supply chain more efficient, when buyer and supplier can clearly allocate responsibilities in product development, manufacturing process, logistics, and quality improvement. Finally, sharing costs, benefits and risks in product development,

process improvement, logistics, and quality management allows buyers and suppliers to utilize their financial resources and expertise in an optimized way.

Seventh, this study brings attention to the opinions of suppliers, which were largely ignored in previous supply chain studies. Suppliers play a more reactive role than buyers in supply chain management. However, without proactive participations of suppliers, the supply chain cannot function smoothly. Therefore, the buyer should first (1) establish a partner relationship with its suppliers, then (2) consider both financial gains of suppliers (i.e., financial alignment) and psychological feelings of its suppliers (i.e., supplier empowerment), and (3) have joint operations activities and sharing information with its suppliers. It is through this process that the supply chain can increase build-to-order capabilities.

6.3 Implications for Researchers

There are several implications for researchers. First, strong theories lay the foundations for this study. The theories of social dilemma and resource dependency for an alliance of multiple members are used in the supply chain context. The structural and emotional solutions to the social dilemma used in other disciplines are also adopted in the supply chain context. Therefore, the research model in this study is not only more convincing and reasonable than those built on intuition but also an interdisciplinary to achieve high academic values.

Second, the measurement of supplier empowerment must take place at an inter-organizational level. This is the first study to measure empowerment at an inter-organizational level in the context of supply chain management. This study refers to the

definition of empowerment at the individual level and team level as well as the measurement of it at the team level. The measurement of supplier empowerment has high reliability and validity. This brings a new way of thinking from other disciplines into supply chain research, expanding the concept of empowerment hitherto limited to individual or team research.

Third, the measurement of supplier alignment built on previous case studies has a high value in terms of linking to other constructs. Since it is well described to be valuable in several articles, the measurement can be widely used by future researchers in supply chain management. This study is the first research to measure supplier alignment with high reliability and validity.

Fourth, this study expands two measurements developed in the manufacturing context into the supply chain context. The construct of supplier modularity practices was built on modularity-based manufacturing practices by Tu et al. (2004). The former includes all three dimensions of the latter and a new dimension of strategic supplier segmentation. The construct of build-to-order supply chain capabilities includes mass customization by Tu et al. (2004) and two new dimensions of order fulfillment and inventory. These two new measurements work very well in terms of validity and reliability. This study shows a way of expanding the well-developed measurements in the manufacturing context into the supply chain context. Therefore, this study testifies the effective way of expanding knowledge in operations management and supply chain management.

Fifth, the revised model combines two constructs of supply chain practices (i.e., supplier partnership practices and supplier modularity practices) into one construct of

supply chain practices. By this way, all hypotheses are significant in the revised model. This allows researchers to have different views of the models built with the same blocks (i.e., dimensions). Different views have different research and partition values.

Sixth, the "expanding network" data collection methodology used in this study is an effective and efficient one for supply chain studies. It has several values in terms of research methodology: (1) it allows research to have opportunities to get in-depth information of a supply chain, which normally can be only gained through case studies; (2) this study can ensure a high response rate, which is the desire of many operations management (OM) and supply chain (SC) management researchers; the response rate of 45.6% in this study shows hopes for a lot of OM/SC researchers who are getting less than 10% response rates in their large-scale survey studies; (3) Since in the "expanding network" survey, all companies are willing to provide their company names, these names allow researchers to find some public financial reports to link perceptional measurements to financial data in their researches; it also allows researchers to conduct follow-up in-depth studies. In sum, the "expanding network" methodology combines advantages of case studies and advantages of survey methodology. The key success factor in using the "expanding network" methodology is to find industry supporters.

Seventh, respondents in different countries have different questionnaire format preferences: respondents in North America prefer on-line survey while respondents in China prefer email or mail questionnaires. Researchers can increase response rates by using different questionnaire formats to respondents in different regions.

Eighth, the development process of the construct of Supplier Postponement Practices illustrates that there are huge differences between OEM and suppliers in some

aspects: Postponement Supply Chain developed for OEM loses its value to evaluate suppliers' involvements in postponement because suppliers normally do not use the same practices as OEMs do. In the situation of literature scarcity, researchers should conduct case studies before they build the measurement of one construct.

Ninth, good industry connections are indeed valuable assets for researches. Industry experts can not only help researchers develop measurements but also give other supports, such as data collection and the evaluation of insignificant hypotheses. Researchers should maintain good industry networks in their disciplines if it is possible since OM/SC studies are closely related to industry practices.

Tenth, after several studies of general supply chain practices, supply chain management research should go deeper to first tier suppliers and even to second-tier suppliers. This may bring more values to supply chain research.

6.4 Limitations of the Research

Although this study has made several contributions to both supply chain theory and industrial practices, there are several limitations, as described below.

First, although the response rate is as high as 45.6%, the sample is only from North America and China. Collecting more responses from other countries would make the results of this study more convincing. In addition, 83.2% responses are from China and only 16.8% responses are from North America; it is better to collect more responses from North America if this study is claimed as a multinational study.

Second, as in other similar supply chain studies, individual respondents in this study have limited information about the different aspects of their supply chain. Although

the author tried to form a team in each supplier to answer a survey at the beginning stage in this study, only a limited number of suppliers used a team to answer.

Third, this study uses the auto industry as the representative of all industries. The sample is not random, so the generalizability of this study may be limited.

Fourth, the pilot sample size of 30 does not allow researchers to evaluate the instruments accurately although purposes of the pilot study also include logistics issues in the survey and the accuracy of the wordings.

Fifth, the data collected in this study is cross-sectional. Cross-sectional data can only have a snapshot of the company. Since it takes some time to have effects when firms implement some strategies, longitudinal data might reflect the delayed effects better.

6.5 Recommendations for Future Research

There are some recommendations for future research. First, this study can be expanded to include buyers' views on build-to-order supply chain to make it more comprehensive. Data from the buyer of each responding supplier can be collected because this study uses "expanding network" data collection methodology as described in Chapter Three. Most suppliers indicated their companies' names in the survey. The buyer has even a closer relationship with the author.

Second, future research can test hypotheses for different tiers, different industries, and different countries, if enough data could be collected for each tier, each industry, and each country. This may allow researchers to identify tier-specific, industry-specific, or country-specific causal relationships in this model.

Third, Supplier Postponement Practices for suppliers may be redefined to measure the involvement for suppliers in the whole supply chain's postponement activities. Then, supplier postponement involvement can be reevaluated in the research framework to see if it is significant.

Fourth, sub-construct level relationships may be evaluated to explore alternative models of structural relationships. There would be many possible research findings through this kind of explorations.

Finally, the research model can be expanded to include new constructs or constructs developed from other researches to build new meaningful relationships. For example, firm performance could be included to see how build-to-order supply chain capability promotes it.

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Appendix 1: Items Generated Through Literature Review

PARTNER RELATIONSHIP- 14 items

Trust- 4 items

1. Our OEM have been open and honest in dealing with us
2. Our OEM are reliable
3. Our OEM respect the confidentiality of the information they receive from us
4. Our transactions with OEM do not have to be closely supervised

Commitment – 6 items

5. Our OEM have made sacrifices for us in the past
6. Our OEM are willing to provide assistance to us without exception
7. We expect to increase business with our OEM in the future
8. We have invested a lot of effort in our relationship with OEM
9. Our OEM abide by agreements very well
10. We and our OEM always try to keep each others' promises

Shared Vision- 4 items

11. We and our OEM understand each others' business policies and rules very well
12. We and our OEM have a similar understanding about the aims and objectives of the supply chain
13. We and our OEM have a similar understanding about the importance of collaboration across the supply chain
14. We and our OEM have a similar understanding about the importance of improvements that benefit the supply chain as a whole

SUPPLIER ALIGNMENT- 16 items

Strategic alignment- 4 items

1. Our OEM have given us their strategic priority of cost, quality, delivery and flexibility
2. Our OEM have recommend us to have consistency with their strategic priority
3. Our OEM and we have similar strategic priority
4. Our OEM and we can maintain consistency when their strategic priority have been changed

