TOWARDS A UNIFIED THEORY IN SUPPLY CHAIN MANAGEMENT: CRITICAL CONSTRUCTS AND THEIR EFFECT ON PERFORMANCE

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TOWARDS A UNIFIED THEORY IN SUPPLY CHAIN MANAGEMENT: CRITICAL CONSTRUCTS AND THEIR EFFECT ON PERFORMANCE

ABSTRACT

While supply chains have existed for a long time, the notion of the competitive advantage of supply chains and consequently supply chain management is a relatively recent idea in management literature. Extant literature frequently reflects a combination of separate initiatives focused on isolated topics like beneficial buyer-supplier interface, importance of supplier development, and implementation of information technology. There is no comprehensive step towards unifying the islands of theory as well as defining the essential constructs of supply chain management. The focus of this research, therefore, is threefold. First, to explore the critical factors that affect supply chain management by consolidating research from diverse disciplines; second, to explore the relationships that will enhance the effective management of the supply chain; and third, to develop a unified theory in supply chain management.

The survey instrument was developed based on an extensive literature review. A cross-sectional mail survey was conducted for data collection. An iterative instrument development procedure that satisfies all the requirements of instrument reliability, validity and unidimensionality is utilized to consolidate the theoretical constructs. Multiple research models based on divergent focus were developed to study the interrelationship between the factors. Structural equation modeling (SEM) approach was used to analyze the research models.

The theoretical constructs satisfied all the requirements of reliability, validity, and unidimensionality. The results prove the importance of strategic purchasing, customer

focus, competitive priorities, top management support, and information technology to the successful management of supply chain. The evaluation of the research models also provides a better understanding into the environmental uncertainty, customer-oriented supply chain management, supplier relationship and management, enterprise logistics, and networked organizational structure. In its entirety, this study provides a better understanding of the critical elements of supply chain management and the effect of their interrelationships on supply chain performance.

The findings of this study are expected to have a significant impact on academicians as well as practitioners. The proposed framework will be of great value not only to readers who desire to extend their research avenues into this exciting area, but also to those who have already investigated this topic but in isolation or with limited scope. On the whole, the results of this study is expected to provide researchers, academicians and practitioners with a much better understanding of supply chain management and the ability to evaluate the various success and failure formulae within a consistent domain of theoretical knowledge.

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CHAPTER I

Introduction

The observation that firms are co-operating rather than trying to do everything themselves is supported by evidence of a reversal in the previous tendency to integrate vertically. Since the mid 1980s, as firms have increased strategic cooperation, a trend towards vertical disintegration has been reported in a range of industries (Porter, 1987; Thackray, 1986). In addition to the increased capability of attaining global coverage, cooperating firms, rather than vertically integrated firms, have been able to reduce the risk of becoming locked into inappropriate technologies (Miles & Snow, 1986). Many companies are reorganizing their value chains and focusing on a few core activities where they can achieve and maintain a long-term competitive advantage, outsourcing all other activities in which they do not have world-class status (Quinn, 1992). Resources that provide competitive advantage to a firm are difficult to imitate, have no direct substitutes and allow firms to pursue opportunities or avoid threats (Barney, 1991; Wernerfelt, 1984). This has given rise to increased attention being paid to the concept of "core" and "non-core competencies" (Hamel & Pralahad, 1989), the latter being seen as appropriate activities to "outsource" to other companies (Quinn, 1992; Quinn, Doorley, & Paquette, 1990). This echoes the well-known operations strategy concept of "focus" (Skinner,

1969) in which firms concentrate on a limited, manageable number of tasks at which they becoming increasingly competent.

Skinner (1969) claimed that vertically integrated factories attempt to achieve too many conflicting objectives within a single plant. This often leads to higher costs and lower product quality because the factory cannot focus on the tasks it absolutely must do in order to be successful (Anderson, Cleveland, & Schroeder, 1989; Skinner, 1969). Many researchers have advocated the focused factory concept as a major factor of operations strategy where the firm can improve productivity and quality (e.g., Hayes & Abernathy, 1980; Hayes & Wheelwright, 1984; Wheelwright, 1979). Burgert (1988), Huber & Vasilash (1988), and Warren (1985) documented successful focus factory adoption in automotive and related industries with high-volume discrete production processes. Their findings indicated that it is easier to control quality and productivity in focused factories than in fully integrated facilities. Other researchers have also proved that the focused factory approach improved the overall quality, delivery lead-time, and costs (Miller, 1987; Mullins, 1990; Ruwe & Skinner, 1987).

Many highly successful Japanese as well as American companies like 3M, Hewlett-Packard, Honda, Mitsubishi, Sony, Toyota, Xerox, Yamaha, etc., have outsourced significant support activities in order to create unique value for their customers (Karmarkar, 1996; Quinn & Hilmer, 1994). It is estimated that companies spending 50% to 70% of their sales dollars on outsourcing and having a net profit of 7% would require $3.51 in sales in order to equal the savings accrued to the company for one-dollar savings in procurement. These numbers indicate the strong role that outsourcing can play in profitability for manufacturing as well as service organizations

(Heizer & Render, 1993). Outsourcing of materials, services, and components to external suppliers has recently been recognized as a source of great advantage. Increasingly, the management of business and relationships with other members of the supply chain is being referred as supply chain management. Supply chain management, an integrative approach to dealing with planning and control of the material flow from suppliers to end users, is the recognition that competition today is based on the entire supply chain partners rather than just the manufacturing firm. This notion of supply chain management has become a subject of increasing interest in recent years to academics, consultants and business management.

With recent advances in communication and information technology, firms have an opportunity for significant savings in logistics costs by coordinating the planning of various stages of supply chain management (Peters, 1992). Client/Server supply chain management software that includes a completely integrated supply chain management and electronic commerce component also aids in the evolution of supply chain management (King, 1996; Semich, 1994). The results of these advanced technologies in addition to the narrowing supplier bases, improved relationship, efficient transportation and logistics, and product innovation have made today's supply chains more dynamic and feasible than ever before. In light of this, many American companies are realizing that to control the critical steps in a business system, they need not necessarily have to own them (Sheth & Eshghi, 1989) and that market power is rather a function of their ability to efficiently and effectively manage the entire supply chain (Gupta & Zhender, 1994; Quinn & Hilmer, 1994).

1.1. Evolution of Supply Chain Management

In the 1950s and 1960s, most manufacturers emphasized mass production to minimize unit production cost as the primary operations strategy with little product or process flexibility. New product development was slow and relied exclusively on in-house technology and capacity. Bottleneck operations were cushioned with inventory to maintain a balanced line flow, resulting in huge investment in work in process (WIP) inventory. Sharing technology and expertise with customers or suppliers was considered too risky and unacceptable, and little emphasis appears to have been placed on cooperative and strategic buyer-supplier partnership. The purchasing function was generally regarded as being a service to production, and managers paid limited attention to issues concerned with purchasing (Farmer, 1997). In the 1970s, material requirement planning was introduced and managers realized the impact of huge WIP on manufacturing cost, quality, new product development and delivery lead-time.

The intense global competition in the 1980s forced world-class organizations to offer low-cost, high-quality and reliable products with greater design flexibility. During this period, manufacturers utilized manufacturing resource planning (MRP II) to improve the performance within the four walls of the company. They also adopted just-in-time (JIT) and other management initiatives to improve manufacturing efficiency and cycle time. In the fast-paced JIT manufacturing environment with little inventory to cushion production or scheduling problems, manufacturers began to realize the potential benefit and importance of strategic partnerships with their immediate suppliers. In addition to the procurement professionals, experts in transportation and logistics carried the concept of materials management a step further to incorporate the physical distribution and transportation functions, resulting in the integrated logistics concept, also known as the supply chain management. The evolution of supply chain management continued into the 1990s as organizations further extended best practice in managing corporate resources to include strategic suppliers and the logistics function in the value chain. Supplier efficiency was broadened to include more sophisticated reconciliation of cost and quality considerations. Instead of duplicating non-value-adding activities, such as receiving inspection, manufacturers trusted suppliers' quality control by purchasing only from a handful of qualified or certified suppliers (Inman & Hubler, 1992).

More recently, many manufacturers and retailers have embraced the concept of supply chain management to improve efficiency across the value chain. Manufacturers now commonly exploit supplier strengths and technology in support of new product development (Morgan & Monczka, 1995; Ragatz, Handfield, & Scannell, 1997), and retailers seamlessly integrate their physical distribution function with transportation partners to achieve direct store delivery or cross docking without the need for receiving inspection (St. Onge, 1996). As worldwide economic competitiveness increases through the 1990s and into the next century, an increasing number of firms are combining domestic and international sourcing as a means of achieving a sustainable competitive advantage (Kotabe & Murray, 1990). A key facilitating mechanism in the evolution of supply chain management is a customer-focus corporate vision, which drives change throughout a firm's internal and external linkages. It is quite clear that we have entered a new speed-driven global economic era that is altering the production and operations strategies of companies. In this era, competitive price and high quality are necessary but not sufficient determinants of commercial success. Speed to market and quick, flexible customer response are increasingly pivotal (Kasarda, 1996). Towards this end, the supply chain management seeks improved performance through elimination of waste and better use of internal and external supplier capabilities and technology to create a seamlessly coordinated supply chain (AMR, 1997), thus, elevating inter-company competition to inter-supply chain competition (Anderson & Katz, 1998; Birou, Fawcett, & Magnan, 1998; Christopher, 1996; Lummus, Vokurka, & Alber, 1998; Morgan & Monczka, 1996).

1.2. Definition

In the literature of supply chain management, there is a profusion of overlapping terminologies and meanings. As the concept gained popularity, various definitions were found referring to supply chain and to practices of supply chain management, including: integrated purchasing strategy (Burt, 1984), supplier integration (Dyer, Cho, & Chu, 1998), buyer-supplier partnership (Lamming, 1993), supply base management, strategic supplier alliances (Lewis, 1995), supply chain synchronization (Tan, Kannan, & Handfield, 1998), network supply chain (Lummus & Alber, 1997; Nassimbeni, 1998; Nishiguchi, 1994), value-added chain (Lee & Billington, 1992), lean chain approach (New and Ramsay, 1995), supply pipeline management (Farmer & Van Amstel, 1991), and value stream (Womack & Jones, 1994), integrated supply chain (Ellram & Cooper, 1993; Monczka & Morgan, 1997). APICS dictionary describes the supply chain as the processes from the initial raw materials to the ultimate consumption of the finished product linking across supplier-user companies and the functions within and outside a company that enable the value chain to make products and provide services to the customer (Cox, Blackstore, & Spencer, 1995). The Supply Chain Council (2002) uses the definition that the supply chain encompasses every effort involved in producing and delivering a final product from the supplier's supplier to the customer's customer. The Institute for Supply Management (2002) defines it as the design and management of seamless, value-added processes across organizational boundaries to meet the real needs of the end customer. The Global Supply Chain Forum defines supply chain management as the integration of business processes from end-user through original suppliers that provides products, services, and information that add value for customers (Lambert, Stock, & Ellram, 1998). From the array of definitions, a summary definition of the supply chain can be stated as all the activities involved in delivering a product including sourcing of raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution, delivery to the customer, and the information systems necessary to monitor all these activities. Supply chain management combines and coordinates all activities into an integrated and seamless process by linking all the members in the chain (Tan, 2001).

1.3. Importance of Theory

A good theory offers the researcher several important and highly compelling benefits (Melnyk & Handfield, 1998). First, a theory provides structure for data. Data, when captured from the field, has no structure. It neither tells the researcher the sequence in which activities took place nor identify what factors influenced what other factors. Rather, data simply shows that something did happen. To make sense of this data, it must be converted into information identified using sequences, constructs and relationships. These traits offered by theory are not only important to researchers but also to practitioners. Second, theory helps direct research by identifying those parts of current thinking that are unclear or incomplete. As a result, research becomes less a matter of hit and miss and more a targeted and purposeful search. Third, theory explains events and patterns occurring in a field, not only to other researchers but also to students and practicing managers. Theory and theory building approach are critical to the continuous success of any field since nothing is so practical as a good theory (Simon, 1967; Van De Ven, 1989). Without theory, it is impossible to make meaningful sense of empirically-generated data, and it is not possible to distinguish positive from negative results (Kerlinger, 1986). Without theory, empirical research merely becomes 'data-dredging' (Handfield & Melnyk, 1998). It is also crucial for the future of any research discipline to establish its own distinct theoretical identity. Furthermore, the theory-building process serves to differentiate science from common sense (Reynolds, 1971).

1.4. Scope of this Research

A major hindrance to understanding the dynamics of supply chain improvement is in untangling its various components. Managerial and commercial reality is complicated; interpreting the global stories that feed supply chain mythology is problematic (New, 1994). There has been relatively little guidance from academia, which in general has been following, rather than leading, business practice (Cooper, Ellram, Gardner, & Hanks, 1997; Hewitt, 1994; Lambert, Cooper, & Pagh, 1998). Without an ability to classify activities and situations, the development of clear theory or reliable prescription is unlikely. One particular problem is in identifying what can be included within the orbit of supply chain management (New, 1996). Numerous studies have focused on the buyer-supplier interface and supplier development (e.g., Choi & Hartley, 1996; Cooper & Ellram, 1993; Shin, Collier, & Wilson, 2000), importance of information sharing (e.g., Hahn, Watts, & Kim, 1990; Newman & Rhee, 1990), and implementation of information technology (e.g., Drew & Smith, 1995; Greis & Kasarda, 1997). Nevertheless, there is no comprehensive step towards building theory as well as defining the various constructs of supply chain management (Babbar & Prasad, 1998; Cooper, Lambert, & Pagh, 1997; Saunders, 1998). For any evolving research discipline, there appears to be a pattern of development that is based on the usage of concepts, definition, theories, rules and principles from other disciplines. In other words, scholars determine that there is no reason to reinvent the wheel and therefore, search out for concepts that can or might apply to the research area (Stock, 1997). Therefore, the scope of this research is to explore the essential factors that constitute the supply chain management by consolidating research from diverse disciplines including purchasing and supply, logistics and transportation, marketing, organizational dynamics, and operations literature and to identify the relationships that will enhance the effectiveness of the supply chain management.

1.5. Significance of this Research

Supply chain management, among a number of other emerging areas within operations management, is still in its embryonic stage (Handfield & Melnyk, 1998). The scientific development of a coherent supply chain management discipline requires that advances be made in the development of theoretical models to inform our understanding of supply chain phenomena (Croom, Romano, & Giannakis, 2000). So, the research agenda in supply chain management must not be driven by industrial interest alone (New, 1997). Research about supply chain management as a conceptual artifact of the modern world is also important. Indeed, it is necessary to understand the broader context before robust prescription is possible. In the move towards developing theory in supply chain management, this research effort is set to explore the gamut of supply chain management and define the various constructs that affect its effective management. It also recognizes the requirement of a multi-disciplinary approach for supply chain management research. As a result, this study will aid to both the classification of research in the field, and as a means of providing a framework for the identification of the key contents of the subject.

Moreover, most of the prior research frequently reflects a combination of separate initiatives focused on isolated topics like beneficial buyer-supplier interface, importance of supplier development, importance of information sharing, and implementation of information technology. This research effort brings together these individual efforts to provide a comprehensive theoretical model that will evaluate the interrelationship between various factors of supply chain management. Thus, this initiative will promulgate more insight into the buyer-supplier interface, logistics, organizational structure, etc. within the light of uncertainty, strategic and customer focus. Also, this study will satisfy the dearth in research regarding the influence of information technology on the various supply chain factors and subsequently performance. On the whole, the results of this study will provide researchers, academicians as well as practitioners a better understanding of the supply chain management and the ability to evaluate the various success and failure formulae within a consistent domain of theoretical knowledge.

1.6. Overview of the Contributions

The conceptual framework developed herein will not only be conducive to further research but will also help practitioners to better understand the scope of the problems and opportunities associated with supply chain management. This framework will be of great value to researchers who desire to extend their research avenues into this exciting area and also to those who have already investigated this topic but in isolation or with limited scope. Moreover, it can be further expanded into several theoretical models, allowing researchers to test the validity of and relationships among the various constructs along with their impact on supply chain performance and to ultimately create a coherent theory of supply chain management.

The theoretical constructs defined will help the researchers to evaluate the various success and failure formulae for the successful management of the supply chain. It will also give practitioners an insight into the most conducive practices that their counterparts, in general, consider as important. The findings of this study are expected to have a significant effect on both the academicians as well as the practitioners equally. It will provide a better understanding in to the management of supply chain, in general, by facilitating unification of the domain of theoretical knowledge. The various research models will show the importance of strategic purchasing, customer focus, competitive priorities, top management support, and information technology on successful supply chain management. The evaluation of these models will help provide a better understanding into the buyer-supplier relationship, logistics, and network organizations. It will also show the importance of environmental uncertainty and its impact on the management of supply chains. This study will emphasize the increased importance of using information technology for facilitating communication, leanness, agility, as well as performance. Also, it will give an overview of the extent of usage of the different types of information technologies like electronic data interchange, enterprise resource planning, and electronic commerce.

1.7. Outline of the Dissertation

This section identifies the organization of the dissertation. *Chapter 1* presents an introduction and definition on supply chain management. It also points out the need for this effort along with its significance. *Chapter 2* provides an overview of supply chain management and the various factors that affect its management. Drawing on wider literature from different research areas, this chapter presents the factors that are of significance to the successful management of supply chain management. *Chapter 3* presents the theoretical constructs of supply chain management and the research hypotheses relating them. It also presents information on the research design, instrument, data collection, and analytical methods used in the instrument development and hypotheses testing. *Chapter 4* focuses on the results of the analysis. It presents the response rate information along with the results of non-response analysis. It provides a brief explanation on the demographic information relating to the respondents and their companies. It also presents the finalized indicators of the various theoretical constructs and the results of the structural equation modeling analysis. *Chapter 5* presents the discussion and managerial implications of the results along with the reasons for acceptance and rejection of hypotheses. *Chapter 6* presents the concluding remarks, limitations of the present study, and the scope for future research in the scientific development of a coherent supply chain management discipline.

CHAPTER II

Literature Review

2.1. Introduction

The recent popularity of the supply chain concept has been driven from many directions: the quality revolution (Dale, Lascelles, & Lloyd, 1994); the notions of materials management and integrated logistics (Carter & Price, 1993); the growing interest in industrial markets and networks (Ford, 1990; Jarillo, 1993); the increased notion of focus (Porter, 1987; Snow, Miles, & Coleman, 1992); and influential industry-specific studies (Lamming, 1993; Womack, Jones, & Roos, 1990). It has resulted in a plethora of terminology, including supply chains, demand pipelines (Farmer & Van Amstel, 1991), value streams (Womack & Jones, 1994), support chains, and many others. There are several meanings of the term "supply chain" in popular use, and this makes interpretation of anecdotal evidence particularly difficult. For example, it is used as a synonym for logistics in both integrative (Bowersox, Closs, & Helferich, 1986) and technical sense (Payne, 1994). There is no shortage of anecdotal evidence concerning supply-chain management, supplier development, information sharing, and partnership, but these frequently reflect a combination of possibly separate initiatives. The new orthodoxy of supply-chain management is in danger of collapsing into a discredited management fad unless a reliable conceptual basis is developed (New, 1996). Towards the journey of developing a conceptual base, this section identifies the various important constructs of supply chain management by consolidating research from diverse disciplines including purchasing and supply, logistics and transportation, marketing, organizational dynamics, and operations management literature.

2.2. Supply Chain Management Theory

The origins of the concept of supply chain management are unclear, but its development was initially along the lines of physical distribution and transport, using the techniques of industrial dynamics, derived from the work of Forrester (1961). Another antecedent can be found in the total cost approach to distribution and logistics (Heckert & Miner, 1940; Lewis, 1956). Both these approaches show that focusing on a single element in the chain cannot assure the effectiveness of the whole system (Croom et al., 2000). The term "supply chain management" was originally introduced by consultants in the early 1980s (Oliver & Webber, 1992) and has subsequently gained tremendous attention (La Londe, 1998). Analytically, a typical supply chain as shown in Figure 2.1 is simply a network of material processing cells with the following characteristics: supply, transformation, and demand (Spekman, Kamauff, & Myrh, 1998). The term supply chain management has not been used only with regard to the logistics activities and the planning and control of materials and information flows internally within a company or externally between companies (Christopher, 1992; Cooper, Lambert, et al., 1997; Fisher, 1997). Researchers have used it to describe strategic, inter-organizational issues (Cox, 1997, Harland, Lamming, & Cousins, 1999), others to discuss an alternative organizational form to vertical integration (Hakansson & Snehota, 1995; Thorelli, 1986), and others to identify and describe the relationship a company develops with its suppliers (e.g., Helper, 1991; Hines, 1994; Narus & Anderson, 1995). Most of the recent literature addresses the purchasing and supply perspective (e.g., Farmer, 1997; Morgan & Monczka, 1996). This perspective of supply chain management evolves from the traditional purchasing and supply management functions. In general, different subject areas like purchasing and supply, logistics and transportation, marketing, organizational behavior, network, strategic management, etc., have contributed towards the core of supply management literature from different perspectives.

Drawing on wider literature from these different research areas, the following section presents the factors that are of significance to the successful management of supply chain management within the framework presented in Figure 2.2. The framework has strategic purchasing as the center. Environmental uncertainty, customer focus, competitive priorities, and information technology are the four driving forces instrumental to the development of supply chain management.

2.3. Factors influencing supply chain management

2.3.1. Environmental Uncertainty

Uncertainty has been an important construct in a number of fields, including organization theory, marketing, and strategic management. In the organization theory literature, Thompson (1967) postulates that "uncertainty appears as the fundamental problem for complex organization" and that organizations respond to uncertainty in the environment by "buffering" their "technical core" from its effects. A number of studies have shown that perceived environmental uncertainty exerts a considerable influence on organizational structures and processes (Huber, O'Connell, & Cummings, 1975; Huber &

Daft, 1987) Though early research has operationalized uncertainty as a unidimensional construct, increasingly researchers question this assumption (Milliken, 1987; Sutcliffe & Zaheer, 1998; Tosi & Slocum, 1984; Yasai-Ardekani, 1986). Milleken (1987) suggests that uncertainty is multidimensional and develops a typology of uncertainty dimensions as follows: *state* uncertainty, the inability to assign probabilities to states of nature; *effect* uncertainty, a lack of knowledge about cause-effect relationships about how states of nature will affect the organization; and *response* uncertainty, an inability to predict the outcomes of decisions. Koopmans (1957) distinguished uncertainty as follows: primary uncertainty, the lack of knowledge about states of nature such as the uncertainty regarding natural events; secondary uncertainty, the lack of knowledge about the actions of other economic actors. Williamson (1985) describes both primary and secondary uncertainty as "innocent" and "non-strategic" forms of uncertainty and distinguishes them from behavioral uncertainty, the deliberate nondisclosure of information or the strategic misrepresentation of information by economic agents. Sutcliffe and Zaheer (1998) classify uncertainty as follows: primary uncertainty; competitive uncertainty, arising from the actions of potential or actual competitors; supplier uncertainty, arising from the actions of the exchange partner firm and relates specifically to possible opportunism by either the upstream or the downstream exchange partner.

Davis (1993) suggests that there are three different sources of uncertainty that plague supply chains: supplier uncertainty, arising from on-time performance, average lateness, and degree of inconsistency; manufacturing uncertainty, arising from process performance, machine breakdown, supply chain performance, etc; and customer or demand uncertainty, arising forecasting errors, irregular orders, etc. The extant supplier development literature proposes that increased competition in the marketplace and the increased pace of technological innovation are two primary factors driving companies' needs for world-class suppliers and for supplier development (Hahn et al., 1990). As given in Figure 2.3, when demand in the market fluctuates, instability will occur in the firm and eventually the entire supply chain (McClelland & Marucheck, 1986). The result is a combination of less than ideal customer service, excess capacities at various stages, excess inventory, waste, and therefore, a higher than necessary total cost of supply (Fisher, Hammond, Obermeyer, & Raman, 1994; McGuffog & Wadsley, 1999). Under conditions of increased uncertainty and the lack of better alternatives, organizations in the value chain are likely to engage in collective action in order to stabilize their environment (Ouchi, 1980; Pfeffer & Salancik, 1978). One approach used to manage uncertainty in demand is to identify small local suppliers with simplified processes and product lines who can focus on maintaining schedule flexibility at low cost (St. John & Heriot, 1993). Such suppliers are often more dependable than larger suppliers and can provide delivery of materials on short notice (Burt, 1989; Lascelles & Dale, 1989). A preliminary step in this effort is a program of supply base consolidation, involving a reduction in the number of primary suppliers used by the firm and the allocation of majority of purchased material requirements to these sources (Manoocheri, 1984).

2.3.2. Customer Focus

Despite the use of the latest process improvement techniques and capable management, a firm's neglect of its customers may lead to disaster (Kordupleski, Rust, & Zahorik, 1993). In fact, the pressure to revitalize manufacturing over the last decade has been rooted in customers' demand for a greater variety of reliable products with short lead times (Draaijer, 1992). Since customer expectations are dynamic in nature (Shepetuk, 1991), an organization needs to regularly assess them to realign and refine their customer focus and adjust its supply chain strategy accordingly (Takeuchi & Quelch, 1983). Voss (1992) suggests that an organization's long-term success is tied to customer retention efforts. Organizations may outperform their competition by being able to: (1) respond quickly to customers' demands with new ideas and technologies, (2) produce products that satisfy or exceed customers' expectations, and (3) anticipate and respond to customers' evolving needs and wants (Stalk, Evans, & Schulman, 1992). Therefore, customer focus must be reflected in the overall planning and execution of quality efforts (See Figure 2.4). Doyle (1994) writes that satisfying customer needs is the central purpose of any business and Dibb, Simkin, Pride, and Ferrell (1994) describe customer satisfaction as the major aim of marketing concept. The main message is that the more attention a company pays to researching its customer base in order to identify customer needs, the more rewarding the exchange transaction will be for that company (Carson, Gilmore, & Maclaran, 1998).

More recently educators are compounding and reinforcing this focus with the current philosophies based on building relationships with customers, mainly through increased customer service and customer care (Stewart, 1994). This thinking places the emphasis on product or service quality and customer service as a means to enhance the customer's perceived value of the product (Carson et al., 1998; Lewis, 1991). For example in the marketing, services marketing and quality literature, many authors argue that improved product and service quality allow companies to widen and increase their price range (Chernatony, Knox, & Chedgay, 1992; Gummesson, 1995). Similarly, these and the relationship marketing literatures emphasize that creating satisfied customers leads to long-term loyalty (Christopher, 1986; Gronroos, 1980; Lewis, 1991; Stewart, 1994).

2.3.3. Top Management Support

The critical role of top management in providing leadership has been illustrated in the literature for several diverse organizations (Chapman, Clarke, & Sloan, 1991; Fah, 1988; Kennedy, 1989; Nakajo & Kono, 1989). Burt's (1978) study of long-range planning in the Australian retailing industry found that increasing top management involvement was associated with superior results. Langley (1988) and Naidish (1988) note that the success of strategic planning in general depends almost wholly on the willingness and ability of senior managers to conceptualize strategy and make appropriate strategic decisions. Forman (1988) also posited that the major function of the top management executives is to influence the setting of organizational values and to develop suitable management styles.

The importance of top management's role is heavily emphasized in the supplier chain literature (Blenkhorn & Leenders, 1988; Hahn et al., 1990; Monczka, Trent, & Callahan, 1993; Ward, Leong, & Boyer, 1994). Top-level managers will have a better understanding of the need of supply chain because they are the most cognizant of the firm's strategic imperatives to remain competitive in the market place (Hahn et al., 1990). Monczka et al. (1993) note that top management must commit the time, personnel and financial resources to support the suppliers who are willing to be a long-term partner of the company through supplier development. Top management must initiate the supplier development programs (Krause and Ellram, 1997). From the results of a survey of US buying firms, Watts and Hahn (1993) found that supplier development programs were in effect at the divisional or corporate levels in 77% of their respondent firms. Hines (1994) also noted the importance of gaining top management support, specifically when setting up supplier association, or *kyoryoku kai*. Anon (1999) noted that top management must be prepared to provide corporate development resources and make the necessary decision to provide the communication linkages between partners using advanced information technology. Thus, top management must be aware of the competitive benefits that can be derived through the firm's purchasing department from effective supply relationships. Without this awareness, the purchasing department is unlikely to have the resources and willingness to manage supplier performance.

2.3.4. Competitive Priorities

In one of the more popular definitions of strategy, Quinn (1980) states that strategy is the plan that integrates an organization's major goals, policies and action sequences into a coherent whole. Supply strategy is inherently broader than manufacturing strategy, because it includes aspects relating to more than one supply chain network player, as well as the interaction between players. Each focal organization is in its own unique network: this network comprises a unique set of actors, resources and activities, which together constitute its identity (Gadde & Hakansson, 1993). It also takes a position in comparison with other organizations and networks; the position of a company with respect to others reflects its capacity to provide values to others (productiveness, innovativeness, competence) (Hakansson & Snehota, 1995). As an organization repositions itself, it changes its identity. Therefore, it can be seen that the decision elements of a supply strategy relate to the network, whereas those elements of a manufacturing strategy relate to one operation.

In the past decade, research in strategy, especially manufacturing strategy, has advanced considerably. The two generic strategies of low cost and product differentiation have been developed into at least four competitive priorities, where a competitive priority is defined as the choice of dominant attitude for a company (Buffa, 1984; Wheelwright, 1984). Consistent with the literature, the term "competitive priorities" is used to describe manufacturers' choice of manufacturing tasks or key competitive capabilities, which are broadly expressed in terms of low cost, flexibility, quality, and delivery (Berry, Bozarth, Hill, & Klompmaker, 1991; Hayes & Wheelwright, 1984; Skinner, 1969; Ward, Duray, Leong, & Sum, 1995). The list has since been growing with the additions of innovativeness, time, delivery speed, and delivery reliability (Corbett & Van Wessenhove, 1993; Miller & Roth, 1994). Flexibility has further been split into product or design flexibility and volume flexibility (Kathuria, 2000; Miller & Roth, 1994). Flexibility can also refer to a firm's ability to deal with uncertainty (Gerwin, 1987). Innovation in either product or process development is often considered to be an element of flexibility, as well (Parthasarthy & Sethi, 1992). These lists are closely related to the idea of generic strategies from the business strategy literature (Porter, 1980, 1990).

Early research in manufacturing strategy held that a firm could emphasize one, or at most a few, competitive priorities simultaneously. The idea was that the skills and capabilities needed to excel at one competitive priority were often inconsistent with the skills and capabilities needed at another competitive priority (Hayes & Wheelwright, 1979; Skinner, 1969). Most recent research in manufacturing strategy has recognized that changes in technology, managerial thinking, and global competition have, to a large extent, eliminated the idea that trade-offs are necessary (Corbett & Van Wessenhove, 1993; Ferdows & De Meyer, 1990; Hayes & Pisano, 1994). Figure 2.5 presents the cumulative sand cone model presented by Ferdows and De Meyer (1990).

2.3.5. Information Technology

More than ever before, today's information technology is permeating the supply chain at every point, transforming the way exchange-related activities are performed and the nature of the linkages between them (Palmer & Griffith, 1998). Inter-organizational systems are information and communication technology-based systems that transcend legal enterprise boundaries (Bakos, 1991; Chismar & Meier, 1992; Konsynski, 1993). A more recent perspective on linkages within the supply chain considers the role of inter-organizational systems, which are sophisticated information systems connecting separate organizations (Kumar & van Dissel, 1996; Samli, Browning, & Busbia, 1998). Research has shown information technology to be an effective means of promoting collaboration between collections of firms, such as groups of suppliers and customers organized into networks. The strength of inter-organizational systems has been particularly important with respect to enabling the process transformation needed to create effective networks (Christiaanse & Kumar, 2000; Drew & Smith, 1995; Holland, Lockett, & Blackman, 1994; Holland, 1995; Greis & Kasarda, 1997; Kumar & van Dissel, 1996; Teng, Grover, & Fiedler, 1996; Venkataraman, 1994). Information technology also enhances supply chain efficiency by providing real-time information regarding product availability, inventory level, shipment status, and production requirements (Radstaak & Ketelaar, 1998). In particular, it has vast potential to facilitate collaborative planning among supply chain partners by sharing information on demand forecasts and production schedules that dictate supply chain activities (Karoway, 1997). Furthermore, information technology can effectively link customer demand information to upstream supply chain functions (e.g., manufacturing, distribution, and purchasing) and subsequently facilitate "pull" (demand driven) supply chain operations (Min & Galle, 1999).

