An International Study on Supply Chain Restructuring: A Coordination Theory Approach

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Abstract

The current dynamic business environment demands firms to reconsider the efficiency and effectiveness of their supply chains. As a result, firms constantly make efforts to restructure their supply chains. The concept of supply chain restructuring appeared in mid 1990s, but the past studies did not provide what antecedents of supply chain restructuring are and how it helps firms to increase their organizational and technological integration. This study, based on coordination theory, construct a research framework that shows causal links among coordination with suppliers, information sharing with suppliers, supply chain restructuring, and technological and organizational integration. Empirical results from International Manufacturing Strategy Survey IV confirm the coordination theory that coordination mechanisms and information sharing with suppliers drive supply chain restructuring, which enhances organizational integration. Theoretical and managerial implications are discussed as well.
1. Introduction

Fundamental changes in external environments call for fundamental changes in internal environments (Hammer & Champy 2003). With the external environment becoming more dynamic, organizations face uncertainty and attempt to adapt to changes in consumer behaviors. Advancement of technology, widely available products, higher income, and greater access to information have empowered consumers to look for better products and services, making the competition in markets more intense. This dynamic nature of customer necessitates firms to assess not only the current customers, but also the driving factors behind the changing perception of customers’ future proposition (Flint et al. 1997).

When it comes to the supply chain, firms have responded to these dynamics in two ways. The first of these reactions has focused on reinforcing price competition and eliminating waste from all possible sources, from production to delivery (Womack et al., 1990; Womack and Jones, 1996). The lean paradigm modeled after Toyota’s success in the 1980s and the early 1990s spurred the implementation of operational improvement programs such as Six Sigma and Total Quality Management. The second category of response to the dynamic environment has been to emphasize agility in the supply chain (Goldman et al. 1995; Mason-Jones et al. 2000). Agile supply chains stress flexibly and rapidly responding to the unpredictable demand (Christopher, 2000). Scholars and practitioners encourage firms to apply lean supply chains in a relatively stable market, and agile supply chains in a volatile market with high product variety (Fisher, 1997; Lee 2002; Vonderembse et al., 2007).
Efficiency-oriented and supply-central approach poses considerable limitations on the supply chain in three ways. First, efficiency oriented supply chains have only a limited room for improvement. Skinner (1986) points out that increasing productivity and removing wasteful elements in labor and operations areas will not create the greatest value for a company. According to Skinner, direct labor costs hardly account for 10% of total sales. In contrast, sales could drastically decrease more than 20% of total revenue (Skinner 1986). Therefore, rather than excessively focusing on increasing efficiency in labor and production systems, firms should direct their attention to the structure and technology of the whole production. In the same vein, Porter (1996) warns that a cost-efficiency approach leads firms to concentrate on the short-term profitability instead of the long-term profitability (Porter 1996).

Second, efficiency-led supply chains may fail to synchronize their processes with customer changes. The crises that companies like Marks and Spencer, Sainbury, and Motorola faced in the late 1990s and early 2000s stemmed not from an inefficient supply chain but from their failure to promptly respond to the shift in the customer base (Finkelstein 2003; Walters 2006). Motorola’s market share in the total U.S. cell phone industry plummeted from 60% in 1994 to 31% in 1998 and then to 16% in 2002 (Finkelstein 2003). This result originated from their slow adaptation to digital technologies. Motorola failed to see the heavy customer demand for digital technology, and even surprisingly licensed the digital patents that they had to Nokia and Ericsson. These examples serve to demonstrate the need for scanning customer changes as well as making business processes efficient. As Lee (2004) indicated, high-speed, low-cost supply chains are vulnerable to unanticipated shifts in demand and supply (Lee, 2004).
The third limitation that efficient supply chains carry is the fact that efficiency-led management hinders firms from cultivating innovation-friendly culture, a critical advantage in the dynamic business environment. The recent decision by 3M to divest the Six Sigma program in order to revive its previous innovative culture speaks loud for this point (Hindo 2007). Since the implementation of Six Sigma, 3M could streamline its manufacturing processes, fulfilling the expectation of the former CEO, McNerney. However, it also brought a downside of efficiency-oriented management philosophy, which is discouraging innovation-provoking culture. Some argue that Six Sigma inculcated employees with a mindset that displaced innovative thinking. When leadership changed from McNerney to Buckley, the incoming CEO saw Six Sigma as the main reason that dispirited innovative way of thinking and risk-taking culture. He made a decision to “shift the corporate mandate back to sales growth, eased up on Six Sigma, and is looking for more innovative breakthroughs on his watch (Hindo 2007).” As shown in this example, management program for efficiency tends to suppress innovation-encouraging culture.

As a result, firms constantly seek to make their supply chain responsible to customer demands by restructuring their supply chains. They aim to produce a variety of products with high quality, short life cycles, and low prices. To remain viable in a competitive market landscape, companies must equip themselves with the capacity to quickly respond to various changes (flexibility, time-based competition), to continuously create innovative products and processes (innovation), and to offer superior quality products (quality).
The concept of supply chain restructuring appeared in mid 1990s and early 2000s (Kopczak 1997), but the past studies did not provide what antecedents of supply chain restructuring are and how it helps firms to increase their organizational and technological integration. This study, based on coordination theory, construct a research framework that shows causal links among coordination with suppliers, information sharing with suppliers, supply chain restructuring, and technological and organizational integration. Empirical results from International Manufacturing Strategy Survey IV confirm the coordination theory that coordination mechanisms and information sharing with suppliers drive supply chain restructuring, which enhances organizational integration. Theoretical and managerial implications are discussed as well.

2. Research Framework

2.1. General Framework

Figure 1 presents the research framework for this study. Coordination theory suggests that the coordination mechanism is set to meet a set of goals. In a producer and customer relationship, firms increasingly prefer make-to-order to make-to-stock method because make-to-order eliminates inventories and work-in-process materials. This just-in-time method, one of production method is being adopted to meet the goal to make production and delivery process lean (Schonberger 1986; Womack & Jones 2003). However, firms that deal with functional products and competes on price may focus on using massive make-to-stock method. Firms set goals and accordingly choose appropriate coordination mechanisms. To meet their goals, entities such as firms or individuals choose or devise appropriate coordination mechanisms and implement them.
The employment of certain coordination mechanisms results in restructuring of
the existing structures. For instance, Malone and Crowston (1994) understand usability as
a type of dependencies between producer and customer. Usability means that products
that a producer manufactures must be usable by consumers. Some mechanisms that deal
with this dependency are standardization, communication with users, and participatory
design. Participatory design, in particular, indicates that producers and customers actively
take part in design of products from its early stage. Concurrent engineering can be
understood as a form of participatory design. The change of coordination mechanism
from standardization to participatory design leads firms to considering product design
from its early stage and likely alters product architecture and production culture from
vertical communication to horizontal communication.