Tactical alignment-6 items

5. My company and our OEM have clear responsibility allocation in new product development

6. My company and our OEM have fair responsibility allocation in new product development
7. My company and our OEM have clear responsibility allocation in processes
8. My company and our OEM have fair responsibility allocation in processes
9. My company and our OEM have clear responsibility allocation in logistics
10. My company and our OEM have fair responsibility allocation in logistics

Financial alignment- 6 items

11. My company and our OEM share costs of developing new products
12. My company and our OEM share costs of improving process
13. My company and our OEM share benefits of new products
14. My company and our OEM share benefits of the improved process
15. My company and our OEM share risks of the new products
16. My company and our OEM share risks of the new processes

SUPPLIER EMPOWERMENT - a 26-item measure

My Company:

Potency

1. has confidence in itself
2. believes it can be extremely good at producing high-quality work
3. expects to be known as a high performing company
4. feels it can solve any problem that comes up
5. believes it can be very productive
6. can get a lot done when it works hard
7. believes that no job is too tough
8. expects to have a lot of influence around here

Meaningfulness

9. cares about what it does
10. believes that its work is valuable
11. believes that its projects are significant
12. feels that its company purpose is important
13. finds that what we are trying to do is meaningful
14. feels that its company tasks are worthwhile

Autonomy

15. can select different ways to do its work
16. determines as a company how things are done
17. feels a sense of freedom in what it does

18. determines as a company what things are done
19. makes its own choices without being told by other company
20. has a lot of choice in what it does

Impact

21. makes good progress on its projects
22. has a positive impact on other companies that depend on it
23. has a positive impact on the supply chain's ultimate customers
24. accomplishes its objectives
25. performs tasks that matter to the whole supply chain
26. makes a difference in the supply chain

SUPPLIER PARTNERSHIP PRACTICES- 15 items

Joint operations practices- 7 items

1. We have joint planning with our OEM
2. We have joint product developments with our OEM
3. We have joint process improvement with our OEM
4. We have joint quality problem solving activities with our OEM
5. We have logistics coordination with our OEM
6. Our OEM send their employees to help us to solve problems
7. We send our employees to our OEM to solve some problems related to our products

Information sharing practices- 8 items

8. We share information of new product development with our OEM frequently
9. We share information of new product development with our OEM freely
10. We share information of process with our OEM frequently
11. We share information of process with our OEM freely
12. We share information of logistics with our OEM frequently
13. We share information of logistics with our OEM freely
14. We share information of finance with our OEM frequently
15. We share information of finance with our OEM freely

SUPPLIER MODULARITY PRACTICES- 24 items

Product Modularity- 7 items

1. Our products use modularized design
2. Our products share common modules
3. Our product features are designed around a standard base unit
4. Our products can be customized by adding feature modules as requested
5. Product modules can be reassembled into different forms
6. Product feature modules can be added to a standard base unit
7. Product modules can be rearranged by end-users to suit their needs

Process Modularity- 6 items

8. Our production process is designed as adjustable modules
9. Our production process can be adjusted by adding new process modules
10. Production process modules can be adjusted for changing production needs
11. Our production process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units
12. Production process modules can be rearranged so that customization sub-processes occur last
13. Production process modules can be rearranged so that customization sub-processes be carried out later at distribution centers

Dynamic Teaming- 7 items

14. Production teams that can be reorganized are used in our plant
15. Production teams can be reorganized in response to product / process changes
16. Production teams can be reassigned to different production tasks
17. Production teams are not permanently linked to a certain production task
18. Production team members can be re-assigned to different teams
19. Production team members are capable of working on different teams
20. Production teams have no difficulty accessing necessary resources

Strategic Supplier Segamentation-4 items

21. Our suppliers are managed in a modulated way
22. We are in a modular of our OEM's supply network
23. We categorized our suppliers based on the importance of their products to us
24. Our OEM categorized our suppliers based on the importance of our products

SUPPLIER POSTPONEMENT PRACTICES- 4 items

25. Our production process modules can be re-arranged so that customization can be carried out later at distribution centers
26. We delay final product assembly activities until customer orders have actually been received
27. We delay final product assembly activities until the last possible position (or nearest to customers) in the supply chain
28. Our goods are stored at appropriate distribution points close to the customers in the supply chain

IT USAGE IN BOSC- 8 items

1. We use internet to transfer information to our customers
2. We use Internet to transfer information to our supplier
3. We use e-commerce to do transactions with our customers
4. We use e-commerce to conduct transactions with our suppliers
5. We use ERP system to manage our planning
6. We use ERP system communicate with our customers

7. We use ERP systems to communicate with our suppliers
8. We use Radio Frequency Identification (RFID) technology to identify our products

BOSC CAPABILITIES- 15 items

1. Our capability of customizing products at low cost is high
2. Our capability of customizing products on a large Scale is high
3. Our capability of translating customer requirements into technical designs quickly is high
4. Our capability of adding product variety without increasing cost is high
5. Our capability of customizing products while maintaining a large volume is high
6. Our capability of setting up for a different product at low cost is high
7. Our capability of responding to customization requirements quickly is high
8. Our capability of adding product variety without sacrificing overall production volume is high
9. Our capability of changeover to a different product quickly is high
10. Our capability of maintain low final product inventory is high
11. Our capability of low total inventory cost in the supply chain is high
12. Our capability of low obsolete product inventory is high

Appendix 2: The Pilot Study Questionnaire

PILOT MAIL SURVEY QUESTIONNAIRE

A SURVEY OF SUPPLIER PARTNERSHIP AND BUILD-TO-ORDER SUPPLY CHAIN CAPABILLITY

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All RESPONSES WILL BE KEPT CONFIDENTIAL. DATA WILL BE USED FOR STATISTICAL ANALYSIS ONLY.

A SURVEY OF SUPPLIER PARTNERSHIP AND BUILD-TO-ORDER SUPPLY CHAIN CAPABILLITY

GENERAL INSTRUCTION

BOSC can be defined as ‘‘the value chain that manufactures quality products or services based on the requirements of an individual customer or a group of customers at competitive prices, within a short span of time by leveraging the core competencies of partnering firms or suppliers and information technologies such the Internet and WWW to integrate such a value chain.” BOSC is viewed by researchers as the 21st century supply chain strategy. In industries, Dell is utilizing BOSC strategy to become an operation leader in computer industry. BOSC strategy has been realized and utilized as an effective competitive weapon by companies in other industries; BMW uses BOSC in its Z3 cars to allow customers to place orders and change orders; VOLVO is also using build-to-order strategy in its Swedish production practices.

This study is exploring the relationship between partnership practices, modularity supply chain practices, Supplier Postponement Practices and BOSC capabilities. We even go deeper to explore the mechanism of empowering suppliers to participate into partner practices with OEMs.

The questionnaire is divided into nine sections. Each question requires that you choose the alternative that best fits your views on that topic. We estimate that it should take you a **maximum of 20 minutes** to fill this questionnaire. There is no right or wrong answers; we are interested only in your really facts and perceptions. **The anonymous information provided by you will be treated in the strictest confidence. Your responses will be entered in a coded format and in no instance will other persona get these information you provided.**

Thank you for your cooperation. We believe that, with your assistance, this multi-national study can help find best practices for BOSC, which will contribute to the success of Chinese industries and world industries when firms adopt these supply chain practices. **Please seal your completed questionnaire in the enclosed envelop and return it the person who distributed the questionnaire.**

Thank you very for your cooperation!

Unless otherwise specifically requested, please use the following Scale to answer each item:

1	2	3*	4	5	0
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

In this Scale, 3 represents the following: neutral, neither agree or disagree, moderate or average level as the case may be.

SUPPLIER ALIGNMENT

Supplier Alignment is the level of agreement within an supply chain regarding the relative strategic importance of cost, quality, delivery and flexibility, responsibility allocation, and sharing cost, risks and benefits. With regard to the perceived strategic, tactical, and financial alignments between Honda and your firm, please circle the appropriate number that accurately reflects your firm's PRESENT conditions.