The volume of information systems for U.S. business transactions is expected to increase from $8 billion in 1996 to $327 billion by the year 2002 (Radstaak & Ketelaar, 1998). In a recent survey of more than 300 supply chain-related executives, Bradley (1999) found 92% of those questioned were planning to implement one or more supply chain initiatives within 1999. In a more recent study, the Boston Consulting Group estimated that by 2004, business-to-business information systems will generate productivity gains to 1% to 2% of sales, and by 2010, this figure could grow by 6% (Brewton & Kingseed, 2001). Also, Murphy (1996) noted that 81% of the respondents in a purchasing magazine survey indicated their plan to explore inter-organizational information systems as a future purchasing tool. Effective coordination of supply chain activities, by means of excellent information technology processes, is essential to organizational performance (Lewis & Talalayevsky, 1997). The goal of these systems is to replace inventory with perfect information. Figure 2.6 is a more appropriate model for thinking about the movement of information and materials in the information-based supply chain. Seamless material flows are achieved by replacing the notion of a sequential and linear chain of information exchange with a set of simultaneous information exchanges that span the members of the supply chain (Greis & Kasarda, 1997). These information systems may be simple electronic data interchange (EDI) systems for exchanging data such as purchase orders, advice of delivery notice and invoices or may involve more complex transactions such as integrated cash management systems, shared technical databases, internet, intranet, and extranet (Min & Galle, 1999).

2.3.5.1. Electronic data interchange. Electronic data interchange (EDI) can be most simply described as "electronic inter-company transfer of business documents in a standard format" (Banerjee & Sriram, 1996; Gattorna & Walters, 1996). It facilitates the electronic exchange of trading data in a reliable and secure manner over a dedicated network (Gilmour, 1993; Laage-Hellman & Gadde, 1996). Sharing information with supply chain partners through EDI is a critical component of supply chain management (Ellram, LaLonde, & Weber, 1989). According to EDI Yellow Pages (1992), more than 25,000 companies used EDI to execute at least one transaction set between itself and at least one trading partner. EDI is not just an electronic ordering system; it helps to integrate stocking, logistics, materials acquisition, shipping and other functions to create a more proactive and effective style of business management and customer responsiveness (Mische, 1992) and thereby be of competitive advantage (Calza & Passaro, 1997; Johnston & Vitale, 1988). It helps in sharing information about markets, materials requirements forecasts, inventory levels, production and delivery schedules (Webster, 1995). Through direct transfer of information between firms and their suppliers, it aids in improving the supply chain efficiency and supports increased customer service levels (Scott-Morton, 1991; Srinivasan, Kekre, & Mukhopadhyay, 1994). Besides the ability to increase accuracy and timeliness of information transferred, EDI may also improve cycle reliability, accuracy, and help decrease cycle time (Iacovou

& Benbasat, 1995; Mackay, 1993; Massetti & Zmud, 1996; Mukhopadhyay, Kekre, & Kalathur, 1995; Ramaseshan, 1997; Zorfass & Michel, 1992).

2.3.5.2. Enterprise resource planning (ERP) systems. The development of ERP systems was a result of the increasing demand for re-engineering, combined with the advent of client/server technologies (Earl, 1997). There was also a desire to replace Materials Requirement Planning (MRP) systems which fell short of supporting multiple plants, multiple suppliers and multiple currencies, and did not include functions as inventory control, plant management and order processing (Kalakota & Whinston, 1997). ERP encompasses functions such as human resource planning, decision support applications, distribution and manufacturing, supply chain management, sales and marketing, etc. (Riciuti, 1992; Wolfenden, 1994; Yusuf & Little, 1998). ERP systems can be considered as an information technology infrastructure that is able to facilitate the flow of information between all supply chain processes in an organization (Martin, 1998). The ERP systems represent an optimum technology infrastructure that, when integrated properly with a process-oriented business design, can support the supply chain management systems effectively (Chen, 2000; Chen, Small, & Muscatello, 2000; Hicks, 1997; Mullin, 1997). They have also been found to be effective in reducing inventory costs, improving efficiency and increasing profitability (Al-Mashari & Zairi, 2000; Appleton, 1997; Brakely, 1999; Mullin, 1997). Researchers have also suggested that an ERP system that is not intricately tied into the supply chain will lack the ability to provide the type of business intelligence that is needed to grow the business (Carr, 1999; Hicks & Stecke, 1995; Koch, 1999).

2.3.5.3. Electronic commerce. Supporting more collaborative relationships by changing the multi-functional interactions between customers and their suppliers is enabled by electronic commerce technologies (McIvor, Humphreys, & Huang, 2000). Electronic commerce has currently become synonymous with the explosion of internet-based technology (Sawabini, 2001). It is best thought of as a platform that rides on the Internet of hypermedia information storage system that links computer-based resources around the world (Pitt et al., 1999). Given that the web is a flexible, interactive, and relatively efficient medium through which various business partners and consumers can communicate, the potential that it offers for improvements in the efficiency in channel functions is great (Griffith & Palmer, 1999; McGaughey & Mason, 1998; Roberts & Mackay, 1998; Urbaczewski, Jessup, & Wheeler, 1998). The web facilitates information sharing and process integration by providing the infrastructure shown in Figure 2.7 (Shaw, 2000). Grover and Malhotra (1997) have argued that innovations in technologies such as intranets and extranets are critical in integrating and coordinating cross-functional teams across organizational boundaries. Extranet connects enterprises to their partners, and the internet links the enterprises to their customers and other agencies (Shaw, 2000). Intranets merge the advantages of internet with those of local area networks (Chellappa, Barua, & Whinston, 1996). It provides support for electronic connections between intra-organizational partners and electronic access to operational data. Intranets use web-based and internet technology to inexpensively and easily share data across a private network (Carr, 1996); they can provide information in a way that is immediate, cost-effective, easy to use, rich in format, and versatile (Netscape Communications, 1996).

2.3.6. Strategic Purchasing

Historically, purchasing was considered to have a passive role in the business organization (Ammer, 1989; Fearon, 1989). But in the 1980s, purchasing was involved in the corporate strategic planning process (Carlisle & Parker, 1989; Spekman & Hill, 1980). By the 1990s, both academics and managers were giving much more attention to strategic purchasing (Ellram & Carr, 1994; Freeman & Cavinato, 1990; Gadde & Hakansson, 1993; Lamming, 1993; Pearson & Gritzmacher, 1990; Watts, Kim, & Hahn, 1992). The ability of purchasing to impact strategic planning has increased in a number of firms due to the rapidly changing competitive environment (Carter & Narasimhan, 1996; Spekman, Kamauff, & Salmond, 1994). The strategies pursued by purchasing are aligned with the firm's strategic plans (Aguillar, 1992; Freeman & Cavinato, 1990).

The conceptual re-description of purchasing as integration of internal and external exchange functions is concomitant with many neo-classical tasks of industrial purchasing: measuring internal customer's perception of purchasing's service quality (Young & Varble, 1997); making entrepreneurial ventures through innovation, risk-taking and proactiveness (Morris & Calantone, 1991); and establishing cooperative supplier relationships that match a firm's competitive posture (Landeros & Monczka, 1989; Watts et al., 1992). The perspective of strategic purchasing is consistent with the general strategy literature (Carr & Smeltzer, 1999). As Certo and Peter (1994) state, strategy is the attempt to direct the firm's activities toward a long-term goal. Similarly, Pearson, Ellram, and Carter (1996) state that strategic purchasing also has a proactive, long-term focus. Within the strategic purchasing context: the purchasing professionals are trained in the cross-functional areas and strategic elements of the competitive strategy

(Reck and Long, 1988); purchasing selects the right type of relationship with its suppliers and supplier relationships are strategically managed (Keough, 1994); purchasing performance is measured in terms of contributions to the firm's success (Aguillar, 1992; Reck & Long, 1988).

More and more evidence reveals that purchasing is increasingly seen as a strategic weapon to establish cooperative supplier relationships to enhance a firm's competitive stance. The strategic recognition is best evidenced by a recent action taken by the National Association of Purchasing Management (NAPM), founded in 1915. In May 2001, the NAPM membership voted to change the association's name to the Institute for Supply Management (ISM) to reflect the increasing strategic and global significance of purchasing. Thus, contemporary purchasing (See Figure 2.8) is now best recognized as a basic unit of supply chain management (Fung, 1999; Gadde & Hakansson, 1994).

2.3.7. Supply Network Structure

Traditionally, structure has been considered within a single firm or organization. Within the context of supply chain management, the structure refers to a group of firms– the firm plus its suppliers and customers. Therefore, the topic of interest is the task, authority, and coordination mechanisms across distinct firms or organizational units. Organizational structure has been defined and classified in a number of ways in the literature. A very simple way of describing organizational structure differentiates between organizations on the dimension of centralization or decentralization (Ghoshal, Korine, & Szulanski, 1994). A second approach is to classify organizational structure into functional, project, and matrix categories (Habib & Victor, 1991). Another approach is the mechanistic-organic continuum of structure (Burns & Stalker, 1961). Each of these methods in some way differentiates organizations in terms of how tasks are allocated among organizational units and how decision-making authority is specified. Organizational structure involves decisions relating to division of task, authority, and a set of coordination mechanisms (Parthasarthy & Sethi, 1992).

Williamson (1985) characterizes two extremes of governance forms: perfectly competitive markets and vertically integrated hierarchies. An intermediate form of governance is the network. A network structure is a difficult concept to define precisely, although the idea is probably relatively easy to grasp intuitively. In the literature there are a number of articles that have examined the concept (Ghoshal & Bartlett, 1990; Jarillo, 1988; Larson, 1992; Miles & Snow, 1986, 1992; Powell, 1990; Saxenian, 1991; Snow et al., 1992; Stock, Greis, & Kasarda, 1998; Storper & Harrison, 1991). Some authors take the position that there is a continuum of organizational forms with vertically integrated hierarchies at one extreme, perfectly competitive markets at the other, and networks somewhere between the two endpoints (Jarillo, 1988; Jarillo & Ricart, 1987; Thorelli, 1986). An alternative view is that a network is a distinct organizational type that cannot be considered to fall at some point between the other two (Powell, 1990). There is not a clear consensus in the literature of exactly what constitutes a network, but three dimensions can be drawn from prior research to differentiate networks from other types of organizations: vertical integration, flexibility, and cooperation. These three dimensions and their differences can be used to differentiate the basic types of organizations (hierarchy, market, and network). Vertical integration is the extent to which the firm owns the stages of the supply chain from raw materials to distribution. Flexibility is the ability to react to changes in circumstances relating to suppliers and customers.

Cooperation, control or power relates to the extent to which one firm can influence other firms in the relationship. Network firms are characterized by strong linkages between supply chain members but with low levels of vertical integration. Table 2.1 summarizes the difference between vertical and network organization on various dimensions.

Concern for the way in which firms organize the production and delivery of their goods and services is central to both economic and social theories of the firm. Transaction cost economics (TCE) concentrates on the degree of dedication of assets by one firm to another under differing exchange conditions with a view to maximizing the efficiency of the transaction (Dietrich, 1994; Williamson, 1994), whilst social network theory emphasizes inter-firm co-ordination, emphasizing the informal social systems that are linked through a network of relations (Alter & Hage, 1993; Granovetter, 1992). These entities are involved in continuous exchange relationships with the organization, with each party exerting considerable influence on the organization. Such forms of governance have been observed in a wide range of industries (Jones, Hesterly, & Borgatti, 1997) with several empirical studies (e.g., Hakansson, 1989; Turnbull & Valla, 1986) suggesting that this type of situation may be the rule rather than the exception for a wider population of business organizations in general. It has been claimed that influence or power is the central concept in network analysis (Thorelli, 1986) and is often couched in predominantly unilateral terms (dependence), whilst the more typical phenomenon is that of interdependence. In particular, there is a move away from what might be termed power-based relationships in which there is some hierarchical dependence, towards more of a network model in which there is a sense of mutual development within a partnership (Bessant, 1990).

While studies in organizational structure in general have not been lacking, research addressing the network structure conducive to supply chain performance has been very limited. It is encouraging to note that several recent studies have just broken the groundwork for future research in this area (e.g., Dyer & Nobeoka, 2000; Harland & Knight, 2001). It has been argued that organizations can proactively intervene in many widely differing networks, rather than merely cope within them (Harland and Knight 2001).

2.3.8. Supplier Relationship

2.3.8.1. Trust and commitment. Within the requirements of the new competition, a shift in the level of intensity among trading partners emerges. Co-operation, whereby firms exchange bits of essential information and engage some suppliers/customers in longer-term contracts, has become the threshold level of interaction (Spekman et al., 1998). Supply chain management is built on a foundation of trust and commitment (Kumar, 1996; Lee & Billington, 1992). The consensus is that trust can contribute significantly to the long-term stability of an organization (Heide & John, 1990). Trust is conveyed through faith, reliance, belief or confidence in the supply partner and is viewed as willingness to forego opportunistic behavior. Trust is simply one's belief that one's supply chain partner will act in a consistent manner and do what he/she says he/she will do. It is the sense of performance in accordance with intentions and expectations that hold in check one's fear of self-serving behavior on the part of the other members of the supply chain (Nooteboom, Berger, & Noorderhaven, 1997). Commitment is the belief that the trading partners are willing to devote energy to sustaining this relationship (Dion, Banting, Picard, & Blenkhorn, 1992). That is, committed partners dedicate resources to sustain and further the goals of the supply chain. To a large degree, commitment makes it more difficult for partners to act in ways that might adversely affect overall supply chain performance. Supply chain partners throughout the supply chain become integrated into their major customers' processes and more tied to their overarching goals. Supply chain partners willingly share information about future plans and designs, competitive forces, and research and development. Partners recognize their long-term success is as strong as their weakest supply chain partner.

One can co-operate or be coordinated in a supply chain but not collaborate. Figure 2.9 summarizes the requisite transition from being an important supplier to becoming a collaborating supply chain partner. Collaboration requires high levels of trust and commitment and information sharing among supply chain partners. In addition, partners also share a common vision of the future. Collaboration has become a popular topic as an integral facet of supply chain management sourcing strategies (Anderson & Narus, 1990; Bhote, 1987; Ellram, 1990; Kanter, 1994; Kapoor, 1988; Spekman & Sawhney; 1995). Collaborative behavior engages partners in joint planning and processes beyond levels reached in less intense trading relationships. A particularly interesting aspect of this belief is that it suggests that the procurement function can transcend its traditional role of contributing to "cost leadership" and can support other revenue-enhancing strategic initiatives a firm might choose such as new product development.

2.3.8.2. Supplier base reduction. In the past, American firms commonly contracted with a large number of suppliers. The underlying premises behind this tradition of multiple sourcing include: (1) competition is the basis of the American economic system; (2) purchasing must not become source dependent; and (3) multiple sourcing is a risk-reducing technique (Newman, 1989). Reduction of the supplier base is a unique characteristic of contemporary buyer-supplier relationship (Helper, 1991; Newman, 1988b). Many firms are reducing the number of primary suppliers used and allocating a majority of the purchased material requirements to a single source (Hahn, K. H. Kim, & J. S. Kim, 1986; Kekre, Murthi, & Srinivasan, 1995; Manoocheri, 1984; Pilling & Zhang, 1992; Spekman, 1988). This action provides multiple benefits including: (1) fewer suppliers to contact in the case of orders given on short notice; (2) reduced inventory management cost (Trevelen, 1987); (3) volume consolidation and quantity discounts; (4) increased economies of scale based on order volume and learning curve effect (Hahn et al., 1986); (5) reduced lead times due to dedicated capacity and work-in-process inventory from the suppliers; (6) reduced logistical costs (Bozarth, Handfield, & Das, 1998); (7) coordinated replenishment (Russell & Krajewski, 1992); (8) improved buyer-supplier product design relationship (De Toni & Nassimbeni, 1999); (9) improved trust due to communication (Newman, 1988a); (10) improved performance (Shin et al., 2000); and (11) in the long run, better customer service and market penetration (St. John & Heriot, 1993). The benefits attributable by this action can often exceed those achieved through traditional bidding from multiple sources, which often emphasizes low price at the expense of performance (Mohr and Spekman, 1994). Moreover, supply base consolidation sets the stage for future development of the chosen suppliers (Handfield, 1993a). In practice, a significant shift has occurred from the traditional adversarial buyer-seller relationships to the use of a limited number of qualified suppliers (Burt, 1989; Helper, 1991; Morgan, 1987; Offodile & Arrington, 1992; Raia, 1988, 1993).

2.3.8.3. Long-term relationship. An extended planning horizon is an important feature of relationship since each participant expects the relationship to continue for a considerable amount of time. A close relationship means that channel participants share the risks and rewards and have willingness to maintain the relationship over the long term (Cooper & Ellram, 1993; Landeros & Monczka, 1989; Stuart, 1993). Hahn et al. (1983) provide useful insights to compare the potential costs associated with different sourcing strategies. They also state that companies will gain benefits by placing a larger volume of business with fewer suppliers using long-term contracts. Through long-term relationship the supplier will become part of a well-managed chain and will have a lasting effect on the competitiveness of the entire supply chain (Choi & Hartley, 1996). De Toni and Nassimbeni (1999) found that a long-term perspective between the buyer and supplier increases the intensity of the buyer-supplier coordination. Carr and Pearson (1999) found that strategically managed long-term relationships with key suppliers have a positive impact on firms' supplier performance. Supplier contracts have increasingly become long-term, and more and more suppliers must provide customers with information of their processes, quality performance, and even cost structure (Helper, 1991; Helper & Sako, 1995). Closer, longer-term relationships with suppliers are evident in some industries, reported notably in the Japanese automotive industry (Womack et al., 1990; Lamming, 1993; Nishiguchi, 1994), the Japanese textile industry (Dore, 1983), craft based Italian industries (Lorenzoni & Ornati, 1988) and various Swedish manufacturing industries (Hakansson, 1987). This has caused increasing dependence on suppliers and the relationships with them (Christopher, 1992; Sabel, Herrigel, Kazis, & Deeg, 1987; Schonberger, 1987; Slack, 1991). The terms "partnership" and "partnership sourcing" have been used to refer to these closer, longer-term relationships with suppliers (Hines, 1994; Johnston & Lawrence, 1990; Macbeth & Ferguson, 1994).

2.3.8.4. Supplier selection. Supplier selection for specified goods and services is a critical decision for many purchasing organizations, since supply performance can have a direct financial and operational impact on the business (Baily, Farmer, Jessop, Jones, 1994). It has thus been argued that in such circumstances organizations are buying the supplier's capabilities (Croom, 1992). *Ceteris paribus*, the formal sourcing protocol relied heavily on the supplier's ability to meet cost targets. However, in practice a wider set of concerns are involved (Croom, 2001). Quality has always been one of the most important performance criteria even with a conventional purchasing strategy (Choi & Hartley, 1996; Dempsey, 1978; Dickson, 1966; Helper, 1991; Narasimhan, 1983; Weber, Current, & Benton, 1991; Willis & Huston, 1989). Trustworthiness, integrity, commitment, and characteristics that imply "fair dealing" are also considered with importance in selecting the supplier (Anderson & Narus, 1990; Lewis, 1995). Dickson (1966) states that the abilities to meet quality standard, to deliver products on time, and performance history are the most critical determinants in choosing suppliers. Many conceptual studies also emphasize that the supply management must have a quality focus (Baxter, Ferguson, Macbeth, & Neil, 1989; Manoocheri, 1984; Treleven, 1987). Helper (1991) shows that the importance of quality criteria has increased the most while that of price went up the least during the period. Choi and Hartley (1996) also found that companies place more importance on consistency (quality and delivery) and the least importance on price. On the whole, quality, on-time delivery, and uninterrupted supply become critical selection criteria because supplier failures on these dimensions have more serious adverse effects on the buyer's operations (Ellram, 1990).

2.3.9. Supplier Management

2.3.9.1. Communication. Effective two-way communication is characterized throughout the literature as essential to successful supplier relationship (Ansari & Modarress, 1990; Galt & Dale, 1991; Hahn et al., 1990; Krause, 1999; Lascelles & Dale, 1989; Newman & Rhee, 1990). Effective inter-organizational communication can be characterized as frequent, genuine, and involving personal contacts between buying and selling personnel (Giunipero, 1990). In order to jointly find solutions to material problems and design issues, buyers and suppliers must commit a greater amount of information and be willing to share sensitive design information (Giunipero, 1990; Carr & Pearson, 1999). This is often achieved through engineer-to-engineer communication on design issues in order to improve process capability, manufacturability, and performance without affecting profit margins (Bhote, 1987; Dobler, Burt, & Lee Jr., 1990; Turnbull, Oliver, & Wilkinson, 1992). Carter and Miller (1989) found that when communication occurs among design, engineering, quality control and other functions between the buyer and supplier firms, in addition to the purchasing-sales interface, the supplier's quality performance is superior to that experienced when only the buying firm's purchasing department and supplier's sales department act as the inter-firm information conduit. In their case study, Newman and Rhee (1990) found that many supplier product problems were due to poor communication. Lascelles and Dale (1989) also noted that poor communication was often a fundamental weakness in the interface between buying firm and supplier, which undermined the buying firm's efforts to achieve increased levels of supplier performance. In addition, in their ten case studies of buying firms in the UK, Galt and Dale (1991) emphasized the importance of two-way communication with suppliers and its potential positive effect on the buying firm's competitiveness.

2.3.9.2. Cross-functional teams. Managing long-term relationship with customers using cross-functional teams is becoming a common practice in supply chains (Deeter-Schmelz & Ramsey, 1995; Helfert & Vith, 1999; Moon & Armstrong, 1994; Narus & Anderson, 1995; Smith & Barclay, 1993). Teamwork is a critical component of many organizational change efforts in the 1990s. The breadth of corporate objectives pursued through teamwork indicates it is central to many attempts at wide-ranging organizational transformation (Drew & Coulson-Thomas, 1997). Organizations that are achieving transformation through increased customer focus, service and international business anticipate quite dramatic increases in team-based effort. Firms that are changing their value chain and supplier relations also anticipate major contributions through teams. The greatest changes occur in those areas of the firm that interact with outsiders–customers, suppliers and international partners (Davidow & Malone, 1992; Handy, 1990; Hastings, 1993).

Over the past several years, cross-functional teams have been identified as important contributors to the success of such efforts as supplier selection, product design (Burt, 1989), just-in-time manufacturing, cost reduction, total quality initiatives (Burt & Doyle, 1993; Ellram & Pearson, 1993), and most of all, improvised communication. Because of the wide range of supplier problems potentially addressed by supplier relationship, expertise is required from various functions (Helfert & Gemunden, 1998; Hines, 1994; Krause & Elram, 1997; Narus & Anderson, 1995). Teams dedicated to supplier development have been organized either around the material being purchased or according to supplier's needs so team members can interact with their supplier counterparts (Hahn et al., 1990).

2.3.9.3. Supplier integration. A considerable amount has been written documenting the integration of suppliers in the new product development process (Burt & Soukup, 1985; Clark & Fujimoto, 1991; Dowlatshahi, 1998, 2000; Hakansson & Eriksson, 1993; Helper, 1991; Hines, 1994; Lamming, 1993). The involvement may range from giving minor design suggestions to being responsible for the complete development, design and engineering of a specific part of assembly (Wynstra, Axelsson, & van Weele, 2000, Wynstra & Pierick, 2000). This practice can be attributed to the fact that suppliers accounted for approximately 30% of the quality problems and 80% of product lead-time problems (Burton, 1988; Naumann & Reck, 1982). Aleo (1992) discussed Kodak's early production supplier involvement program that involved suppliers in its new R&D efforts. Cayer (1988) discussed Motorola's strategy to include suppliers in the early developmental stages of new products for their technical expertise. Clark (1989) and Clark and Fujimoto (1991) discuss the use by Japanese manufacturers of suppliers in the new product development process and the potential benefits of such supplier involvement. Kamath and Liker (1994) also examine Japanese product development practices and identify a variety of roles that suppliers may play. Mabert, Muth, and Schmenner (1992) found supplier involvement to be an important part of the strategy of five out of six firms they examined that were attempting to collapse new product development time. Birou and Fawcett (1994) compared the experiences of U.S. and European manufacturers with supplier integration into product development.

Eisenhardt and Tabrizi (1994) looked at supplier involvement as one factor in reducing product development times within the computer industry. LaBahn and Krapfel (1994) examined factors that affect supplier interest in early involvement in new product development. Ragatz et al. (1997) conclude that effective integration of suppliers into new product development can yield such benefits as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology.

2.3.9.4. Supplier certification. According to Murphy (1992), supplier quality begins with supplier certification. Supplier certification involves the thorough examination of all aspects of a vendor's performance and is expected to increase buyer/supplier trust and communication, to increase supplier product quality, reduce communication errors, and to reduce inspection and inventory costs for the buyer (Inman & Hubler, 1992; Jancsurak, 1992; Larson & Kulchitsky, 1998; Lockhart & Ettkin, 1993; Schneider, Pruett, & Lagrange, 1995). Baiman et al. (1998) describes a certified supplier as a vendor who, after extensive investigation of its manufacturing operations, production capabilities, personnel, and technology, is certified to provide materials and components without routine testing of each receipt. Grieco (1989) describes supplier certification as a buyer/supplier partnership, involving higher levels of trust and communication, leading to improved quality and lower costs. Eventually, supplier certification extends to include the logistics function. Gibson, Mundy, and Sink (1995) describe the utilization of supplier certification to certify carriers and its benefits. Inman and Hubler (1992) carry the concept of supplier certification further by suggesting that manufacturers should consider certification of the supplier's product as well as its processes to avoid the situation where the supplier's product falls well within customer specifications but fails to perform as required. Maass, Brown, and Bossert (1990) conclude that a small group of organizations even encourage suppliers to pursue self-certification. American Quality Foundation and Ernst & Young (1998) in their international quality study of over 500 organizations report that "Formal programs for certifying suppliers showed an across-the-board beneficial impact on performance, especially in quality and productivity." Researchers also conclude that supplier certification supports greater joint action between buyer and supplier by providing a mechanism for screening a supplier's motivation and capabilities (Carr & Ittner, 1992; Ellram & Siferd, 1998; Heide & John, 1990).

2.3.10. Logistics Integration

Logistics provides industrial firms with time and space utilities (Caputo & Mininno, 1998). According to the traditional interpretation, it has been defined as the process of planning, implementing and controlling the efficient flow and storage of goods, services and related information as they travel from point of origin to point of consumption (Council of Logistics Management, 1998). Some of the activities that are included in the logistics domain include transportation, warehousing, purchasing and distribution. Within this model, the locus of logistics control has been the individual firm. A more recent interpretation calls for logistics to guarantee that the necessary quantity of goods is in the right place at the right time (La Londe, 1983). The reduction of organizational slack, of which inventory is a typical example, requires a close coordination as well as intensive information exchange between the supply chain partners (Caputo, 1996; Vollman, Berry, & Whybark, 1997). This current trend in using strategic partnerships and cooperative agreements among firms forces the logistics integration to extend outside the boundaries of the individual firm (Langley & Holcomb, 1992).

The traditional area of logistics integration across functional boundaries within a firm was termed as "internal integration" (Bowersox & Daugherty, 1987). The new area of logistics integration across firm boundaries is termed as "external integration" (McGinnis & Kohn, 1990; Stock et al., 1998). This has been the subject of a good deal of research in logistics management, although it is known in a variety of terms, including supply chain integration (Armistead & Mapes, 1993; Berry, Towill, & Wadsley, 1994; Cooper, Lambert, et al., 1997b; Towill, 1997), "enterprise logistics" (Drew & Smith, 1995; Fox, 1991, 1992; Wasik, 1992), and "integrated logistics" (Bowersox, 1997; Drew & Smith, 1995; Gustin, Daugherty, & Stark, 1995; Larson, 1994; Stock, 1990). This term underlines the mutual completion of procurement, production planning and distribution in order to carry out a unitary process (Busch, 1988; La Londe, Grabner, & Robeson, 1970; La Londe & Powers, 1993). Enterprise logistics integration is the extent to which a firm implements both internal and external integration. Enterprise integration would be characterized by integration of logistics activities across functional departments within the firm, as well as integration of logistics activities with the logistics activities of other supply chain members (Stock, et al., 1998). This concept of enterprise logistics integration reflects the growing importance of logistics as a coordinating mechanism among multiple units of the enterprise and, ultimately, as a source of customer value and competitive advantage.

2.3.10.1. Internal integration. Internal integration is the degree to which firms are able to integrate and collaborate across traditional functional boundaries to provide better customer service (Cespedes, 1996; Kahn & Mentzer, 1996; Kingman-Brundage et al., 1995). Stolle (1967) pointed out that managing logistical activities involve other functions within the firm; namely, marketing, finance, purchasing, and production. Coordination is required between the firm's internal supply chain departments to realize the desired benefits for the firm (Ballou, Gilbert, & Mukherjee, 2000). It is widely agreed that task interdependence is the catalyst for interdepartmental integration (Ellinger, 2000). In simpler terms, customer satisfaction is dependent on the output of more than one worker or one functional area. Benefits will be realized by companies that operate their logistics processes as an integrated system rather than by optimizing functional subsystems (Kent & Flint, 1997). Numerous empirical studies suggest that collaborative cross-functional integration is positively associated to performance (Griffin & Hauser, 1996; Kahn, 1996; Souder, 1987). Collaborative interdepartmental integration involves predominantly informal process based on trust, mutual respect and information sharing, the joint ownership of decision, and collective responsibility for outcomes (Bowersox, Daugherty, Droge, Germain, & Rogers, 1992; Griffin & Hauser, 1996; Kahn, 1996; Moenaert, Souder, DeMeyer, & Deschoolmeester, 1994; Rinehart, Cooper, & Wagenheim, 1989). Thus, collaboration between departments is often needed to ensure delivery of high quality services to customers, and involves the ability to work seamlessly across the silos that have characterized organizational structures (Liedtka, 1996). Collaborative behavior is based on cooperation (willingness), rather than on compliance (requirement). Its success is contingent upon the ability of individuals from interdependent departments to build meaningful relationships (Appley & Winder, 1977; Gray, 1989; Schrage, 1990; Tjosvold, 1988). Higher levels of internal integration would include increased coordination of logistics activities with other departments in the firm, increased importance of logistics in the overall business strategy, and a blurring of the formal distinction between logistics and other areas of the firm (McGinnis & Kohn, 1990).

2.3.10.2. External integration. External integration is the integration of logistics activities across firm boundaries. It reflects an extension of manufacturing enterprise to encompass the entire supply chain, not just an individual company, as the competitive unit (Greis & Kasarda, 1997). Managers are coordinating with companies beyond their own, seeking new ways to lower costs or improve service through such mechanisms as vendor managed inventory and just-in-time scheduling (Ballou et al., 2000). Collaboration will need to be achieved across enterprise boundaries interfacing with external suppliers, carrier partners and customers. As such, logistics is in a boundary-spanning role with these external customers as well (Bowersox & Closs, 1996; Bowersox et al., 1988; Leifer & Delbecq, 1978). Morash, Droge, and Vickery (1997) identify customer service, quality, channel distribution, and total cost maximization as major boundary-spanning interface capabilities. Although not meant to be exhaustive of logistics capabilities, these concepts are mentioned most often in modern logistics literature and are central to logistics thinking (Christopher, 1994; Lambert & Stock, 1993; Morash, 1990; Stock & Lambert, 1992). Various external logistics interactions have been examined extensively in prior research (Dolan, 1987; Vonderembse, Tracey, Tan, & Bardi, 1995; Walton & Marucheck, 1997). Higher levels of external integration would include increased logistics-related communication, greater coordination of the firm's logistics activities with those of its suppliers and customers, and more blurred organizational distinctions between the logistics activities of the firm and those of its suppliers and customers (Stock, Greis, & Kasarda, 2000).