Another example is Wal-Mart’s inventory management method. Wal-Mart
adopted the coordination mechanism that its suppliers have a direct access to point-of-
sale data and manage their own inventories on the shelves in Wal-Mart (Lewis &
Talalayevsky 1997). This adoption demanded a flatter distribution structure through
disintermediation between Wal-Mart and Manufacturer, a form of restructuring that
integrated distribution with sales systems. In other words, change in coordination
mechanism brought restructuring in supply chain.
Kopczak (2005) defines supply chain restructuring as “significant changes in supply chain structure” (p. 228) that includes (1) change in the warehouse structure (number of tiers, number of warehouses, substitution of direct shipment for warehousing), (2) reassignment of tasks between tiers, (3) redistribution of inventory between tiers (e.g., centralized versus distributed stocking), (4) significant changes in transportation network, mode, consolidation points, (5) significant reassignment of roles and responsibilities among supply chain entities. These changes facilitate firms to integrate its internal manufacturing practices from technology to new product development.

2.2. Research Model

Figure 2 portrays the research framework for a responsive supply chain (RSC) from a focal company’s standpoint. In accordance with general research framework, coordination theory is applied in the research model. Coordination in supply chain is driven by a set of goals, namely, responsive product strategy, and results in supply chain restructuring. Information sharing in supply chain plays a key role in fostering coordination in supply chain and restructuring the supply chain. Supply chain restructuring, in turn, leads firms to implement integrative product development programs.
Figure 2. Research Model for Responsive Supply Chain
At the coordination level, strategic goals drive a firm to adopt coordinate mechanisms with suppliers and customers in order to achieve the goals to be more responsive to customers’ requirements. Three components play important roles at this coordination level. The first is the information sharing in the supply chain. Time, geographical distances, and fast changing competitive landscapes urge firms to acquire efficient information systems in delivering products from demand management to order fulfillment. Information systems connect a manufacturing firm with its suppliers and customers especially through various information systems such as the internet or electronic data interchanges. Coordinating supply chain practices, the second construct at coordination level has received increasing attention because it is being recognized as a potential competitive weapon, as shown in the cases of Toyota, Dell and WalMart. Efficient product development exhibits concurrent engineering that engages the major stakeholders of product design with marketing, engineering, and manufacturing. Involving suppliers and customers from an early stage of the product design significantly decreases ambiguity and complexity, and enhances information sharing and adept product competence (Ellram et al., 2007; Koufteros et al., 2001).

At the intra-organization level, a well-coordinated responsive chain enables a firm to integrate design and manufacturing at organizational and technological level, aiming to enhance agility in a dynamic market. An integrative product development program executed in a firm would make it easier for firms to implement pull production system promptly.
2.3. Literature Review and Constructs Definitions

2.3.1. Competitive market environment

Champlin and Olson (1999) characterize the current economic environment into three revolutionary change forces: intense global competition, rapid technological advancements, and innovative managerial practices (Champlin & Olson 1999). Intense competitions triggered by development of technology, proliferation of democracy and market economy, and increased economic power of consumers have made the world flatter than ever before, resulting in intense competition and ever-changing dynamics in market place (Friedman 2005). Since the shift from an industrial to post-industrial environment, notable elements have been identified for this change such as high degrees of turbulent change, concurrent competition on multiple criteria, competitiveness, information overload, greater reliance on information technology, shortened new product development cycle, and increasing uncertainty (Nahm et al. 2004; De Meyer 1992; Anderson 2004). This phenomenon called globalization has brought fundamental changes in dimensions of competitions in the market.

One of strong sources of turbulence in the external environment is market competition. Competition intensifies as globalization makes barriers of market entry lower, and invites more competitors from abroad to the market. Foreign competition has had a significant impact on domestic markets. Competitors bring various and unfamiliar capabilities and practices into the industry, and can add more unpredictability to the market environment. As a result, firms are under pressure to enhance productivity and efficiency, and to decrease the profit margin. In the meantime, competition offers opportunities for firms to acquire comparative advantage (Driffield et al. 2002). Firms that successfully face the competition will be prepared to compete with other companies.
2.3.2. Responsive Product Strategy

One of the problems that manufacturing management faces is that the manufacturing function is not taken seriously in forming and implementing business strategy. This is partly because corporate strategy is developed as the sum of each functional strategy, and also partly because the manufacturing management does not see the link to realize strategic role of manufacturing in marketing and corporate strategy. To resolve this issue, Hill (2000) presented five steps to link manufacturing to marketing when developing a corporate development strategy: “1) define corporate objectives, 2) determine marketing strategies to meet these objectives, 3) assess how different products qualify in their respective markets and win orders against competitors, 4) establish the appropriate process to manufacture these products (process choice), and 5) provide the manufacturing infrastructure to support production.” His seminal work is the presentation of qualifying and order-winning criteria. Hill defined qualifiers as “criteria that a company must meet for a customer to even consider it as a possible supplier,” and order-winners as “criteria that win the order.”

The essential role of these criteria is facilitating the communication between manufacturing and marketing/corporate strategy. In accordance with business objectives, marketing will conduct a sample research, provide future forecasts on sales volume for a certain period, and identify qualifiers and order winners. To derive clear and accurate information, marketing and accounting departments must then ask information about the actual cost of the manufacturing process. After debates and research, qualifiers and winners can be created, and the appropriate manufacturing strategy formulated. Under market dynamism, firms need to proactively deal with challenges by acquiring innovation, manufacturing flexibility, speed, and quality.
2.3.3. Information sharing in supply chain

Information sharing in supply chain refers to the way in which a manufacturer uses information technology to enhance communication with suppliers and customers in the areas such as order tracking, knowledge management, and collaboration. The development and proliferation of IT tools made it possible to incorporate supply chains into business processes, facilitating inter-organizational coordination.