Strategic Alignment (SA)

[SA1]My OEM has given us my firm its strategic priorities	1	2	3	4	5	0
[SA2]My firm's strategic priority with respect to *cost* is consistent with My OEM's strategic priority	1	2	3	4	5	0
[SA3]My firm's strategic priority with respect to *quality* is consistent with My OEM's strategic priority of our OEM	1	2	3	4	5	0
[SA4]My firm's strategic priority with respect to *delivery* is consistent with My OEM's strategic priority	1	2	3	4	5	0
[SA5]My firm's strategic priority with respect to *flexibility* is consistent with My OEM's strategic priority	1	2	3	4	5	0
[SA6]My firm can maintain strategic consistency with My OEM when My OEM's strategic priority has been changed	1	2	3	4	5	0

Tactical Alignment (TA)

My firm and My OEM have

[TA1]*clearly* defined responsibilities in *product development*	1	2	3	4	5	0
[TA2]*fairly* allocated responsibilities in *product development*	1	2	3	4	5	0
[TA3]clearly defined responsibilities in manufacturing processes	1	2	3	4	5	0
[TA4]fairly allocated responsibilities in manufacturing processes	1	2	3	4	5	0
[TA5]clearly defined responsibilities in logistics	1	2	3	4	5	0
[TA6]fairly allocated responsibilities in logistics	1	2	3	4	5	0
[TA7]clearly defined responsibilities in quality improvement	1	2	3	4	5	0

[TA8]fairly allocated responsibilities in quality improvement 1 2 3 4 5 0

Financial Alignment (FA)

My firm and My OEM share

[FA1]the costs of developing products 1 2 3 4 5 0

[FA2]the costs of quality improvements 1 2 3 4 5 0

[FA3]the costs of manufacturing process improvements 1 2 3 4 5 0

[FA4]the costs of logistics improvements 1 2 3 4 5 0

[FA5]the benefits of new product introductions 1 2 3 4 5 0

[FA6]the benefits of quality improvements 1 2 3 4 5 0

[FA7]the benefits from manufacturing process improvements 1 2 3 4 5 0

[FA8]the benefits of logistics improvements 1 2 3 4 5 0

[FA9]the risks of new product introductions 1 2 3 4 5 0

[FA10]the risks of quality improvements 1 2 3 4 5 0

[FA11]the risks from manufacturing process improvements 1 2 3 4 5 0

[FA12]the risks of logistics improvements 1 2 3 4 5 0

PARTNER RELATIONSHIP BETWEEN MY OEM AND MY FIRM

The degree of buyer's trust, commitment, and sharing vision, which is perceived by the supplier. With regard to partner relationship between My OEM and your firm, please circle the appropriate number that accurately reflects your firm's PRESENT conditions.

Trust (TRT)

[TRT1]My OEM has been open and honest in dealing with my firm 1 2 3 4 5 0

[TRT2]My OEM respects the confidentiality of the information they receive from my firm 1 2 3 4 5 0

[TRT3]Our transactions with My OEM do not

have to be closely supervised by My OEM 1 2 3 4 5 0

[TRT4]my firm has been open and honest
in dealing with My OEM 1 2 3 4 5 0

[TRT5]my firm respects the confidentiality of the
information they receive from My OEM 1 2 3 4 5 0

[TRT6]Our transactions with My OEM do not have
to be closely supervised by my firm 1 2 3 4 5 0

Commitment (COM)

[COM1]My OEM has been helped my firm
in the past 1 2 3 4 5 0

[COM2]My OEM has made sacrifices for
my firm in the past 1 2 3 4 5 0

[COM3]My OEM abides by agreements with
my firm very well 1 2 3 4 5 0

[COM4]My OEM has invested a lot of efforts
in our relationship with my firm 1 2 3 4 5 0

[COM5]my firm has been helped My OEM
in the past 1 2 3 4 5 0

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My OEM in the past 1 2 3 4 5 0

[COM7]my firm abides by agreements
with My OEM very well 1 2 3 4 5 0

[COM8]my firm has invested a lot of efforts
in our relationship with My OEM 1 2 3 4 5 0

[COM9]My firm and My OEM always try to
keep each others' promises 1 2 3 4 5 0

Shared Vision (SHV)

My firm and my OEM have a similar understanding about

[SHV1]the aims and objectives of
the supply chain 1 2 3 4 5 0

[SHV2]the importance of collaboration
across the supply chain 1 2 3 4 5 0

[SHV3]the importance of improvements that
benefit the supply chain as a whole 1 2 3 4 5 0

[SHV4]My OEM will have good scales 1 2 3 4 5 0

[SHV5]My OEM will have good profits 1 2 3 4 5 0

[SHV6]My OEM will have high customer satisfaction 1 2 3 4 5 0

[SHV7]My OEM will have good brand reputation 1 2 3 4 5 0

SUPPLIER EMPOWERMENT

Supplier empowerment is a process of enhancing feelings of potency of suppliers through identification of the potential value of proactively involving in supply chain practices

With regard to the project with My OEM, please circle the number that accurately reflects your firm's PRESENT conditions.

Meaningfulness (MN)

My company

[MN1]believes that My OEM projects are worthwhile in increasing my company's profits 1 2 3 4 5 0

[MN2]believes that My OEM projects are significant in increasing my company's design capability 1 2 3 4 5 0

[MN3]believes that My OEM projects are significant in increasing my company's manufacturing capability 1 2 3 4 5 0

[MN4]believes that My OEM projects are significant in increasing my company's logistics capability 1 2 3 4 5 0

[MN5]believes that My OEM projects are significant in increasing my company's quality management capability 1 2 3 4 5 0

[MN6]believes that My OEM projects are significant in increasing my company's purchasing capability 1 2 3 4 5 0

Potency (PT)

My company

[PT1]has confidence in its R&D capability 1 2 3 4 5 0

[PT2]has confidence in its manufacturing capability 1 2 3 4 5 0

[PT3]has confidence in its purchasing capability 1 2 3 4 5 0

[PT4]has confidence in its logistics capability	1	2	3	4	5	0
[PT5]has confidence in quality management capability	1	2	3	4	5	0
[PT6]can get a lot done when it works hard	1	2	3	4	5	0
[PT7]believes that it can be very productive	1	2	3	4	5	0

Autonomy (AT)

My company

[AT1]can select different R&D ways to do My OEM's work	1	2	3	4	5	0
[AT2]can select different manufacturing ways to do My OEM's work	1	2	3	4	5	0
[AT3]can select different logistics ways to do My OEM's work	1	2	3	4	5	0
[AT4]can select different purchasing ways to do My OEM's work	1	2	3	4	5	0
[AT5]can select different quality management ways to do My OEM's work	1	2	3	4	5	0

Impact (IP)

My company's My OEM project

[IP1]has a positive impact on My OEM's customers	1	2	3	4	5	0
[IP2]Provide products that matter to My OEM	1	2	3	4	5	0
[IP3]makes a difference in My OEM supply chain	1	2	3	4	5	0
[IP4]has a positive impact on customers other than My OEM	1	2	3	4	5	0
[IP5]makes a difference in my firm's industry	1	2	3	4	5	0

SUPPLLIER PARTNERSHIP PRACTICES

Supplier Partnership practices is the degree of join activities of partners within a supply chain on the information flow and the material flow. With regard to SCM practices, please circle the number that accurately reflects your firm's PRESENT conditions.

Joint operations practices (JOP)

[JOP1]My firm jointly develops products with My OEM 1 2 3 4 5 0

[JOP2]My firm jointly improves manufacturing processes with My OEM 1 2 3 4 5 0

[JOP3]My firm jointly improves qualities of products with My OEM 1 2 3 4 5 0

[JOP4]My firm coordinates logistics with My OEM 1 2 3 4 5 0

[JOP5]My OEM sends its employees to help my firm solve problems 1 2 3 4 5 0

[JOP6]My firm sends its employees to My OEM to solve problems related to my firm's products 1 2 3 4 5 0

Information sharing practices (ISP)

My firm shares

[ISP1] product development information frequently with My OEM 1 2 3 4 5 0

[ISP2] product development information freely with My OEM 1 2 3 4 5 0

[ISP3] manufacturing process information frequently with My OEM 1 2 3 4 5 0

[ISP4] manufacturing process information freely with My OEM 1 2 3 4 5 0

[ISP5] logistics information frequently with My OEM 1 2 3 4 5 0

[ISP6]logistics information freely with My OEM 1 2 3 4 5 0

[ISP7] finance information frequently with My OEM 1 2 3 4 5 0

[ISP8] finance information freely with My OEM 1 2 3 4 5 0

SUPPLIER MODULARITY PRACTICES

Supplier Modularity Practices are practices of applying modularity in product, process, supply base and teaming in the supply chain context. With regard to your modularity supply chain practices, please circle the number that accurately reflects your firm's PRESENT conditions.