2.3.11. Supply Chain Performance

Performance is a recurrent theme in most branches of management, and it is of interest to both academic scholars and practicing managers. While prescriptions for improving and managing performance are widely available (Nash, 1983), the academic community has been preoccupied with discussion and debates about issues of terminology, level of analysis (i.e., individual, work unit, or organization as a whole), and conceptual bases for assessment of performance (Ford & Schellenberg, 1982). The performance concept and the broader area of organizational effectiveness and its importance have been widely recognized by several authors (Connally, Conlon, & Deutsch, 1980). The treatment of performance in research settings is perhaps one of the thorniest issues confronting academic research today (Neely, 1998). With the volume of literature on this topic increasing, there appears to be little hope of reaching any agreement on basic terminology and definitions (Venkatraman & Ramanujam, 1986). Several authors have argued the importance of organizational or business performance along three dimensions: namely, (1) theoretical (Cameron & Whetten, 1983), (2) empirical (Ginsberg & Venkatraman, 1985); and (3) managerial (Nash, 1983).

The narrowest conception of business performance centers on the use of simple outcome-based financial indicators that are assumed to reflect the fulfillment of the economic goals of the firm and is referred to as the financial performance, which has been the dominant model in empirical strategy research (Hofer, 1983; Venkatraman & Ramanujam, 1987). Typical of this approach would be to examine such indicators as sales growth, profitability, earnings per share and so forth. The inadequacies of solely using financial performance measures in manufacturing have been well documented in the literature. (Chen & Lee, 1995; Dixon, Nanni, & Vollmann, 1990; Geanuracos & Meiklejohn, 1993; Hall, 1983; Johnson & Kaplan, 1987; Medori, Steeple, Pye, & Wood, 1995; Neely, 1998; Neely, Gregory, & Platts, 1995; Skinner, 1971). It has been stated (Eccles & Pyburn, 1992) that every manager knows that there are important limitations in relying exclusively on financial measures of performance. Traditional measures are at best too summarized to be useful and, at worst, they provide a very limited and often misleading picture of the performance of the organization (Tarr, 1995). Kaplan (1988) states that companies have relied on summary financial measures and have ignored the powerful opportunities for continuous improvement that a well-constructed set of non-financial operating measures can give.

Performance measurement incorporating non-financial measures has been a topic of great interest throughout most of the 1990s. This is mainly because non-financial measures overcome the limitations of just using financial performance measures (Medori & Steeple, 2000). There are many advantages of using non-financial measures: the measures are more timely than financial ones (Chen & Lee, 1995); the measures are very measurable and precise; the measures are consistent with company goals and strategies; and, non-financial measures change and vary over time as market needs change and so tend to be flexible (Medori, 1998; Medori & Steeple, 2000). Prior research has considered measures like quality, flexibility along with time-based performance. Researchers have considered different aspects of time-based performance relative to various stages of the overall value delivery cycle and have proposed several measures to evaluate them (Jayaram, Vickery, & Droge, 1999). The frequency of appearance of the items: delivery speed (Handfield & Pannesi, 1992; Vickery, Droge, Yeomans, & Markland, 1995), new product development time (Vickery et al., 1995), delivery reliability/dependability (Handfield, 1995; Roth & Miller, 1990), new product introduction (Safizadeh, Ritzman, Sharma, & Wood, 1996; Vickery et al., 1995) and manufacturing lead time (Handfield & Pannesi, 1995) suggests that they are key dimensions of time-based performance. Stalk and Hout (1990) state that there are four primary payoffs to becoming responsive to customer needs: (1) customers are more loyal; (2) customers will pay a premium; (3) customers will buy more goods and services; and (4) the firm becomes strategically advantaged when it serves the demanding customer through continual improvement of its product-delivery system. In particular, a recent study concludes that customer responsiveness is rated as the highest in terms of strategic importance (Jayaram et al., 1999). Customer responsiveness is the ability to respond in a timely manner to the needs and wants of the company's customers including potential customers (Tunc & Gupta, 1993; Ward, Duray, et al., 1995). In addition, customer responsiveness has also been recognized in the agility literature as a key aspect of time-based performance (Hendrick, 1994; Kim, 1994; Roth & Maruchek, 1993). The literature identifies rapid confirmation of orders and rapid handling of customer complaints as two key indicators of customer responsiveness (Roth & Maruchek, 1993; Stalk & Hout, 1990; Tersine & Hummingbird, 1995; Tunc & Gupta, 1993; Ward, McCreery, Ritzman, & Sharma, 1995).

2.3.11.1. Supplier performance. Suppliers play a more direct role in an organization's quality performance than is often recognized (Lascalles & Dale, 1989).

While it is possible to produce a low-quality product using excellent raw materials, it is impossible to produce a high-quality product from low-quality raw materials. Thus, the quality of supplied parts defines the upper limit for the finished product quality. Poor quality of incoming parts adds significantly to buyers' cost in terms of inspection, rework and returns, purchasing, and overproduction. Therefore, quality-oriented organizations have a few reliable, competent, and cooperative suppliers on a long-term basis (Garvin, 1987; Giunipero & Brewer, 1993; Newman, 1988b). The supplier quality management strategies, however, must result in a good supplier performance in terms of reliability, competence, and cooperation (Ahire, Golhar, & Waller, 1996). This performance, in turn, affects the final product quality. Thus, supplier quality, flexibility, delivery, responsiveness and cost performance is an intermediate outcome of the implementation of appropriate supply chain strategy.

2.3.11.2. Buyer performance. A broader conceptualization of business performance would include emphasis on indicators of operational performance (i.e., non-financial) in addition to indicators of financial performance. Financial performance measures are more likely to reflect the assessment of a firm by factors outside of the firm's boundaries. These measures would include conventional indicators of business performance, such as market share, return on investment, present value of the firm, firm's net income, and profit after sales. Operational measures of performance relate to the efficiency and effectiveness of the operations within the firm. These categories of performance reflect competencies in specific areas of manufacturing and logistics, including cost, delivery speed and reliability, quality, and flexibility. They also reflect the two arguably most important dimensions of performance-efficiency, or the ability to provide a service at a lowest possible cost, and customer service, or the ability to accommodate customers' special requests (Fawcett & Clinton, 1996). Operational performance measures provide a relatively direct indication of the effects of the relationship between the various supply chain constructs. Under this framework, it would be logical to treat such measures as return on investment, profit, present value, net income, new product introduction, product quality, marketing effectiveness, manufacturing value-added, and other measures of technological efficiency within the domain of business (Smith & Grimm, 1987; Tushman & Romanelli, 1985; Venkatraman & Ramanujam, 1986).

2.4. Need for this Research - Emphasized

Supply chain management has received attention since the 1980s, yet conceptually the management of supply chains is not particularly well-understood, and many authors have highlighted the necessity of clear definitional constructs and conceptual frameworks on supply chain management (Babbar & Prasad, 1998; Cooper, Ellram, et al., 1997; New, 1995; Saunders, 1995, 1998). Saunders (1995) highlights the fragmented nature of the field of supply chain management, drawing as it does on various antecedents including industrial economics, marketing, purchasing, logistics, and inter-organizational behavior. The scientific development of a coherent supply chain management discipline requires that advancements be made in the development of theoretical models to inform our understanding of supply chain phenomena. Further, Handfield and Melnyk (1998) note that supply chain management among a number of other emerging areas in the operations area is still in its embryonic stage. Therefore, this research is directed to explore the various factors that affect the supply chain management by consolidating research from diverse disciplines including purchasing and supply, logistics and transportation, marketing, organizational dynamics, and operations literature and to identify the relationships that will enhance the effectiveness of the supply chain management.

2.5. Conclusion

Supply chain management has become a subject of increasing interest in recent years to academics, consultants and business management. The recent popularity of the supply chain concept has been driven from many directions and there is no shortage of anecdotal evidence concerning supply-chain management, supplier development, information sharing, and partnership. But, most of this information frequently reflects a combination of possibly separate initiatives focused on disjoint topics like buyer-supplier interface, supplier development, importance of information sharing, and implementation of information technology. In this chapter, the various factors that affect the supply chain management were presented using a framework by consolidating research from diverse disciplines including purchasing and supply, logistics and transportation, marketing, organizational dynamics, and operations management. The following chapter presents the theoretical constructs of supply chain management and the research hypotheses relating them.

CHAPTER III

Methodology

3.1. Theory Development

The main focus of any research effort is to create knowledge. Knowledge can be created primarily by building new theories, extending old theories and discarding either those theories or those specific elements in current theories that are not able to withstand the scrutiny of empirical research. Pure deductive research is involved in theory testing, and any failure to confirm hypothesis would result in rethinking theory independent of the data. Inductive approaches recommend adjustments in the data to make it work and subsequently modify the theory based on these adjustments. It should also be noted that there is an increasingly vociferous group of researchers that espouse inductive research (or theory building) approaches (Eisenhardt, 1989). These approaches can use exploratory techniques (e.g., exploratory surveys) to search for patterns among variables and therefore build theory (Malhotra & Grover, 1998). Theory development reduces errors in problem solving by building upon current theory. Building upon current theory is equivalent to incorporating all that is known from the current literature into a single, integrated consistent body of knowledge (Wacker, 1998). For researchers, using a single integrated body of knowledge for analytical and empirical testing gives the results a deeper theoretical meaning by differentiating between the competing theories. An integrated body of knowledge can only be pursued efficiently if integrated theory is developed through a consistent theory-building approach.

Literature reviews, data, and intuition form the bases of most theory development methods (Lewis, 1998). Yet, focusing predominantly on one base may impede theoretical quality. Building theory largely on literature review may stifle creativity (Bourgeois, 1979). Reviews often are restricted by sparse, contradictory, or ambiguous literature and by premature exclusion of studies because of their misfit with the theorist's dominant perspective or discipline (Larsson, 1993). Grounding theory on data requires considerable primary data, usually in the form of original case studies (Eisenhardt, 1989; McCutcheon & Meredith, 1993) or survey data (Malhotra & Grover, 1998). However, the expense of developing original cases typically results in small sample sizes that inhibit the diversity of phenomena examined, often producing idiosyncratic theories (Larsson, 1993). Lack of familiarity of its procedures and rigor are also considered as serious disadvantages of case study research (Meredith, 1998). Due to its statistical rigor, surveys are preferable for theory development when a priori theory exists. From a theory building perspective, this methodology also offers empirical support for theoretical relationships in larger samples in real world (Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989) and reduces development errors in problem solving by building upon current theory (Wacker, 1998). Developing theory based predominantly on intuition like theorists' assumptions i.e., judgment, and past experiences requires entering with a hypothetical blank slate. This method potentially limits theory utility, as it risks rediscovering existing theories or developing a completely unique theory that complicates research comparisons

(Bourgeois, 1979). To foster development of higher quality theories, some theorists have prescribed using systematic processes that integrate the three bases (eg., Bourgeois, 1979; Mintzberg, 1979; Weick, 1989).

3.2. Theoretical Domain and Constructs

Supply chain management entails the management of decisions across functional and boundary spanning processes. From earlier research, it could be noted that different subject areas like purchasing and supply, logistics and transportation, marketing, organizational behavior, network, strategic management, operations management, etc., have contributed towards the core of supply management literature from different perspectives. Therefore, the domain of this research is considered to be the wider literature base. Based on the literature review from the diverse research fields, this study formulates and evaluates the interrelationships between the various factors that are of significance to the successful management of the entire supply chain. As a result of an extensive literature review in the initial phase of this study, factors such as *trust and commitment* (Kanter, 1994; Spekman & Sawhney; 1995), *supplier selection* (Choi & Hartley, 1996; Croom, 2001), *supplier certification* (Carr & Ittner, 1992; Ellram & Siferd, 1998), *internal logistics integration* (Kahn & Mentzer, 1996; Ballou et al., 2000; Ellinger, 2000) were also identified. Though these factors are of great interest, they were removed from further consideration due to the length of the survey instrument and thus, a concern on response rate.

3.2.1. Environmental Uncertainty

As discussed in the literature, environmental uncertainty may be characterized by fluctuating prices, unpredictable competitor actions, unreliability of inbound suppliers, rapid change in production processes, rapid change in customer preferences, volatile levels of demand, and/or quick product obsolescence. In this study, uncertainty in the forms of supply, demand and technology is considered. *Supply uncertainty* is based on the opportunistic behavior on the part of suppliers as well as the performance outcomes that arise from lateness and degree of inconsistency. *Demand uncertainty* is based on the variation in the demand for products and the competitive nature of the market. *Technology uncertainty* is based on the obsolescence of the process and technology used for processes and products. These constructs were operationalized based on prior research involving environmental uncertainty (Droge & Germain, 1998; Handfield, 1993b; Krause, 1999; Miller, 1991; St. John & Heriot, 1993; Stuart, 1993; van Hoek, 1998).

3.2.2. Customer Focus

Customer expectations are dynamic in nature and mostly demand a greater variety of reliable products with short lead times. It has been pointed out that, to be competitive, organizations need to assess customer requirements regularly and adjust its operations accordingly. The adoption of an explicit focus on the customer presents multiple advantages over prevailing orientations. Organizations can outperform their competition only by satisfying as well as exceeding the needs of their customers. As the customer needs to be the central element in this strategy, this theoretical construct is formulated based on the importance given to customers in the execution of strategic planning, quality initiatives, product customization, and responsiveness (Ahire et al., 1996; Carson et al., 1998; Stalk et al., 1992; Tan, Kannan, Handfield, & Ghosh, 1999).

3.2.3. Top Management Support

The major function of top management executives is to influence the setting of organizational values and to develop suitable management styles to improve the firm's performance. Prior research has noted that top management must be aware of the competitive benefits that can be derived through the impact of strategic purchasing and information technology on effective supply relationships. So, in this study, top management support is characterized in terms of time and resources contributed by top management to strategic purchasing, supplier relationship development and adoption of advanced information technology. The theoretical construct has been derived from prior research (Hahn et al., 1990; Krause, 1999; Krause & Ellram, 1997; Monczka et al., 1993).

3.2.4. Competitive Priorities

Competitive priority is described as the manufacturers' choice of manufacturing tasks or key competitive capabilities, which are broadly expressed in terms of low cost, flexibility, quality, and delivery. Prior research has noted that supply chain strategy should not be based on cost, but should be based on the issues of quality, flexibility, innovation, speed, time, and dependability. Therefore, the theoretical construct of competitive priority is derived based on non-cost initiatives, and the indicators are formulated based on prior research (Corbett & van Wassenhove, 1993; Kathuria, 2000; Miller & Roth, 1994; Santos, 2000; Stock et al., 1998).

3.2.5. Information Technology

Information technology represents the various inter-organizational systems that link the separate supply chain partners. It has vast potential to facilitate collaborative planning among them by sharing information on demand forecasts and production schedules that dictate supply chain activities. In particular, the goal of these systems is to replace inventory with perfect information. Research has shown information technology to be an effective means of promoting collaboration between collections of firms, such as groups of suppliers and customers organized into networks. Furthermore, numerous research have noted that information technology is permeating the supply chain at every point, transforming the way exchange-related activities are performed and the nature of the linkages between them. To achieve the objective of replacing inventory with information, the indicators of this construct are conceptualized to denote the presence of electronic transaction and communication in any form between the supply chain partners (Carr & Pearson, 1999; Greis & Kasarda, 1997; Vastag, Kasarda, & Boone, 1994).

The information systems used by supply chain partners may be simple electronic data interchange (EDI) systems for exchanging data such as purchase orders, advice of delivery notice and invoices or may involve more complex transactions such as integrated cash management systems, shared technical databases, internet, intranet, and extranet. Therefore, the types of information technology being used by the responding firms were captured using a separate section on the questionnaire.

3.2.6. Strategic Purchasing

Strategic purchasing relates to the specific actions the purchasing function may take to achieve its objectives. The goal of the strategic purchasing function is to support the firm's effort to achieve its long-term goals. Researchers note that if purchasing has an integrative role, then it can be characterized as a strategic function. Therefore, strategic purchasing is conceptualized by its proactive as well as long-term focus, its contributions to the firm's success, and strategically managed supplier relationship. This theoretical construct is adopted from prior research (Carr & Smeltzer, 1997, 1999; Carter & Narasimhan, 1993; Reck & Long, 1988; van Weele & Rozemeijer, 1996).

3.2.7. Supply Network Structure

Organizational structure involves decisions relating to division of task, authority, and a set of coordination mechanisms. Numerous studies have noted that in the new management of supply chain, network-based organizational structure is used widely rather than markets or hierarchies. Network firms are characterized by strong linkages between supply chain members but with low levels of vertical integration. They involve select, persistent, and a structured set of autonomous firms engaged in any value-adding process. As discussed in prior research, this study characterizes organizational structure to emphasize inter-firm co-ordination as well as to emphasize the informal social systems that are linked through a network of relations (Alter and Hage, 1993; Croom, 2001; Harland et al., 1999; Jones et al., 1997; Lambert & Cooper, 2000; Miles & Snow, 1986; Snow et al., 1992; Stock et al., 1998, 2000).

3.2.8. Supplier Relationship

Supplier base reduction has become a unique characteristic of the contemporary buyer-supplier relationship. In practice, a significant shift has occurred from the traditional adversarial buyer-seller relationships to the use of a limited number of qualified suppliers. This study follows prior research in characterizing supplier base reduction as the required nature of contemporary supply chain management. The indicators of supplier base reduction are adopted from prior research efforts (Bozarth et al., 1998; Handfield, 1993b; Kekre et al., 1995; Shin et al., 2000).

Long-term relationship denotes an extended planning horizon, which is important to the effectiveness of the buyer-supplier relationship. Prior research has shown that a close relationship means that channel participants share the risks and rewards and have a willingness to maintain the relationship over the long term. Following these guidelines, the theoretical construct is operationalized to involve the initiatives taken by the buying firm to encourage long-term relationship with their suppliers and is adopted from prior research (Krause & Ellram, 1997; Shin et al., 2000).

3.2.9. Supplier Management

Communication could be characterized as frequent, genuine, and would involve personal contacts between buying and selling personnel. In order to jointly find solutions to problems and other issues, buyers and suppliers must commit a greater amount of information and be willing to share sensitive design information. Hence, this theoretical construct is conceptualized to involve two-way communication and interaction with suppliers and is adopted from earlier research (Carr & Pearson, 1999; Carr & Smeltzer, 1999; Hahn et al., 1990; Krause, 1999; Krause & Ellram, 1997; Morgan & Zimmerman, 1990).

Over the past several years, *cross-functional teams* have been identified as an important contributor to the success of any relationship management. The breadth of corporate objectives pursued through cross-functional teamwork indicates that it is central to many attempts at wide-ranging organizational transformation. As wide range of supplier problems can be potentially addressed by supplier relationship, this construct is operationalized to define the efforts taken towards encouraging as well as using such supplier-involved teams (Ellram & Pearson, 1993; Hahn et al., 1990; Krause & Ellram, 1997; Santos, 2000).

Supplier integration is the practice of involving suppliers in the buying firm's decision making. A considerable amount has been written documenting the benefits of integrating suppliers in the new product development process as well as the business and strategic planning. This theoretical construct is based on the involvement of the suppliers in crucial project and planning processes and is adopted from prior research efforts (Croom, 2001; Dowlatshahi, 2000; Ragatz et al., 1997; Shin et al., 2000; Swink, 1999).

3.2.10. Logistics Integration

Logistics integration reflects a transformation of manufacturing enterprise to encompass all supply chain partners. Prior research has indicated that collaboration and logistics integration will need to be achieved across enterprise boundaries interfacing with external suppliers, carrier partners and customers. Grounded on earlier research, the theoretical construct of external integration is derived to include the seamless integration of the logistics function of the various supply chain partners (Stock et al., 1998, 2000).

3.2.11. Supply Chain Performance

Supplier performance is an intermediate outcome of the implementation of appropriate supply chain strategy. It has been noted in prior research that the suppliers play a more direct role in an organization's performance than is often recognized. In this study, supplier performance construct is measured in terms of quality, cost, flexibility, delivery, prompt response and other measures of technological efficiency. The indicators for this construct were based on prior research (Ahire et al., 1996; Jayaram et al., 1999; Kathuria, 2000; Shin et al., 2000; Tan et al., 1998, 1999).

Buyer performance can be measured either in terms of financial indicators or in terms of operational performance indicators. Many researchers have noted the inadequacies of solely using financial performance measures in manufacturing. Keeping the various limitations in mind, the business performance in this study is measured using indicators such as return on investment, profit, present value, net income, new product introduction, product quality and performance, manufacturing value-added, and other measures of technological efficiency within the domain of business. The indicators of business performance were adopted from earlier research (Beamon, 1999; Jayaram et al., 1999; Kathuria, 2000; Medori and Steeple, 2000; Neely, 1999; Vickery, et al., 1995).

3.3. Research Models

This section links the essential constructs of supply chain management using multiple research models. Each of the research models is formulated based on a main point of focus. The research hypotheses are presented within the domain of each of these research models.

3.3.1. Model 1: Strategic Supply Management

Figure 3.1 presents the proposed model of strategic supply management. In this model the impact of strategic purchasing on supplier relationship and supplier management constructs are studied. Supply base reduction, long-term relationships and communication are included in this model. Buyer's customer responsiveness and financial indicators are considered as performance constructs.

Numerous studies within purchasing literature point out that the strategic importance of supplier relationship and supplier management have grown in prominence due to purchasing becoming more strategic in nature (Burt & Soukup, 1985; Cousins, 1992; Cox, 1996; Ellram & Carr, 1994; Lamming, 1993; Nishigushi, 1994; Carr & Pearson, 1999). Strategic purchasing is considered pertinent to supply base reduction since the latter compromises the leveraging ability of the buying firms, and, thereby requires a totally different management style (Cousins, 1999). Many firms with strategic purchasing focus are reducing the number of primary suppliers and allocating a majority of the purchased material to a single source (Manoocheri, 1984; Hahn et al., 1986; Spekman, 1988; Pilling & Zhang, 1992; Kekre et al., 1995). Firms that conduct long-term planning and consider purchasing to be strategic are more likely to build long-term cooperative relationships with their key suppliers (Carr & Pearson, 1999). A cooperative or close relationship refers to the process of working together, over an extended period of time, for the benefit of both firms (Landeros & Monczka, 1989; Cooper & Ellram, 1993). Kraljic (1983) notes that strategic purchasing focus is critical for communication throughout the supply chain. More specifically, it has been found that information sources are related to the buyer's strategic behavior (Spekman, Stewart, & Johnston, 1995). Since strategic purchasing appears to have a significant effect on supplier base reduction, communication, and cooperative relationships, the following hypotheses are considered.

H1.1: Strategic purchasing has a positive effect on communication

H1.2: Strategic purchasing has a positive effect on supply base reduction

H1.3: Strategic purchasing has a positive effect on long-term relationships

Many researchers have shown that reduced supplier base plays a major role in the effective long-term relationship. Hahn et al. (1986) note that multiple sourcing prevents suppliers from achieving the economies of scale based on order volume and learning curve effect. Also, the multiple supplier system can be more expensive than a single supplier system (Treleven, 1987). Dowlatshahi (2000) further points out that a close and workable relationship is only achievable with a limited number of suppliers. Extant research has also pointed out the multiple benefits of supplier base reduction including long-term relationship, improvised communication, logistics improvement, supplier involvement, etc. (Deming, 1986; Dowst, 1985; Newman, 1988b; Morgan & Zimmerman, 1990; Helper, 1991; Han, Wilson, & Dant, 1993; Kekre et al., 1995; Dobler & Burt, 1996; De Toni & Nassimbeni, 1999). Hence,

H1.4: Supply base reduction has a positive effect on communication

H1.5: Supply base reduction has a positive effect on long-term relationships

Co-operation, whereby firms engage some suppliers/customers in longer-term contracts and exchange bits of essential information, has become the threshold level of interaction (Spekman et al., 1998). An extended planning horizon is a crucial characteristic of supply chain relationships, since each participant expects the relationship to continue for a considerable amount of time (Shin et al. 2000). A close relationship means that channel participants share information, risks and rewards; can rely on each other 100% of the time; and are willing to maintain the relationship into the future (Landeros & Monczka, 1989; Ellram, 1991; Cooper & Ellram, 1993; Stuart, 1993). De Toni and Nassimbeni (1999) found that a long-term perspective between the buyer and supplier increases the intensity of buyer-supplier coordination. Carr and Pearson (1999) suggest that strategically managed long-term relationships with key suppliers have a positive impact on firm's supplier performance. Furthermore, recent research shows that higher levels of trust and mutual cooperation evident in long-term relationships will improve the firms' performance as well as responsiveness (Noordewier, John, & Nevin, 1990; Oliver, 1990; Goldhar & Lei, 1991; Ring & Van De Ven, 1994; Wetherbe, 1995; Jones et al., 1997; Handfield & Nichols, 1999; Hoyt & Huq, 2000). Zeller and Gillis (1995) concur by demonstrating that businesses can increase their competitiveness by implementing a cooperative long-term supplier relationship. Hence,

H1.6: Long-term relationships have a positive effect on communication

H1.7: Long-term relationships have a positive effect on customer responsiveness

Researchers have noted that poor communication is often a fundamental weakness in the interface between a buying firm and its supplier, which undermine the buying firm's efforts to achieve increased levels of supplier performance (Lascelles & Dale, 1989; Galt & Dale, 1991). Lengnick-Hall (1998) argued that effective communication between supply chain partners can create trust and resources that will lead to competitive advantage, and eventually to improved performance. Numerous articles also point to the importance of communication in elimination of waste as well as in increasing of supplier's performance (Lascelles & Dale, 1989; Sohal & Egglestone, 1994; Lamming, 1996; Krause & Ellram, 1997; Krause, 1999; Lewis, 2000). Therefore, we test the following hypotheses, expecting communication to have positive effects on time-based performance measures.

H1.8: Communication has a positive effect on customer responsiveness

This model includes customer responsiveness as the only operational performance measure because (1) it transcends other measures due to its significance in all stages of the overall value delivery systems (Vickery et al., 1995; Jayaram et al., 1999), (2) it has the strongest effect on the firm's financial performance (Jayaram et al., 1999), and (3) other measures such as cost, quality, delivery, and flexibility have been well documented in the literature. A recent study concludes that customer responsiveness is rated as the highest in terms of strategic importance (Jayaram et al., 1999). Customer responsiveness has also been recognized in the agility literature as a key aspect of time-based performance (Roth & Maruchek, 1993; Hendrick, 1994; Kim, 1994). Therefore, in this model it is hypothesized that:

H1.9: Customer responsiveness has a positive effect on financial performance

3.3.2. Model 2: Supply Uncertainty and Quality Performance

Model 2 is developed to present the constructs that are important in negating the effect of supplier quality uncertainty. The five supplier relationship and supplier management constructs are grouped into two higher-level constructs: supplier relationship and supplier management. Since supply uncertainty is based on supplier's quality, this model includes the supplier and buyer quality as the performance measures. This model is presented in Figure 3.2.

Research on environmental uncertainty and governance form shows that even the modest levels of supply uncertainty will entice firms to integrate vertically (Helfat & Teece, 1987). But, an alternative argument is that under conditions of increased uncertainty and the lack of better alternatives, organizations in the value chain are likely to engage in collective action in order to stabilize their environment (Ouchi, 1980; Pfeffer & Salancik, 1978). Since the strategic nature of the purchasing department can facilitate the increased coordination needed with the supply chain partners, it is hypothesized that supply uncertainty can lead to increased levels of strategic purchasing. This can also result in the reduced number of primary suppliers used by the firm (Manoocheri, 1984).

Therefore, as a step towards increasing collective action and coordination, it is hypothesized that this will increase the long-term strategic relationship between the buyer and supplier.

H2.1: Supply uncertainty has a positive effect on strategic purchasing.

H2.2: Supply uncertainty has a positive effect on supplier relationship.

As argued in model 1, strategic purchasing is considered to have a positive impact on supplier relationship and management. Prior research has shown that many firms with strategic purchasing focus are reducing the number of primary suppliers and allocating a majority of the purchased material to a single source (Manoocheri, 1984; Hahn et al., 1986; Spekman, 1988; Pilling & Zhang, 1992; Kekre et al., 1995). Carr and Pearson (1999) conclude that firms that conduct long-term planning and consider purchasing to be strategic are more likely to build long-term cooperative relationships with their key suppliers. A cooperative or close relationship refers to the process of working together, over an extended period of time, for the benefit of both firms (Anderson, Britt, & Favre, 1996; Bracker and Pearson, 1986; Landeros & Monczka, 1989; Cooper & Ellram, 1993). Moreover, as the strategic nature of purchasing will make the management of suppliers much easier, the following hypotheses are considered.

H2.3: Strategic purchasing has a positive effect on supplier relationship.

H2.4: Strategic purchasing has a positive effect on supplier management.

As indicated in Model 1, prior research has pointed out the multiple benefits of effective supplier relationship including improvised communication, logistics improvement, supplier integration, and other supplier management activities (Landeros & Monczka, 1989; Ellram, 1991; Cooper & Ellram, 1993; Stuart, 1993; Dowst, 1985;

Newman, 1988b; Morgan & Zimmerman, 1990; Helper, 1991; Han et al., 1993; Kekre et al., 1995; Dobler & Burt, 1996; De Toni & Nassimbeni, 1999). Also, many researchers have noted that long-term relationship and supply base reduction encourage the suppliers to become part of a well-managed supply chain and thereby have a lasting effect on the competitiveness of the entire supply chain (Carr & Pearson, 1999; De Toni & Nassimbeni, 1999). Therefore, this model hypothesizes that supplier relationship will have a significant effect on supplier management.

H2.5: Supplier relationship has a positive effect on supplier management.

Numerous studies have pointed out the effectiveness of supplier management on supply performance. The importance of communication in eliminating waste as well as increasing supplier's performance has been noted by numerous researchers (Lascelles & Dale, 1989; Sohal & Egglestone, 1994; Lamming, 1996; Krause & Ellram, 1997; Krause, 1999; Lewis, 2000). Cross-functional teams have been identified as important contributors to the success of such efforts as product design (Burt, 1989), total quality initiatives (Burt & Doyle, 1993; Ellram & Pearson, 1993), and most of all, improvised performance. Studies also suggest that increased involvement in new product development produces greater consistency among product tolerances and process capabilities, increased refinement of product designs, and better availability of detailed process data (Bonaccorsi & Lipparini, 1994). Therefore, based on prior research, this model hypothesizes that supplier management will have a positive effect on supplier as well as buyer quality performance.

H2.6: Supplier management has a positive effect on supplier quality performance.

H2.7: Supplier management has a positive effect on buyer quality performance.

While it is possible to produce a low-quality product using excellent raw materials, it is impossible to produce a high-quality product from low-quality raw materials. Thus, the quality of supplied parts defines the upper limit for the finished product quality. Poor quality of incoming parts adds significantly to buyer's cost in terms of inspection, rework and returns, purchasing, and overproduction. Moreover, Noordewier et al. (1990) state that the supplier performance is a very important determinant of a buying firm's performance and competitiveness. Thus, supplier quality performance is hypothesized as an intermediate outcome of buyer's quality performance.

H2.8: Supplier quality performance has a positive effect on buyer quality performance.

3.3.3. Model 3: Customer-oriented Supply Management

The model depicted in Figure 3.3 presents the importance of customer focus in the effective management of the supply chain. In this model, customer focus is considered as the main driving force. The five factors of supplier relationship and supplier management have been combined to form a second-order factor called supply management. This model also considers strategic purchasing as an important construct within the customer-oriented supply management paradigm. Buying firm's customer responsiveness and customer satisfaction indicators are combined to form the customer-oriented performance measue.

Stalk et al. (1992) have noted that businesses should consider the customer as the focal point in order to perform better in this dynamic environment. Today's customers have concepts of value that go beyond some combination of quality and price. Delivering customer value implies that the firms need to know the future customer needs and preferences and focus their competitive priorities accordingly (Hoekstra, Leeflang, & Wittink, 1999). By making customers the central focus, it is also crucial that the various departments and supply partners are integrated intimately and managed strategically. Also, aligning the operations with customer needs will lead to improved business performance as well as a satisfied customer (Chernatony et al., 1992; Tan et al., 1999). Therefore, customer focus is hypothesized to have positive impact on strategic purchasing, supply management and ultimately customer-oriented performance.

H3.1: Customer focus has a positive effect on strategic purchasing.