The past 40 years of history has witnessed the rapid growth of information technology (IT) and its ever-increasing role in business (Keen 1991; Cline & Guynes 2001). In early days, manufacturing firms utilized IT mainly on an individual transaction basis, but now, it is used as a strategic weapon that not only designs the competitive manufacturing system but also manages supply chains (Coates 2000; Tan & Uijttenbrock 1997). Firms have striven to incorporate manufacturing functions and business strategies into the information system (Das et al. 1991). A successful integration of IT goes beyond assisting the common manufacturing function; it enables manufacturing firms to achieve product standardization, manufacturing flexibility, and supply chain integration that ultimately leads to a competitive advantage (Coates, 2000; Lee & Whang, 2000; Teo & King, 1997). The US Department of Energy (1997), in the report of the Next Generation Manufacturing Project, describes information systems as imperative to attaining the competitive advantage of reducing the product cost, process development cost, time to market, and risks in innovation.

The emergence of a commercial Radio Frequency Identification Device (RFID) about five years ago is an illustrative example of how information sharing can transform business practices and enhance efficiency and effectiveness. The emergence of RFID in the early 2000s led to sweeping changes in the way that organizations track goods in their supply
chains. Large organizations, such as Wal-Mart, Proctor & Gamble, Gillette, and HP, have complex supply chains, and have adopted RFID; this has led to a ripple effect to their suppliers, and raised their interest in this technology.

RFID demonstrates how information sharing among the constituents in a supply chain could increase the supply chain visibility. A firm having supply chain visibility can reduce bottlenecks, and out-of-stock or low inventory levels in its supply chain. Supply chain visibility significantly lowers the uncertainty of goods, and enables firms to efficiently track and manage the flow of inventory or products (Kinsella 2003). As a result, the adoption of RFID enhances transparency in supply chains, and decreases bullwhip effects. For instance, Wal-Mart reduced its inventory stocks by 10 percent after adopting RFID (Kinsella 2003). RFID helped it to align and make information from the product distribution channels available to its suppliers so that they could reduce safety stock inventory, product shipments, inventory obsolescence, material handling costs, and stock-outs (Kuchinska 2005). Furthermore, rich information exchange among partners in a supply chain makes it easier for firms to coordinate production and distribution, outsourcing functions and services, and partner with suppliers and (Straub et al. 2004). The accumulated information helps firms to analyze the performance of suppliers, scrutinize the bottlenecks, and identify portions that should be improved.

The theory of transaction cost explains the underlying rationale behind the implementation of IT tools-decreasing the coordinating costs of supply chain through IT tools. Malone and Laubacher (1998) report that IT provides firms with capabilities that migrate transaction costs. The key capabilities offered by IT are distant transaction, distant negotiation, and distant monitoring.
Information sharing can take a variety of forms. This research circumscribes it to areas such as data analysis, access to catalogues, order management, order and tracking management, knowledge management, and collaboration support services with suppliers and customers.

2.3.4. Coordination in Supply Chain

Supply chains are complex mechanisms based on a particular product they are designed to support. In recent decades, the supply chain has received increasing attention from both researchers and practitioners. Beginning in the 1980s and the early 1990s, researchers and practitioners focused on analyzing the general principles of supply chain management as an offshoot of an interest in Toyota’s successful application of the “lean” paradigm (Womack & Jones 2003; Womack et al. 1990). The core concept of lean supply chains is to eliminate waste from the entire supply chain process, from production to delivery (Womack et al., 1990).

Starting in the late 1990s, researchers realized that supply chains strategies worked best when they were market-specific, and that certain types of supply chains fit better in an “agile” paradigm. Agile supply chains are able to respond flexibly to a rapidly changing market (Mason-Jones et al., 2000). Over the years, much effort was focused on finding the right supply chain for the right product, industry, and product life cycle. Fisher (1997), for example, suggested a typology of products/supply chains, and emphasized that a mismatch between the product type and the supply chain strategy could result in negative performance consequences.

More recently, collaborative supply chains have emerged as an implementation choice for firms dealing with rapid technological changes and hyper-competition. Today,
industries and researchers widely recognize that supply chain collaboration brings transparency, efficiency, and synergy to a supply chain (Holweg et al. 2005).

Manufacturers face dependencies with their customers and suppliers. From product design to delivery, many issues demand close attention to managing these dependencies. Manufacturers, suppliers, and customers share their goals in that they want products that satisfy consumers. Coordination serves to meet these goals of participants through coordination mechanisms. Now, there could be a variety of coordination mechanisms. In a demand chain context, this research chooses to use sharing inventory knowledge, sharing production planning, and using collaborative planning, forecasting, and replenishment (CPFR) as coordination mechanisms. In the mean time, this study focuses on vendor managed inventory, CPFR, and physical integration of the supplier into the plant as coordination mechanisms. Coordination in a supply chain is an amorphous term. This study defines it as the practice of managing dependencies among entities and resources in the supply chain through planning decisions and sharing demand and delivery knowledge among the hub-manufacturer, suppliers, and customers.

More specifically, coordination in the supply chain contains two parts in this study: coordination with customers and coordination with suppliers. Coordination in the supply chain mainly concerns planning decisions and flow of good with strategic customers and suppliers. Coordination with customers means in this research that a focal company employs managing dependencies with customers through sharing inventory knowledge, production planning decisions, and demand forecast knowledge and through the usage of collaborative planning, forecasting and replenishment (CPFR). These
methods intend to enhance active collaboration with strategic customers in response to competitive and volatile environment.

Another aspect of coordination in the supply chain comes from downstream of the supply chain: coordination with strategic suppliers. In planning decisions and flow of goods with key suppliers, a focal company shifts its supply chain coordination mechanisms from control and command to knowledge sharing and collaboration. Examples are vendor managed inventory, CPFR, and integration with the plant.

2.3.5. Supply Chain Restructuring

The concept of supply chain restructuring appeared in several researcher’s works and the research is still in progress (Kopczak 1997; Croom 2001; Grant 2005; van Hoek et al. 1999). The most relevant study to supply chain restructuring appeared in Kopczak (1997). She introduced six types of supply chain restructuring: (1) faster modes, decreased cycle times, more direct shipment; (2) transportation route/LSP consolidation; (3) centralization of inventory/elimination of stocking points; (4) substitution of merge centers or consolidation/deconsolidation points for warehouses; (5) addition of a regional warehouse or a warehouse for a particular customer; (6) reassignment of roles and responsibilities among supply chain entities. Depending on the perspective, supply chain restructuring could be used in a variety of settings. In this research, supply chain restructuring refers to the extent of implementing action programs that will bring up significant changes in the supply chains. Restructuring in supply chain includes the suppliers’ portfolio, the supplier development, and the coordination of flow of goods.