Product Modularity (PDM)

[PDM1] Our products use modularized design	1	2	3	4	5	0
[PDM2] Our products share common modules	1	2	3	4	5	0
[PDM3] Our product features are designed around a standard base unit	1	2	3	4	5	0
[PDM4] Product modules can be reassembled into different forms	1	2	3	4	5	0
[PDM5] Product feature modules can be added to a standard base unit	1	2	3	4	5	0

Process Modularity (PSM)

[PSM1]Our production process is designed as adjustable modules	1	2	3	4	5	0
[PSM2]Our production process can be adjusted by adding new process modules	1	2	3	4	5	0
[PSM3]Production process modules can be adjusted for changing production needs	1	2	3	4	5	0
[PSM4]Our production process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units	1	2	3	4	5	0
[PSM5]Production process modules can be re-arranged so that customization sub-processes occur last	1	2	3	4	5	0

Dynamic Teaming in Manufacturing (MDT)

[MDT1]Production teams that can be re-organized are used in our plant	1	2	3	4	5	0
[MDT2]Production teams can be re-organized in response to product / process changes	1	2	3	4	5	0
[MDT3]Production teams can be re-assigned to different production tasks	1	2	3	4	5	0
[MDT4]Production team members can be re-assigned to different teams	1	2	3	4	5	0
[MDT5]Production team members are capable of working on different teams	1	2	3	4	5	0

Dynamic Teaming in R&D (DDT)

[DDT1]R&D teams that can be re-organized are used in our plant 1 2 3 4 5 0

[DDT2]R&D teams can be re-organized in response to product / process changes 1 2 3 4 5 0

[DDT3]R&D teams can be re-assigned to different R&D tasks 1 2 3 4 5 0

[DDT4]R&D team members can be re-assigned to different teams 1 2 3 4 5 0

[DDT5]R&D team members are capable of working on different teams 1 2 3 4 5 0

Strategic Supply Segmentation (SSM/SSO)

[SSM1]My firm classifies its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSM2]My firm classifies its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSM3]My firm classifies its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSM4]My firm classifies its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSM5]My firm interacts its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSM6]My firm interacts its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSM7]My firm interacts its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSM8]My firm interacts its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSO1]My OEM classifies its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSO2]My OEM classifies its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSO3]My OEM classifies its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSO4]My OEM classifies its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSO5]My OEM interacts its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSO6]My OEM interacts its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSO7]My OEM interacts its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSO8]My OEM interacts its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

SUPPLIER POSTPONEMENT PRACTICES (PSP)

Supplier Postponement Practices are the practices of moving forward one or more operations or activities (making, sourcing and delivering) to a much later point in the supply chain .With regard to the ACTUAL level of the performance of your SCM, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement

---

Until customer orders have been received,

[PSP1]My firm postpones product design 1 2 3 4 5 0

[PSP2]My firm postpones production 1 2 3 4 5 0

[PSP3]My firm postpones final product assembly activities 1 2 3 4 5 0

[PSP4]My firm postpones final product labeling activities 1 2 3 4 5 0

[PSP5]My firm postpones final packaging activities	1	2	3	4	5	0
[PSP6]My firm postpones the forward movement of goods	1	2	3	4	5	0
[PSP7]Our goods are kept in storage at central location	1	2	3	4	5	0

INFORMATION TECHNOLOGY USAGE (ITU)

With regard to Information Technology Usage of your firm, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement

---

My firm uses_____.

[ITU1]the internet to transfer information to our customers	1	2	3	4	5	0
[ITU2]the Internet to transfer information to our supplier	1	2	3	4	5	0
[ITU3]the e-commerce to conduct transactions with our customers	1	2	3	4	5	0
[ITU4]the e-commerce to conduct transactions with our suppliers	1	2	3	4	5	0
[ITU5]EDI to conduct transactions with our customers	1	2	3	4	5	0
[ITU6]EDI to conduct transactions with our suppliers	1	2	3	4	5	0
[ITU7]the ERP system to manage our planning	1	2	3	4	5	0
[ITU8]the ERP system communicate with our customers	1	2	3	4	5	0
[ITU9]the ERP systems to communicate with our suppliers	1	2	3	4	5	0
[ITU10]the Radio Frequency Identification (RFID) technology to identify our products	1	2	3	4	5	0

BUILD-TO-ORDER SUPPLY CHAIN CAPABILITIES (BOC)

BOSC capability is the ability of a firm to produce varieties of customized products on a large Scale to fulfill customer orders efficiently at a reasonable cost through technical and managerial innovations. With regard to BOSC Capabilities of your firm, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement.

[BOC1]my firm can customize products on a large Scale	1	2	3	4	5	0
[BOC2]my firm can add product variety without increasing cost	1	2	3	4	5	0
[BOC3]my firm can customize products while maintaining high production	1	2	3	4	5	0
[BOC4]my firm is capable of low cost set-up	1	2	3	4	5	0
[BOC5]my firm can customize product features quickly	1	2	3	4	5	0
[BOC6]my firm can add product variety without sacrificing overall production efficiency	1	2	3	4	5	0
[BOC7]my firm fulfill orders (products & volume) completely	1	2	3	4	5	0
[BOC8]my firm fulfill orders timely	1	2	3	4	5	0
[BOC9]my firm maintain low work-in-process inventory	1	2	3	4	5	0
[BOC10]my firm maintain low finished goods inventory	1	2	3	4	5	0

General Information about Your Firm

For the following question, please check the appropriate response.

---

1) What percentage is your scales of My OEM projects to your total scales? _____%

2) Has your organization embarked upon a program aimed specially at implementing "Supply Chain Management"?
_____ Yes _____ No.
If your answer is Yes, how long ? _____ years.

3) The number of product lines your firm makes_____

4) Number of employees in your company:
___ 1 -50 ___ 51-100 ___ 101-250
___251-500 ___ 501 -1000 ___ Over 1000

5) Average annual scales of your company in millions of $:
___ Under 5 ___5 to <10 ____10 to <25
___25 to <50 ___ 50 to <100 ____ >100

6) Your present job title:
____CEO/president _____Director
____Manager _____Other (please indicate_____)

7) Your present job function (mark all that apply):
_____ Corporate Executive _____ Purchasing
_____ Manufacturing Production _____ Distribution
_____ Transportation _____ Scales
_____ Other (please indicate _____)

8) The years you have stayed at this organization:
_____ under 2 years _____2-5 years
_____ 0-10 years _____over 10 years

9) Please rank the importance of the following factors (from 1-most important to 5-least important) in selecting your suppliers (use each number only once)

_____ Cost _____Quality _____ On time delivery

_____ Product and process flexibility

10) What is frequency that My OEM sends employees to your company? _____ persons/month

11) What is frequency that your company sends employees to My OEM? _____ persons/month

12) What percentage of your business transactions with your customers is done electronically?
_____ Less than 10% _____10-30% _____30-50%
_____50-80% _____More than 80%

13) What percentage of your business transactions with your suppliers is done electronically?
_____ Less than 10% _____10-30% _____30-50%
_____50-80% _____ More than 80%

THANK YOU FOR YOUR ASSISTANCE IN THIS PROJECT!

If you would like to receive the summary of results of this research, please complete the following details or attach your business card:

Your Name: _____

Business Name: _____

_____

Address: _____

_____

City: _____ State:_____

Zip Code: _____

Tel: _____ Fax: _____

E-mail: _____

Appendix 3: The Large-Scale Survey Questionnaire

LARGE SURVEY QUESTIONNAIRE

A SURVEY OF SUPPLIER PARTNERSHIP AND BUILD-TO-ORDER SUPPLY CHAIN CAPABILLITY

Kun Liao

PhD Candidate in Manufacturing Management

College of Business Administration

The University of Toledo

If you have any questions regarding this study please:

Phone: (509) 963-1174

Fax: (509) 963-2875

E-mail: kunliao2002@yahoo.com

All RESPONSES WILL BE KEPT CONFIDENTIAL. DATA WILL BE USED FOR STATISTICAL ANALYSIS ONLY.