H3.2: Customer focus has a positive effect on supply management.

H3.3: Customer focus has a positive effect on customer-oriented performance.

Due to its profound impact on all aspects of supply management, strategic purchasing is hypothesized to have a significant effect on the various factors of supply management (Burt & Soukup, 1985; Carr & Pearson, 1999; Cousins, 1992; Ellram & Carr, 1994; Hahn et al., 1986; Kekre et al., 1995; Lamming, 1993; Manoocheri, 1984; Nishigushi, 1994; Pilling & Zhang, 1992). This hypothesis follows the same guidelines as presented in the past two models.

H3.4: Strategic purchasing has a positive effect on supply management.

Recent research shows that higher levels of trust and mutual cooperation evident in long-term relationships will improve the firms' performance as well as responsiveness (Noordewier et al., 1990; Oliver, 1990; Goldhar & Lei, 1991; Ring & Van De Ven, 1994; Wetherbe, 1995; Jones et al., 1997; Handfield & Nichols, 1999; Hoyt & Huq, 2000). Numerous articles also point to the importance of communication in elimination of waste as well as in the improvement of supplier's performance (Lascelles & Dale, 1989; Sohal & Egglestone, 1994; Lamming, 1996; Krause & Ellram, 1997; Krause, 1999; Lewis, 2000). Lengnick-Hall (1998) argued that effective communication between supply chain partners can create trust and resources that will lead to competitive advantage, and eventually to improved performance. Moreover, cross-functional teams have been identified as important contributors to the success of such efforts as supplier selection, product design (Burt, 1989), Just-In-Time manufacturing, cost reduction, total quality initiatives (Burt & Doyle, 1993; Ellram & Pearson, 1993), and most of all improvised performance. Therefore, it is hypothesized that supply management will have a positive effect on customer responsiveness and customer satisfaction.

H3.5: Supply management has a positive effect on customer-oriented performance.

As indicated by Stalk et al., (1992), customers are considered as the central focus of most businesses. Customer responsiveness and customer satisfaction are the most important indicators of any organization's performance. Jayaram et al. (1999) found that customer responsiveness has the strongest effect on the firm's financial performance. It is quite intuitive that customer satisfaction leads to improved firm performance as a whole. Also, as customer responsiveness and satisfaction are important in the various stages of overall business process, it is hypothesized that the customer-oriented performance will have a positive effect on financial performance.

H3.6: Customer-oriented performance has a positive effect on financial performance.

3.3.4. Model 4: Strategic Supply Management: Effect of Supplier Integration

Model 4 discusses the importance and benefits of supplier involvement in various activities of the buying firm. In this model, long-term relationships, communication, and cross-functional teams are considered as important proponents of effective supplier integration. As noted by various researchers, in this model supplier integration is hypothesized to have a significant positive effect on various manufacturing performance measures. Performance measures such as cost, quality, delivery, flexibility, responsiveness and new product introduction time are included. Six different sub-models for each of these performance measures are proposed and evaluated. Figures 3-4 to 3-9 present these six different models.

Closer and longer-term relationships with suppliers have led to increased communication and dependence on suppliers (Sabel et al., 1987; Schonberger, 1987; Slack, 1991; Christopher, 1992). This dependence on suppliers and their integration into the buying firms' activities have further increased the usage of cross-functional teams (Deeter-Schmelz & Ramsey, 1995; Helfert & Vith, 1999; Moon & Armstrong, 1994; Narus & Anderson, 1995; Smith & Barclay, 1993). Therefore, in this model it is hypothesized that long-term relationships will have a positive effect on communication and cross-functional teams.

H4.1: Long-term relationships have a positive effect on communication.

H4.2: Long-term relationships have a positive effect on cross-functional teams.

Cross-functional integration of personnel has reportedly produced great positive effect on product development performance (Swink, 1998, 1999). Successful integration of suppliers in the new product development requires removal of barriers in communication and better coordination between the functional group members (Hauptman & Hirhi, 1996; Souder, 1987, 1998). When cross-functional personnel are accessible and team-oriented, they are presumably more proficient at intense information processing, making the organization more responsive to the design changes and thereby the customer needs (Cooper, 1988; Susman & Dean, 1992). Moreover, cross-functional teams have been identified as important contributors to the success of such efforts as supplier selection, product design (Burt, 1989), just-in-time manufacturing, cost reduction, total quality initiatives (Burt & Doyle, 1993; Ellram & Pearson, 1993), and most of all, improvised communication. Therefore, it is hypothesized that cross-functional teams will have the following effects:

H4.3: Cross-functional teams have a positive effect on communication.

H4.4: Cross-functional teams have a positive effect on supplier integration.

Carter and Miller (1989) found that when communication occurs among design, engineering, quality and other functions between buyer and supplier firms, in addition to the purchasing-sales interface, the supplier's quality performance is superior to that experienced when only the buying firm's purchasing department and supplier's sales department act as the inter-firm information conduit. Extant literature points to the importance of communication in elimination of waste as well as increasing of supplier's performance (Lamming, 1996; Lascelles & Dale, 1989; Lewis, 2000; Krause, 1999; Krause & Ellram, 1997; Sohal & Egglestone, 1994). Therefore, it is hypothesized that communication will have a profound effect on supplier involvement in the design process.

H4.5: Communication has a positive effect on supplier integration.

Suppliers are playing increasingly important roles in the new product development process (Womack et al., 1990; Ragatz et al., 1997). Case studies suggest that increased involvement in new product development produces greater consistency among product tolerances and process capabilities, increased refinement of product designs, and better availability of detailed process data (Bonaccorsi & Lipparini, 1994). Involving suppliers in this manner increases opportunities for identifying the most reliable manufacturing methods and for designing product specifications that meet process capabilities of the firm as well as its suppliers. Ragatz et al., (1997) further conclude that among others, effective integration of suppliers into new product development also yields such benefits as reduced cost and improved quality of purchased materials and reduced product development time. Therefore, supplier integration in the product development as well as strategic planning is hypothesized to have the following effect on the various supplier and buyer's manufacturing performance measures.

H4.6a: Supplier integration has a positive effect on supplier cost [reduction] performance.

H4.6b: Supplier integration has a positive effect on supplier quality performance.

H4.6c: Supplier integration has a positive effect on supplier delivery performance.

H4.6d: Supplier integration has a positive effect on supplier flexibility performance.

H4.6e: Supplier integration has a positive effect on supplier prompt response.

H4.7a: Supplier integration has a positive effect on buyer cost [reduction] performance.

H4.7b: Supplier integration has a positive effect on buyer quality performance.

H4.7c: Supplier integration has a positive effect on buyer delivery performance.

H4.7d: Supplier integration has a positive effect on buyer flexibility performance.

H4.7e: Supplier integration has a positive effect on buyer customer responsiveness.

H4.9: Supplier integration has a positive effect on buyer new product introduction time reduction.

Noordewier et al. (1990) state that the supplier performance is a very important determinant of a buying firm's performance and competitiveness. Moreover, numerous prior studies have considered supplier performance as one of the determining factors for the company's operational performance (Baxter et al., 1989; Davis, 1993). Thus, in this model supplier performance is hypothesized as an intermediate outcome of buyer's performance.

H4.8a: Supplier cost performance has a positive effect on buyer cost performance.

H4.8b: Supplier quality performance has a positive effect on buyer quality performance.

H4.8c: Supplier delivery performance has a positive effect on buyer delivery performance.

H4.8d: Supplier flexibility performance has a positive effect on buyer flexibility performance.

H4.8e: Supplier prompt-response performance has a positive effect on buyer customer responsiveness.

3.3.5. Model 5: Supply Management and Performance: Effects of Business and Purchasing Strategy

The main focus of Model 5 is the strategic elements of the business as well as the purchasing department. This model includes important strategy-oriented constructs like top management support, competitive priorities and strategic purchasing. Supplier relationship and supplier management were introduced as second-order constructs. Performance of the supplier and buyer are measured in terms of various manufacturing-related measures. Since the competitive priorities construct is based on non-cost initiative, individual non-cost based performance measures are grouped to form a separate manufacturing performance measure for the supplier and buyer. Figure 3-10 presents this model.

Research has proven that the strategic focus of the purchasing department is influenced profoundly by the top management support (Carr & Smeltzer, 1997). The status of the purchasing function refers to the purchasing's strategic role emphasized by top management (Krause, 1999). Krause and Ellram (1997) noted that top management must initiate the supplier development programs and Monczka et al. (1993) noted that top management must commit the time, personnel and financial resources to support the suppliers. Blenkhorn and Leenders (1988) point out that top management must encourage the adoption of a more long-term and aggressive strategic perspective toward suppliers. Based on these earlier conclusions, the following hypothesis has been formulated to test the effect of top management support on strategic purchasing.

H5.1: Top management support has a positive effect on strategic purchasing.

As argued in Model 2, this model also hypothesizes strategic purchasing to have a positive impact on supplier relationship and management (Carr & Pearson, 1999; Cooper & Ellram, 1993; Manoocheri, 1984; Landeros & Monczka, 1989; Hahn et al., 1986; Spekman, 1988; Pilling & Zhang, 1992; Kekre et al., 1995).

H5.2: Strategic purchasing has a positive effect on supplier relationship.

H5.3: Strategic purchasing has a positive effect on supplier management.

Competitive priorities can be expressed in terms of low cost, flexibility, quality, and delivery (Corbett & Van Wessenhove, 1993; Miller & Roth, 1994). The choice of any competitive priority requires the capability of the various functions and the supply chain partners to coordinate the efforts during planning and execution of the various programs in order to achieve the capabilities and objectives related to the competitive priorities (Santos, 2000). This needs a better coordination of the cross-functional and inter-firm efforts by facilitating improvised supplier relationship and management. Therefore, it is intuitively hypothesized that competitive priorities will have the following effect on other theoretical constructs.

H5.4: Competitive priorities have a positive effect on supplier relationship.

H5.5: Competitive priorities have a positive effect on supplier management.

Similar to the arguments presented in Model 2, this model also recognizes the multiple benefits of effective supplier relationship on supplier management activities (Carr & Pearson, 1999; De Toni & Nassimbeni, 1999; Landeros & Monczka, 1989; Ellram, 1991; Cooper & Ellram, 1993; Stuart, 1993; Dowst, 1985; Newman, 1988b; Morgan & Zimmerman, 1990; Helper, 1991; Han et al., 1993; Kekre et al., 1995; Dobler & Burt, 1996). Hence, this model hypothesizes that supplier relationship will have a significant effect on supplier management.

H5.6: Supplier relationship has a positive effect on supplier management.

The importance of supplier management has been noted extensively in the prior models. Along the same line, this model also hypothesizes that supplier management will have a positive effect on supplier as well as buyer manufacturing performance.

H5.7: Supplier management has a positive effect on supplier manufacturing performance.

H5.8: Supplier management has a positive effect on buyer manufacturing performance.

As considered in prior models, this model also considers suppliers' manufacturing performance as an intermediate outcome of buyers' manufacturing performance. Hence, it is hypothesized that:

H5.9: Supplier manufacturing performance has a positive effect on buyer manufacturing performance.

3.3.6. Model 6: Impact of Supply Network Structure on Supplier Management and Performance

Model 6, depicted in Figure 3-11, focuses on the importance of supply network structure. Though supplier relationship is made up of two sub-constructs, this model includes only the long-term relationship construct. Communication, cross-functional teams and supplier integration are grouped together to form the second-order construct of supplier management. Performance of the supplier and buyer are measured in terms of various manufacturing related measures. The individual non-cost based performance measures are grouped to form separate manufacturing performance measures for the supplier and buyer. The cost-based performance indicators were not included due to concern on the internal consistency [reliability] of the latent performance variables.

Network organization structure presents a sense of mutual development between the supply chain partners (Croom, 2001). Network theory touts inter-firm co-ordination, emphasizing the informal social systems that are linked through a network of relations (Alter and Hage, 1993). Firms in a networked structure are characterized by strong linkages between the supply chain members but with low levels of vertical integration. They involve select, persistent, and structured set of autonomous firms engaged in any value-adding process. Therefore, a horizontally integrated network organization is hypothesized to facilitate the long-term relationships, communication, involvement, and cross-functional teams needed for the successful supplier relationship management.

H6.1: Network supply structure has a positive effect on long-term relationships.

H6.2: Network supply structure has a positive effect on supplier management.

Prior research has found that a long-term perspective between the buyer and supplier increases the intensity of the buyer-supplier coordination (Carr & Pearson, 1999; Choi & Hartley, 1996; De Toni & Nassimbeni, 1999). This dependence on suppliers and their integration into the buying firms activities will increase effective communication, usage of cross-functional teams, and supplier integration (e.g., Helper, 1991; Han et al., 1993; Kekre et al., 1995; Dobler & Burt, 1996; Deeter-Schmelz & Ramsey, 1995; Helfert & Vith, 1999; Moon & Armstrong, 1994; Narus & Anderson, 1995; Smith & Barclay, 1993). Hence,

H6.3: Long-term relationships have a positive effect on supplier management.

The importance of supplier management has been noted extensively in the prior models. Based on similar assumptions, this model also hypothesizes that supplier management will have a positive effect on supplier as well as buyer quality performance.

H6.4: Supplier management has a positive effect on supplier manufacturing performance.

H6.5: Supplier management has a positive effect on buyer manufacturing performance.

This model also recognizes suppliers' manufacturing performance as an intermediate outcome to buyers' manufacturing performance. Hence, it is hypothesized that:

H6.6: Supplier manufacturing performance has a positive effect on buyer manufacturing performance.

3.3.7. Model 7: Agile Supply Chain: Benefits of Information Technology

The primary focus of this model is to study the significance of inter-organizational information systems in agile supply chains. This model includes environmental uncertainties as an important driving force. Among the various supplier relationship and supplier management factors only long-term relationship and communication are considered in this model. Agility performance of the supplier and buyer are measured in terms of various time-based indicators. Figure 3-12 presents the proposed structural model of information technology.

Prior research has shown that perceived environmental uncertainty exerts a considerable influence on organizational processes (Huber & Daft, 1987; Huber et al., 1975). Under conditions of increased uncertainty and the lack of better alternatives, organizations in the value chain engage in collective action so as to stabilize their environment. This will require excellent coordination between the supply partners on both the supply and customer side. Therefore, it is hypothesized that increased uncertainty will lead to increased use of information technology as it will help in stabilizing the environment by facilitating coordination between the partners and sharing of information across boundaries.

H7.1: Environmental uncertainties have a positive effect on information technology.

Research has shown information technology to be an effective means of promoting collaboration between collections of firms, such as group of suppliers and customers organized into networks. Information technology is noted to have a profound effect on collaborative relationships by facilitating cross-functional interactions between the supply chain partners (Grover & Malhotra, 1997). It eliminates the barriers between functional areas and firms for a smooth information flow. In addition, all non-value adding activities are eliminated by avoiding congestion in different supply chain partner firms. Information technology also enables the role of the purchasing function to move from being involved in clerical type activities to include strategic activities such as integrating suppliers into new product development and joint planning (McIvor et al., 2000). Among others, the potential benefits of information technology include instantaneous communication integrated into the environment, customized products, a bigger market share, a better understanding of customers' needs, real-time accurate information, applicability of postponement, cost-efficient productivity, time-efficient productivity, better customer service, better competitive advantage, and winning new customers (Al-Mashari & Zairi, 2000; Bowersox, Stank, & Daugherty, 1999; Griffith & Palmer, 1999; Iacovou & Benbasat, 1995; Konsynski, 1993; Kwan, 1999; Massetti & Zmud, 1996; Mukhopadhyay et al., 1995; Ramaseshan, 1997; Walton & Marucheck, 1997). Thus, it is hypothesized that information technology will have a positive effect on long-term relationships and communication.

H7.2: Information technology has a positive effect on long-term relationships.

H7.3: Information technology has a positive effect on communication.

As discussed in prior models, long-term relationship between the supplier and buyer will increase the intensity of the relationship between them. The increased interaction between them will foster a smooth two-way communication (Carr & Pearson, 1999). Due to increased market share and improvised relationship between the players, the reliability and dependence of the suppliers increases. This model purports that increased reliability will eventually stream line the relationship management, thereby, resulting in improved supplier agility. Therefore, it is hypothesized to have the following effect.

H7.4: Long-term relationships have a positive effect on communication.

H7.5: Long-term relationships have a positive effect on supplier agility.

The important ingredient in expediting the transaction between the supply partners is the communication channel that exists between them. Information sharing through inter-firm communication will effectively replace inventory and thereby lead to an agile supply chain (Billington & Amaral, 1999). Therefore, it is hypothesized that communication will significantly improve supplier agility.

H7.6: Communication has a positive effect on supplier agility.

As indicated earlier, this model also considers supplier agility performance as an intermediate outcome of buyer agility performance.

H7.7: Supplier agility has a positive effect on buyer agility.

3.3.8. Model 8: Supply Strategy-Structure Fit: Effect on Supply Management

This model (depicted in Figure 3-13) studies the importance of fit or alignment between purchasing strategy and supply network structure. The five factors of supplier relationship and supplier management have been combined to form a second-order factor called supply management. This model includes both operational as well as financial indicators to measure the buying firm's performance.

Due to its profound impact on all aspects of supply management, strategic purchasing is hypothesized to have a significant effect on the various factors of supply chain management (Burt & Soukup, 1985; Carr & Pearson, 1999; Cousins, 1992; Ellram & Carr, 1994; Hahn et al., 1986; Kekre et al., 1995; Lamming, 1993; Manoocheri, 1984; Nishigushi, 1994; Pilling & Zhang, 1992). This hypothesis follows the same guidelines as presented in the previous models.

H8.1: Purchasing strategy has a positive effect on supply management.

As noted earlier, this model also recognizes that networked firms are characterized by strong linkages between supply chain members but with low levels of vertical integration. Therefore, a horizontally integrated network based supply structure is hypothesized to facilitate the supplier relationships, communication, involvement, and cross-functional teams needed for the successful management of the supply chain activities.

H8.2: Supply network structure has a positive effect on supply management.

Since the seminal work on strategy and structure by Chandler (1962), numerous researchers have studied the relationship between strategy and structure. Most of them have demonstrated that the successful implementation of strategies is influenced by the alignment or fit between strategy and structure (Chandler, 1962; Miles & Snow, 1978; Uyterhoeven, Ackerman, & Rosenblum, 1977). This model extends the importance of single-firm strategy-structure alignment to the context of networked firms in supply chains. It suggests that a better alignment or fit between the purchasing strategy and supply network structure will lead to a better management of the entire supply chain.

H8.3: Purchasing strategy-structure fit [interaction] has a positive effect on supply management.

Based on a complementary strategy, structure and strategy-structure alignment this model asserts that supply management will have a positive impact on the buyer performance, both operational and financial. Moreover, it recognizes that operational and financial performance measures provide a relatively direct indication of the effectiveness of the management of the supply chain.

H8.4: Supply management has a positive effect on buyer operational performance.

H8.5: Supply management has a positive effect on buyer financial performance.

Operational measures of performance relate to the efficiency and effectiveness of the operations within the firm. Due to this very nature, it is hypothesized that operational performance measures leads to improved financial performance

H8.6: Buyer operational performance has a positive effect on buyer financial performance.

3.3.9. Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility

The main focus of this model is external logistics integration. It presents the critical driving forces of effective integration of the logistics activities. The driving forces considered in this model include purchasing strategy, supply structure, and information technology. Performance is measured in terms of the agility of supply chain partners. Agility Performance of the supplier and buyer are measured in terms of various time-based indicators. Figure 3-14 presents the proposed structural model of external logistics integration.

Researchers note that the strategic nature of purchasing reflects its integrative role (Freeman & Cavinato, 1990; Gadde & Hakansson, 1993; Ellram & Carr, 1994). The conceptual re-description of purchasing as integration of internal and external exchange functions shows that it will be conducive to networked supply structure and enterprise-wide logistics integration. Therefore, purchasing strategy is hypothesized to have a positive effect on supply structure and logistics integration.

H9.1: Strategic purchasing has a positive effect on supply structure.

H9.2: Strategic purchasing has a positive effect on logistics integration.

Information technology is very vital in supporting strategic and operational logistics decisions. It enhances supply chain logistics efficiency by providing real-time information regarding product availability, inventory level, shipment status, and production requirements (Radstaak & Ketelaar, 1998). In particular, it has vast potential to facilitate collaborative planning among supply chain partners by sharing information on demand forecasts and production schedules that dictate supply chain activities (Karoway, 1997). Furthermore, information technology can effectively link customer demand information to upstream supply chain functions (e.g., manufacturing, distribution, and purchasing) and subsequently facilitate "pull" (demand driven) supply chain operations (Min & Galle, 1999). Therefore, this model hypothesizes that information technology will lead to better integration of the external logistics activities.

H9.3: Information technology has a positive effect on logistics integration.

As noted earlier, a network supply structure is characterized by strong linkage between the supply partners. The decentralized, non-power based organizational structure touted by network organizations is conducive to effective communication and exchange of information. This enterprise wide interaction facilitated by network supply structure will support effective logistics integration (Stock et al., 2000). Therefore, it is hypothesized that network supply structure will have a positive effect on logistics integration.

H9.4: Supply network structure has a positive effect on logistics integration.

An organization's performance is only as good as the weakest link in its supply chain. This notion reflects the importance of logistics as a coordinating mechanism among multiple units of the enterprise and ultimately, as a source of customer value and competitive advantage (Stock et al., 2000; Vonderembse et al., 1995). Improvised logistics coordination will also enable the supply chain partners to practice agile just-in-time production approach. Therefore, logistics integration is hypothesized to have the following impact on supplier and buyer agility.

H9.5: Logistics integration has a positive effect on supplier agility.

H9.6: Logistics integration has a positive effect on buyer agility.

As hypothesized in the earlier models, this model also considers supplier performance measure as an intermediate outcome. Improved supplier agility is considered to have a significant positive effect on buyer agility.

H9.7: Supplier agility has a positive effect on Buyer agility.

3.3.10. Model 10: Information Technology-Communication Fit: Effect on Logistics Integration

This model presents the importance of information technology and communication for effective logistics integration. Numerous studies have noted the importance of logistics information systems. Similarly, the impact of communication is also presented by various studies. This model takes a step further in evaluating the effect of alignment or fit between information technology and communication on logistics integration. Performance is measured in terms of the financial indicators of the buying firm. Figure 3-15 presents the proposed structural model.

Information technology can facilitate enterprise-wide logistics integration by providing the right information at the right time (Chiu, 1995). Furthermore, by replacing inventory with information, it can effectively link customer demand information to upstream supply chain functions and subsequently facilitate lean as well as agile operations (Min & Galle, 1999). Information technology enhances supply chain efficiency by providing real-time information regarding product availability, demand forecasts, inventory level, shipment status, and production schedules and requirements (Karoway, 1997; Radstaak & Ketelaar, 1998). Therefore, information technology is hypothesized to have the following effect.

H10.1: Information technology has a positive effect on logistics integration.

Extant literature has noted that inter-organizational communication is very vital to successful supplier relationships (Lascelles & Dale, 1989; Ansari & Modarress, 1990; Hahn et al., 1990; Newman & Rhee, 1990; Galt & Dale, 1991; Krause, 1999). Effective two-way communication will lead to exchange of pertinent information like production demand, inventory level, and shipment status. Thus, it can eliminate gap or discrepancies in the integration of the logistics activities. So, it is hypothesized that communication among the supply partners will lead to a better logistics integration.

H10.2: Communication has a positive effect on logistics integration.

Hypothesis 10.1 and 10.2 studies the impact of information technology and communication on logistics integration separately. But, information technology facilitates independent companies to maintain close links by facilitating cross-company interaction and electronic transaction-based communication exchange (Clarke, 1992; Grover & Malhotra, 1997). It eliminates the barriers between functional areas and firms for a smooth information flow. Thus, it is hypothesized that the fit between information technology and communication is critical to enterprise-wide logistics integration.

H10.3: Information technology-communication fit [interaction] has a positive effect on logistics integration.

Logistics integration ensures faster availability of products to members of the supply chain and thus ultimately to the end customer. The previous model recognized that it enhances the agility of the supply chain members. In this model, it is hypothesized that logistics integration will ultimately have a positive effect on financial performance.

H10.4: Logistics integration has a positive effect on buyer financial performance.

3.3.11. Other Research Questions

Geographic dispersion. Geographic dispersion of supply chain members is a very important factor in the integration of logistic activities. St. John and Heriot (1993) note that identifying local suppliers reduces the extent of supply uncertainty. But, the various cost-saving opportunities available to companies within a global market have increased the use of suppliers around the world. Exchange of information between suppliers in this new era of global supply chain management is significantly different. To study the differences, if any, Model 10 is extended and analyzed using split samples based on the global dispersion of the suppliers.

Information technology usage. Inter-organizational information systems may be simple electronic data interchange (EDI) systems for exchanging data such as purchase orders, advice of delivery notice and invoices or may involve more complex transactions such as integrated cash management systems, shared technical databases, internet, intranet, and extranet (Min & Galle, 1999). Five survey questions were used to evaluate the extent of usage of the various information technologies. Depending on the complexity and extent of the information system infrastructure, the expenditure involved might vary. Given the extent of expenditure involved, demographic characteristics like size and sales volume of the firm could distinguish the type of information technology used in communicating with the supply partners. A simple analysis is conducted to find out the extent of usage of the various information technologies.

3.4. Data Collection

3.4.1. Methodology

Empirical methodologies provide empirical verification of models and relationships, while offering evidence for the development of new theory. There are many types of research: structured and unstructured interviews, telephone surveys, mail survey, historical/archival research, expert panel, Delphi technique that fall in this category. Survey is undoubtedly the most commonly used research design in operations management. Emory (1980) relates surveying as the questioning of respondents and recording their responses to be used as data for analysis. There is a variety of ways to question respondents. It can be done by face-to-face interviewing, by telephone, by mail, or by a combination of these methods. A mail survey is considered to be appropriate for respondents who are widely dispersed because they may not otherwise be accessible and may require time to gather information relevant to a response. Emory (1980) has further identified these very items as strengths of the mail survey. This study will therefore utilize a cross-sectional mail survey within the United States to develop an instrument for Supply Chain Management strategy. In an effort to increase the response rate, a modified version of the methodology of Dillman's total design method was followed (Dillman, 1978). All mailings were sent via first-class mail to the respondents. The initial mailing included a cover letter, the survey, and a postage-paid return envelope. Two weeks after the initial mailing, reminder postcards were sent to all potential respondents. For those who did not respond, a second mailing of surveys, cover letters, and postage-paid return envelopes were mailed approximately 28 days after the initial mailing.

3.4.2. Survey Instrument

The survey instrument design was focused in generating a good response rate and at the same time helping develop a sound instrument. A single questionnaire is used to measure multiple theoretical constructs of supply chain management. Most of the theoretical construct is made up of four items (Cronbach & Meehl, 1955) or more (Likert, 1932; Spector, 1992). Likert scale of measurement is used to measure the items. The number of points in the Likert scale should be considered carefully. Reliability increases as the number of scale points increases to five and continues to increase at a much smaller rate for additional points above five (Lissitz & Green, 1975). A 7-point Likert scale is used for all applicable items in order to ensure higher statistical variability among the survey responses (Ahire et al., 1996; Roth & Miller, 1992; Saraph, Benson, & Schroeder, 1989; Schonberger, 1983). As reverse-scored items may reduce the validity as well as induce systematic errors (Hinkin, 1995; Jackson, Wall, Martin, & Davids, 1993; Schriesheim & Hill, 1981), they were not used extensively in the survey instrument. The questions have been placed in a logical order so that the completion of the questionnaire is easy for the respondents (Flynn, Schroeder, & Sakakibara, 1994). Appendices 1 and 2 presents a copy of the cover letter and the survey sent to the respondents.

3.4.3. Unit of Analysis

The unit of analysis in this study is the dyadic relationship between the buyer and supplier. As the purchasing department is the most important link in this dyadic relationship, it will be the best candidate to answer the various research questions posed in this study. Therefore, the purchasing department of the buying firm is targeted in order to accumulate the necessary information that is important towards the development of a unified theoretical domain of supply chain management. Figure 3.16 illustrates the data acquisition process utilized in this study.

3.4.4. Sample Selection

A study by the National Association of Purchasing Management (Muller, 1990) evaluated the amount of divergence in purchasing activities for different types of industries. A survey with 1500 respondents revealed that there were few differences in terms of the general tasks or duties that were performed in different sectors. This relationship result suggests that the purchasing activities and relationships faced by managers in different industries are of a fairly homogeneous nature, justifying the use of a cross-industry sample. Therefore, a cross-industry sample is believed to be appropriate for studying the constructs and their relationships proposed in this study. The sample frame will consist of members of Institute for Supply Management (ISM). The title of the specific respondent being sought from the sample companies would typically be Chief Purchasing Officer, Director of Purchasing, Vice President of Purchasing, Vice President of Materials Management, Purchasing Manager. Due to budget constraints, the sample size was restricted to 1000.

3.5. Measurement Instrument Development and Hypotheses Testing

In any instrument development study, it is imperative that the new instrument is creditable as well as usable by future researchers in developing the body of knowledge. Therefore, it is important to conduct a thorough measurement analysis on the instrument (Flynn et al., 1994) in order to reduce measurement errors (Churchill, 1979). A thorough analysis encompasses the assessment of reliability, validity and unidimensionality. Bohrnstedt (1983) has documented the importance of establishing the reliability and validity of a measurement instrument. He states that survey researchers would not deny the importance of knowing the degree to which items would give a consistent and repeatable result (reliability) and knowing whether or not one's items measure what they are intended to measure (validity). Furthermore, Gerbing and Hunter (1982) describe that achieving unidimensional measurement is an essential undertaking in theory testing and development.

3.5.1. Reliability

Reliability concerns the accuracy and precision of a measurement procedure and the estimates of the degree to which a measurement is free of random or unstable error. Reliability is a prerequisite to validity, but not sufficient (Schwab, 1980). There are a number of methods for measuring various aspects of reliability. The three most commonly used perspectives on reliability are: stability, equivalence and internal consistency. *Stability* measures the extent to which the questionnaire, summated scale or item that is repeatedly administered to the same people will yield the same results. Test-retest methodology can be used to test the stability of an instrument. *Equivalence* considers how much error is introduced by constructing two equivalent forms of the same instrument and administering them to a common set of subjects over time. This can be tested using parallel or alternative forms of the same instrument (Cronbach, 1951; Nunnaly, 1978; Sellitz, Wrightman, & Cook, 1976). Internal consistency assesses the homogeneity of the instrument and is important when there is only one form of a measure available. There should be a high degree of inter-correlation among the items that comprise the measure or summated scale. Internal consistency can be estimated using a reliability coefficient such as Cronbach's alpha (Cronbach, 1951; Hull & Nie, 1981; Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975; Nunnaly, 1978; Sellitz et al., 1976). The calculation of Cronbach's alpha can be obtained from the variance/covariance matrix (Fornell & Larcker, 1981), or by evaluating the average correlation among items in a scale (Bohrnstedt, 1983; Brown, 1983; Nunnaly, 1978). Typically, reliability coefficients of 0.70 or more are considered adequate (Cronbach, 1951; Nunnaly, 1978; Sellitz et al., 1976). Nunnaly (1978) further states that permissible alpha values can be slightly lower (0.60) for new scales. Bagozzi and Yi (1988) suggest that the average variance extracted for a construct should exceed 0.50. Also, a slightly lower alpha value for a scale with a smaller number of items is considered permissible.

3.5.2. Validity

The validity of a measure is the degree to which it measures what it is intended to measure. There are usually three different types of validity measures: *content validity, construct validity* and *criterion-related validity*. *Content validity* of an instrument is the extent to which it provides adequate coverage for the construct domain or essence of the domain being measured (Churchill, 1979). The determination of content validity is not numerical, but subjective and judgmental (Emory, 1980). It can be achieved by consulting the theoretical basis of items in the literature or a panel of experts who are well versed with the domain (Flynn et al, 1994). *Construct validity* is the extent to which the items in a scale measure the abstract or theoretical construct (Carmines & Zeller, 1979; Churchill, 1987). Testing of construct validity concentrates not only on finding out whether an item loads significantly on the factor it is measuring *"Convergent,"* but also on ensuring that it measures no other factors *"Discriminant"* (Campbell & Fiske, 1959). It can be tested either using the correlation between total scores and item scores or using factor analysis (Kerlinger, 1978; Kim & Mueller, 1978; Spector, 1992). *Criterion (Predictive or External) validity* is a measure of how well the scales representing various constructs (predictor) measure an objective outcome "criterion" (Saraph et al., 1989). Testing of this validity reflects the success of the measures towards empirical estimation purpose. It can be tested either using simple correlation or canonical correlation depending on the number of outcome measures (Hair, Anderson, Tatham, & Black, 1995; Nunnaly, 1978).