Supply chain restructuring research provides the means to make a firm more market-responsive, and to reduce the inventory lead time. This has happened
substantively in Europe with the launch of the European Union that integrated many different economies regions into one (Kopczak, 1997). The development of technology enabled firms to eliminate unnecessary delays associated with administrative works, and helped them to reallocate their supply chains in a more decentralized way, and relegate responsibilities to suppliers and distributors. After conducting a survey on 26 partnerships in the computer industry, Kopczak identified at least 6 types of supply chains: (1) use of faster modes of transportation (air freight, express delivery), and more direct shipment; (2) consolidation of transportation routes, sometimes accompanied by relocation of consolidation/deconsolidation points; (3) elimination of local inventory stocking points, and centralization of inventories; (4) substitution of consolidation/deconsolidation points for warehouses as mixing points; (5) addition of a regional warehouse, or of a warehouse for a particular customer; (6) reassignment of roles and responsibilities among supply chain entities.

The possibility of supply chain restructuring also increases as the market becomes more volatile and as competitors rapidly changes their strategy. It is reported that outsourcing is one of the strong drivers of supply chain restructuring. Firms that implement market responsive product strategy will face the question of how to approach supply chain restructuring.

2.3.6. Integrative product development programs

Integrative product development programs mean implementing action programs that are designed to increase the product development performance by integration manufacturing, product development, and technology together (Bralla, 1986; Brown &
Eisenhardt, 1995; Gerwin & Barrowman, 2002; Koufteros et al., 2002). Platform design, quality function deployment, design for manufacturing, teamwork, job rotation, and co-location and the implementation of CAD-CAM are examples of integrative product development programs. Research on this topic has received significant attention over the years because of its strategic importance in position.

In a turbulent market, volatile customer demands drive firms to find ways to deal with these dynamics. One method of tackling this kind of uncertainty is to take preventive actions. Proactive actions begin with the product and process design stage. By designing modularized and postponement-friendly products and processes, firms can cope more promptly with the uncertainty. Supporting these integrated design practices, design methodologies have been developed to propose design principles.

One of these design methodologies is Design for Manufacture (DFM), which is a managerial approach to address manufacturing issues from the product design stage (Adler 1995). DFM emphasizes process cost reduction and the simultaneous improvement of production processes. While conventional design methods focus on sequential product development, DFM highlights a more concurrent and integrated design process. This integrated process intends to modify and restructure conventional design methods, creating and inserting manufacturing integration checkpoints into the new product development process. These checkpoints, by sharing information earlier across the new product impacted areas, can help reduce the component and material costs, and the lead time from product design to full scale production (Adler 1995). Table 1 presents the definition of the constructs and supporting literature.
<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Competitive market environment</td>
<td>Degree of turbulence in a market on account of intensity of competition and number of competitors</td>
<td>Emery &amp; Trist 1965; Vonderembse et al. 1997; Cyert &amp; March 2007; Milliken 1987</td>
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<tr>
<td>Responsive Product Strategy</td>
<td>A set of order winners that aim to increase market responsiveness by mirroring customers’ needs for innovative product features, wider product range and frequent products delivery</td>
<td>Calori &amp; Ardisson, 1988; Porter, 1979; Porter, 1996; Hill, 2000; Hayes et. al, 2005</td>
</tr>
<tr>
<td>Information Sharing in Supply Chain</td>
<td>Information sharing in supply chain refers to the usage of information technology by a manufacturer with the purpose of enhancing communication with suppliers and customers in areas such as order tracking, knowledge management, and collaboration services.</td>
<td>Cline &amp; Guynes, 2001; Coates, 2000; Da Silveira et al. 2001; Goldman et al., 1995; Gunasekaran, 1998; Hoek et al., 2001; Keen, 1991; Teo &amp; King, 1997</td>
</tr>
<tr>
<td>Coordination in Supply Chain</td>
<td>The mechanisms to manage dependencies among manufacturers and suppliers and customers in sharing planning decisions, demand, and delivery knowledge in order to increase collaboration</td>
<td>(Barratt 2004); (Chan et al. 2004); Holweg et al., 2005; Malone &amp; Crowston 1994; Olson et al. 2001; Lewis &amp; Talalayevsky 1997</td>
</tr>
<tr>
<td>Supply Chain Restructuring</td>
<td>The extent of implementing action programs that will bring significant changes in the supply chain, including the suppliers’/customers’ portfolio, the supplier/customer development, and the coordination of flow of goods.</td>
<td>Camm et al. 1997; Christman 1999;  van Hoek et al. 1999; Voordijk 1999; Croon 2001; Grant 2005; Kopczak 2005</td>
</tr>
<tr>
<td>Integrative Product Development</td>
<td>The degree of implementing action programs that were designed to increase product development performance through integration among manufacturing, product development, and technology.</td>
<td>Bralla, 1986; Brown &amp; Eisenhardt, 1995; Gerwin &amp; Barrowman, 2002; Koufteros et al., 2002; Hong 2000; Hong et al. 2005</td>
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2.4. Hypothesis Development

2.4.1. Research Hypothesis 1

According to Venkatraman and Prescott (Venkatraman & Prescott 1990), scholars have found a strong relationship between environment and strategy, and Venkatraman and Prescott empirically reported that environment-strategy alignment has a positive impact on performance. Since Skinner’s seminal work in 1969, studies have found the significance of aligning manufacturing strategy with business strategies. Organizational theory suggests that firm’s strategy influenced by environments affects firm structure and performance.

The turbulent external environment for manufacturing firms presents the challenges of producing a variety of products with high quality, shorter life cycles, and low prices. To remain competitive in the market, manufacturing company must equip itself with the capability to quickly respond to various changes (flexibility, time-based competition), to continuously innovate products and processes (innovation), and to offer superior quality products (quality).

The task of the management is to match “the performance of an operation’s resources with the requirements of its markets” (Slack and Lewis, 2003), and this is called “fit”. However, manufacturing strategy goes beyond static decision making. To acquire or maintain a competitive advantage in a constantly changing environment, it needs to have a dynamic adjustment process. In other words, manufacturing strategy continues to evolve by adjusting its structural and infrastructural processes to the changing market reality (Hill, 2000; Slack and Lewis, 2003). Contingency theory
suggests that firms have to make the fit between the environment and its strategy (Hofer 1975; Van de Ven & Drazin 1984). Therefore, it is hypothesized that:

**Hypothesis 1:** Firms operating in a competitive market environment will formulate a higher level of responsive product strategy than firms operating in a less competitive market environment.