ADULT RESEARCH - INFORMED CONSENT INFORMATION

Required by

THE UNIVERSITY OF TOLEDO

SOCIAL, BEHAVIORAL & EDUCATIONAL INSTITUTIONAL REVIEW BOARD

Achieving Build-to-order Supply Chain Capability through Practices and Partnership Generating Mechanisms

Kun Liao, PhD Candidate in Manufacturing Management at University of Toledo

Tel: (509)963-1174

Email: kunliao2002@yahoo.com

Purpose: You are invited to participate in the research project entitled, Achieving Build-to-order Supply Chain Capability through Practices and Partnership Generating Mechanisms, which is being conducted at the University of Toledo under the direction of Dr. Mark Vonderembse and Dr. T. S. Ragu-Nathan. The purpose of this study is to explore practices of Build-to-Order Supply Chain (BOSC). BOSC is viewed by researchers as the supply chain strategy of the 21st century. Across diverse industries, leading firms are effectively using a BOSC strategy as a competitive weapon. For example, Dell's BOSC strategy has allowed it to become an operations leader in the consumer PC market. In the auto industry, BMW has used BOSC for its popular Z3 roadster, allowing customers to place and change orders through the production process, and VOLVO has incorporated BOSC into its Swedish production practices.

For this survey, there is no right or wrong answers; we are interested only in your specific facts and perceptions.

Description of Procedures: This research will take place in University of Toledo before August 2008. You will be asked to complete various questionnaires in which you will evaluate your company's supply chain. Your participation will take about 30 minutes.

Potential Risks: There are minimal risks to participation in this study, including loss of confidentiality. Answering the surveys (or participating in this study) might cause you to feel upset or anxious. If so, you may stop at any time.

Potential Benefits: The only direct benefit to you if you participate in this research may be that you will learn about how BOSC are run and may learn more about BOSC. Others may benefit by learning about the results of this research.

Confidentiality: The researchers will make every effort to prevent anyone who is not on the research team from knowing that you provided this information, or what that information is. The anonymous information provided by you will be treated in the strictest confidence. Your responses will be entered in a coded format, and in no instance will any outside party have access to the information you provided. Although we will make every effort to protect your confidentiality, there is a low risk that this might be breached.

Voluntary Participation: Your refusal to participate in this study will involve no penalty or loss of benefits to which you are otherwise entitled *and will not affect your relationship with The University of Toledo.* In addition, you may discontinue participation at any time without any penalty or loss of benefits.

Contact Information: Before you decide to accept this invitation to take part in this study, you may ask any questions that you might have. If you have any questions at any time before, during or after your participation you should contact a member of the research team, Mr. Kun Liao at (509)-963-1174. If you have questions beyond those answered by the research team or your rights as a research subject or research-related injuries, please feel free to contact Dr. Jeffrey Busch, research compliance coordinator at (419) 530-2844.

By going to the next and completing the following survey – you are giving your informed consent to participate in this research project.

This survey is about the supply chain related perception and activities between you and ONE SPECIFIC CUSTOMER of yours

(We use "my CUSTOMER" to indicate the customer in this questionnaire).

Please indicate the customer's name :

Unless otherwise specifically requested, please use the following Scale to answer each item:

1	2	3*	4	5	0
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

In this Scale, 3 represents the following: neutral, neither agree or disagree, moderate or average level as the case may be.

SUPPLIER ALIGNMENT

Supplier Alignment is the level of agreement within an supply chain regarding the relative strategic importance of cost, quality, delivery and flexibility, responsibility allocation, and sharing cost, risks and benefits. With regard to the perceived strategic, tactical, and financial alignments between Your CUSTOMER and your firm, please circle the appropriate number that accurately reflects your firm's PRESENT conditions.

Strategic Alignment (SA)

[SA01]My firm's strategic priority with respect to *cost* is consistent with My CUSTOMER's strategic priority 1 2 3 4 5 0

[SA02]My firm's strategic priority with respect to *quality* is consistent with My CUSTOMER's strategic priority of our CUSTOMER 1 2 3 4 5 0

[SA03]My firm's strategic priority with respect to *delivery* is consistent with My CUSTOMER's strategic priority 1 2 3 4 5 0

[SA04]My firm's strategic priority with respect to *flexibility* is consistent with My CUSTOMER's strategic priority 1 2 3 4 5 0

[SA05]My firm's strategic priorities are consistent with My CUSTOMER's 1 2 3 4 5 0

[SA06]My firm can maintain strategic consistency with My CUSTOMER when My CUSTOMER's strategic priority has been changed 1 2 3 4 5 0

Tactical Alignment (TA)

My firm and My CUSTOMER have

[TA01]*clearly* defined responsibilities in *product development* 1 2 3 4 5 0

[TA02]*fairly* allocated responsibilities in *product development* 1 2 3 4 5 0

[TA03]clearly defined responsibilities in manufacturing processes 1 2 3 4 5 0

[TA04]fairly allocated responsibilities in manufacturing processes 1 2 3 4 5 0

[TA05]clearly defined responsibilities in logistics 1 2 3 4 5 0

[TA06]fairly allocated responsibilities in logistics 1 2 3 4 5 0

[TA07]clearly defined responsibilities in quality improvement 1 2 3 4 5 0

[TA08]fairly allocated responsibilities in quality improvement 1 2 3 4 5 0

Financial Alignment (FA)

My firm and My CUSTOMER share

[FA01]the costs of developing products 1 2 3 4 5 0

[FA02]the costs of quality improvements 1 2 3 4 5 0

[FA03]the costs of manufacturing process improvements 1 2 3 4 5 0

[FA04]the costs of logistics improvements 1 2 3 4 5 0

[FA05]the benefits of new product introductions 1 2 3 4 5 0

[FA06]the benefits of quality improvements 1 2 3 4 5 0

[FA07]the benefits from manufacturing process improvements 1 2 3 4 5 0

[FA08]the benefits of logistics improvements 1 2 3 4 5 0

[FA09]the risks of new product introductions 1 2 3 4 5 0

[FA10]the risks of quality improvements 1 2 3 4 5 0

[FA11]the risks from manufacturing process improvements 1 2 3 4 5 0

[FA12]the risks of logistics improvements 1 2 3 4 5 0

PARTNER RELATIONSHIP BETWEEN MY CUSTOMER AND MY FIRM

The degree of buyer's trust, commitment, and sharing vision, which is perceived by the supplier. With regard to partner relationship between Your CUSTOMER and your firm, please circle the appropriate number that accurately reflects your firm's PRESENT conditions.

Trust (TRT)

[TRT01]My CUSTOMER has been open and honest in dealing with my firm 1 2 3 4 5 0

[TRT02]My CUSTOMER respects the confidentiality of the information they receive from my firm 1 2 3 4 5 0

[TRT03]Our transactions with My CUSTOMER do not have to be closely supervised by My CUSTOMER 1 2 3 4 5 0

[TRT04]my firm has been open and honest in dealing with My CUSTOMER 1 2 3 4 5 0

[TRT05]my firm respects the confidentiality of the information we receive from My CUSTOMER 1 2 3 4 5 0

[TRT06]Our transactions with My CUSTOMER do not have to be closely supervised by my firm 1 2 3 4 5 0

Commitment (COM)

[COM01]My CUSTOMER has helped my firm in the past 1 2 3 4 5 0

[COM02]My CUSTOMER has made sacrifices for my firm in the past 1 2 3 4 5 0

[COM03]My CUSTOMER abides by agreements with my firm very well 1 2 3 4 5 0

[COM04]My CUSTOMER has invested a lot of efforts in our relationship 1 2 3 4 5 0

[COM05]my firm has been helped My CUSTOMER in the past 1 2 3 4 5 0

[COM06]my firm has made sacrifices for My CUSTOMER in the past 1 2 3 4 5 0

[COM07]my firm abides by agreements with My CUSTOMER very well 1 2 3 4 5 0

[COM08]my firm has invested a lot of efforts in our relationship 1 2 3 4 5 0

[COM09]My firm and My CUSTOMER always try to keep each others' promises 1 2 3 4 5 0

Shared Vision (SHV)

My firm and My CUSTOMER have a similar understanding about

[SHV01]the aims and objectives of the supply chain 1 2 3 4 5 0

[SHV02]the importance of collaboration across the supply chain 1 2 3 4 5 0

[SHV03]the importance of improvements that benefit the supply chain as a whole 1 2 3 4 5 0

[SHV04]My CUSTOMER's scales 1 2 3 4 5 0

[SHV05]My CUSTOMER's profits 1 2 3 4 5 0

[SHV06]My CUSTOMER's customer satisfaction
1 2 3 4 5 0

[SHV07]My CUSTOMER's brand reputation 1 2 3 4 5 0

SUPPLIER EMPOWERMENT

Supplier empowerment is a process of enhancing feelings of potency of suppliers through identification of the potential value of proactively involving in supply chain practices

With regard to the project with Your CUSTOMER, please circle the number that accurately reflects your firm's PRESENT conditions.