3.5.3. Unidimentionality

Assessing unidimensionality means determining whether a set of indicators reflect one, as opposed to more than one, underlying factor (Droge, 1997; Gerbing & Anderson, 1988). Unidimentionality checks the extent to which items on a scale estimate that construct or factor (Hattie, 1985; McDonald, 1981). There are two implicit conditions for establishing unidimensionality. First, an empirical construct must be significantly associated with the empirical representation of a construct and, second, it can be associated with one and only construct (Anderson & Gerbing, 1982; Hair et al., 1995; Phillips & Bagozzi, 1986). A measure must satisfy both of these conditions in order to be considered unidimensional. Lack of unidimensionality can lead to artificial correlations among constructs developed. Gerbing and Hunter (1982) describe that achieving unidimensional measurement is a crucial undertaking in theory testing and development. Unless supported by a plausible theoretical underpinning, absence of unidimensionality in scales will lead to distorted findings. Venkataraman (1989) supports this by concluding that a single number cannot be used to represent the value of a scale in the absence of unidimensionality.

3.5.4. Procedure

An iterative procedure (Figure 3.17) was used to develop an instrument that satisfied all the requirements of reliability, validity and unidimensionality. This procedure is different from those presented by Saraph et al. (1989) and Flynn et al. (1994) in that it uses confirmatory factor analysis which is more applicable for *unidimensional* measurement (Ahire et al., 1996; O'Leary-Kelly & Vokurka, 1998). Content validity was verified both by strong literature underpinning and by pre-testing the instrument using a panel of experts within the regional ISM chapter. Reliability was determined using the internal consistency method estimated by Cronbach's alpha. As the scales being developed in this study are both new and adopted from prior research, in general, alpha value of 0.60 was considered as the cut-off value. A three-step approach as presented by Flynn et al., (1994) was used in selecting scales after the calculation of Cronbach's alpha. First, the scales were accepted as is if the Cronbach's alpha value is greater than 0.7. Second, the scales within the acceptable Cronbach alpha of at least 0.6 were further evaluated for the possibility of improvement. Items that contribute least to the overall internal consistency were the first to be considered for exclusion. Third, a similar elimination procedure was performed on the scales that failed to achieve the minimum value of alpha. The items with the least correlation value were deleted prior to others. If the scale still failed to achieve the target value of Cronbach alpha, it was discarded. The item inter-correlation matrix was utilized in determining the items that contributed the least, and thus are the best candidates for deletion. The items that were negatively correlated to other items within a scale were first discarded before conducting exploratory factor analysis. Also, the items with correlation value below 0.10 were discarded from consideration. The cut-off value of 0.30 as given by Flynn et al. (1994) was not to be used to discard the items, but to mark them for possible deletion. Using exploratory factor analysis (principal component), items were discarded after comparing their loading on the scale they are intended to measure and other scales. Also, the nuisance items identified using factor analysis were deleted. Nuisance items are those that did not load on the factor they measure, but on other factors they are not intended to measure. After analyzing the data using exploratory factor analysis (principal component), the data was analyzed using confirmatory factor analysis so as to ensure unidimensionality. Joreskog and Wold (1982) conclude that confirmatory factor analysis or confirmatory measurement model using the maximum likelihood estimate is the best method in achieving unidimensional measurement for theory testing and development. Testing of the research models will further consolidate the criterion validity of the instrument. The research models were tested using the structural equation modeling technique. As this technique is a comprehensive approach, many interrelated hypotheses were tested using a complete model. Another major advantage of using structural equation modeling is the ready accessibility to indirect and total effects in addition to the direct causal effects between the exogenous and endogenous variables. The following sections present some brief information on structural equation modeling technique.

3.6. Structural Equation Modeling

Structural equation modeling (SEM), also referred to as *latent-variable analysis* or *linear structural relationships* (Duncan, 1975), is a comprehensive statistical approach for testing hypotheses about the relationships among observed and latent variables. Statistical theory that underlies SEM appears as early as the1970s (e.g., Joreskog, 1973; Keesling, 1972; Wiley, 1973), SEM, however, has received widespread attention from the researchers only recently (e.g., Anderson, 1987; Bagozzi, 1982; Bentler, 1980; Bollen & Ting, 1991; Joreskog & Sorbom, 1993; Saris & Stronkhorst, 1984). Due to the increasing complexity and specificity of research questions and also the appearance of flexible, extensive, and user-friendly computer software (e.g., (Bentler, 1992; Bentler & Wu, 1993; Joreskog & Sorbom, 1989; Joreskog & Sorbom, 1999), SEM has evolved as a superior and increasingly popular approach in analyzing hypotheses. Detailed explanation of the mathematical and statistical aspects of structural models can be found in sources such as Bollen (1989), Bollen & Long (1993), Hayduck (1987), Hoyle (1995), Maruyama (1997), and Schumacker & Lomax (1996).

3.6.1. Benefits of SEM

The primary basis for causal inference in SEM is the same as the basis for causal inference in any other statistical technique: the design of data collection. Researchers must bear in mind that no amount of sophisticated analyses can strengthen the inference obtainable from a weak design. SEM is similar to standard approaches such as correlation, multiple regression, and ANOVA in three fundamental ways. First, both

SEM and these approaches are based on *linear statistical models*. Second, statistical tests associated with SEM and standard statistical approaches are valid only if certain *assumptions* about the observed data are met. For SEM, the assumptions include independence of observations and multivariate normality. However, there is a growing repertoire of estimation methods and mounting evidence that the maximum likelihood method is reasonably robust to modest violations of normality (Hu, Bentler, & Kano, 1992), signifying the superiority of this method in many situations. Third, neither SEM nor standard approaches offer statistical tests of *causality*. By virtue of their capacity to evaluate association, each approach can provide necessary but not sufficient evidence of causality. The SEM approach enjoys some advantage over the more restricted methods in evaluating causal hypotheses because of its ability to specify models in which the putative cause is isolated from extraneous influences and measurement error.

The testing of structural model shares some similarity with the more familiar use of multiple regression; however, the two techniques do not answer the same question. Path models estimated with multiple dependent variables (Pedhauzur, 1982) assume, but do not test, the absence of correlated errors of prediction. In contrast, most SEM explicitly tests this assumption. As a result , a model with good fit obtained using multiple regression and path analyses may not fit the data when estimated using SEM. SEMs can be evaluated in a more comprehensive fashion because of the availability of global measures of model fit (Brannick, 1995). In actual practice, global measures are used as sequential tests of the model whereby one first assesses the global fit before proceeding to a consideration of the individual parameters comprising the model (Joreskog, 1993). Also, SEM gives *"full information"* estimation of parameters using such loss functions as maximum likelihood and generalized least squares. Special cases of structural models allow the estimation of parameters for virtually any subset of the general linear model, including factor analysis, path analysis without latent variables, ANOVA, and multiple regression (Brannick, 1995; Hoyle, 1995; Tanaka, Panter, Winborne, & Huba, 1990). Thus, SEM is a very general linear statistical model that can be used to evaluate most research hypotheses of interest with the greater rigor that results from explicit testing of the absence of correlated errors of prediction.

3.6.2. Matrix Notation of General SEM

This section presents the technical matrix notation of the structural equation model as associated with LISREL computer package (Joreskog & Sorbom, 1993). The structural model is written as follows in the equation form:

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \boldsymbol{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta} \tag{3.1}$$

The latent dependent variables are denoted by η (eta) as a vector (m x 1) of m such variables. The latent independent variables are denoted by ξ (ksi) as a vector of (n x 1) of n such variables. A matrix Φ contains the variances and covariances among these latent independent variables. The relationship between the latent variables are denoted by B and Γ the elements of which are denoted by β and γ, respectively. B is an m x m matrix of structure coefficients that relate the latent dependent variables to one another. Γ is an m x n matrix of structure coefficients that relate the latent independent variables to the latent dependent variables. The error term ζ in the structural model equation is a vector that contains the equation prediction errors or disturbance terms. The matrix Ψ contains the variances and covariances among these latent dependent prediction errors or disturbance terms. The measurement models are written in the following set of matrix equations:

$$Y = \Lambda_Y \eta + \varepsilon \tag{3.2}$$

$$X = \Lambda_X \xi + \delta \tag{3.3}$$

Equation (3.2) and (3.3) denote the equations for the latent dependent and latent independent variables respectively. The observed variables are denoted by the vector Y (p x 1) for the measures of the latent dependent variables η (m x 1), and by the vector X (q x 1) for the measures of the latent independent variables ξ (n x 1). The relationship between the observed variables and the latent variables, typically referred to as factor loadings, are denoted by the (p x m) matrix Λ_Y for the Ys, the elements of which are denoted by λ_Y; and by the q x n matrix Λ_X for the Xs, the elements of which are denoted by λ_X. Finally, the measurement errors for the Ys are denoted by the p x 1 vector ε and for the Xs by the q x 1 vector δ. The matrix Θ_ε contains the variances and covariances among the errors for the observed dependent variables. The matrix Θ_δ contains the variances and covariances among the errors for the observed independent variables.

A graphic summary of the general structural model in matrix format has been depicted by Hayduk (1987) and is reproduced in Figures 3.18a and 3.18b. The three equations diagrammed in matrix format correspond respectively to the structural equation model (equation 1), measurement model for the Y latent dependent variables (equation 2), and the measurement model for the X latent independent variables (equation 3). Totally, eight matrices are available to denote a general structural equation model. Obviously, not all of the eight matrices are necessary in a given model; for example, the confirmatory factor model. Table 3.1 presents the notation used in the LISREL and EQS programs (Bentler, 1992; Joreskog & Sorbom, 1993). Appendix 3 presents an illustrative example for the matrix notation of a structural equation model. Appendix 4 presents the equations based on the structural equation model in Appendix 3.

3.7. Using SEM – The Five Basic Steps

The five basic steps used in SEMs are (i) Model Specification, (ii) Identification, (iii) Estimation, (iv) Assessment of model fit, and (v) Model re-specification

3.7.1. Model Specification

SEM begins with the specification of a model to be estimated. At the most basic level, a model is a statistical statement about the relations among variables and specification is the exercise of formally stating a model. In SEM, model specification involves formulating a statement about a set of parameters. The parameters that require specification are constants that indicate the nature of the relation between two variables. Although specification can be quite specific regarding both the magnitude and sign, parameters typically are specified as either fixed or free. Fixed parameters are estimated from the data and are those the investigator believes to be non-zero. The pattern of fixed and free parameters in an SEM defines two components: the measurement model and the structural model. The measurement model is that component of the general model in which latent variables are prescribed. Often referred to as factors, latent variables are unobserved variables implied by the covariances among two or more indicators. The structural model is that component of the general model that prescribes relations between latent variables and also the observed variables that are not indicators of latent variables. When the measurement and structural components are combined, the result is a comprehensive statistical model that can be used to evaluate relations among variables that are free of measurement error.

Relations between variables, observed or latent, are of three types. The *association* is a relation between two variables treated within the model as non-directional; it is identical in nature to the relation typically evaluated by correlational analysis. The *direct effect*, which is the building block of SEMs, is a directional relation between an independent variable and dependent variable, although the dependent variable in one direct effect can be an independent variable in another. Moreover, as in multiple regression, a dependent variable can be related to multiple independent variables, and as in MANOVA, an independent variable can be related to multiple dependent variables. The capacity to treat a single variable as both a dependent and an independent variable lies at the heart of the indirect effect. The *indirect effect* is the effect of an independent variable on a dependent variable through one or more intervening/mediating variables (Baron and Kenny, 1986). The sum of the direct and indirect effects of an independent variable on a dependent variable is termed the total effect of the independent variable.

3.7.2. Identification

One of the fundamental considerations when specifying models in SEM is identificaton. Identification concerns the correspondence between the information to be estimated–the free parameters–and the information from which it is to be estimated–the observed variances and covariances. More specifically, identification concerns whether a single, unique value for each and every free parameter can be obtained from the observed data. If for each free parameter a value can be obtained through one and only one manipulation of the observed data, then the model is *just-identified* and has zero degrees of freedom. If a value for one or more free parameters can be obtained in multiple ways from the observed data, then the model is *over-identified* and has degrees of freedom equal to the number of observed variances and covariances minus the number of free parameters. If a single, unique value cannot be obtained from the observed data for one or more free parameters, then the model is *under-identified* and cannot be estimated because a restriction on model specification is that for any model to be estimated, it must be either just identified or over-identified.

3.7.3. Estimation

The estimation process involves the use of a particular fitting function to minimize the difference between the observed and estimated matrices. Several fitting functions or estimation procedures are currently available. Some of the earlier methods include *ordinary least squares* (OLS), *generalized least squares* (GLS), and *maximum likelihood* (ML). GLS and ML methods are scale-free and have desirable asymptotic properties, such as minimum variance and unbiasedness (Schumacker & Lomax, 1996). Also, both of these methods assume multivariate normality of the observed variables. A growing body of research indicates that ML performs reasonably well under a variety of less-than-optimal analytic conditions like small sample size or excessive kurtosis (Hoyle & Panter, 1995). Because ML is widely available and is the most widely researched estimator among those otherwise available: OLS, GLS (Hoyle & Panter, 1995), researchers are recommended to routinely report results from ML estimation. Also, the most popular and widely used computer programs designed use this estimator.

An ever-increasing number of programs are available to researchers for analyzing SEMs. LISREL is one of the most widely used SEM software packages. Until version 7, the LISREL program used to test SEMs was matrix based, requiring the user to input covariance matrices for every variable (Joreskog & Sorbom, 1993). Version 8 of LISREL includes the equation-based SIMPLIS package, which allows users to input relevant information in the form of equations, rather than covariance matrices (Joreskog & Sorbom, 1999). EQS is another software package that is equation based (Bentler, 1992; Satorra & Bentler, 1994). One of the nicest features of EQS over LISREL is its capacity to work off diagrams using a drawing program within it. LISREL provides the option for using diagrams as input once the program is running, but does not start with a drawing option. A number of other programs for SEM are available, varying in ease of use, flexibility and options offered. Researchers who normally use SPSS may want to learn AMOS (Arbuckle 1994, 1997), which is equation based and can also run from a diagram created by the user. AMOS can read SPSS system files, providing a nice interface for SPSS users. MX (Neale, 1994) is another program. For new users, one advantage of using MX is that it can be downloaded for use from the World Wide Web (http://views.vcu.edu/mx/). Another frequently used SEM program is EZPATH (Steiger, 1990) that is tied to the statistical package SYSTAT. PROC-CALIS (SAS, 1991) is an SEM program that is tied with SAS. Though this program is not as user-friendly when compared to the others like LISREL or EQS, researchers working with SAS might want to consider this program in evaluating SEMs. Several papers provide useful reviews to aid researchers in gaining a clearer understanding of various programs available. For example, Waller (1993) provided a review of seven different programs. Hox (1995) presents a review of EQS, LISREL and AMOS. A very recent and comprehensive discussion of various programs appears in the preface of Hayduk (1996).

3.7.4. Assessment of Model Fit

After estimating a model, given a converged and proper solution, a researcher would assess how well the specified model accounted for the data with one or more model fit criteria. Most investigators who have evaluated and compared extant indices encourage reporting multiple indices of overall fit (Bollen, 1989; Marsh, Balla, & Hau, 1996; Tanaka, 1993; Tanaka & Huba, 1985). The meaning of the term "fit," as it applies to evaluating SEMs, is not entirely straightforward (Tanaka, 1993). At the most general level, references to and evaluations of the fit of a SEM can refer to one of three characteristics of the model: *absolute fit*, *incremental fit* and *parsimony-based fit*. Most fit indices have been formulated to range in the value from 0 (no fit) to 1 (perfect fit) and are subjectively assessed as to what is an acceptable model fit. Researchers have suggested that a SEM with a value of 0.90 and higher for these indices is acceptable (Baldwin, 1989; Bentler & Bonnet, 1980).

Absolute fit concerns the degree to which the covariances implied by the fixed and free parameters specified in the model match the observed covariances from which free parameters in the model were estimated. Indices of absolute fit typically gauge *"badness of fit."* The optimal fit is indicated by a value of zero, and increasing values indicate greater departure of the implied covariance matrix from the observed covariance matrix. One of the most commonly used absolute fit criteria is the χ^2 value. A significant χ^2 value relative to the degrees of freedom indicates that the observed and estimated matrices differ. Statistical significance indicates the probability that this difference is due to sampling variation. A non-significant χ^2 value indicates that the observed and estimated matrices are not statistically different. The researcher is interested in obtaining a non-significant χ^2 test, which indicates that the data fit the model. Joreskog and Sorbom (1989) proposed goodness-fit-index (GFI), adjusted goodness-fit-index (AGFI), and root-mean-square-residual (RSMR) measure of absolute fit indices based on the comparison between the observed and predicted variances and covariances of the observed variables. GFI is based on the ratio of the sum of the squared differences between the observed and model-implied matrices to the observed variances, thus allowing for scale. AGFI adjusts the GFI for the degrees of freedom of a model relative to the number of variables. The RMSR uses the square root of the mean squared differences between the observed and model-implied covariance matrices.

Incremental fit concerns the degree to which the model in question is superior to an alternative model, usually one that specifies no covariances among variables (i.e., the "null" or independence model), in reproducing the observed covariances. Indices of incremental fit typically gauge "goodness of fit"; larger values indicate greater improvement of the model in question over an alternative model in reproducing the observed covariances. These indices can be computed given the knowledge of the null model χ^2, null model degrees of freedom (df), hypothesized model χ^2, hypothesized model degrees of freedom, number of observed variables in the model, and the sample size. The widely used indices in this category are: Tucker-Lewis index (TLI), Normed fit index (NFI). Tucker-Lewis index (Tucker & Lewis, 1973) is computed using the χ^2 statistic of the proposed and null model.

$$\mathbf{TLI} = \frac{(\chi^2_{null} / df_{null}) - (\chi^2_{proposed} / df_{proposed})}{[(\chi^2_{null} / df_{null}) - 1]} \tag{3.4}$$

The NFI is a measure that rescales χ^2 into a 0 to 1 range (Bentler & Bonett, 1982). It is used to compare a restricted (null) model with a full model using a baseline null model.

$$\mathbf{NFI} = \frac{(\chi^2_{\text{null}} - \chi^2_{\text{proposed}})}{\chi^2_{\text{null}}} \qquad \mathbf{(3.5)}$$

Parsimony refers to the number of estimated coefficients required to achieve a specific level of fit. Basically, an over-identified model is compared with a restricted model. The *parsimony-based-fit* indices take into account the number of parameters required to achieve a given value of χ^2. The AGFI measure discussed earlier serves as an index of model parsimony. The other indices that indicate model parsimony are normed χ^2 (NC), and parsimonious fit index (PFI) which is a modification of the NFI measure (James, Muliak, & Brett, 1982). The NC, proposed by Joreskog (1969), adjusts the χ^2 by the degrees of freedom to assess the model fit. It is calculated as NC = χ^2 /df. The PFI as compared to the NFI measure, however, takes into account the degrees of freedom used to obtain a given level of fit and is calculated as follows,

$$\mathbf{PFI} = \frac{\mathbf{df}_{\text{proposed}}}{\mathbf{df}_{\text{null}}} * \mathbf{NFI} \qquad \mathbf{(3.6)}$$

In summary, Table 3.2 presents these fit indices used to assess model fit, model comparison, or model parsimony along with appropriate references. More information on the usefulness and/or limitations of the indices can be found in the literature (e.g., Marsh et al., 1996; Muliak, James, Alstine, Bennett, Lind, & Stilwell, 1989; Williams & Holahan, 1994).

3.7.5. Model Respecification

A model is properly specified when the model generated from the data (true model) is deemed consistent with the model tested. The ultimate goal is to determine the extent to which the true model deviate from the model tested. The difference between the true model and the model tested may be due to errors of omissions and/or inclusion of any variable or parameter. A misspecified model may result in biased parameter estimates termed as specification error. In the presence of specification error, it is likely that one's theoretical model may not be deemed statistically acceptable. There are a number of procedures to perform specification search (Leamer, 1978) to detect specification errors and evaluate more properly specified subsequent models during respecification. The purpose of specification search is to alter the original model in the search for a model that is "best fitting" in some sense and yields parameter having practical significance and substantive meaning. *Substantive theoretical and logical interest* must be the guiding force in the specification search; otherwise the resultant model will not have practical value or importance.

Typically, applications of structural equation modeling include some type of specification search; an obvious intuitive method is to consider the statistical significance of each parameter estimated in the model. All parameters should be in the expected direction and statistically significant (Fraas and Newman, 1994). A specification strategy would be to fix parameters that are not statistically significant to zero in the subsequent model. If the parameter is not significant but is of sufficient substantive interest, then the parameter could probably remain in the model. The guiding rule should be that the parameter estimates make sense and are meaningful. Another intuitive method of examining misspecification is to examine the residual matrix. These values should be small in magnitude and should not be large for one variable than for another. Large overall values indicate serious general model misspecification, while large values for a single variable indicate misspecification for that variable only, probably in the structural model (Bentler, 1989).

3.8. Modeling Interaction Effects Using SEM

The analysis of interaction effects between continuous variables has been widely done using multiple regression. But, researchers point out the problems inherent in the analysis of interaction effect using this methodology. These problems include measurement errors and the low statistical power that result from such errors. Therefore, in this dissertation, models involving interaction effects were evaluated using the SEM approach presented by Jaccard and Wan (1996).

The LISREL models defined by equations (3.1), (3.2), and (3.3) assumed all random variables to have zero means. This assumption is relaxed when evaluating interaction effects. Thus, the estimation of structural models involving product terms requires four more matrices in addition to the previous eight. These matrices are the Kappa matrix, the Alpha matrix, the Tau-X matrix and the Tau-Y matrix. These parameter matrices contain intercept term in the relationships and mean values of the latent variables. They can be defined by the following three equations that correspond to the equations (3.1), (3.2) and (3.3) respectively:

$$\eta = \alpha + \mathbf{B}\eta + \Gamma\xi + \zeta \tag{3.7}$$

$$\mathbf{Y} = \mathrm{T}_{Y} + \Lambda_{Y}\eta + \varepsilon \tag{3.8}$$

$$\mathbf{X} = \mathrm{T}_{X} + \Lambda_{X}\xi + \delta \tag{3.9}$$

In the above equations, α, T_X, and T_Y are vectors of constant intercept terms. In addition to these three new parameter matrices, the mean value of ξ is denoted by a fourth parameter matrix κ.

3.9. Conclusion

The various theoretical factors that affect supply chain management is introduced from the theoretical domain of a wider literature base including purchasing and supply, logistics and transportation, marketing, organizational behavior, network, strategic management, etc. Multiple research models linking these theoretical constructs are presented based on previous literature as well as intuition. The iterative methodology to be used for the instrument development is also illustrated. This methodology utilizes exploratory factor analysis, confirmatory factor analysis along with internal consistency analysis. Structural equation modeling technique is considered to be the best approach for analyzing the research models. A brief presentation on the benefits on SEM along with the procedural explanation of its usage is also included.

CHAPTER IV

Results

This chapter presents the results of the instrument development process as well as the various models considered in the study. The chapter is grouped as follows: The first section presents pertinent information on the research design. This section covers the data collection strategies, respondent and firm profile, and results of non-respondents analysis results. The second section presents the results of the measurement instrument development process. After a brief section including some general observation on the data collected, the fourth section presents the results of the various research models. Results are grouped based on the different models. For each model, overall model fit indices as well as individual path fit values are presented.

4.1. Research Design

4.1.1. Data Collection

This study utilized a cross-sectional mail survey within the United States. The target sample frame consisted of members of the Institute for Supply Management (ISM) drawn from firms covered under the two-digit SIC codes between 34 and 39. One thousand respondents were selected from a list of 2,500 Title 1 & 2 members provided by the ISM headquarters. The title of the specific respondent being sought from the sample companies was typically Vice Presidents of Purchasing, Materials Management, and Supply Chain Management or Directors/Managers of Operations, Purchasing, Material Management.

In an effort to increase the response rate, a modified version of the methodology of Dillman's total design method was followed (Dillman, 1978). All mailings were sent via first-class mail to the respondents. The initial mailing included a cover letter, the survey, and a postage-paid return envelope. Two weeks after the initial mailing, reminder postcards were sent to all potential respondents. For those who did not respond, a second mailing of surveys, cover letters, and postage-paid return envelopes were mailed approximately 28 days after the initial mailing. Of the 1,000 surveys mailed, 46 were returned due to address discrepancies. From the resulting sample size of 954, 232 responses were received, resulting in a response rate of 24.3%. A total of 11 were discarded due to incomplete information, resulting in an effective response rate of 23.2% (221/954). Considering the length of the survey, this response rate is quite satisfactory. Also, the response rate correlates well with other empirical studies within supply chain management (e.g., Choi and Hartley (1996), a usable rate of 21%; Krause, Pagell, and Curkovic (2001), a usable rate of 19.6%; Stanley and Wisner (2001), a usable rate of 23.6%) and operations management in general (Bozarth et al. (1998), a usable rate of 19.4%; Small and Chen (1995), a usable rate of 20.4%).

4.1.2. Respondent and Firm Profile

The final sample comprised of purchasing executives and included 35 presidents/vice presidents (16%), 138 directors (62%), 33 purchasing managers (15%), and 15 others (7%). The respondents worked primarily for medium to large firms with nearly 36% working for firms employing more than 1,000 employees. Nearly 60% of the firms had a gross income of greater than $100 million. The distribution of the samples with regard to respondent and firm profile is presented in Tables 4.1 and 4.2 respectively.

4.1.3. Non-response Bias

Non-response bias is the difference between the answers of non-respondents and respondents (Lambert and Harrington, 1990). In this study, non-response bias was tested by comparing the responses of early and late waves of returned surveys (Armstrong and Overton, 1977; Lambert and Harrington, 1990). This is based on the assumption that the opinions of late respondents are representative of the opinions of non-respondents. It has been a common practice to employ only demographic variables for non-response bias analysis (e.g., Chen et al., 2000; Soteriou and Chase, 1998). The inclusion of other variables for this analysis has been adopted by more recent research (e.g., Krause et al., 2001; Stanley and Wisner, 2001; Swink, 1999). The present study includes 30 randomly selected variables in addition to the 10 demographic variables for non-response bias analysis. The final sample was spilt into two, depending on the dates they were received. The early wave group consisted of 123 responses while the late wave group consisted of 98 responses. T-tests were performed on the responses of these two groups. The t-tests yielded no statistically significant differences (at 99% confidence interval) for the survey items tested. These results suggest that non-response may not be a problem.

4.2. General Observation

Table 4.3 displays the mean and standard deviation values for the questions included in the survey instrument. Review of data in this manner does not show any noteworthy differences. But, it does show the importance respondents place on the different factors and the underlying indicators. Except for demographic variables, all questions were measured using a 7-point Likert scale wherein 1 represents "strongly disagree" and 7 represents "strongly agree." Reverse-scored items were recoded before proceeding with any analysis. It can be clearly seen that the respondents place very high importance on the *customer focus* construct (most of the mean values were closer to 6.00). Also, the low standard deviation values for these indicators suggest that there is uniformity in this opinion among the respondents. Respondents also consider most of the supplier relationship and supplier management constructs as important. Though considered as important, respondents place lesser significance on factors like *cross-functional teams*, *supplier integration*, and *logistics integration*. In general, all the constructs included in this study are considered by the respondents as important to the successful management of the supply chain. The following sections present more detailed analysis of the instrument and the relationship between the constructs.

4.3. Measurement Instrument

An iterative instrument development process was used to develop an instrument that satisfies the requirements of reliability, validity and unidimensionality. The 3-stage continuous improvement cycle, which lies at the heart of the instrument development process, employs confirmatory factor analysis that is more applicable for assessing construct validity and unidimensionality of an instrument (Ahire et al., 1996; O'Leary-Kelly and Vokurka, 1998). Prior to data collection, the content validity of the instrument was established by grounding it strongly in existing literature and conducting pre-tests. In the first stage of the instrument development process, a Cronbach's alpha value was generated for each construct. The three-step approach presented by Flynn et al., (1994) was adopted in selecting constructs after the calculation of Cronbach's alpha. *First*, the constructs were accepted if the Cronbach's alpha value was greater than 0.7. *Second*, the constructs with an acceptable Cronbach alpha of at least 0.6 were further evaluated for the possibility of improvement. Items that contribute least to the overall internal consistency were the first to be considered for exclusion. The item inter-correlation matrix was utilized in determining the items that contributed the least and thus were the best candidates for deletion. The items that were negatively correlated to other items within a scale were first discarded. Also, the items with correlation value below 0.10 were discarded. The cut-off value of 0.30 as given by Flynn et al. (1994) was not used to discard the items, but for marking them for possible deletion. *Third*, a similar elimination procedure was performed on the constructs that failed to achieve the minimum alpha value of 0.60. Under normal practice, if a construct still failed to achieve the target value of Cronbach alpha, it should be discarded. Since all the constructs achieved the target value, the analysis moved on to the next stage of instrument development.

The second stage of the development process involved exploratory factor analysis (EFA) using principal component analysis. The commonly recommended method of varimax rotation with Kaiser normalization was used to clarify the factors (Loehlin, 1998). Since the number of constructs was determined prior to the analysis, the exact number of factors to be extracted was provided in this analysis. Indicator items were discarded after comparing their loading on the construct they were intended to measure to their loading on other scales. Furthermore, nuisance items, those that did not load on the factor they intended to measure, but on other factors they did not intend to measure, were deleted from consideration. The final stage involved confirmatory factor analysis (CFA) in evaluating construct validity and unidimensionality. Due to the existence of a large number of indicators and constructs, as well as the limitation on sample size, four different LISREL measurement models were evaluated (Atuahene-Gima and Evangelista, 2000; Moorman, 1995). In this stage, indicator items were eliminated from further consideration if their proportion of variance (R^2) value was less than 0.30. Five different goodness-of-fit indices were used to evaluate the tenability of the models. Multiple iterations of the 3-stage continuous improvement cycle were performed until the theoretical constructs exhibited acceptable levels of reliability, validity, and unidimensionality. The final measurement instrument is presented in Appendix 5. The performance measures used in the models are presented in Appendix 6. A more detailed explanation and the results of the various analyses are presented in the following sections.

4.3.1. Reliability

Table 4.4a presents the Cronbach alpha for the scales at various stages of the analysis. The first column presents the alpha value before any item was deleted from the constructs. The second column presents the alpha value after the completion of internal consistency tests and EFA. The third column presents the alpha value after the measurement instrument purification process. Table 4.4b presents the reliability value for the SCM performance constructs after the instrument purification process. As it can be seen from these tables, Cronbach's alpha values of the factors were well above the cut-off value and ranged from 0.652 to 0.951 with only one value below 0.70.

4.3.2. Content Validity

As a first step towards establishing content validity, the supply chain management factors were identified based on an exhaustive review of relevant literature including over

400 articles. Secondly, the instrument was pre-tested in two stages before being considered for data collection. First, six experienced researchers were asked to critique the questionnaire for ambiguity, clarity, and appropriateness of the individual items within each construct (DeVellis, 1991). They were also asked to verify whether or not the indicators sufficiently addressed the subject area (Dillman, 1978). The instrument was modified based on their input. Due to concerns about response rate, some factors were then dropped to reduce the length of the survey. In the second stage of the pre-test, the survey instrument was emailed to 42 purchasing executives affiliated with ISM. The executives were asked to review the questionnaire for structure, readability, ambiguity, and completeness (Dillman, 1978). All reviewers reacted favorably to the questionnaire. The final survey instrument incorporated minor changes to remove a few ambiguities that were discovered during this validation process. These tests indicated that the resulting measurement instrument represented the content of the supply chain management factors.