### 2.4.2. Research Hypothesis 2

Responsive product strategy comprises of order winners that the manufacturing firm pursues in order to compress time to market and to increase customization capability. Examples of responsive product strategies are increasing product customization ability, increasing mix flexibility, reducing time to market, and making the product more innovative. According to the organization’s culture and strategic orientation theory, when a firm pursues this strategic orientation, it results in a pattern that reflects the strategic orientation and organization culture (Nahm et al., 2004; Porter, 1980; Schein, 1996). Having the goals of increasing product variety and innovativeness, and of delivering new products frequently would urge firms to increase the level of information sharing in its supply chain, because they would have to assess the current product development situation as accurately as possible. Thus, to implement RPS, it is essential for firms to communicate relevant information about customer demands and supplier’s status throughout the supply chain. In addition, to increase market responsiveness, firms need to frequently change information among suppliers, manufacturers, and customers.

Another aspect of RPS is coordination. Offering innovative products, making frequent new product delivery, and shortening product deliver time take coordination with suppliers and customers. A firm needs to know what products are in high demand
and what are not. It should pay close attention to suppliers so that they could make
costant improvement and innovation on product components. Moreover, the changes in
demand information that happens on monthly or daily basis demand firms to maintain a
close trust relationship with customers and suppliers. Thus, implementing RPS requires a
great deal of coordination with suppliers and customers either in the form of information
sharing or practices (Bharadwaj et al. 2007; Kulp et al. 2004; Gurbaxani & Whang 1991;
Cline & Guynes 2001; Argyres 1999). Therefore, it is hypothesized that:

**Hypothesis 2a:** The higher the extent of responsive product strategy a firm
implements, the higher level of information sharing in the supply chain the firm will
achieve.

**Hypothesis 2b:** The higher the extent of responsive product strategy a firm
implements, the higher level of coordination practices in the supply chain the firm will
achieve.

2.4.3. **Research Hypothesis 3**

Gerwin (1987) emphasized the importance of flexibility that increases market
responsiveness. He stated that the expected intensification of market instability will
become the most important dimension of competition. In a changing competitive
environment, there is a need to develop organizations and facilities that are considerably
more flexible and responsive than existing ones. Sharing knowledge aids firms to move
forward to this goal. In particular, information on operations flows and customer trends
should be seamlessly shared in the supply chain. The flow of information throughout the
supply chains can also increase market responsiveness by enhancing the level of
communication among employees. Increasingly, information technology has been
recognized as an essential enabler that facilitates the communication in the supply chain (Da Silveira et al. 2001; Vickery et al. 1999; Argyres 1999; Banker & Bardham 2006).

Information processing theory suggests that the usage of information technology helps firms to lower the cost involved in processing information (i.e., the cost of sending and receiving messages between actors) and to reduce the costs of processing information (i.e., the costs of sending organization’s structure more efficient than others) (Argyres, 1999).

Further, coordination theory suggests that the advent of information technology lowered the cost of coordination significantly (Malone & Crowston 1994; Olson et al. 2001). For example, Wal-Mart mandated its top 100 suppliers to implement radio frequency identification (Kinsella 2003). This adoption made the coordination of supply chain activities much easier than before. In addition, Wal-Mart could now manage the inventory movement and probe changes in customer demands in real time. Therefore, it is hypothesized,

**Hypothesis 3a:** The higher the level of information sharing in the supply chain a firm implements, the higher the level of coordination in the supply chain the firm will achieve.

Information sharing enabled by the adoption of information technology further brings about restructuring the ways human organizations and markets work by significantly reducing costs involved in specific type of coordination. Malone and Crowston (1994) predict three levels of effects. Just as a car replaced carriages and horse-riding, so does information technology replace manual works among entities. This
substitution triggers amplification of the usage of information technology and restructuring of the existing configuration. The restructuring can take various formats such as fewer coordination levels, smaller size, more centralized or decentralized structure (Malone & Crowston 1994; Gurbaxani & Whang 1991).

When it comes to the impact of information sharing on supply chain, information technology can bring many changes. First of all, the alteration in coordination mechanisms changes dependencies and relationships among activities, tasks, and actors. Second, information sharing through information technology adoption makes supply chain structure be simpler in greater scale. The decision making process could become either centralized or decentralized.

Moreover, increased information sharing produces a network effect. Suppliers, distributors, and manufacturers know how things are being progressed in the supply chain, and they can thus collaborate with each other. It also helps firms to spot symptoms of manufacturing or delivery delay, which informs them of possible restructuring opportunities at many intervals. Information sharing will eventually help firms to consider supply chain restructuring in terms of planning the flow of goods, and the supplier development.

**Hypothesis 3b**: The higher the level of information sharing in the supply chain a firm implements, the higher the level of supply chain restructuring the firm will achieve.

### 2.4.4. Research Hypothesis 4

Coordination theory suggests that implementing a certain coordination mechanism will entail restructuring between entities involved in the coordination
Coordination is adopted when there are dependencies or interrelationship among entities. For example, in the context of the supply chain, Malone and Crowston (1994) understand usability as a type of dependencies between producer and customer. Usability means that products that a producer manufactures must be usable by consumers. Some mechanisms that deal with this dependency are standardization, communication with users, and participatory design. Participatory design, in particular, indicates that producers and customers actively take part in design of products from its early stage. Concurrent engineering can be understood as a form of participatory design. The change of coordination mechanism from standardization to participatory design leads firms to considering product design from its early stage and likely alters product architecture and production culture from vertical communication to horizontal communication. Another example is Wal-Mart’s inventory management method. Wal-Mart adopted the coordination mechanism that its suppliers have direct access to the point-of-sale data and manage their own inventories on the shelves in Wal-Mart (Lewis & Talalayevsky 1997). This adoption demanded a flatter distribution structure through disintermediation between Wal-Mart and Manufacturer, a form of restructuring that integrated distribution with sales systems.

**Hypothesis 4**: The higher the level of coordination in the supply chain a firm implements, the higher the level of supply chain restructuring the firm will achieve.

### 2.4.5. Research Hypothesis 5

Several theoretical perspectives also lay the rationale for integrated product design. Brown & Eisenhardt (1995) surveyed product development literature, and framed
them into three perspectives: rational plan, communication web, and disciplined problem solving. The first perspective, product development as rational plan, believes that rational and careful planning precedes successful product development and launch. The plan starts from the internal organization such as marketing and manufacturing, and the strength of the internal organization strongly correlates with product success (Zirger & Maidique 1990). R&D involvement and predevelopment planning exemplify the rational planning.

The second theoretical perspective sees integrative product development as a communication web. The product development process opens a sphere for a variety of people with different expertise to come together, and to communicate their knowledge and perspectives. The key idea behind product development as a communication web is that interconnectedness among team members enhances information flows, which in turn leads them to achieve higher performance.