Meaningfulness (MN)

My company

[MN01]believes that My CUSTOMER projects are worthwhile in increasing my company's profits 1 2 3 4 5 0

[MN02]believes that My CUSTOMER projects are significant in increasing my company's design capability
1 2 3 4 5 0

[MN03]believes that My CUSTOMER projects are significant in increasing my company's manufacturing capability
1 2 3 4 5 0

[MN04]believes that My CUSTOMER projects are significant in increasing my company's logistics capability
1 2 3 4 5 0

[MN05]believes that My CUSTOMER projects are significant in increasing my company's quality management capability
1 2 3 4 5 0

[MN06]believes that My CUSTOMER projects are significant in increasing my company's purchasing capability
1 2 3 4 5 0

Potency (PT)

My company

[PT01]has confidence in its R&D capability 1 2 3 4 5 0

[PT02]has confidence in its manufacturing capability	1	2	3	4	5	0
[PT03]has confidence in its purchasing capability	1	2	3	4	5	0
[PT04]has confidence in its logistics capability	1	2	3	4	5	0
[PT05]has confidence in quality management capability	1	2	3	4	5	0
[PT06]can get a lot done when it works hard	1	2	3	4	5	0
[PT07]believes that it can be very productive	1	2	3	4	5	0

Autonomy (AT)

My company

[AT01]can select different R&D ways to do My CUSTOMER's work	1	2	3	4	5	0
[AT02]can select different manufacturing ways to do My CUSTOMER's work	1	2	3	4	5	0
[AT03]can select different logistics ways to do My CUSTOMER's work	1	2	3	4	5	0
[AT04]can select different purchasing ways to do My CUSTOMER's work	1	2	3	4	5	0
[AT05]can select different quality management ways to do My CUSTOMER's work	1	2	3	4	5	0

Impact (IP)

My company's project for My CUSTOMER

[IP01]provide products that matters to My CUSTOMER's customers	1	2	3	4	5	0
[IP02]provide products that matter to My CUSTOMER	1	2	3	4	5	0
[IP03] has a positive impact on My CUSTOMER supply chain	1	2	3	4	5	0
[IP04]has a positive impact on customers other than My CUSTOMER	1	2	3	4	5	0
[IP05]has a positive impact on my firm's reputation in the industry	1	2	3	4	5	0

SUPPLLIER PARTNERSHIP PRACTICES

Supplier Partnership practices is the degree of join activities of partners within a supply chain on the information flow and the material flow. With regard to SCM practices, please circle the number that accurately reflects your firm's PRESENT conditions.

Joint operations practices (JOP)

[JOP01]My firm jointly develops products with My CUSTOMER 1 2 3 4 5 0

[JOP02]My firm jointly improves manufacturing processes with My CUSTOMER 1 2 3 4 5 0

[JOP03]My firm jointly improves qualities of products with My CUSTOMER 1 2 3 4 5 0

[JOP04]My firm coordinates logistics with My CUSTOMER 1 2 3 4 5 0

[JOP05]My CUSTOMER sends its employees to help my firm solve problems 1 2 3 4 5 0

[JOP06]My firm sends its employees to My CUSTOMER to solve problems related to my firm's products 1 2 3 4 5 0

Information sharing practices (ISP)

My firm shares

[ISP01] product development information frequently with My CUSTOMER 1 2 3 4 5 0

[ISP02] product development information freely with My CUSTOMER 1 2 3 4 5 0

[ISP03] manufacturing process information frequently with My CUSTOMER 1 2 3 4 5 0

[ISP04] manufacturing process information freely with My CUSTOMER 1 2 3 4 5 0

[ISP05] logistics information frequently with My CUSTOMER 1 2 3 4 5 0

[ISP06]logistics information freely with My CUSTOMER 1 2 3 4 5 0

[ISP07] quality information frequently with My CUSTOMER 1 2 3 4 5 0

[ISP08] quality information freely with My CUSTOMER 1 2 3 4 5 0

[ISP09] finance information
frequently with My CUSTOMER 1 2 3 4 5 0

[ISP10] finance information
freely with My CUSTOMER 1 2 3 4 5 0

SUPPLIER MODULARITY PRACTICES

Supplier modularity practices are practices of applying modularity in product, process, supply base and teaming in the supply chain context. With regard to your modularity supply chain practices, please circle the number that accurately reflects your firm's PRESENT conditions.

Product Modularity (PDM)

[PDM01] Our products use
modularized design 1 2 3 4 5 0

[PDM02] Our products share
common modules 1 2 3 4 5 0

[PDM03] Our product features are designed
around a standard base unit 1 2 3 4 5 0

[PDM04] Product modules can be
reassembled into different forms 1 2 3 4 5 0

[PDM05] Product feature modules can be
added to a standard base unit 1 2 3 4 5 0

Process Modularity (PSM)

[PSM01]Our production process is designed
as adjustable modules 1 2 3 4 5 0

[PSM02]Our production process can be adjusted
by adding new process modules 1 2 3 4 5 0

[PSM03]Production process modules can be
adjusted for changing production needs 1 2 3 4 5 0

[PSM04]Our production process can be broken down
into standard sub-processes that produce standard
base units and customization sub-processes
that further customize the base units 1 2 3 4 5 0

[PSM05]Production process modules can
be re-arranged so that customization
sub-processes occur last 1 2 3 4 5 0

Dynamic Teaming in Manufacturing (MDT)

[MDT01]Production teams that can be re-organized
are used in our plant 1 2 3 4 5 0

[MDT02]Production teams can be re-organized in response to product / process changes 1 2 3 4 5 0

[MDT03]Production teams can be re-assigned to different production tasks 1 2 3 4 5 0

[MDT04]Production team members can be re-assigned to different teams 1 2 3 4 5 0

[MDT05]Production team members are capable of working on different teams 1 2 3 4 5 0

Dynamic Teaming in R&D (DDT)

[DDT01]R&D teams that can be re-organized are used in our plant 1 2 3 4 5 0

[DDT02]R&D teams can be re-organized in response to product / process changes 1 2 3 4 5 0

[DDT03]R&D teams can be re-assigned to different R&D tasks 1 2 3 4 5 0

[DDT04]R&D team members can be re-assigned to different teams 1 2 3 4 5 0

[DDT05]R&D team members are capable of working on different teams 1 2 3 4 5 0

Strategic Supply Segmentation (SSM/SSO)

[SSM01]My firm classifies its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSM02]My firm classifies its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSM03]My firm classifies its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSM04]My firm classifies its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSM05]My firm interacts its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSM06]My firm interacts its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSM07]My firm interacts its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSM08]My firm interacts its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSO01]My CUSTOMER classifies its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSO02]My CUSTOMER classifies its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSO03]My CUSTOMER classifies its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSO04]My CUSTOMER classifies its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

[SSO05]My CUSTOMER interacts its suppliers based on the importance of their parts to my firm's final products 1 2 3 4 5 0

[SSO06]My CUSTOMER interacts its suppliers based on their ability to customize components for my firm's final products 1 2 3 4 5 0

[SSO07]My CUSTOMER interacts its suppliers based on the product development interdependency of their parts to my firm's final products 1 2 3 4 5 0

[SSO08]My CUSTOMER interacts its suppliers based on the level of ownership that my firm has in the supplier 1 2 3 4 5 0

SUPPLIER POSTPONEMENT PRACTICES (PSP)

Supplier Postponement Practices are the practices of moving forward one or more operations or activities (making, sourcing and delivering) to a much later point in the supply chain .With regard to the

ACTUAL level of the performance of your SCM, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement

Until customer orders have been received,

[PSP01]My firm postpones product design	1	2	3	4	5	0
[PSP02]My firm postpones production	1	2	3	4	5	0
[PSP03]My firm postpones final product assembly activities	1	2	3	4	5	0
[PSP04]My firm postpones final product labeling activities	1	2	3	4	5	0
[PSP05]My firm postpones final packaging activities	1	2	3	4	5	0
[PSP06]My firm postpones the forward movement of goods	1	2	3	4	5	0
[PSP07]Our goods are kept in storage at central location	1	2	3	4	5	0

INFORMATION TECHNOLOGY USAGE (ITU)

With regard to Information Technology Usage of your firm, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement

My firm uses_____.