4.3.3. Unidimensionality

Unidimensionality was established using CFA. Due to the existence of a large number of indicators and constructs, as well as the limitation on sample size, four different measurement models were evaluated (Atuahene-Gima and Evangelista, 2000; Moorman, 1995). The environmental uncertainty measurement model includes factors of demand, supply, and technology uncertainties, while the driving forces measurement model contains factors of customer focus, top management support, competitive priorities, strategic purchasing, and information technology. The supply chain measurement model includes supply network structure, long-term relationship, supply base reduction, communication, cross-functional teams, supplier integration, and logistics integration. Unidimensionality was established by assessing the overall model fit of these models. Tables 4.5a - 4.5d present the results of the assessment of unidimensionality. As recommended by many researchers, multiple fit criteria were utilized to assess the tenability of the measurement models (Bollen and Long, 1993; Tanaka, 1993). An indication of an acceptable fit is the ratio of the chi-square statistic to the degrees of freedom. Some researchers have recommended using ratios of less than 5 to indicate a reasonable fit (e.g., Marsch and Hocevar, 1985) while others have recommended using ratios less than 3 (Chau, 1997; Hair et al., 1995; Hartwick and Barki, 1994). More recent research, however, suggests the use of ratios less than 2 as indication of good fit (Koufteros, 1999). The other measures of model fit used in this study include adjusted goodness of fit [AGFI] (Joreskog and Sorbom, 1999), root mean square residual [RMSR] (Joreskog and Sorbom, 1999), the Bentler and Bonnet non-normed fit index [NNFI] (Bentler and Bonett, 1980), and the Bentler comparative fit index [CFI] (Bentler, 1986). Adequate fit is suggested for models exhibiting AGFI indices greater than 0.80 and models exhibiting NNFI and CFI indices greater than 0.90. Though values for RMSR of less than 0.05 are generally considered to be very good, values between 0.05 and 0.10 are acceptable by many investigators (e.g., Rupp and Segal, 1989). It can be seen from Tables 4.5a – 4.5d that all the measurement models have acceptable fit indices, and consequently signify the unidimensionality of the constructs. Moreover, the following section on convergent and discriminant validity further solidifies the extent of unidimensionality of the constructs.

4.3.4. Construct Validity

Construct validity is the extent to which the items in a scale measure the abstract or theoretical construct (Carmines and Zeller, 1979; Churchill, 1987). Testing of construct validity concentrates not only on finding out whether or not an item loads significantly on the factor it is measuring-- "*convergent*"--but also on ensuring that it measures no other factors-- "*discriminant*" (Campbell and Fiske, 1959). It can be tested either using the correlation between total scores and item scores or using factor analysis (Kerlinger, 1978; Kim and Mueller, 1978; Spector, 1992).

Convergent validity is assessed using both EFA and CFA. Due to existence of many constructs as well as the limitation on sample size, four different measurement models were evaluated (Atuahene-Gima and Evangelista, 2000; Moorman, 1995). In EFA, a construct is considered to have convergent validity if its eigen value exceeds 1.0 (Hair et al., 1995). Also, all the factor loadings must exceed the minimum value of 0.30. Table 4.6 presents the final factor loading of the retained items on their underlying factors. It can be seen that all the loadings are quite high and their eigen values exceed the minimum criterion. In CFA, convergent validity can be assessed by testing whether or not each individual item's coefficient is greater than twice its standard error (Anderson and Gerbing, 1988). Bollen (1989) states that the larger the t-values or the relationship, the stronger the evidence that the individual items represent the underlying factors. Furthermore, the proportion of variance (R^2) in the observed variables, accounted for by the theoretical constructs influencing them, can be used to estimate the reliability of an indicator. In previous research studies, R^2 values above 0.30 were considered acceptable (e.g., Carr and Pearson, 1999). The result of the confirmatory factor analyses is presented in Tables 4.7a-4.7d. Examination of the above conditions indicates that all indicators are significantly related to their underlying theoretical constructs.

Discriminant validity is established using CFA. Models were constructed for all possible pairs of latent constructs. These models were run on each selected pair, (1) allowing for correlation between the two constructs and (2) fixing the correlation between the constructs at 1.0. A significant difference in chi-square values for the fixed and free solutions indicates the distinctiveness of the two constructs (Bagozzi and Phillips, 1982; Bagozzi et al., 1991). The chi-square difference was tested for statistical significance at $p < 0.001$ confidence level. The number of models (combinations) to be tested for n constructs will be:

$$C(n,2) = \frac{n!}{(n-2)! * 2!} = \frac{n * (n-1)}{2} \tag{4.1}$$

For the 15 constructs excluding the supply chain performance factors, a total of 105 different discriminant validity checks were conducted. As can be seen in table 4.8, all the differences between the fixed and free solutions in chi-square are significant. This result provides a strong evidence of discriminant validity among the theoretical constructs.

4.4. Model Results

As recommended by many researchers, multiple fit criteria were utilized to assess the tenability of the measurement model (Bollen and Long, 1993; Tanaka, 1993). An indication of acceptable fit is the ratio of chi-square statistic to the degrees of freedom also termed as normed chi-square [NC] value. Some researchers have recommended using ratios of less than 5 to indicate a reasonable fit (e.g., Marsch and Hocevar, 1985) while others have recommended using ratios of less than 3 (Chau, 1997; Hair et al., 1995;

Hartwick and Barki, 1994). More recent research, however, suggests the use of ratios of less than 2 as indication of good fit (Koufteros, 1999). The other measures of model fit used in this study include goodness of fit [GFI] (Joreskog and Sorbom, 1999), adjusted goodness of fit [AGFI] (Joreskog and Sorbom, 1999), root mean square residual [RMSR] (Joreskog and Sorbom, 1999), root mean square error of approximation [RMSEA] (Hair et al. 1995), the Bentler and Bonnet normed fit index [NFI] and non-normed fit index [NNFI] (Bentler and Bonett, 1980), and the Bentler comparative fit index [CFI] (Bentler, 1986). Adequate fit is suggested for models exhibiting AGFI indices greater than 0.80 and models exhibiting GFI, NFI, NNFI, and CFI indices greater than 0.90. Models with values for RMSEA and RMSR of less than 0.05 are generally considered to be very good. But, a value less than or equal to 0.10 is considered to be of adequate fit. The hypotheses for the causal relationships were tested using their associated t-statistics. T-values greater than 1.65 or 1.98 or 2.576 were considered to be significant at the 0.10 level, 0.05 level and 0.01 level respectively (Hair *et al.*, 1995).

4.4.1. Model 1: Strategic Supply Management

Table 4.9 presents the result of the model analysis along with the cut-off values for the fit indices. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 5)}} = 5.50$ (p = 0.50) suggests that the hypothesized model and the set of coefficients estimated are very consistent with the observed covariance. Other indices of the model specified by the hypothesized model add credence to the acceptance of the model. The GFI for the hypothesized model accounted for 99% of the variance and covariance, and the AGFI was as high as 97%. Both these values surpassed the cut-off values and suggest a good fit of the data to the hypothesized model. The NNFI and CFI were equal to 1.01 and 1.00

respectively. The RMSR value was equal to 0.04 and less than the cut-off value of 0.05. All the other overall indices of fit also surpassed the cut-off value. Therefore, we conclude that the hypothesized model fits the data very well.

Figure 4.1 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. In this figure, the significance for all causal relationships is also presented. All of the nine hypothesized causal relationships were found to be significant. Of these, seven of the hypotheses were significant at beyond the 0.001 level. Two of the hypotheses were significant at the 0.005 level while the other hypothesis was significant at 0.01 level. One of the major advantages of using SEM is the ready accessibility to indirect and total effects, in addition to the direct causal effects between the exogenous and endogenous variables. All the indirect effects were statistically significant. Eleven of the 15 possible indirect effects were significant at the 0.001 confidence level and four were significant beyond the 0.005 level. Nineteen of the 20 possible total effects were significant beyond the 0.001 level while the other hypothesis was significant at the 0.01 confidence level. Table 4.10 presents the indirect and total effects between the variables in the model.

It was hypothesized that strategic nature of purchasing will have a positive effect on effective two-way communication ($H_{1.1}$), supply base reduction ($H_{1.2}$), and long-term relationships ($H_{1.3}$). Hypothesis $H_{1.2}$ was supported by the underlying data. The standardized coefficient for this causal relationship (standardized coefficient = 0.20; t-value = 2.95) indicates that strategic purchasing has a significant positive impact on supply base reduction. The path between strategic purchasing and long-term relationships was also significant (standardized coefficient = 0.24; t-value = 3.94). The coefficient of total effect of strategic purchasing on long-term relationships ($H_{1.3}$) was significant as well as higher (standardized coefficient = 0.31; t-value = 4.81) due to strategic purchasing's significant indirect effect through supply base reduction (standardized coefficient = 0.07; t-value = 2.62). The direct causal path between strategic purchasing and communication ($H_{1.1}$) was positive and significant (standardized coefficient = 0.16; t-value = 2.94). But, the total effect of strategic purchasing on communication (standardized coefficient = 0.34; t-value = 5.44) was found to be greater than its direct effect. This difference was attributed to its significant indirect effect on communication through supply base reduction and long-term relationships (standardized coefficient = 0.18; t-value = 4.48). Apart from the hypothesized relationships, it was also found that strategic purchasing had a significant indirect effect on customer responsiveness (standardized coefficient = 0.11; t-value = 3.53), and financial performance (standardized coefficient = 0.03; t-value = 2.72).

Supply base reduction was hypothesized to facilitate long-term relationships ($H_{1.5}$) as well as effective communication ($H_{1.4}$) between firms. The standardized coefficient for the causal relationships represented by $H_{1.5}$ (standardized coefficient = 0.34; t-value = 5.64) establishes a strong positive impact of supply base reduction on long-term relationships. The path between supply base reduction and communication ($H_{1.4}$) was also significant (standardized coefficient = 0.28; t-value = 5.04). The coefficient of total effect on communication was higher as well as significant (standardized coefficient = 0.43; t-value = 7.38) due to its significant indirect effect through long-term relationships (standardized coefficient = 0.15; t-value = 4.55). From

Table 4.9, it can be seen that supply base reduction had a significant impact on customer responsiveness (standardized coefficient = 0.12; t-value = 3.76), and financial performance (standardized coefficient = 0.03; t-value = 2.82).

It was hypothesized that long-term relationships will have a positive impact on the communication ($H_{1.6}$) between firms. The standardized coefficient for the causal relationships represented by $H_{1.6}$ (standardized coefficient = 0.44; t-value = 7.69) establishes a strong positive impact of long-term relationships on communication. It was also hypothesized that this construct will improve the buyer's customer responsiveness ($H_{1.7}$). This hypothesis was significant at 95% confidence level (standardized coefficient = 0.18; t-value = 2.29). The indirect effect of long-term relationships on customer responsiveness through communication was found to be significant at 90% confidence level (standardized coefficient = 0.07; t-value = 1.74) thereby leading to a significant total effect on customer responsiveness (standardized coefficient = 0.25; t-value = 3.71). The above results show that long-term relationships will improve buyer's customer responsiveness. Long-term relationships were also found to have a significant indirect effect on the financial performance of the buying firm (standardized coefficient = 0.07; t-value = 2.80).

Effective two-way communication was hypothesized to have a positive impact on the customer responsiveness of the buyer firms ($H_{1.8}$). The effect of communication on customer responsiveness ($H_{1.8}$) was found to be significant at 90% confidence level (standardized coefficient = 0.14; t-value = 1.79). Though none of the earlier studies have explicitly indicated that communication will have a positive impact on buyer's customer responsiveness, it was conjectured to be so in this study. The results support the notion that effective communication can have a significant direct impact on buyer's customer responsiveness. Effective communication was also found to have a significant indirect effect on the financial performance of the buying firm (standardized coefficient = 0.04; t-value = 1.65).

It was hypothesized that customer responsiveness will lead to improved financial performance ($H_{1.9}$). The path between customer responsiveness and financial performance was supported significantly by the data (standardized coefficient = 0.28; t-value = 4.25). This result provides empirical evidence to the fact that firms will be able to translate customer responsiveness into improved financial performance. Moreover, it demonstrates that customer responsiveness is of great importance for buying firms in enhancing their financial performance.

4.4.2. Model 2: Supply Uncertainty and Quality Performance

The model fit was assessed using eight overall indices of fit. Table 4.11 presents the result of the model analysis along with the cut-off values for the fit indices. For the hypothesized model, $\chi^2_{(\text{degrees of freedom} = 7)} = 14.88$ ($p = 0.04$) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. Other indices of the model fit also prove that the model fits the data well. The GFI for the hypothesized model accounted for 98% of the variance and covariance, and the AGFI was as high as 93%. Both GFI and AGFI values surpassed the cut-off values and suggest a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.94, 0.92 and 0.96 respectively. The RMSR value of 0.05 was equal to the cut-off value. All the other overall indices of fit also surpassed the cut-off value. Though the RMSEA value (0.07) is greater than 0.05, it is below the acceptable value of 0.10.

Based on these fit values, it is concluded that the hypothesized supply uncertainty model fits the data precisely.

Figure 4.2 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. As it can be seen from this figure, all the eight hypothesized causal relationships were found to be significant. Table 4.12 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 90% confidence level.

Supply uncertainty was hypothesized to have a positive impact on strategic purchasing ($H_{2.1}$) and supplier relationship ($H_{2.2}$). Both hypotheses were supported by the underlying data. The coefficient for the causal relationship between supply uncertainty and strategic purchasing (standardized coefficient = 0.17; t-value = 2.49) indicate that they are positively related. The path between supply uncertainty and supplier relationship ($H_{2.2}$) was significant at the 90% confidence level (standardized coefficient = 0.14; t-value=2.10). The coefficient of total effect of supply uncertainty on supplier relationship ($H_{2.2}$) was higher as well as significant (standardized coefficient = 0.18; t-value = 2.77) at the 99% confidence level due to its significant indirect effect through strategic purchasing (standardized coefficient = 0.03; t-value = 2.19). Supply uncertainty was also found to have significant indirect effect on the other endogenous variables considered in this model. This result provides further empirical evidence to the notion that under conditions of uncertainty, the firms will engage in collective counter-measures in order to stabilize their environment.

It was hypothesized that strategic purchasing will have significant positive effect on supplier relationship ($H_{2.3}$) and supplier management ($H_{2.4}$) constructs. Hypothesis $H_{2.3}$ was found to be significant at 99% confidence level (standardized coefficient = 0.29; t-value = 4.55). The relationship between strategic purchasing and supplier management ($H_{2.4}$) was also found to be significant (standardized coefficient = 0.34; t-value = 6.14). Apart from the hypothesized relationships, strategic purchasing was also found to have a significant indirect effect on supplier management through the supplier relationship construct (standardized coefficient = 0.12; t-value = 3.89). Strategic purchasing was also found to have significant indirect effect on the performance measures: supplier and buyer quality.

Supplier management was hypothesized to have a positive effect on supplier ($H_{2.5}$) and buyer quality performance ($H_{2.6}$). The coefficient for the causal relationship between supplier management and supplier quality performance (standardized coefficient = 0.26; t-value = 3.96) indicate that they are positively related. The path between supplier management and buyer quality performance ($H_{2.6}$) was also significant (standardized coefficient = 0.20; t-value = 3.26). The coefficient of total effect of supplier management on buyer performance was higher as well as significant (standardized coefficient = 0.31; t-value = 4.75) at the 99% confidence level due to its significant indirect effect through supplier performance (standardized coefficient = 0.11; t-value = 3.46). Supplier quality performance was considered to have a positive effect on buyer quality performance ($H_{2.7}$). This hypothesis was supported significantly by the underlying data (standardized coefficient = 0.43; t-value = 7.10). This result proves that supplier quality performance can be considered as an intermediate outcome to buyer's quality performance.

4.4.3. Model 3: Customer-oriented Supply Management

Table 4.13 presents the result of the model analysis along with the cut-off values for the fit indices. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 4)}} = 3.37$ (p = 0.50) suggests that the hypothesized model and the set of coefficients estimated are very consistent with the observed covariance. Other indices of the model specified by the hypothesized model add credence to the acceptance of the model. The GFI for the hypothesized model accounted for 99% of the variance and covariance, and the AGFI was as high as 98%. Both these indices suggest a good fit of the data to the hypothesized model. The NNFI and CFI were equal to 1.01 and 1.00 respectively. The RMSR was equal to 0.03 and less than the cut-off value of 0.05. From Table 4.13, it can be seen that all other overall indices of fit also surpassed the cut-off value. Therefore, it is concluded that the hypothesized model fits the data precisely.

Figure 4.3 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. The significance for all causal relationships is also presented. All the six hypothesized causal relationships considered in this model were found to be significant. Table 4.14 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at the 0.001 confidence level.

It was hypothesized that customer focus will have a positive effect on strategic purchasing ($H_{3.1}$), supply management ($H_{3.2}$), and customer-oriented performance ($H_{3.3}$). Hypothesis $H_{3.1}$ was supported by the underlying data. The standardized coefficient for this causal relationship (standardized coefficient = 0.41; t-value = 6.64) indicates that customer focus has a significant positive impact on strategic purchasing. The path between customer focus and supply management was also significant (standardized coefficient = 0.28; t-value = 4.40). The coefficient of total effect of customer focus on supply management ($H_{3.2}$) was higher as well as significant (standardized coefficient = 0.42; t-value = 6.88) due to its significant indirect effect through strategic purchasing (standardized coefficient = 0.15; t-value = 4.32). The direct causal path between customer focus and customer-oriented performance ($H_{3.3}$) was positive and significant (standardized coefficient = 0.28; t-value = 4.24). But, the total effect of this relationship was found to be greater than its direct effect (standardized coefficient = 0.39; t-value = 6.21). This difference was attributed to its significant indirect effect on customer-oriented performance through strategic purchasing and supply management (standardized coefficient = 0.10; t-value = 3.27). Apart from these hypothesized relationships, it was also found that customer focus had a significant indirect effect on financial performance (standardized coefficient = 0.13; t-value = 3.95).

It was hypothesized that the strategic nature of purchasing will have a positive effect on supply management ($H_{3.4}$). This hypothesis was supported by the underlying data. The standardized coefficient for this causal relationship (standardized coefficient = 0.36; t-value = 5.69) indicates that strategic purchasing has a significant positive impact on supply management. Apart from this hypothesized relationship, it was also found that strategic purchasing had a significant indirect effect on customer-oriented performance (standardized coefficient = 0.09; t-value = 3.11) as well as financial performance (standardized coefficient = 0.03; t-value = 2.66). This result demonstrates that by fostering superior strategic relationship between supply partners, the strategic role of purchasing will have a significant effect on the performance of the buying firm.

Hypothesis $H_{3.5}$ stated that supply management will have a positive impact on the customer-oriented performance. The standardized coefficient for the causal relationships represented by $H_{3.5}$ (standardized coefficient = 0.25; t-value = 3.72) establishes a strong positive impact of these two factors. Supply management practices were also found to have a significant indirect effect on the financial performance of the buying firm (standardized coefficient = 0.08; t-value = 3.01). The above results show that strategic supply management will improve a firm's customer-oriented as well as financial performance. It was also hypothesized that customer-oriented performance will lead to improvised financial performance ($H_{3.6}$). The path between customer-oriented performance and financial performance was supported significantly by the data (standardized coefficient = 0.33; t-value = 5.12).

4.4.4. Model 4: Strategic Supply Management: Effect of Supplier Integration

Model 4 was comprised of six different sub-models that were based on different performance measures. The fit for all these models was assessed using multiple indices of fit. Table 4.15 presents the result of the model analysis for the cost-based model. As it can be seen in this table, all the fit indices surpassed the cut-off value. Based on this result, it is concluded that the hypothesized cost-based model fits the data precisely. Figure 4.4 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. As it can be seen from this figure, seven out of eight hypothesized causal relationships were found to be significant above the 90% confidence level. Table 4.16 presents the indirect and total effects between the variables in the model. Seven out of 10 indirect effects were statistically significant at or above the 90% confidence level. Eleven out of 15 total effects were statistically significant at or above the 90% confidence level.

Table 4.17 presents the result for the quality-based model. All the model fit indices satisfied the requirements. Even though not excellent, the p-value of 0.012 for this model shows that the estimated coefficients are consistent with the observed covariance. Though the RMSR (0.07) and RMSEA (0.09) values are greater than 0.05 they are below the acceptable value of 0.10. Based on these fit values, it is concluded that the hypothesized quality-based supply uncertainty model fits the data to an acceptable level. Figure 4.5 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. From this figure, it can be seen that all the eight hypothesized causal relationships were found to be significant at or above the 95% confidence level. Table 4.18 further presents the indirect and total effects between the variables in the model. All the indirect and total effects were found to be statistically significant at the 99% confidence level.

Table 4.19 presents the result of the delivery-based model. All model fit indices surpassed the cut-off values. So, it is concluded that the delivery model fits the underlying data appropriately. Figure 4.6 presents the results of the causal relationships. As it can be seen from this figure, all of the eight hypothesized causal relationships were found to be significant at or above the 95% confidence level. Table 4.20 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at 99% confidence level.

Table 4.21 presents the result of the flexibility-based model. It is evident that all the fit indices satisfied the cut-off requirements. Though RMSR (0.06) was greater than 0.05, it is below the acceptable value of 0.10. So, this model is also considered to fit the data appropriately. Figure 4.7 presents the results of the causal relationships. As it can be seen from this figure, seven out of eight hypothesized causal relationships were found to be significant at or above the 99% confidence level. Table 4.22 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 95% confidence level.

Table 4.23 displays the result of the responsiveness-based model. The p-value of χ^2 (0.00) shows that this estimated coefficients are not consistent with the observer covariance. The normed- χ^2 value of 3.15 is greater than cut-off value of 3.00. Since, prior research does accept values below 5.00 as a reasonable fit (e.g., Marsch and Hocevar, 1985), this value is considered as an acceptable fit. All other fit indices surpassed the cut-off value. Though the RMSR (0.08) and RMSEA (0.10) values are greater than 0.05, they are below or equal to the acceptable value of 0.10. Since all the fit indices denote a reasonable fit, this model is considered to fit the underlying data. Figure 4.8 presents the results of the causal relationships. As it can be seen from this figure, all the eight hypothesized causal relationships were found to be significant at or above the 99% confidence level. Table 4.24 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at 99% confidence level.

Table 4.25a presents the result of the new product introduction time (NPT)-based model. All model fit indices surpassed the cut-off values. So, it is concluded that this model fits the underlying data appropriately. Figure 4.9 presents the results of the causal relationships. As it can be seen from this figure, five out of six hypothesized causal relationships were found to be significant at or above the 99% confidence level. The insignificant path was the one leading from supplier integration to new product introduction time. Due to this surprising result, additional analysis was done to find out the possible reason. The sample was split into two based on the buyer financial performance construct. The lower performance (financial performance value < 4.50) group consisted of 108 data points. The mean and standard deviation of financial performance for this sample is 3.57 and 0.79 respectively. The higher performance (financial performance value >= 4.50) group consisted of 113 data points. The mean and standard deviation of financial performance for this sample is 5.44 and 0.68 respectively. The NPT-based model was evaluated with these two data sets. Table 4.25b presents the result of the lower performance sample. All model fit indices surpassed the cut-off values. So, it is concluded that this model also fits the underlying data appropriately. Figure 4.10 presents the results of the causal relationships. As presented in this diagram, five out of six hypothesized causal relationships were found to be significant at or above the 99% confidence level. This result is similar to the original model analysis. Table 4.25c presents the result of the higher performance sample. All model fit indices surpassed the cut-off values. Figure 4.11 presents the results of the causal relationships. As it can be seen from this figure, all the six hypothesized causal relationships were found to be significant at or above the 90% confidence level. Based on the three different analyses, it is concluded that supplier integration will have a significant effect on NPT only in case of high performance companies. Table 4.26 presents the indirect and total effects between the variables in the higher performance model. Four out of six indirect effects were statistically significant at or above the 90% confidence level. Eight out of 10 total effects were statistically significant at or above the 90% confidence level.

From Figures 4.4 to 4.11, it is evident that the result for the first five hypotheses in all the sub-models are the same. It was hypothesized that long-term relationship will have a positive effect on communication ($H_{4.1}$) and cross-functional teams ($H_{4.2}$). Hypothesis $H_{4.1}$ was supported by the underlying data. The standardized coefficient of this causal relationship (standardized coefficient = 0.46; t-value = 8.78) indicates that long-term relationship has a significant positive impact on communication. The coefficient of total effect of long-term relationship on communication ($H_{4.1}$) was higher as well as significant (standardized coefficient = 0.59; t-value = 10.88) due to its significant indirect effect through cross-functional teams (standardized coefficient = 0.13; t-value = 4.44). The path between long-term relationship and cross-functional teams ($H_{4.2}$) was also significant (standardized coefficient = 0.35; t-value = 5.57). Cross-functional team was hypothesized to have a significant effect on communication ($H_{4.3}$) and supplier integration ($H_{4.4}$). Hypothesis $H_{4.3}$ was statistically significant at 99% confidence level (standardized coefficient = 0.38; t-value = 7.36). The relationship between cross-functional teams and communication ($H_{4.4}$) was also supported by the underlying data (standardized coefficient = 0.39; t-value = 6.37). Cross-functional teams also had a significant indirect effect on supplier integration through communication (standardized coefficient = 0.13; t-value = 4.37). Hypothesis $H_{4.5}$ posited that communication has a positive effect on supplier integration. This hypothesis was significant at the 99% confidence level (standardized coefficient = 0.33; t-value = 5.43).

In the cost-based model, supplier integration was hypothesized to have a significant negative effect on supplier ($H_{4.6a}$) as well as buyer ($H_{4.7a}$) cost performance. Hypothesis $H_{4.6a}$ was supported at the 90% confidence level (standardized coefficient = -0.12; t-value = -1.72). The direct path $H_{4.7a}$ between supplier integration and buyer cost performance was not supported by the data. Supplier cost performance was hypothesized to have a significant positive effect on buyer cost performance ($H_{4.8a}$). This hypothesis was strongly supported by the data (standardized coefficient = 0.51; t-value = 8.73).

Quality-based model hypothesized that supplier integration will have a significant positive effect on supplier ($H_{4.6b}$) as well as buyer ($H_{4.7b}$) quality performance. Hypothesis $H_{4.6b}$ was supported at the 99% confidence level (standardized coefficient = 0.21; t-value = 3.16). The direct path $H_{4.7b}$ between supplier integration and buyer quality performance was supported by the data (standardized coefficient = 0.14; t-value = 2.27) at the 95% confidence level. The indirect relationship between supplier integration and buyer quality through supplier quality was also significant (standardized coefficient = 0.06; t-value = 2.91). Supplier quality was hypothesized to have a significant positive effect on buyer quality performance ($H_{4.8b}$). This hypothesis was strongly supported by the data (standardized coefficient = 0.45; t-value = 7.47).

The delivery-based model hypothesized that supplier integration will have a significant positive effect on supplier ($H_{4.6c}$) as well as buyer ($H_{4.7d}$) delivery performance. Hypothesis $H_{4.6c}$ was supported at the 99% confidence level (standardized coefficient = 0.22; t-value = 3.31). The direct path $H_{4.7c}$ between supplier integration and buyer quality performance was significant (standardized coefficient = 0.16; t-value = 2.51) at the 95% confidence level. The indirect relationship between supplier integration and buyer quality through supplier quality was also significant (standardized coefficient = 0.05; t-value = 2.73). Supplier quality was further hypothesized to have a significant positive effect on buyer quality performance ($H_{4.8b}$). This hypothesis was strongly supported by the data (standardized coefficient = 0.31; t-value = 4.82).

The flexibility-based model hypothesized that supplier integration will have a significant positive effect on supplier ($H_{4.6d}$) as well as buyer ($H_{4.7d}$) flexibility performance. Hypothesis $H_{4.6d}$ was supported at the 99% confidence level (standardized coefficient = 0.21; t-value = 3.23). The direct path $H_{4.7d}$ between supplier integration and buyer flexibility performance was not supported by the data. Supplier flexibility performance was hypothesized to have a significant positive effect on buyer's flexibility ($H_{4.8d}$). This hypothesis was strongly supported by the data (standardized coefficient = 0.45; t-value = 7.44). This result shows that by improving supplier flexibility, supplier integration indirectly improves the buyer flexibility.

In the responsiveness-based model, supplier integration was hypothesized to have a significant positive effect on supplier ($H_{4.6e}$) as well as buyer ($H_{4.7e}$) responsiveness. Hypothesis $H_{4.6e}$ was supported at the 99% confidence level (standardized coefficient = 0.25; t-value = 3.75). The direct path $H_{4.7d}$ between supplier integration and buyer responsiveness was significant (standardized coefficient = 0.20; t-value = 3.04). Supplier integration also had a significant indirect relationship on buyer responsiveness through the supplier performance (standardized coefficient = 0.05; t-value = 2.76). Supplier responsiveness was hypothesized to have a significant positive effect on buyer responsiveness ($H_{4.8e}$). This hypothesis was strongly supported by the data (standardized coefficient = 0.26; t-value = 4.06).

In the NPT model, supplier integration was hypothesized to have a significant negative effect on new product introduction time ($H_{4.9}$). This hypothesis was not supported by the data. This model was further evaluated using samples split based on the financial performance of the buying firm. The path between these two constructs ($H_{4.9}$) was not significant in the case of the lower performance group. In the case of the higher performance group, supplier integration had a significant negative effect on the new product introduction time (standardized coefficient = -0.16; t-value = -1.71).

4.4.5. Model 5: Supply Management and Performance: Effects of Business and Purchasing Strategy

Table 4.27 presents the result of the model analysis along with the cut-off values for the fit indices. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 7)}} = 20.96$ (p = 0.03) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. Other indices of the overall fit also prove that the hypothesized model fits the data well. The GFI for the hypothesized model accounted for 97% of the variance and covariance, and the AGFI was as high as 93%. Both GFI and AGFI values surpassed the cut-off values and suggest a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.95, 0.96 and 0.98 respectively. The RMSR was equal to 0.05 and equal to the cut-off value of 0.05. All the other overall indices of fit also surpassed the cut-off value. Though the RMSEA (0.06) is greater than 0.05, it is below the acceptable value of 0.10. Based on these fit values, it is concluded that this model fits the data precisely.

Figure 4.11 presents the results of the causal relationships between the exogenous and endogenous variables as well as the causal relationships between the endogenous variables. As it can be seen from this figure, eight out of nine hypothesized causal relationships were found to be significant. Table 4.28 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 99% confidence level.

It was hypothesized that top management support will have a positive effect on strategic purchasing ($H_{5.1}$). This hypothesis was supported by the underlying data. The standardized coefficient of this causal relationship (standardized coefficient = 0.70; t-value = 14.74) indicates that top management has a significant positive impact on strategic purchasing. From table 4.28 it is evident that top management support has a significant indirect effect on all the endogenous variables through strategic purchasing. Strategic purchasing was hypothesized to have a positive effect on supplier relationship ($H_{5.2}$) and supplier management ($H_{5.3}$). Hypothesis $H_{5.2}$ was significant at the 99% confidence level (standardized coefficient = 0.26; t-value = 4.27). The path between strategic purchasing and supplier management ($H_{5.3}$) was also significant (standardized coefficient = 0.34; t-value = 6.09). The coefficient of total effect of strategic purchasing on supplier management was higher as well as significant (standardized coefficient = 0.44; t-value = 7.51) due to its significant indirect effect through strategic purchasing (standardized coefficient = 0.10; t-value = 3.55).

Competitive priorities construct was hypothesized to have a positive effect on supplier relationship ($H_{5.4}$) and supplier management ($H_{5.5}$). The path between competitive priorities and supplier relationship ($H_{5.4}$) was found to be significant (standardized coefficient = 0.36; t-value = 6.00). Hypothesis $H_{5.5}$ was not supported by the data. But, competitive priorities were found to have a significant indirect effect on supplier management through supplier relationship (standardized coefficient = 0.14; t-value = 4.38). This shows that competitive priorities will lead to better supplier management through superior supplier relationship. Hypothesis $H_{5.6}$ states that supplier relationship will lead to better management of the suppliers. This hypothesis was supported at the 99% confidence level (standardized coefficient = 0.38; t-value = 6.40). Supplier relationship construct was also found to have a significant indirect effect on the performance measures.