Collaboration with strategic suppliers and customers increases a firm’s responsiveness to market changes (Holweg et al., 2005). This increased responsiveness is from the fact that supply chain restructuring brings greater customization capability to the supply chain. A hub manufacturer can more flexibly deal with market dynamics when it is supported by its suppliers and customers, thus giving it greater leeway to deal with various changes. For instance, to accommodate a customer’s needs, a firm often has to procure different sets of components and materials from suppliers. From the customers’ standpoint, a firm should know what the customers’ needs and demands are. This information keeps the firm updated about the market situation, and enables it to customize products in the right way at the right time. For instance, Business Week (May,
2008) reports that GM is happy with a $3 billion loss in the first quarter of 2008 because they expected to have greater losses. One of primary reasons is that a major supplier decided to go strike. The supplier strike caused several important plants to come to a halt, causing significant losses, but with the resolution of the strike, the losses ended. This example shows the significant impact a key supplier could have on a company.

Restructuring the supply chain helps a firm to streamline its suppliers and customers. Optimized supply chains make it easier for constituents of the supply chain to share information regarding production process and customer’s wants. Simplified and optimized supply chains also make it easier to integrate product development process from manufacturing to procurement to engineering.

Integrated product design is crucial for firms success in decreasing production errors and selling the right product. This process requires cross-functional integration which means the collaboration from suppliers and customers. Supply chain restructuring makes it clear who the main customers and suppliers are. This identification and clearer target help firms to communicate. Therefore, it is hypothesized that:

*Hypothesis 5*: The higher the level of supply chain restructuring a firm achieves, the higher the integrated product design the firm will achieve.
3. The Research Methods

3.1. Data

In order to examine the research model presented in figure 2.1., empirical evidence was drawn from the International Manufacturing Strategy Survey (IMSS) IV, a worldwide research project involving 761 manufacturing units of 24 countries throughout the Asian Pacific, European, North American, and South American regions. All firms included in the study are considered to be manufacturers according to International SIC (Standard Industrial Classification) code standards. Specific manufacturing industries included: (1) fabricated metal products, (2) machinery and equipment, (3) office, accounting, and computing equipment, (4) electrical machinery, (5) radio, television, and communication equipment, (6) medical, precision, and optical instruments, (7) motor vehicles, trailers, and semi-trailers, (8) other transportation equipment, and (9) other miscellaneous manufactured products. Firms were contacted prior to mailing to assess participation interest. The response rate varied by country, however, all exceeded 25%, which is commonly considered as adequate for a survey method research. The definition of each variable and the relevant literature is illustrated in Table 1.

3.2. Results

The data analysis followed Anderson and Gerbing’s (1988) two-step approach. First, the measures and the measurement model were analyzed. Second, the structural model’s model-data fit was assessed and, as it was found to be adequate, substantive hypotheses H1 through H5 were tested. The instruments used in the large-scale survey are illustrated in Table 2.
Analysis of Moment Structures (AMOS 5) was employed to test the measurement model as it is customary for theoretical model testing (Hair et al., 2006). Hair et al. (2006) recommend the use of one absolute fit index, one incremental, and the chi-squared result as measures for the overall fit of the measurement model. To evaluate the measures the following tests have been taken:

- Reliability – Composite reliability; all above 0.70 except one with 0.65
• Convergent validity - items converge to measure one factor rather than many (single dimension with adequate factor loadings; most above 0.65 except three; for explorative study like this, this is acceptable)

• Discriminant validity - the items form a factor that is different from other variables in the model (Average variance extracted for all constructs are above or near 0.5)

• Predictive validity - variable can predict dependent variable or be predicted by independent variable (all constructs show expected statistical significance (high t value) and adequate size of coefficients).

The resulting model had a good model-to-data fit. Factor loadings, composite reliabilities and average variance extracted are illustrated in Table 2. The fit indices for measurement model, summarized in Table 2, exhibit adequacy of model-to-data fit for chi-square divided by degree of freedom is 2.16 which is less than 3.0 and all of the indices (e.g., GFI, NFI, CFI, AGFI) are greater than 0.94. RMSEA is 0.039, which is significantly less than 0.05 and its 95% confidence interval ranges from 0.033 to 0.045, which is narrow and does not exceed 0.05. The results convey the soundness of the measurement model, warranting the appropriateness of conducting hypothesis testing.
3.3. **Structural Model Results**

Once the measurement model was established, the structural model is tested by applying AMOS. The structural model illustrated in Figure 3 had adequate model-to-data fit. The results present that all hypotheses from H1 through H5 are strongly supported since its corresponding t-values exceed 4.86.

![Structural Model Diagram](image)

**Note:** coefficients are significant at * p<0.001  
Model fit: Chi-square/d.f. 2.42; GFI 0.95; AGFI 0.94; NFI 0.93; CFI 0.96; RMSEA 0.043 (0.037, 0.049).

**Figure 3: Structural Equation Model Results: coefficient (t-values)**

The first hypothesis predicted that the higher the level of competition intensity, the higher the level of responsive product strategy. The impact of competition intensity on responsive product strategy held significant ($\gamma = .33$, $t = 6.24$, $p = 0.00$). This result, almost identical to that in the customer model, indicates the positive relationship between competition intensity and responsive product strategy.
Hypothesis 2a anticipated that a firm with a high level of responsive product strategy would demand it to acquire a higher level of information technology in order to share production, demand data and knowledge management with suppliers. The relationship turned out to be significant ($\beta = .24, t = 5.59, p = 0.00$). The impact lessened in degree compared to 0.33 in the customer model. Firms need to scrutinize how the competitive landscape in the market is changing. It is an imperative task for firms to increase the means of sharing information and knowledge with suppliers. One way is to adopt and implement information systems. The lesser effect on information sharing technology with suppliers may come from the fact that suppliers often cannot afford the financial resources to launch quality information sharing technology. In many cases, however, customers monitor the demand variation and share with the producer more often and consistently by using information technologies.

Hypothesis 2b predicted that a firm with a high level of responsive product strategy would strive to obtain a higher level of coordination with suppliers. Implementing responsive product strategy necessitates a higher level of coordination with suppliers in such areas as inventory knowledge, production planning and demand forecast knowledge and collaborative planning and forecasting. The link turned out to be statistically significant ($\beta = .22, t = 4.86, p = 0.00$). This result contrasts with that from the customer model. The results from the research framework in the customer model did not support this relationship at all. Namely, while responsive product strategy does not have much impact on coordination with customers, it does have a considerable effect on coordination with suppliers. Why would this be the case? One interpretation is that it is easier for manufacturers to control suppliers than customers. Another possible
interpretation is that supplier coordination is recognized as more crucial than customer coordination. In order to implement responsive product strategy, firms need to collaborate with suppliers more than with customers.