[ITU01]the internet to transfer information to our customers	1	2	3	4	5	0
[ITU02]the Internet to transfer information to our supplier	1	2	3	4	5	0
[ITU03]the e-commerce to conduct transactions with our customers	1	2	3	4	5	0
[ITU04]the e-commerce to conduct transactions with our suppliers	1	2	3	4	5	0
[ITU05]EDI to conduct transactions with our customers	1	2	3	4	5	0
[ITU06]EDI to conduct transactions with our suppliers	1	2	3	4	5	0
[ITU07]the ERP system to manage our planning	1	2	3	4	5	0

[ITU08]the ERP system communicate with our customers 1 2 3 4 5 0

[ITU09]the ERP systems to communicate with our suppliers 1 2 3 4 5 0

[ITU10]the Radio Frequency Identification (RFID) technology to identify our products 1 2 3 4 5 0

BUILD-TO-ORDER SUPPLY CHAIN CAPABILITIES (BOC)

BOSC capability is the ability of a firm to produce varieties of customized products on a large Scale to fulfill customer orders efficiently at a reasonable cost through technical and managerial innovations. With regard to BOSC Capabilities of your firm, please circle the appropriate number to indicate the extent to which you agree or disagree with each statement.

[BOC01]my firm can customize products on a large Scale 1 2 3 4 5 0

[BOC02]my firm can add product variety without increasing cost 1 2 3 4 5 0

[BOC03]my firm can customize products while maintaining high production 1 2 3 4 5 0

[BOC04]my firm is capable of low cost set-up 1 2 3 4 5 0

[BOC05]my firm can customize product features quickly 1 2 3 4 5 0

[BOC06]my firm can add product variety without sacrificing overall production efficiency 1 2 3 4 5 0

[BOC07]my firm fulfill orders (products & volume) completely 1 2 3 4 5 0

[BOC08]my firm fulfill orders timely 1 2 3 4 5 0

[BOC09]my firm can deliver products to the assigned location by customers 1 2 3 4 5 0

[BOC10]my firm maintain raw material Inventory 1 2 3 4 5 0

[BOC11]my firm maintain low work-in-process inventory 1 2 3 4 5 0

[BOC12]my firm maintain low finished goods inventory 1 2 3 4 5 0

General Information about Your Firm

For the following question, please check the appropriate response.

---

1) What percentage is your scales of your CUSTOMER projects to your total scales? _____%

2) Has your organization embarked upon a program aimed specially at implementing "Supply Chain Management"?
_____ Yes _____ No.
If your answer is Yes, how long ? _____ years.

3) The number of product lines your firm makes_____

4) Number of employees in your company:
___ 1 -50 ___ 51-100 ___ 101-250
___251-500 ___ 501 -1000 ___ Over 1000

5) Average annual scales of your company in millions of $:
___ Under 5 ___5 to <10 ____10 to <25
___25 to <50 ___ 50 to <100 ____ >100

6) Your present job title:
____CEO/president _____Director
____Manager _____Other (please indicate_____)

7) Your present job function (mark all that apply):
_____ Corporate Executive
_____ Purchasing
_____ Research & Design
_____ Manufacturing Production
_____ Scales
_____ Distribution & Transportation
_____ Other (please indicate _____)

8) The years you have stayed at this organization:
_____ under 2 years _____2-5 years
_____ 5-10 years _____over 10 years

9) Please rank the importance of the following factors (from 1-most important to 5-least important) in selecting your suppliers (use each number only once)

_____ Cost _____Quality _____ On time delivery

_____ Product and process flexibility

10) What is frequency that your CUSTOMER sends employees to your company? _____ persons/month

11) What is frequency that your company sends employees to Your CUSTOMER? _____ persons/month

12) What percentage of your business transactions with your customers is done electronically?
_____ Less than 10% _____10-30% _____30-50%
_____50-80% _____More than 80%

13) What percentage of your business transactions with your suppliers is done electronically?
_____ Less than 10% _____10-30% _____30-50%
_____50-80% _____ More than 80%

THANK YOU FOR YOUR ASSISTANCE IN THIS PROJECT!

If you would like to receive the summary of results of this research, please complete the following details or attach your business card:

Your Name: _____

Business Name: _____

_____

Address: _____

_____

City: _____ State:_____

Zip Code: _____

Tel: _____ Fax: _____

E-mail: _____

Appendix 4: Sample Characteristics

Table 3.7.1: Sample Characteristics of Respondents

1	**Job Title**	
	CEO/President	35.1%
	Director	25.0%
	Manager	5.3%
	Others	17.3%
	Unidentified	17.3%
2	**Job Function**	
	Corporate Executives	13.9%
	Purchasing	6.7%
	Research and Design	8.7%
	Manufacturing	1.0%
	Scales and Marketing	40.4%
	Distribution and Transportation	4.3%
	Others	5.3%
	Unidentified	19.7%
3	**Years at the Organization**	
	<2	7.7%
	2– 5	23.1%
	6 –10	11.1%
	>10	10.1%
	Unidentified	48.1%