Supplier management was linked to supplier ($H_{5.7}$) and buyer's ($H_{5.8}$) manufacturing performance. Hypothesis $H_{5.7}$ was supported by the underlying data (standardized coefficient = 0.29; t-value = 4.51) at the 99% confidence level. The path between supplier management and buyer's performance ($H_{5.8}$) was also found to be significant (standardized coefficient = 0.12; t-value = 2.09) at the 95% confidence level. But, the coefficient of total effect of supplier management on buyer's manufacturing performance was higher as well as significant (standardized coefficient = 0.28; t-value = 4.26) due to its significant indirect effect through supplier's manufacturing performance (standardized coefficient = 0.16; t-value = 4.06). The direct causal path between supplier performance and buyer performance ($H_{5.9}$) was positive as well as significant (standardized coefficient = 0.54; t-value = 9.38).

4.4.6. Model 6: Impact of Supply Network Structure on Supplier Management and Performance

The results for this model are presented in Table 4.29. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 4)}}$ = 4.91 (p = 0.30) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. Other indices of the model fit also prove that the model fits the data well. The GFI for the hypothesized model accounted for 99% of the variance and covariance, and the AGFI was as high as 97%. Both GFI and AGFI values surpassed the cut-off values and suggest a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.98, 0.99 and 1.00 respectively. The RMSR was equal to 0.04. All the other overall indices of fit also surpassed the cut-off value. Based on these fit values, it is concluded that model 6 fits the data precisely.

Figure 4.12 presents the results of the causal relationships between the variables. As it can be seen in this figure, all six hypotheses were found to be significant at or above the confidence level of 95%. Table 4.30 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 99% confidence level.

Supply network structure was hypothesized to have a positive effect on long-term relationships ($H_{6.1}$) and supplier management ($H_{6.2}$). The first hypothesis was supported by the underlying data. The standardized coefficient (0.70) of this causal relationship was significant at a t-value of 9.27. Hypothesis $H_{6.2}$ was also significant at the 99% confidence level (standardized coefficient = 0.19; t-value = 2.83). Apart from these hypothesized relationships, supply network structure was also found to have a significant indirect effect on supplier management, supplier performance, and buyer performance. This result shows that a network-based supply structure is conducive to the effective management of the supply chain activities. Hypothesis $H_{6.3}$ purported that long-term relationships will have a significant effect on supplier management. This relationship ($H_{6.3}$) was found to be significant (standardized coefficient = 0.12; t-value = 2.09) at the 99% confidence level.

Supplier management was linked to supplier ($H_{6.4}$) and buyer's ($H_{6.5}$) manufacturing performance. Hypothesis $H_{6.4}$ was supported by the underlying data (standardized coefficient = 0.29; t-value = 4.50). The path between supplier management and buyer's manufacturing performance ($H_{6.5}$) was also found to be significant (standardized coefficient = 0.12; t-value = 2.09) at the 95% confidence level. But, the coefficient of total effect of supplier management on buyer's manufacturing performance was higher as well as significant (standardized coefficient = 0.28; t-value = 4.25) due to its significant indirect effect through supplier's manufacturing performance (standardized coefficient = 0.16; t-value = 4.06). The direct causal path between supplier performance and buyer performance ($H_{6.6}$) was positive as well as significant (standardized coefficient = 0.54; t-value = 9.38).

4.4.7. Model 7: Agile Supply Chain: Benefits of Information Technology

The results for this model are presented in Table 4.31. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 4)}} = 5.92$ (p = 0.66) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. The GFI for the hypothesized model was 0.99, and the AGFI was 0.98. Both GFI and AGFI values surpassed the cut-off values and suggest a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.97, 1.02 and 1.00 respectively. The RMSR and RMSEA were equal to 0.04 and 0.00 respectively. All the other overall indices of fit also surpassed the cut-off value. Based on these different fit values, it is concluded this hypothesized model fits the data precisely.

The results of the causal relationships are presented in Figure 4.13. As indicated in this figure, six out of seven hypothesized causal relationships were found to be significant. Table 4.32 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 95% confidence level.

It was hypothesized that environmental uncertainties will lead to increased usage of information technology ($H_{7.1}$). This hypothesis was supported by the underlying data. The standardized coefficient of this causal relationship (standardized coefficient = 0.19; t-value = 2.80) indicates that uncertainties do have a significant positive impact on information technology. Information technology usage was hypothesized to have a positive effect on long-term relationships ($H_{7.2}$) and inter-firm communication ($H_{7.3}$). Hypothesis $H_{7.2}$ was significant at the 99% confidence level (standardized coefficient = 0.23; t-value = 3.55). The path between information technology and communication ($H_{7.3}$) was also significant (standardized coefficient = 0.27; t-value = 5.12). The coefficient of total effect on communication was higher as well as significant (standardized coefficient = 0.39; t-value = 6.35) due to its significant indirect effect through long-term relationships (standardized coefficient = 0.12; t-value = 3.35). These results suggest that information technology usage will lead to longer supplier relationship as well as effective two-way information exchange. Apart from the hypothesized relationships, information technology was also found to have a significant indirect effect on supplier (standardized coefficient = 0.10; t-value = 3.34) as well as buyer agility (standardized coefficient = 0.05; t-value = 3.11). Thus, it is concluded that information technology ultimately leads to an agile supply chain by fostering such superior relationship characteristics.

4.4.8. Model 8: Supply Strategy-Structure Fit: Effect on Supply Management

The results for this model are presented in Table 4.33. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 10)}} = 14.50$ (p = 0.15) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. The GFI for the hypothesized model was 0.98, and the AGFI was 0.96. Both these indices surpassed the cut-off values suggesting a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.99, 0.99 and 1.00 respectively. The RMSR and RMSEA was equal to 0.09 and 0.05 respectively. These indices are below the acceptable value of 0.10. All other overall indices of fit also surpassed the cut-off value. Based on this, it can concluded that the supply strategy-structure model fits the data precisely. The results of the causal relationships are presented in Figure 4.14. Five out of six hypothesized causal relationships were found to be significant at or above the 90% confidence level. Due to the constraints introduced in this model, the indirect and total effects between the exogenous and endogenous variables were not estimated.

Strategic purchasing was hypothesized to have a significant effect on supply management ($H_{8.1}$). This hypothesis was supported by the underlying data. The standardized coefficient of this causal relationship (standardized coefficient = 0.31; t-value = 5.36) indicates that strategic purchasing has a significant positive impact on the successful management of supply chain activities. Supply network structure was hypothesized to have a positive effect on supply management ($H_{8.2}$). This hypothesis ($H_{8.2}$) was found to be significant at the 99% confidence level (standardized coefficient = 0.37; t-value = 6.26). The results of these two hypotheses prove that strategic purchasing and supply network structure have a significant impact on the supply management individually. Hypothesis $H_{8.3}$ suggests that, apart from these individual effects, the interaction or fit between these two constructs will also impact the successful management of the supply chain activities. The path between the interaction-term (SP*SS) and supply management was found to be significant at the 95% confidence level (standardized coefficient = 0.13; t-value = 2.34). Supply management was hypothesized to have a positive effect on buyer's operational ($H_{8.4}$) as well as buyer's financial performance ($H_{8.5}$). Though the path between supply management and operational performance ($H_{8.4}$) was found to be significant at the 90% confidence level (standardized coefficient = 0.10; t-value = 1.78), supply management did not have a significant direct effect on the buyer's financial performance. But, the total effect on financial performance was significant (standardized coefficient = 0.06; t-value = 1.63) due to its significant indirect effect through the operational performance (standardized coefficient = 0.03; t-value = 1.70). This result concludes that supply management will enhance the buyer's operational performance and thereby ultimately improve the financial performance.

4.5.9. Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility

Table 4.34 presents the result of the model analysis along with the cut-off values for the fit indices. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 8)}} = 14.44$ (p = 0.07) suggests that the hypothesized model and the set of coefficients estimated are consistent with the observed covariance. Other indices of the model fit also prove that the model fits the data well. The GFI for the hypothesized model accounted for 98% of the variance and covariance, and the AGFI was as high as 94%. This result suggests a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were equal to 0.94, 0.94 and 0.97 respectively. The RMSR and RMSEA were equal to 0.07 and 0.06 respectively. Though these are slightly greater than 0.05, it is below the acceptable value of 0.10. Based on these fit values, it is concluded that this model fits the data precisely.

The results of the causal relationships are presented in Figure 4.15. As it can be seen from this figure, all hypothesized causal relationships were found to be significant. Table 4.35 presents the indirect and total effects between the variables in the model. All the indirect and total effects were statistically significant at or above the 95% confidence level.

Strategic purchasing was hypothesized to have a positive impact on supply network structure ($H_{9.1}$) and logistics integration ($H_{9.2}$). Both hypotheses were supported by the underlying data. The coefficient for the causal relationship between strategic purchasing and supply network structure (standardized coefficient = 0.37; t-value = 5.96) indicate that they are positively related. The path between strategic purchasing and logistics integration ($H_{9.2}$) was significant at the 99% confidence level (standardized coefficient = 0.21; t-value = 3.26). The coefficient of total effect of strategic purchasing on logistics integration was higher as well as significant (standardized coefficient = 0.30; t-value = 4.52) due to its significant indirect effect through supply network structure (standardized coefficient = 0.07; t-value = 2.58). Strategic purchasing was also found to have significant indirect effects on the performance measures. It was hypothesized that information technology will have a significant positive effect on logistics integration ($H_{9.3}$). This relationship was found to be significant (standardized coefficient = 0.33; t-value = 5.38). It was hypothesized that supply network structure will improve the effectiveness of logistics integration ($H_{9.4}$). This hypothesis was found to be significant at the 99% confidence level (standardized coefficient = 0.18; t-value = 2.86). Apart from these hypothesized relationships, information technology and supply network structure were also found to have a significant indirect effect on supplier and buyer agility performance.

Logistics integration was linked to supplier ($H_{9.5}$) and buyer's ($H_{9.6}$) agility performance. The standardized coefficient for the causal relationships represented by $H_{9.5}$ (standardized coefficient = 0.27; t-value = 4.23) establishes a strong positive impact of logistics integration on supplier agility performance. The path between logistics integration and buyer's manufacturing performance ($H_{9.6}$) was found to be significant (standardized coefficient = 0.11; t-value = 1.93) at the 90% confidence level. But, the coefficient of total effect of logistics on buyer's agility performance was higher as well as significant (standardized coefficient = 0.25; t-value = 3.81) due to its significant indirect effect through supplier's agility performance (standardized coefficient = 0.13; t-value = 3.77). Supplier agility performance was hypothesized to have a positive effect on buyer performance ($H_{9.7}$). This relationship was positive as well as significant (standardized coefficient = 0.49; t-value = 8.25). This result further reinstates the fact that supplier performance is an intermediate outcome to the buyer's performance.

4.4.10. Model 10: Information Technology-Communication Fit: Effect on Logistics Integration

The results for this model are presented in Table 4.36. For the hypothesized model, $\chi^2_{\text{(degrees of freedom = 7)}} = 12.75$ (p = 0.07) suggests that this model and the set of coefficients estimated are consistent with the observed covariance. The GFI for the hypothesized model was 0.98, and the AGFI was 0.96. Both GFI and AGFI indices surpassed the cut-off values, thereby, suggesting a good fit of the data to the hypothesized model. The NFI, NNFI and CFI were all equal to 0.99. The RMSR and RMSEA were equal to 0.07 and 0.06 respectively. These indices are below the acceptable value of 0.10. All indices of fit surpassed the cut-off value. Based on this, it can be concluded that the information technology-communication fit model fits the data precisely. The results of the causal relationships are presented in Figure 4.16. As it can be seen from this figure, five out of six hypothesized causal relationships were found to be significant at or above the 95% confidence level. Due to the constraints introduced in this model, the indirect and total effects between the exogenous and endogenous variables were not estimated.

Information technology was hypothesized to have a significant effect on the integration of logistics activities ($H_{10.1}$). This hypothesis was supported by the underlying data. The standardized coefficient of this causal relationship (standardized coefficient = 0.30; t-value = 4.67) indicates that information technology has a significant positive impact on the successful integration of logistics activities. Communication was hypothesized to have a positive effect on logistics integration ($H_{10.2}$). This hypothesis was found to be significant at the 99% confidence level (standardized coefficient = 0.25; t-value = 3.89). These two hypotheses results prove the individual significant effect of information technology and communication on logistics integration. Hypothesis $H_{10.3}$ suggests that, apart from these individual effects, the interaction or fit between information technology and communication will also impact the successful integration of the logistics activities. The path between the interaction-term and logistics integration was found to be significant at the 95% confidence level (standardized coefficient = 0.18; t-value = 3.17). Logistics integration was hypothesized to have a positive effect on buyer's financial performance ($H_{10.4}$). This relationship was found to be significant at the 95% confidence level (standardized coefficient = 0.18; t-value = 3.17). This result concludes that logistics integration will enhance the financial performance of the buying firm.

4.4.11. Other Research Questions

4.4.11.1. Geographic dispersion. Geographic dispersion of suppliers affects various facets of supply chain management. Supplier location is a very crucial determinant in the management of the logistics activities among the supply chain partners. To study the effect of geographic dispersion on logistics activities, the data was split on the distribution of the supplier outside the country. The first group consisted of buying firms with 5% or less suppliers outside the country. The second group consisted of buying firms with 10% or more suppliers outside the country. The results of these two models are presented in Tables 4.37a and 4.37b. All the fit indices in both the models surpassed the cut-off values. From these tables, it can be seen that both the models fit the data precisely. The results of the causal relationships are presented in Figure 4.17a and 4.17b. In the first model, three out of 4 hypothesized causal relationships were found to be significant. In the second model, all the 4 hypothesized causal relationships were significant.

In both the models, the paths from information technology, communication, and interaction terms to the logistics integration were found to be significant. In the first model, the path from communication was found to be more significant (standardized coefficient = 0.35; t-value = 3.85) than the path from information technology (standardized coefficient = 0.15; t-value = 1.67). But, in case of the second model, information technology (standardized coefficient = 0.46; t-value = 5.53) had a more significant effect on logistics integration than communication (standardized coefficient =

0.13; t-value = 1.63). In both models, the path between the interaction term and logistics integration was significant at the 95% confidence level. While the path from logistics integration to buyer financial performance was not significant in the first model, the same path was significant at the 99% confidence level in the second level (standardized coefficient = 0.23; t-value = 2.89). Based on this result, it is concluded that logistics integration play a much more significant role in the case of firms that have suppliers across the world than those with local suppliers. Firms with increasing number of global suppliers recognize logistics integration as a dimension of competitive advantage. Moreover, while information technology plays a significant role in firms with a global focus, communication is found to play a significant role in firms with a less global focus.

4.4.11.2. Information technology usage. The capital investment in inter-organizational information systems vary based on the type being implemented. Numerous articles have focused on complex ERP packages as well as EDI systems. It is evident that depending on the complexity and extent of the information system infrastructure, the expenditure involved varies. In many cases, this could be directly affected by the size of the firms. To capture and study the usage of the various information technologies, five questions were included in the questionnaire. Demographic variables like number of employees [Size1] and annual sales volume [Size2] are used as surrogates for company size. Two separate independent samples test were conducted for each of these demographic variables. The first sample in the [Size1] model, consisting of firms with more than 500 employees, had 152 data points. The second sample in this model, consisting of firms with less than or equal to 500 employees, had 69 data points. Group-wise summary statistics for the five questions are presented Table 4.38a. T-tests were conducted to test the equality of means across the two samples. Table 4.38b presents the result of this test. From this table, it is evident that the usage of EDI, ERP, and Business-to-Business E-Commerce tools are different across the two samples. The difference in sample means for these three technologies is significant at the 99% confidence level. But, the usage of internet, intranet and extranet technologies and e-mail capabilities were found be the same across the two samples.

The second model was split based on the annual sales volume [Size2]. The first sample, consisting of firms with an annual sales volume of more than or equal to 100 million dollars, had a sample size of 128. The second sample, consisting of firms with an annual sales volume of less than 100 million dollars, had a sample size of 93. Sample-wise summary statistics for the five information technology types are presented in 4.39a. The t-test results are presented in Table 4.39b. This table indicates that the mean values of all the five different technologies were found to be statistically different across the two samples. Mean differences for technologies like EDI, ERP, and Business-to-Business E-Commerce tools, and Electronic mails were all significant at 99.9% confidence level. The internet, intranet and extranet technology mean differences were found to be significant at the 99% confidence level. The result of these two models show that the annual sales volume plays a more significant role in determining the types of technologies used by the firms in integrating their supply chain activities.

4.5. Conclusion

This chapter presented the results of measurement instrument development as well the various research models of supply chain management. The results of the measurement instrument process shows that the constructs developed in this study are reliable, valid as well as unidimensional. Except for one, all other research questions were evaluated using the SEM approach. Based on multiple model fit indices and stringent cut-off values, the research models were found to fit the data precisely. These results provide support to the importance of the factors in the successful management of the supply chain. Chapter V focuses on providing more detailed discussion on the results as well as their managerial significance.

CHAPTER V

Discussion and Managerial Implications

This chapter presents a more detailed discussion on the various theoretical constructs and their inter-relationships. The first section presents the general observation on the responses for the survey instrument. The second section presents a detailed discussion on each of the essential constructs. This section is grouped in terms of constructs rather than models so as to present the significance of each construct together rather than based on a particular area of focus. Recommendations for best practices are also evident in these discussions. Wherever appropriate the managerial significance of the results is also presented.

5.1. General Observation

All the constructs included in this study were found to have superior measurement characteristics. They all had acceptable levels of reliability, validity and unidimensionality. This result demonstrates that the respondents consider these factors to be important in the management of the supply chain. Among these, customer focus, top management support, and strategic purchasing constructs were considered as the most important. In the general sense, this outcome shows that the purchasing function is no longer considered as a support role. Rather, it has become more strategic in nature due to the importance given by top management and the consideration of the external customers as its own customer base. The following sections further discuss the importance and effect of each of the supply chain management factors.

5.2. Theoretical Constructs

5.2.1. Environmental Uncertainty

Uncertainties in the form of supply, demand and technology were included in this study. Four indicators of supply and demand environmental uncertainties were removed during the development of the measurement instrument. All the uncertainty constructs were found to have acceptable reliability level. This study recognizes that stabilizing the environment will require excellent coordination between the supply partners on both the supply and customer side. Therefore, the impact of supply uncertainty on strategic purchasing and supplier relationship was studied using two different models. Environmental uncertainty was hypothesized to increase the use of inter-organizational information systems. Supply uncertainty was found to have a significant positive impact on strategic purchasing and supplier relationship. This result shows that the strategic nature of purchasing leads to increased coordination needed between the supply chain partners. It also provides empirical support to the theory that under conditions of uncertainty, supply chain members will engage in collective action in order to stabilize their environment (Ouchi, 1980; Pfeffer & Salancik, 1978; St. John & Heriot, 1993; Zenger and Hesterly, 1997). The significant positive effect on information technology shows that to counteract the potentially detrimental effects of uncertainty, firms are more likely to incorporate sophisticated inter-organizational information systems that will improve coordination between the partners and sharing of information across boundaries.

Based on these conclusions, it is recommended that the best solution under conditions of uncertainty is not to incorporate multiple sourcing strategies. Rather, firms should strive to achieve strategic, long-term relationship with their key suppliers and consider them as an extension of their company. Also, to counteract the problems due to uncertainty, appropriate information technology can be utilized to coordinate the supply activities within as well as outside the organization.

5.2.2. Customer Focus

Since customer expectations are dynamic in nature, it is crucial for businesses to understand the key issues related to customer retention. Research has noted that customers use many standards of comparison in evaluating the products provided by firms. Therefore, this theoretical construct was formulated based on the importance given to customers in the execution of strategic planning, quality initiatives, product customization, and responsiveness. The importance of this construct is quite evident in the survey responses. The mean value for all the indicators of customer focus was high. This outcome, in addition to the low value for standard deviation, shows that the importance of this construct is widely recognized by all the respondents. It shows that the purchasing personnel recognize the external customer in addition to internal customers as their own customer. Customer focus was hypothesized to have a positive effect on strategic purchasing, supply management, and customer-related performance. All these hypotheses were significant above the 99% confidence level. The positive impact of customer focus on strategic purchasing shows that purchasing's role in external customer satisfaction is important because it creates value through management of the relationship with external suppliers. This result also shows that in making customers the central focus, it is crucial that the various supply chain partners are integrated intimately and managed strategically. Therefore, to better satisfy the requirements of the end customers, this study recommends that firms recognize the importance of the customers' needs and align their supply chain activities strategically.

5.2.3. Top Management Support

Top management support is characterized in terms of time, support, and resources contributed by the top management to strategic purchasing. One of the seven indicators of this construct was dropped during the instrument development process. The descriptive statistics for this construct shows that top management does support the purchasing department for its strategic role. The importance of top management support has been documented in various fields. In this study, the construct of top management support was hypothesized to have a significant positive effect on the strategic nature of purchasing. This causal relationship was supported significantly by the underlying data. This result proves that top management support influences the level of the buying firm's strategic perspective toward suppliers. Through strategic purchasing, this construct was also found to have indirect positive effect on supplier relationship, supplier management and supply chain performance. Based on the resounding support, this study suggests that top management should recognize the importance of the purchasing function and consider it strategic and integrative rather than as a support function.

5.2.4. Competitive Priorities

Consistent with prior literature, the term "competitive priorities" can be used to describe manufacturers' choice of manufacturing tasks or key competitive capabilities, which are broadly expressed in terms of low cost, flexibility, quality, and delivery. This study asserts that supply chain strategy should not be based on cost alone, but should be based on the issues of quality, flexibility, innovation, speed, time, and dependability. Therefore, the construct of competitive priorities was derived based on non-cost initiatives pursued by the firms. This construct had a very high mean value [5.27] and a very low standard deviation [1.05]. This result shows that non-cost initiatives are considered as more important than price-based strategies. The choice of any competitive priority requires the supply chain partners to coordinate the efforts so as to achieve the capabilities and objectives related to it. Therefore, this construct was hypothesized to have a positive effect on supplier relationship and supplier management. Non-cost based strategy was found to have a significant positive effect on supplier relationship. This result shows that the non-cost initiatives pursued by the buying firm are in line with the requirements of supply base reduction and long-term strategic relationships. The direct relationship between competitive priorities and supplier management was not supported by the underlying data. But it was found to have a significant indirect effect on supplier management through supplier relationship. This outcome shows that competitive priorities will affect supplier management only through supplier relationship.

5.2.5. Information Technology

The construct of information technology was conceptualized to represent the presence of electronic transaction and communication in any form between the supply chain partners. All the six indicators included in the survey were retained after the measurement instrument development process. This shows that respondents considered all the indicators as essential. The construct of information technology was included in three different models. It was hypothesized to have a significant positive effect on long-term relationship, communication and logistics integration. All these hypotheses were strongly supported by the underlying data. This result signifies the importance of various information technologies such as computer-to-computer electronic links, transaction processing systems, electronic mailing, electronic transfer capabilities, and logistics information systems in the successful integration of supply chain and logistics activities.

This study shows that information technology can reduce or eliminate the barriers between functional areas and firms thereby facilitating smooth information flow. By increasing the speed and accuracy of information, it will further strengthen inter-organizational relationships. Usage of information technology will make suppliers and buyers more process efficient, thereby giving the supply chain partners a significant advantage over their competitors. In addition to reducing paper-based order processing, invoicing errors, and other costs, information technology facilitates the timely and effective exchange of information, not only between the firm and its partners, but also among functional areas within a firm. Moreover, adopting appropriate technology to meet the need for better and faster control of information exchange leads to a strategic and competitive advantage for the supply chain partners. Information technology was also found to have significant indirect effect on agility and financial performance measures. This finding shows that by replacing inventory with information, inter-organizational systems can lead to agile as well as successful supply chains.

Five survey questions were used to evaluate the extent of usage of the various information technologies. The types of technologies included were EDI, ERP, B2B tools, Internet, and e-mail systems. From Table 4.3, it can be seen that electronic mail was the widely used technology. Though there is no data interchange in this technology, it does help the partners to communicate with each other without much financial investment. EDI was the least used technology. It was interesting to find that Internet, intranet and extranet were found to be widely used next to E-mail. Since web-based technology is a flexible, interactive, and a relatively efficient medium through which various business partners and consumers can communicate, the potential that it offers for improvements in the efficiency in channel functions is great. Business-to-business (B2B) and ERP software usage was not found to be different across the samples. This result is not surprising given the fact that the expenditure involved in implementing these complex packages are very high.

It is evident that depending on the complexity and extent of the information system infrastructure, the expenditure involved varies. In many cases, this could be directly affected by the size of the firms. There was a significant difference in the types of technology used in the two models represented by size of the firm (SIZE1) and annual sales volume (SIZE2). In SIZE1 model EDI, ERP, and Business-to-Business E-Commerce tools are found to be different across the two samples. This shows that firms with more than 250 employees used these technologies significantly more than firms with less than 250 employees. But, in the SIZE2 model, differences in mean of all the five technologies were found to be significantly different. This result presents empirical evidence to the argument that information technology usage is directly related to the size and profitability of a firm.

This study highlights the numerous benefits provided by inter-organizational information systems. Due to the profound impact of information technology on various supply chain factors, purchasing and supply chain professionals must keep abreast of the advances in electronic communication technology. They should recognize that these systems offer enormous potential to increase both effectiveness and efficiency of the purchasing function. Moreover, based on the potential benefits, this study recommends that firms should try to adopt the information technology that best fits their needs.

5.2.6. Strategic Purchasing

Strategic purchasing was conceptualized by its proactive as well as long-term focus, its contributions to the firm's success, its integrative role, and its involvement in strategic planning process. Based on the descriptive values for the indicators and the construct as a whole, it is evident that the purchasing function is no longer a passive, but is strategic in nature. Strategic purchasing construct was included in 6 of the 10 models. Based on the model and causal relationship results, it was found to have significant positive effect on long-term relationship, supply base reduction, communication, cross-functional teams, supplier integration, supply network structure, and logistics integration. It was also found to have a significant indirect effect on operational performance of the supplier and buyer firm. This result proves that strategic purchasing is at the heart of supply chain management. In an overall interpretation of the data, it is evident that purchasing sits at a strategic intersection between the organization's supply base and its internal operations. This also implies that the purchasing department plays an integrative role in the effective management of the chain.

Purchasing department's involvement in the firm's strategic planning process can be considered as an important requirement for achieving superior supply chain management. To have superior supplier relationship, purchasing needs to be a full participant in business strategy formulation and implementation. In specific terms, the model results demonstrate that the strategic role of purchasing has a positive effect on the long-term strategic and cooperative relationship with suppliers, will help the buying firms to maintain a closer relationship with limited number of highly responsive suppliers, and will help in communication and frequent sharing of pertinent and sensitive information. It also shows that the integrative nature of strategic purchasing makes it conducive to networked supply structure and enterprise-wide logistics integration.

The positive influence of strategic purchasing on operational and financial performance empirically confirms its importance and is consistent with conclusions of the past studies. The significance of the indirect and total effects on performance further proves that, by fostering such superior relationship, communication and responsiveness of suppliers, logistics integration, and networked supply structure, strategic purchasing ultimately results in an improved operational and financial performance. Firms that have strategic purchasing are more likely to be able to impact the responsiveness of their suppliers. An increase in the responsiveness of the suppliers is an added advantage to the buying firms. This result indicates that strategic purchasing is an indirect predictor of the buyer's performance and that increasing strategic focus of the purchasing function would enable the buying firm to be more responsive to their customer needs, thereby, its overall performance. This study also demonstrates the values added to the firm by strategic purchasing. It provides empirical support to the fact that strategic purchasing is positively related to supplier as well as buyer performance.

5.2.7. Supply Network Structure

The construct of supply network structure was characterized by emphasis on inter-firm co-ordination as well as emphasis on the informal social systems that are linked through a network of relations. It was based on indicators emphasizing non-power based relationships and decentralized network-like structure. A preliminary evaluation of the descriptive statistics denotes that the responding firms do recognize the importance of network-based supply structure. Supply network structure was used in three different models. It was found to have significant impact on long-term relationship, supplier management, logistics integration, and ultimately on supplier and buyer performance. This suggests that vertically integrated hierarchical organization structure is a primary impediment to effective communication. Furthermore, it recognizes that network supply structure overcomes communication barriers established by functional as well as organization boundaries.

Networked supply structure will eliminate traditional vertical lines of functional or organizational authority, thereby, facilitating lateral decision processes that will overcome barriers to communication and information sharing. More blurred organization boundaries between suppliers, customers and other supply chain members facilitate the firm's logistics activities. The evaluation of supply strategy-structure fit model has shown that supply network structure follows purchasing strategy. Moreover, the impact of the interaction of purchasing strategy and supply network structure on supply management was also found to be significant. This reflects the practical implications of aligning the supply structure with the strategy of the purchasing firm. It suggests that similar to the fit between manufacturing strategy and organizational structure, the fit between supply network structure and purchasing strategy will also improve supply chain performance.

5.2.8. Supplier Relationship

Supplier relationship was formulated to include factors such as supply base reduction and long-term relationship. Supply base reduction was included individually in one model while long-term relationship was included in three models. The second-order supplier relationship factor was included in three other models. In two models, this construct was combined with supplier management to form the second-order factor of supply management. The following paragraphs present a more detailed discussion on each of the sub-constructs.

5.2.8.1. Supplier base reduction. After completion of the measurement development process, three out of five indicators were deleted. Though the reliability of this construct was the lowest, it was found to have an acceptable reliability level. Supply base reduction was hypothesized to have significant effect on long-term relationship and communication. The above results demonstrate that supply base reduction and long-term cooperative relationship work hand-in-hand. As noted by just-in-time as well as supply chain literature, it is found that reducing the supply base is commonly one of the best means of creating closer, interdependent supplier relationships. Reduced supply base also leads to interdependency between the involved parties, thereby facilitating improved communication and sharing of information. Therefore, based on this result, it is argued that a supplier within a reduced base will be more cooperative, efficient, and willing since they share a greater trust along with a larger share of the buying firm's business. The indirect and total effects further show that due to an increased trust and interdependence, reducing the supplier base will ultimately improve the firm's operational and financial performance through cooperative relationship and effective communication. As indicated by Trevelen (1987), this could also be attributed to the fact that reduced supply base will reduce the transaction cost involved in managing multiple supplier systems.

5.2.8.2. Long-term relationship. This construct was operationalized to involve the initiatives taken by the buying firm to encourage long-term relationship with their suppliers. The descriptive statistics for this construct indicates that the responding firms do recognize the importance of long-term relationship and that they have a strategic long-lasting relationship with their key suppliers. The mean value for this construct was found to be very high [5.69] with a low standard deviation [0.93]. These numbers signify the importance as well as the uniformity of the opinion among the respondents. Long-term relationship was found to have a significant effect on communication, cross-functional teams, supplier integration, supplier performance and buyer performance.

This study provides empirical evidence to the fact that long-term relationships pave the way for both buyer and supplier firms to better understand each other's problems and help solve them. Firms practicing cooperative relationships are more open in exchanging information because of the mutual sense of responsibility, trust, collaboration, and commitment. Both parties are more likely to look for ways of enhancing each other's competitive advantage and thereby leading to a win-win situation. Moreover, in the long term, buying and selling firms are able to develop relationships that are characterized by increased communication, cooperation, and coordination of all activities associated with production of goods and services for the end customer. The significant indirect effects of this construct on performance indicators further suggest that by fostering such superior characteristics, long-term strategic relationship will indirectly improve the customer responsiveness, operational performance of the supply partners, and the financial performance of the buying firm. More specifically, long-term relationship is found to help lower inventories, increase quality, and reduce lead times.

5.2.9. Supplier Management

Supplier management was formulated to include factors such as communication, cross-function teams and supplier integration. These constructs were included in eight models either as individual constructs or as a second-order supplier management factor. In all the models, these factors were hypothesized to be the link between other supply management factors and supply chain performance. The following paragraphs present a more detailed discussion on each of the sub-constructs.