Hypothesis 3a predicted that there is a positive relationship between the level of information sharing with suppliers and the level of coordination with suppliers. This relationship proved to be strong ($\beta = .38, t = 7.68, p = 0.00$). Information sharing using technology plays a key role in fostering coordination with suppliers. In the customer model, the coefficient of information sharing with customers on coordination with customers were strongest one (0.68) but in supplier model it is 0.38. Although significant, the coefficient is not as strong as that in the customer model. The reason might be that manufacturers sometimes share information with suppliers through direct contact other than information technology. They invite suppliers and train them and share knowledge and practices together. For example, Toyota actively implements supplier development programs and does not depend on information sharing technology alone in collaborating with suppliers (Langfield-Smith & Greenwood 1998).

Hypothesis 3b predicted that there is a positive relationship between information sharing technology execution and supply chain restructuring. This impact appears significant ($\beta = .28, t = 6.61, p = 0.00$). Information and data drawn from information technology implementation with suppliers helps firms to scrutinize the needs for restructuring the supply chain. Information technology relates strongly to distribution chain restructuring. The impact of information sharing with customers on distribution chain restructuring was 0.47, which is stronger than 0.29. Information sharing technology plays a less important role in promoting supply chain restructuring. One reason lies in the
fact that the supply chain is more stable than the distribution chain. Another reason is that technology has been implemented in the supply chain and it does not drive supply chain restructuring in the same degree as in the case of customers.

Hypothesis 4 posited positive influence of coordination with suppliers on supply chain restructuring. As hypothesized, the relationship appeared significant (β = .42, t = 7.59, p = 0.00). 34 Sharing knowledge on inventory and demand information with suppliers and collaborative efforts with suppliers to plan, forecast and replenish help firms to reconsider supply strategy and increase coordination of planning decisions and flow of goods with suppliers. In comparison to the result from customer model (0.34), this result is much stronger. Notice that the impact is more significant than that of information sharing with suppliers (0.29). In suppliers case, the level of coordinating with suppliers is more important than information sharing with suppliers. In other words, without sharing information in too much detail, a manufacturing firm manages to increase coordination level and foster supply chain restructuring.

Hypothesis 5 presented the causal relationship between supply chain restructuring and Integrative Product Development. This relationship came out very strong (β = .72, t = 13.69, p = 0.00). In an effort to reframe supply chain structure, firms realize the needs to compress product development cycle and broaden the scope of product development integration with other functions. Experience and realization gained from restructuring process lead them to endeavor to integrate production development as many functions as possible. Firms will make every effort to increase product development performance by implementing modularization, platform usage design for manufacturing, quality function deployment, technological integration and so forth. Compared against customer model
(0.43), 0.74 is much bigger than that. Amongst H5a, H5b, and H5c, H5c has the strongest impact. In customer model, H5a was the strongest one, putting more weight on advanced manufacturing technology. However, in supplier model, the integrative product development is far important than advanced manufacturing technology and pull production. Restructuring supply chain results in reconsidering product development process and enlarging the scope of integration from functions to organization to technology.

4. Discussion and Implications

4.1. Theoretical Implications

The primary thesis of this study is that coordination mechanism plays a central role in enhancing supply chain restructuring that fosters organizational and technological integration between manufacturing and product development processes. This research found several interesting theoretical implications.

First, this research found the integral role that coordination plays in the supply chain. Contingency theory suggests that a firm produces better firm growth when environment and strategy are aligned (Hofer 1975; Van de Ven & Drazin 1984). Integral operational practices such as advanced manufacturing technology, pull production, and integrated product development have long been known for increasing market responsiveness. However, it was unclear what is between strategy and operational practices when supply chain comes in. This study posited coordination mechanisms as the linkage that connects strategy to intra-organization level of practices. Supply chain management involves managing dependencies among participants, which requires coordination mechanisms (Malone & Crowston 1994).
Now coordination revolves around three things. Firstly, coordination seeks to meet a set of goals. In other words, goals drive firms to select coordination mechanisms. Goals are expressed as priorities and values that firms seek to achieve. Goals, therefore, can be translated to strategy. Since this study pursued responsive supply chain, the goals reflect strategy that represents increasing market responsiveness. In this context, responsive product strategy was defined as a set of order winners that aim to increase market responsiveness by mirroring customers’ needs for innovative product features, wider product range and frequent products delivery. To reflect responsive supply chain, coordination mechanisms in supply chain were determined as vendor managed inventory, collaboration planning and forecasting and replenishment (CPFR), physical integration of suppliers into plant, and share inventory knowledge.

Another point that coordination suggests is that the adoption of coordination mechanisms leads to restructuring (Malone 1987; Crowston 1997; Lewis & Talalayevsky 1997). Change in coordination entails change in the supply chain. An example is vendor managed inventory system. Proctor and Gamble used to receive orders from Wal-Mart but Wal-Mart adopted VMI as a method to manage inventory dependencies with Proctor and Gamble. This change in coordination mechanism resulted in restructuring in supply chain. Before the change, Wal-Mart had power over suppliers. After the change, however, VMI changed the structure that now Proctor and Gamble suppliers had the control on their products on retailers’ shelves. Likewise, adopting a mechanism changes the existing structure. In the supply chain context, adopting the coordination mechanisms that aim to increase market responsiveness lead to supply chain restructuring.
The other point that coordination theory suggest is that information technology mediates the impact of coordination in supply chain. Information technology helps firms to lower the coordination costs by connecting the participants in the chain to each other at a lower cost ever. A manufacturer can coordinate with suppliers and customers even in overseas via the Internet. The advancements of technology make it easier for firms to choose and implement coordination mechanisms. In addition, information technology aides to bring supply chain restructuring to firms. Implementation of information technology entails restructuring information technology (Grant 2005). The restructuring could result from coordination mechanism and information technology, since technology can eliminate the need of having intermediary layers of management (Croom 2001; van Hoek et al. 1999). Thus, information technology is another important factor that facilitates restructuring in the supply chain.