Figure 3.7.1.1: Job Title

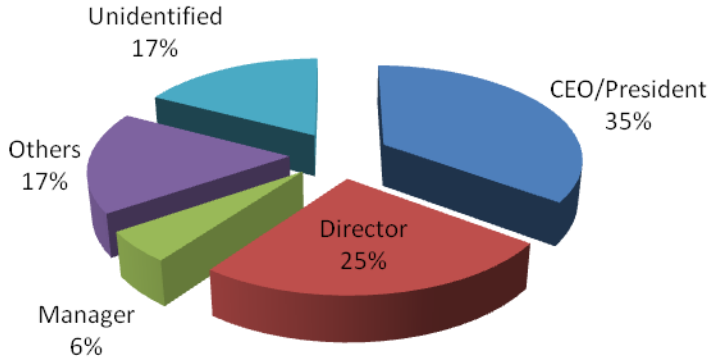

Figure 3.7.1.2: Job Function

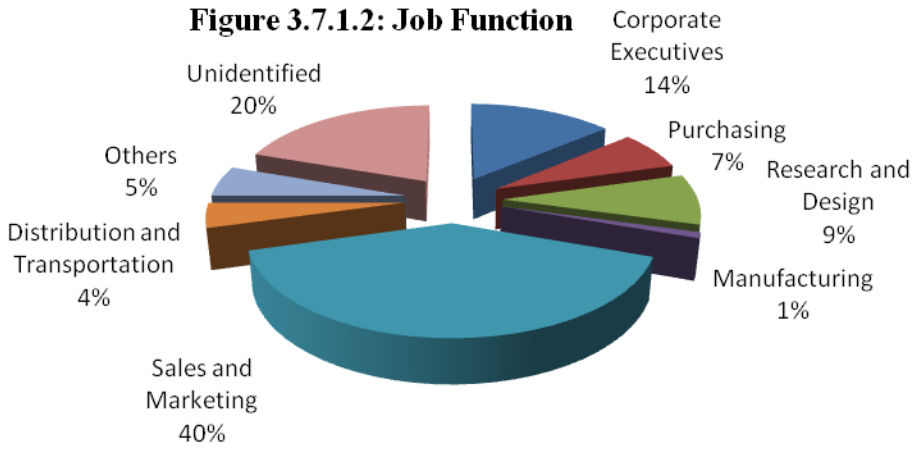

Figure 3.7.1.3: Years at the Organization

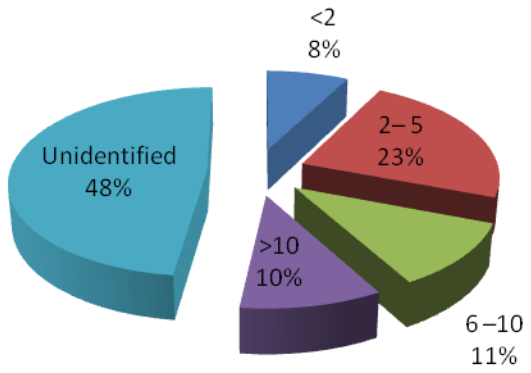

Table 3.7.2: Sample Characteristics of Surveyed Organizations

1	**Number of Employees**	
	<50	10.1%
	51-100	10.6%
	101-250	13.9%
	251-500	23.6%
	501-1000	14.9%
	>1000	21.2%
	Unidentified	5.8%
2	**Annual Scales ($ millions)**	
	<5	8.2%
	5-10	6.7%
	10-25	11.5%
	25-50	8.7%
	50-100	12.0%
	>100	44.2%
	Unidentified	8.7%
3	**Percentage of Electronic Transactions with Customers**	
	<10%	10.1%
	10% - 30%	6.7%
	30% - 50%	10.6%
	50% -80%	17.3%
	>80%	42.8%
	Unidentified	12.5%
4	**Supply Chain Implementation**	
	Yes	38.4%
	No	53.4%
	Unidentified	8.2%
5	**Percentage of Electronic Transactions with Suppliers**	
	<10%	12.5%
	10% - 30%	17.3%
	30% - 50%	18.3%
	50% -80%	19.7%
	>80%	17.3%
	Unidentified	14.9%
6	**Location of Country**	
	North America	16.8%
	China	83.2%
7	**Tier**	
	First-tier Supplier	71.2%
	Second-tier Supplier	28.8%

Figure 3.7.2.1: Number of Employees

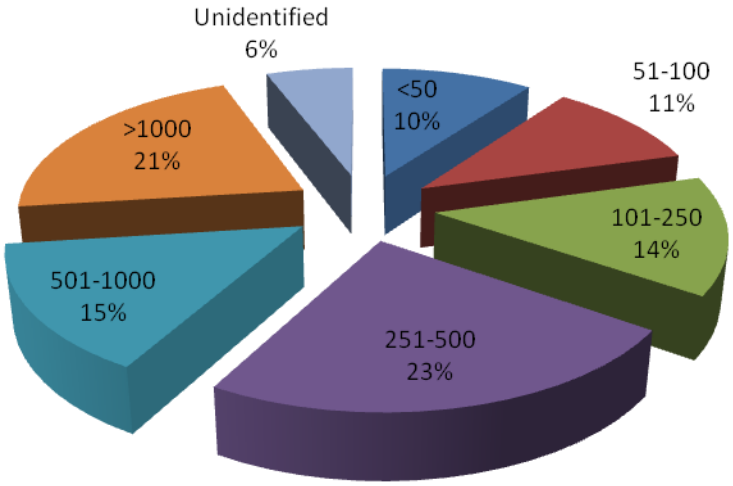

Figure 3.7.2.2: Annual Sales ($ millon)

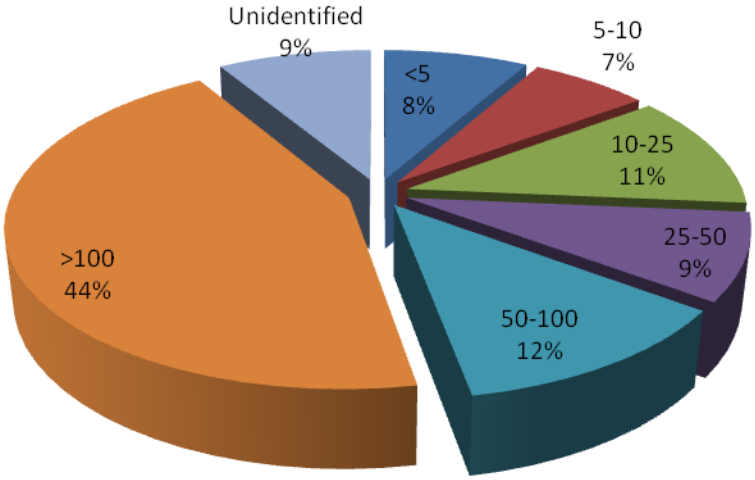

Figure 3.7.2.3: Supply Chain Implementation

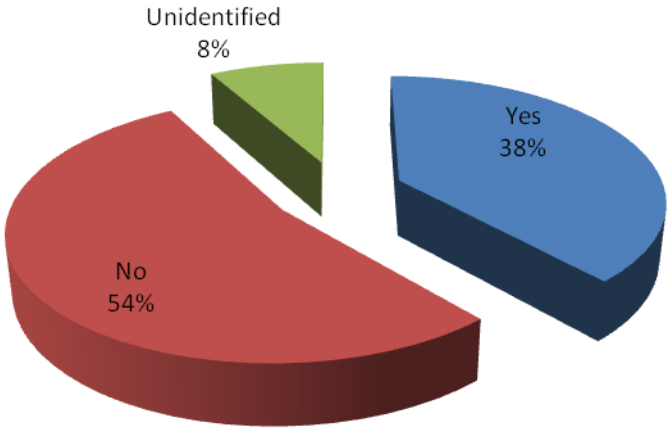

Figure: 3.7.2.4: Percentage of Electronic Transactions with Customers

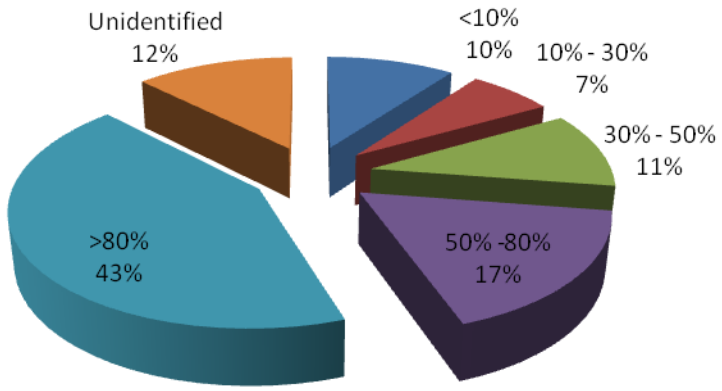

Figure 3.7.2.5: Percentage of Electronic Transactions with Suppliers

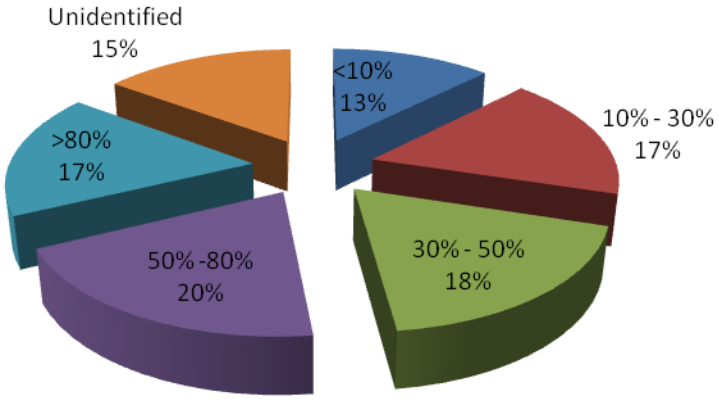

Figure 3.7.2.6: Location of Country

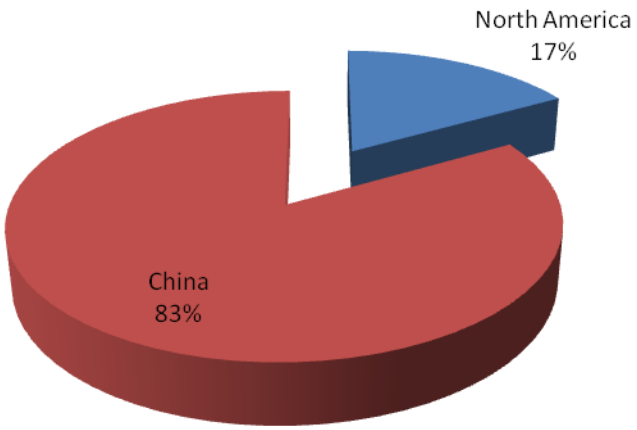

Figure 3.7.2.7: Tier