This study confirms that coordination theoretical framework is valid and strong in the supply chain context. The validity was found in several ways. First of all, breakup analyses in section 4.1 show the research framework can be broke up to three components and test the soundness of coordination mechanisms in the responsive supply chain context. The first component showed that responsive product strategy has a direct impact on market responsiveness. Second component showed that firms put integral practices into action. Third component showed that coordination mechanisms are strongly influencing market responsiveness. For customer model, it turned out that firms are utilizing information technology strongly. RPS does not have a direct impact on coordination with customers, but it influences through information technology. Coordination with customers has a strong influence on distribution chain restructuring.
(i.e., its coefficient is 0.41) and information sharing with customers has also a strong influence on it (0.35). The similar pattern to the results from customer model appeared in the results from supplier model. All the coefficients were significant, showing that coordination mechanisms are working strong. The second way to show the validity of coordination mechanism was to examine the whole research model in section 4.2. In the model, coordination mechanism was proven to be strong in both customer and supplier model. To my best knowledge, this is the first empirical study that applied coordination theory to the supply chain level.

Second, this research extended coordination theory to its application level by examining the influence of restructuring, a result of coordination. Although coordination theory suggests the sequential links among goals, coordination mechanism and restructuring, it does not mention much about the impact of restructuring. This study attempted to explicate the impact of restructuring from a manufacturing perspective. Supply chain restructuring is the link that connects supply chain activities to internal operational practices. Supply chain restructuring means significant reassignment roles and responsibilities among supply chain entities such as readjustment of tasks between tiers, redistribution of inventory between tiers, and warehouse structure changes (Kopczak 2005). The changes in supply chain structure bring a significant change to internal operational practices of a manufacturing firm.

For example, Christman (1999) reported that EMI Music Distribution (EMD) invested $10 million in an attempt to restructure its supply chain in 1998 when it found inefficiency of having manufacturing plant and distribution warehouse separately. Before restructuring, products had to be shipped from manufacturing plant to distribution
warehouse for shipment to customers. The buildings were located in Jacksonville, 100 yard apart. EMD found that this production and distribution approach increased inventory level and slowed down market responsiveness. Thus, EMD decided to integrate distribution center into the manufacturing building and automate shipment process by adopting ‘automated pick, pack, and ship equipment.’ Richard Cottrell, CEO of EMD, said that the integration of automated shipment equipment eliminated the process of transferring products to distribution center via trucks while it cut down inventory level and shortened response time for catalog titles. Furthermore, this restructuring helped EMD to develop specialty labels and flexibility to satisfy the needs of each accounts. Cottrell said, 'Our goal is to be more responsive, efficient, and to develop the ability to have shelf-ready product to stores by year's end.' This case epitomizes the research framework and, in particular, the impact of supply chain restructuring on internal operation systems. EMD wanted to be more responsive, and so the CEO set the goal. The goal was reflected to restructure its distribution chain by integrating warehouse into the factory. This decision drove the firm to adopt automated shipment technology, which improved pull production system and market responsiveness. This example demonstrated how restructuring decisions affect internal operational practices.

Another example comes from Proctor & Gamble. Proctor & Gamble undertook an arduous effort to restructure its supply chain for its variety of products and saved over $200 million by cutting the number of North American plants in 1993 (Camm et al. 1997). The decision to reduce the number of plants led it to adopt new advanced manufacturing technology to increases efficiency and flexibility of manufacturing. The restructuring
decision drove P&G to adopt advanced manufacturing technologies and conduct integrated product development practices more.

The influences of supply chain restructuring on internal operation practices were examined in hypothesis 6a (advanced manufacturing technology), 6b (pull production systems), and 6c (integrated product development practices). These relationships were found significant, supporting the argument that restructuring decisions in supply chain affect internal operation practices. Theoretically, choice of coordination mechanisms driven by a set of goals led firms to make supply chain restructuring decisions. Supply chain restructuring, in turn, influences internal operational practices decision, including advanced manufacturing technology. To the best of my knowledge, this link is empirically studied for the first time in this research.

Third, this research shows that the competitive market environment affects firms to formulate their manufacturing strategy. Organizational theories and other studies strongly suggest that the environment impacts the strategy formulation process. This research confirmed the relationship in hypothesis 1. Competition intensity and the number of competitors force the firm to seek a unique competitive edge in the market. This pressure leads them to develop a responsive product strategy. The manufacturer sets the standard on the supply and distribution chain strategies, which influences the suppliers and the customers to change their behaviors. The change in the suppliers’ and customers’ perceptions and behaviors then influences the manufacturer to continue or alter its practices and expectations. Responsive business strategy strongly affected information sharing practices with both suppliers and customers. It also greatly affected the supplier coordination, although it did not have a significant impact on the customer
coordination. The impact on information sharing practices and collaboration eventually leads to restructuring the supply chain and the distribution chain. The adjustment will also reinforce manufacturer’s expectations on its operational practices in advanced manufacturing technology, pull production, and product and manufacturing integration. This will eventually result in the overall improvement of performance.

4.2. Managerial Implications

This research provides valuable managerial implications to managers. First, firms might consider implementing a responsive supply chain by offering a wider product range and frequently delivering new products with innovative features. Responsiveness is not just about making the production process quick and swift, but about delivering the products that are in demand. In a fast-changing market landscape, firms should consider formulating a more responsive product strategy. Kodak film and Apple computer are contrasting examples. Kodak used to be promising company until digital technology took over analog technology. The company regressed as the competitive market turned to digital technology. Kodak did not turn to digital technology and compete as quickly as it did in the analog market. As a result of not formulating a responsive product strategy, the firm growth of the firm plummeted. Their products ranged around analog technology. On the contrary, Apple computer broadened its product strategy to offer a wider range of more innovative products. Epitomized by the invention of iTune, iPod, and iPhone, the company caught the customer’s attention by capturing their needs and increasing market responsiveness.

Second, the research also gives managers insights as to why to take supply chain restructuring into consideration. Restructuring the supply chain significantly increases the
likelihood of implementing advanced manufacturing technology, pull production, and integrative product development practices. It even has a direct impact on market responsiveness. Competitive market environment increases the level of uncertainty, in which firms have to constantly rethink their supply and distribution chain strategies. Depending on the situation, firms should try to optimize or to decouple supply chain from manufacturing or distribution. Notably, restructuring the supply chain has a significant effect on the integrative product development. Integrative product development has usually been regarded as a part that cross-functional integration has much to do with. However, this research reveals that restructuring the supply chain plays an important role in increasing the likelihood/success of integrative product development practices. Shortening and customizing the supply chain helps a manufacturer to better see the needs of suppliers and customers. In return, restructuring enhances technological integration and modularization in the supply chain.
References