5.2.9.1. Communication. This theoretical construct was conceptualized to involve two-way communication and interaction with suppliers. Due to its profound impact on other supply chain factors, this construct was hypothesized to have significant positive effect on supplier integration, logistics integration, and supply chain performance. All the hypotheses were strongly supported by the underlying data. This result supports the notion that timely exchange of information through effective communication will help to better coordinate buyers' and suppliers' activities. Communication is very important for complex processes such as new product development and strategic initiatives. Therefore, overcoming the resistance to sharing information between supply chain partners will help to integrate suppliers in new product design and other strategic planning.

Direct inter-organizational communication is found to be an extensively used technique in the successful supplier integration. Frequent and timely information exchange will foster confidence and eliminate negative attitudes such as mistrust, fear, disappointment, frustration, and dishonest acts on both sides, thereby, leading to competitive advantage, and eventually to improved financial performance. Frequent and accurate information transfer among the supply chain members can ultimately reduce the distortion of information as it passes up the supply chain. The significant indirect and total effects identified in this study convincingly demonstrate that effective inter-organizational communication leads to improved financial performance of the buying firm through superior coordination of product design, production, relationship and other activities between the members of the supply chain. On the whole, two-way communication is found to be a vital and fundamental element of organizational and supply chain activity.

5.2.9.2. Cross-functional teams. As a wide range of supplier problems can be potentially addressed by better supplier relationships, this construct is defined based on the efforts taken towards encouraging as well as using supplier-involved teams. It was found that the respondents considered cross-functional teams to be instrumental in the successful management of supply chain activities. Cross-functional teams were hypothesized to have a significant effect on communication and supplier integration. Also, as part of supplier management construct, it was hypothesized to have a profound impact on supply chain performance. This construct was found to have a significant positive effect on other factors. This result suggests that cross-functional teams eliminate barriers to communication in high uncertain environments. Moreover, it is evident that cross-functional and inter-organizational team-based problem-solving efforts create an information rich environment.

In the context of this study, it becomes apparent that many supply related problems require a coordinated cross-functional solution that demands information sharing and joint problem solving with external as well as internal members. Thus cross-functional teams involving key supply members beyond company boundaries are effective in meeting the challenges facing supplier involvement in new product development and other strategic projects. Cross-functional teams encouraging collocation of employees will lead to superior joint problem identification as well as resolution. Based on these conclusions, supply chain professionals are encouraged to use cross-functional and inter-organizational teams to meet the challenges of the supply chain as well as the requirements of the end customer.

5.2.9.3. Supplier integration. This theoretical construct is based on the involvement of the suppliers in crucial project and planning processes. Looking at the descriptive statistics for the indicators of this construct, it is evident that most of the responding firms integrate their key supplier in the design and development of new products. But, there was not a strong support to the involvement of key suppliers in the business and strategic planning. This outcome shows that even though firms are moving in the right direction, they are still not integrating their suppliers to the fullest extent. In line with extant literature, supplier integration was hypothesized to have a significant impact on the performance of the supplier as well as buyer firm. This construct was found to have a significant effect on all the performance measures of the supplier firm. In case of the buyer firm, supplier integration had a significant direct effect on quality, delivery, and responsiveness performance. But, it was found to have a significant indirect effect on all the performance measures of the buying firm through superior supplier performance.

Based on the model results, this study shows that supplier integration improves the performance of both parties, thereby, leading to a win-win situation. Therefore, it is concluded that supplier integration in new product design and strategy functions will have greater impact on performance such as cost, quality, customer responsiveness, and delivery performance. Since most of mismatches are often caused by misperceptions of supplier firm capabilities, supplier integration can reduce mismatches between product characteristics and existing process capabilities of all the supply firms.

5.2.10. Logistics Integration

Since logistics is expected to guarantee that the necessary quantity of goods is in the right place at the right time, this theoretical construct was based on the seamless integration of the logistics function of the various supply chain partners. All the indicators of logistics integration were retained after the rigorous measurement instrument development process. This shows that the indicators identified in this study are good representatives of the latent construct. A cursory look at the descriptive statistics further reveals that logistics integration is widely practiced by the responding firms. The effect of driving forces such as strategic purchasing, supply network strategy and information was illustrated in this study. These constructs were found to be important in the effective integration of logistics activities. Logistics integration was hypothesized to have a positive effect on supply chain agility and buyer's financial performance. The coefficients of these hypotheses show that close coordination of external logistics activities will have a positive effect on the agility performance of the supply chain. It also reflects the importance of logistics in coordinating the multiple units in the supply chain and, ultimately, as a source of agility and competitive advantage.

5.2.11. Geographic Dispersion

Prior research has noted that using local suppliers reduces the extent of supply uncertainty. But, the location of foreign or global suppliers may provide a number of cost-saving advantages including availability of cheap labor. Distance and time differences increase the difficulty of establishing and maintaining effective interactions between the supply chain members. But, appropriate coordination mechanisms and information technology could enable more effective management of this added complexity. Exchange of information between suppliers within the global supply chain management is significantly different. Based on the result of this analysis, it is concluded that logistics integration plays a much more significant role in the case of firms that have higher percentage of suppliers across the world. All the hypotheses were significant in the model with more than 10% suppliers outside the country. The relationship between logistics integration and buyer's financial performance was significant only in this model. Based on this effect, it is concluded that logistics integration enable higher levels of performance in geographically dispersed supply chain. Moreover, it is evident that these firms recognize logistics integration as a dimension of competitive advantage.

5.2.12. Supply Chain Performance

5.2.12.1. Supplier performance. Supplier performance was considered as an intermediate outcome to buyer performance. It was measured in terms of quality, cost, flexibility, delivery, prompt response and other measures of technological efficiency. In all the models, supplier performance was found to have a significant impact on buyer performance. In some models, supply chain constructs had a significant indirect effect on buyer performance through supplier performance. This outcome shows that strategic supply chain initiatives lead to a win-win situation for both the buyers and suppliers. Therefore, buying firms should not only strive to improve their own performance, but also concentrate on improving the performance of their suppliers.

5.2.12.2. Buyer performance. Buyer performance was measured in terms of financial indicators as well as operational performance indicators. Operational performance measures including customer responsiveness were found to have a significant impact on financial performance. Therefore, this study concludes that customer responsiveness can lead to customer loyalty, customer willingness to buy more goods and services at a premium price, and the superior financial performance of the buying firm through continual improvement of its product-delivery system. Moreover, operational measures will impact the financial performance as they basically relate to the efficiency and effectiveness of the operations within the firm. Therefore, firms should focus on improving their operational performance because this will eventually result in improved financial performance.

5.3. Conclusion

This chapter presented a detailed discussion of the results from this study. The results were found to be consistent with previous research on these theoretical constructs. A closer look at the results signify the importance of the various supply chain factors and their interrelationships. Rather than being an impediment, environmental uncertainty was found to have a positive impact on supply chain management through successful coordination of supply activities. It is also evident that driving forces such as customer focus, competitive priorities, top management support, and information technology can help in the successful management of supply chains. Superior and strategic supplier relationship and supplier management were found to have a positive impact on supplier as well as buyer performance, thereby leading to a win-win situation within the supply chain. Effective logistics integration was found to be a very important factor in achieving agility within the supply chain. On the whole, it is concluded that the results of this study present the success formulae that can be helpful to companies in effective management of their supply chains.

CHAPTER VI

Summary and Conclusions

Supply chain management represents one of the most significant paradigm shifts of modern business management which recognizes that individual businesses no longer compete as solely autonomous entities, but rather as supply chains (Lambert and Cooper, 2000). Supply chain management, along with a number of other emerging areas in operations management, however, is still in its embryonic stage (Handfield and Melnyk, 1998). The scientific development of a coherent supply chain management discipline requires that advances be made in the development of measurement instruments as well as theoretical models to improve our understanding of supply chain phenomena (Croom et al., 2000). Thus, the research agenda in supply chain management must not be driven by industrial interest alone (New, 1997). Research about supply chain management as a conceptual artifact of the modern world is also quintessential. Indeed, it is necessary to understand the broader context before robust prescription is possible.

Any scientific research discipline can be viewed in terms of two interrelated streams: substantive and construct validation. While the former reflects the relationships among theoretical constructs inferred through empirically observed relationships, the latter involves the relationships between the results obtained from empirical measures and the theoretical constructs that the measures are purported to assess (Schwab, 1980). Since "all theories in science concern statements mainly about constructs rather than about specific, observable variables" (Nunnally, 1978), the process of construct conceptualization and measurement development is at least as important as the examination of substantive relationships (Venkatraman, 1989). Nevertheless, while research on various supply chain relationships has been growing, there has not been a comprehensive approach to construct development and measurement. This could be largely attributed to the fact that phenomenal efforts are necessary to undertake the development and validation of SCM constructs and measures.

This study, through successive stages of analysis and refinement, has arrived at an initial set of constructs and operational measures with a strong support of their measurement properties (i.e., reliable, valid, and unidimensional) by recognizing the interdisciplinary nature of SCM. The measurement instrument could be used by researchers either directly in their research contexts or as a basis for refinement and extension in the best tradition of cumulative theory building and testing and to ultimately create a coherent theory of supply chain management.

6.1. Summary of Results

A preliminary review of means and standard deviation of survey responses showed that the respondents place high importance on driving forces like customer focus, information technology, competitive priorities and top management support. The supplier relationship and supplier management factors were considered as very instrumental to the management of the supply chain. Multiple research models were used to link the essential constructs of supply chain management. Based on multiple fit indices, all the models were found to fit the data quite well. The model results were found to be consistent with previous research. A detailed look at the results further signify the importance of the various supply chain factors and their interrelationships.

Rather than having a detrimental effect, environmental uncertainty was found to have a positive impact on supply chain management through successful coordination of supply activities (Burt, 1989; Lascelles & Dale, 1989; Manoocheri, 1984; St. John & Heriot, 1993). The driving forces such as customer focus, competitive priorities, top management support, and information technology identified in this study were found to be essential in the successful management of the supply chain. Strategic supplier relationship and supplier management were found to have a positive impact on supplier as well as buyer performance thereby leading to a win-win situation within the supply chain. Logistics integration was found to have a positive impact on the agility of the supply chain. Supplier performance was found to have a positive impact on the buyer performance. In multiple models, supply chain factors were related to the buyer performance through superior supplier performance. This shows that supplier performance is an intermediate outcome to buyer performance. On the whole, the results of this study present the importance of the various supply chain factors and their interrelationships. It is also concluded that these results present the success formulae that will be helpful to various firms in the effective management of supply chain activities.

6.2. Research Contributions

The findings of this study are expected to have a significant impact on academicians as well as practitioners. The proposed framework will be of great value not only to readers who desire to extend their research avenues into this exciting area, but also to those who have already investigated this topic but in isolation or with limited scope. In its entirety, this study will provide a better understanding of the various critical elements of supply chain management and their effect on the supply chain performance. Specifically, this study is expected to make many contributions of great interest to supply chain professionals and researchers including:

- Providing the purchasing managers with an insight into the most conducive practices that their counterparts, in general, consider as important
- Presenting the purchasing managers with a better picture of the scope of both problems and opportunities associated with supply chain management
- Verifying the importance of environmental uncertainty and its impact on the management of supply chains
- Providing a better understanding of the relationship between strategic purchasing, supplier relationship, supplier management and performance within the light of uncertainty
- Demonstrating the increased significance of the strategic role of purchasing in the successful management of supply chains
- Studying the importance of aligning the purchasing strategy with the business strategy
- Studying the importance of supply network structure in supplier relationship, supplier management, logistics integration, and supply chain performance
- Studying the effect of supply strategy and structure fit on supplier relationship, supplier management and overall supply chain performance

- Revealing the increased importance of using information technology for facilitating supply networks, supplier management, supply integration, as well as supply chain performance
- Providing insight into the dependence of buyer performance on effective supplier relationship and supplier management
- Providing an overview on the extent of usage of different types of information technologies such as electronic data interchange, enterprise resource planning, and electronic commerce
- Studying the driving forces that impact the effective enterprise-wide logistics integration
- Studying the effect of geographic dispersion of suppliers on logistics integration.
- Studying the effect of information technology-communication fit on external logistics integration
- Discovering the effect of firm characteristics, if any, on effective management of the supply chain
- Providing a better understanding of the management of supply chain by facilitating unification of the domain of theoretical knowledge
- Presenting empirically validated theoretical constructs to help practitioners and researchers to evaluate the various success formulae for the management of supply chains
- Providing an integrated research framework that will offer a well-grounded and robust basis for theoretical development of alternative models, thereby allowing

researchers to test the validity of and relationships among the various supply chain initiatives along with their impact on supply chain performance

- Ultimately, helping to create a coherent theory of supply chain management

6.3. Limitations and Future Research Directions

This study intends to identify and validate key constructs underlying supply chain management research. The constructs were identified based on a thorough literature review. The result of the iterative instrument development and purification process is a set of reliable, valid, and unidimensional constructs. During the purification process, 20 items were deleted in order to improve the reliability and validity of their underlying theoretical constructs. All the constructs are made up of three or more items except for supply uncertainty and supply base reduction, which include only two indicators. Though these two constructs have good psychometric properties, future research can be directed to refining them and adding new indicators to ensure that all the dimensions of these two constructs are better represented.

As defined by the Supply Chain Council (2002), the supply chain encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer. The most crucial problem in defining this phenomenon is in identifying what can be included within the orbit of supply chain management (New, 1996). Therefore, the entire domain of this concept is very extensive and cannot be covered in just one study. Moreover, measurement instrument development is an ongoing process, and the instrument is strengthened only over a series of further refinement and tests across different populations and settings (Hensley, 1999). This study is a first comprehensive step towards the identification of the theoretical domain of supply chain management. Future research should be directed not only to refining and strengthening the constructs identified in this study, but also to expanding the domain by considering additional factors. A few suggestions are provided on the inclusion of additional factors in future research efforts. As a result of an extensive literature review in the initial phase of this study, factors such as *competitive environment* (Hahn et al., 1990; Sutcliffe and Zaheer, 1998), *trust and commitment* (Kanter, 1994; Spekman and Sawhney; 1995), *supplier selection* (Choi and Hartley, 1996; Croom, 2001), *supplier certification* (Carr and Ittner, 1992; Ellram and Siferd, 1998), *internal logistics integration* (Ballou et al., 2000; Ellinger, 2000; Kahn and Mentzer, 1996), *leaness* (Christopher and Towill, 2000; Naylor, Naim, & Berry, 1999), and *agility* (Billington and Amaral, 1999; Christopher, 2000; Fliedner and Vokurka, 1997; van Hoek, 1999) were also identified. Though these factors are of great interest, they were removed from this study due to the length of the survey instrument and thus, a concern on response rate.

This study has identified a wide range of factors that is essential for the successful management of the supply chain. Due to this very fact, it was not able to represent any theoretical construct to the fullest extent [i.e., with lots of indicators]. So, future study can be directed to focus on narrower areas of concern and perform extensive analysis to validate the results presented in this study.

Another limitation in this study is related to the collection of supplier-related indicators. Since the unit of analysis in this study is the dyadic relationship between the buyer and supplier, the purchasing, material management, operations, and supply management functions were considered to be the best candidate to answer both the customer-side and supplier-side questions posed in this study. Although the complexity of data collection increases when a researcher has to collect data from both the buyer and its related supplier, this procedure will help the researcher to validate as well as crosscheck the information from both parties. Future research can also consider gathering data from multiple respondents within each firm to increase the validity of the data collected.

Another limitation of this research is related to the sample population. Having drawn from a list of ISM members, the results of this research are generalizable only to the population of the firms represented by the ISM database. Though the final sample in this study spanned a wider range of firms based on demographics such as the number of employees and annual sales, future research endeavors should attempt to include a mixed population of respondents from multiple sources so as to extend the generalizability of the results.

Due to the inclusion of manufacturing-oriented factors like supplier integration, competitive priorities, etc., the sample firms were limited to manufacturing firms only. Therefore, future research should also include non-manufacturing firms in the sample to validate the relationships illustrated in this research. Also, cross-country samples should be evaluated to study the difference in management style and culture.

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Figure 2.1

Illustration of a Company's Supply Chain

(Adopted from Spekman et al., 1998)

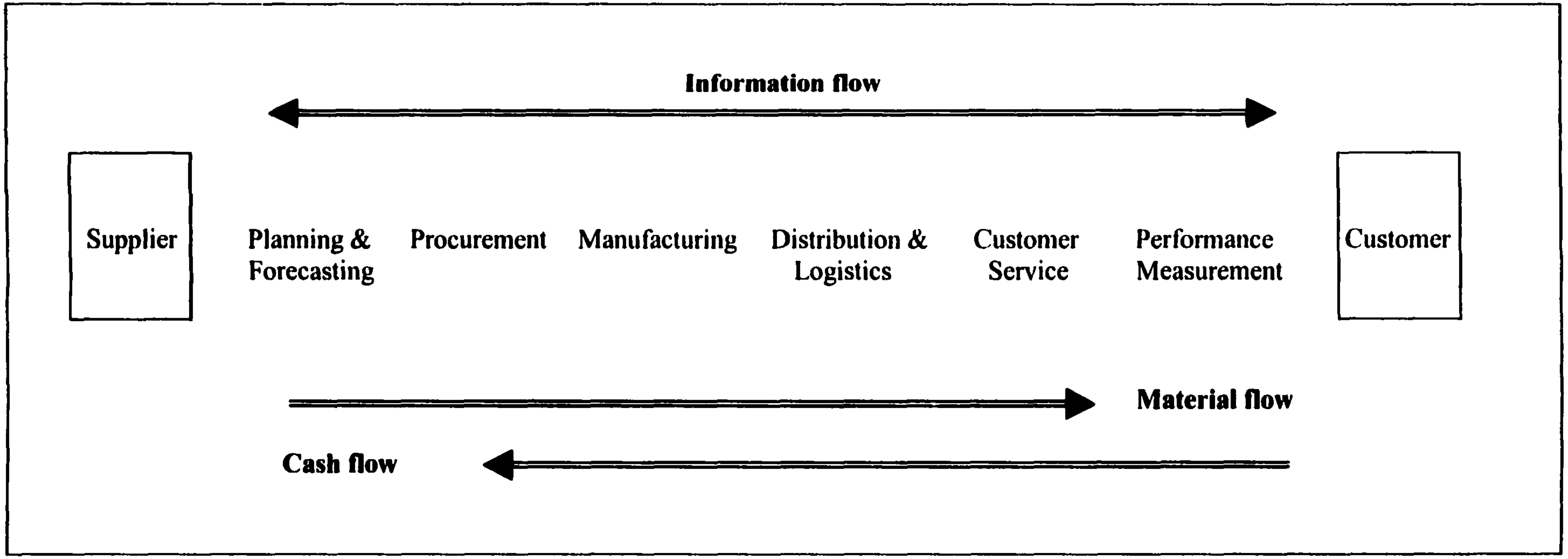


Figure 2.2
A Framework for Studying the Factors of Supply Chain Management

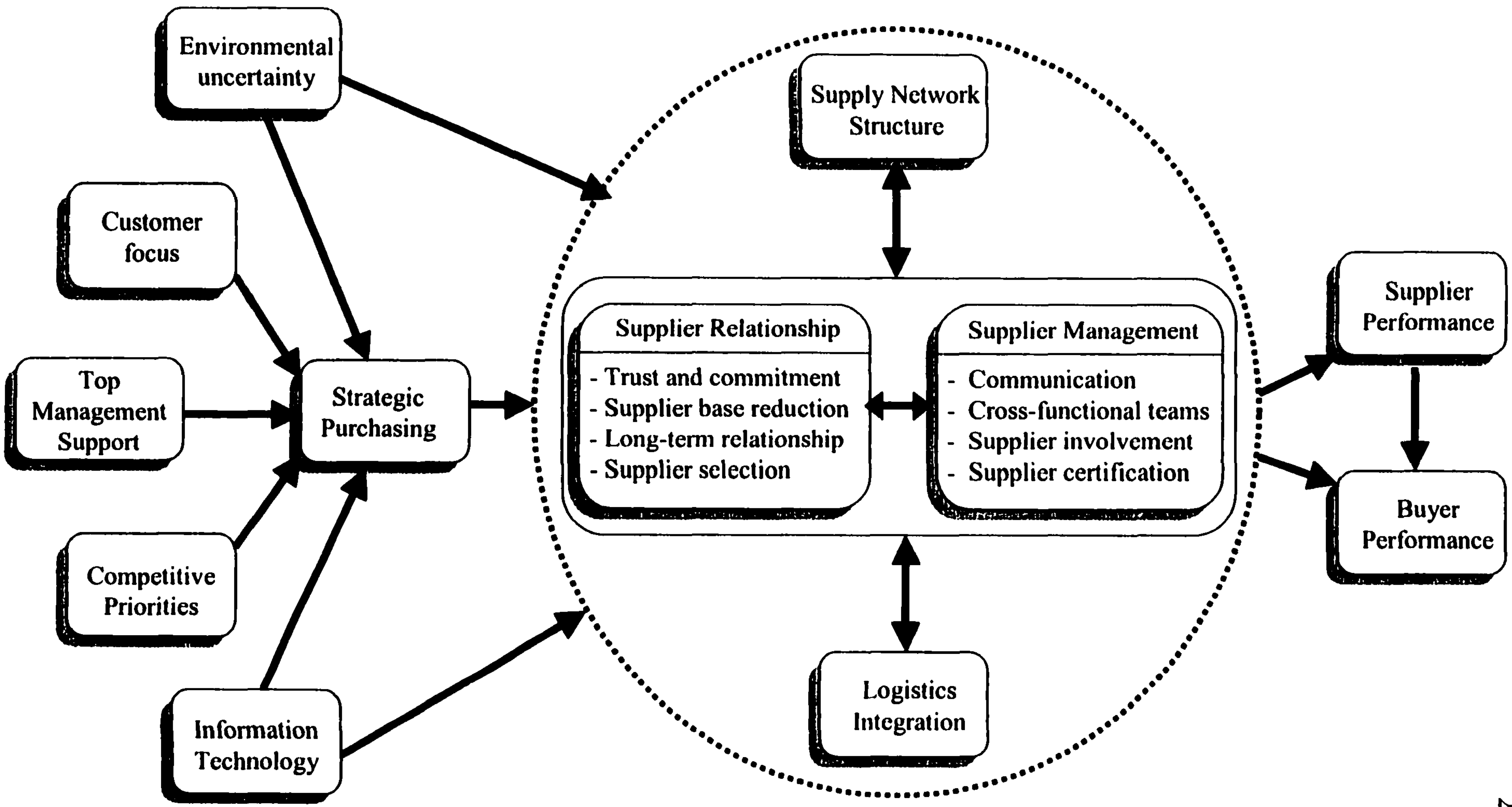


Figure 2.3
Degree of Uncertainty in the Supply Chain
(Adopted from McGuffog and Wadsley, 1999)

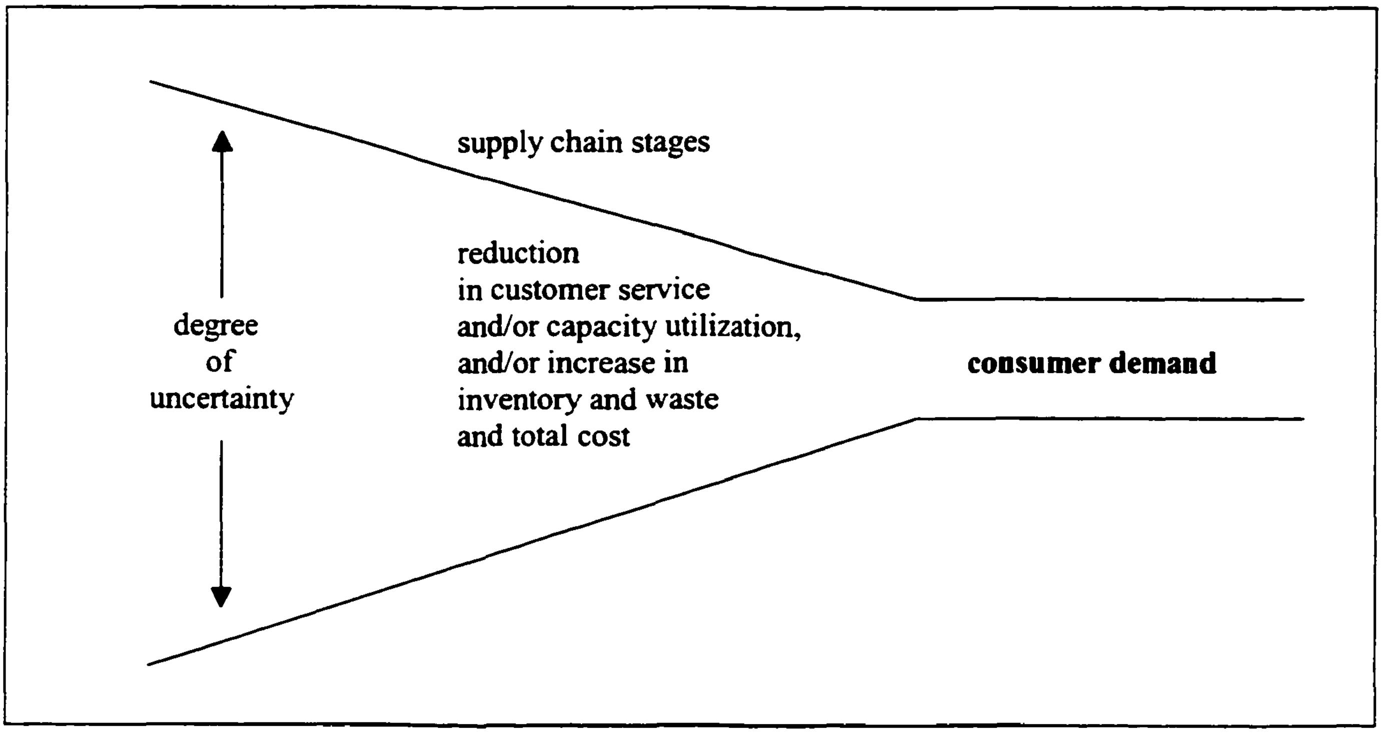


Figure 2.4
The Theoretical Perspective of Customer Focus
(Based on Carson et al., 1998)

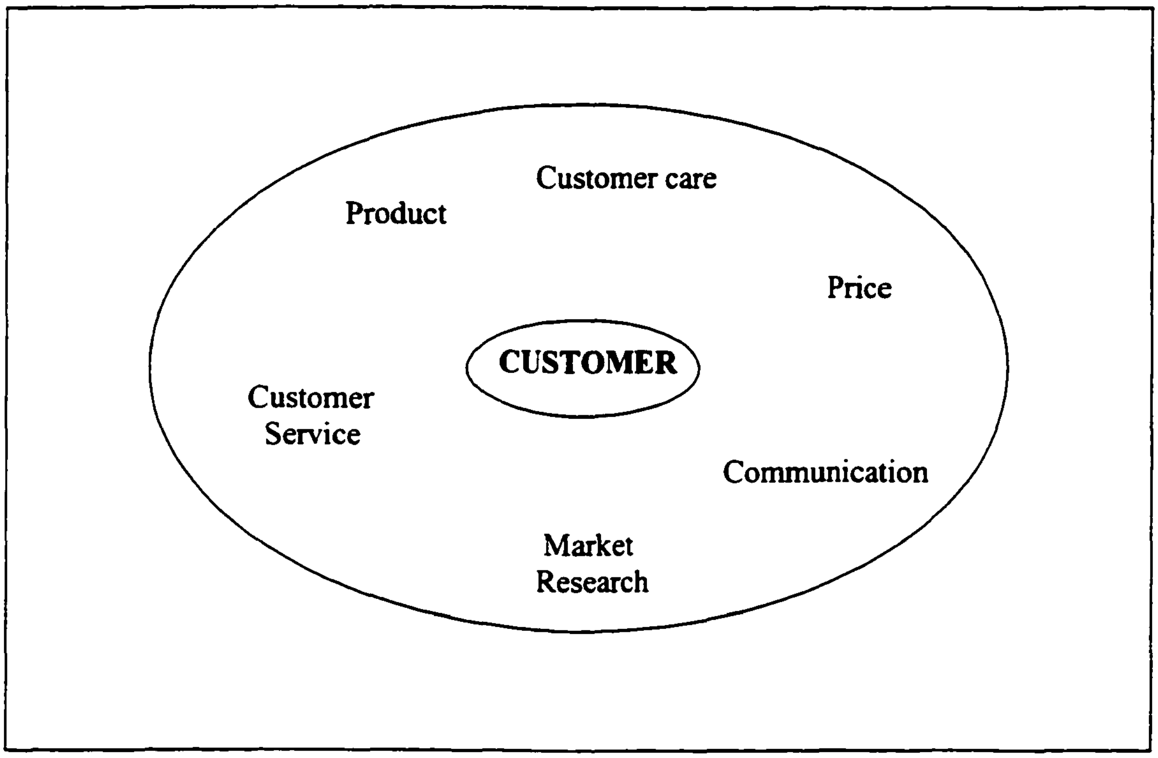


Figure 2.5
The Cumulative Sand Cone Model
(Based on Ferdows and De meyer, 1990)

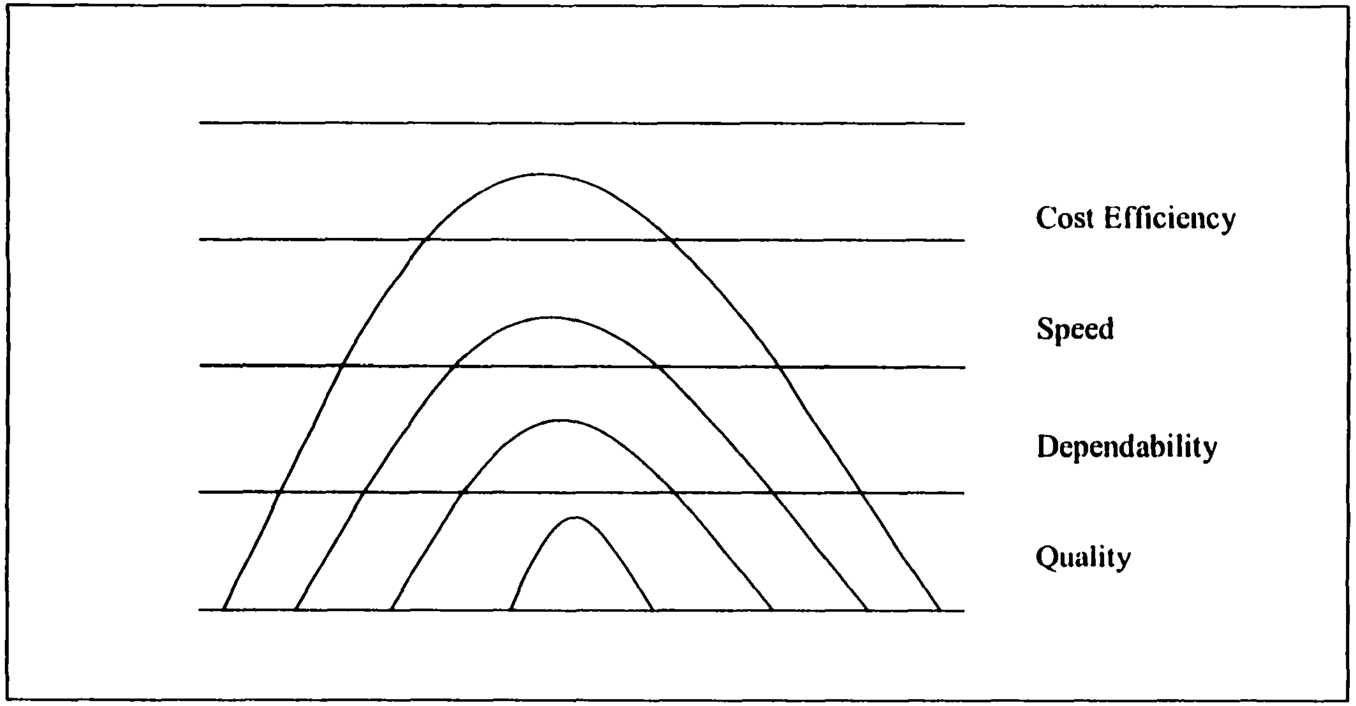


Figure 2.6
Information-based Supply Chain Management
(Adopted from Greis and Kasarda, 1997)

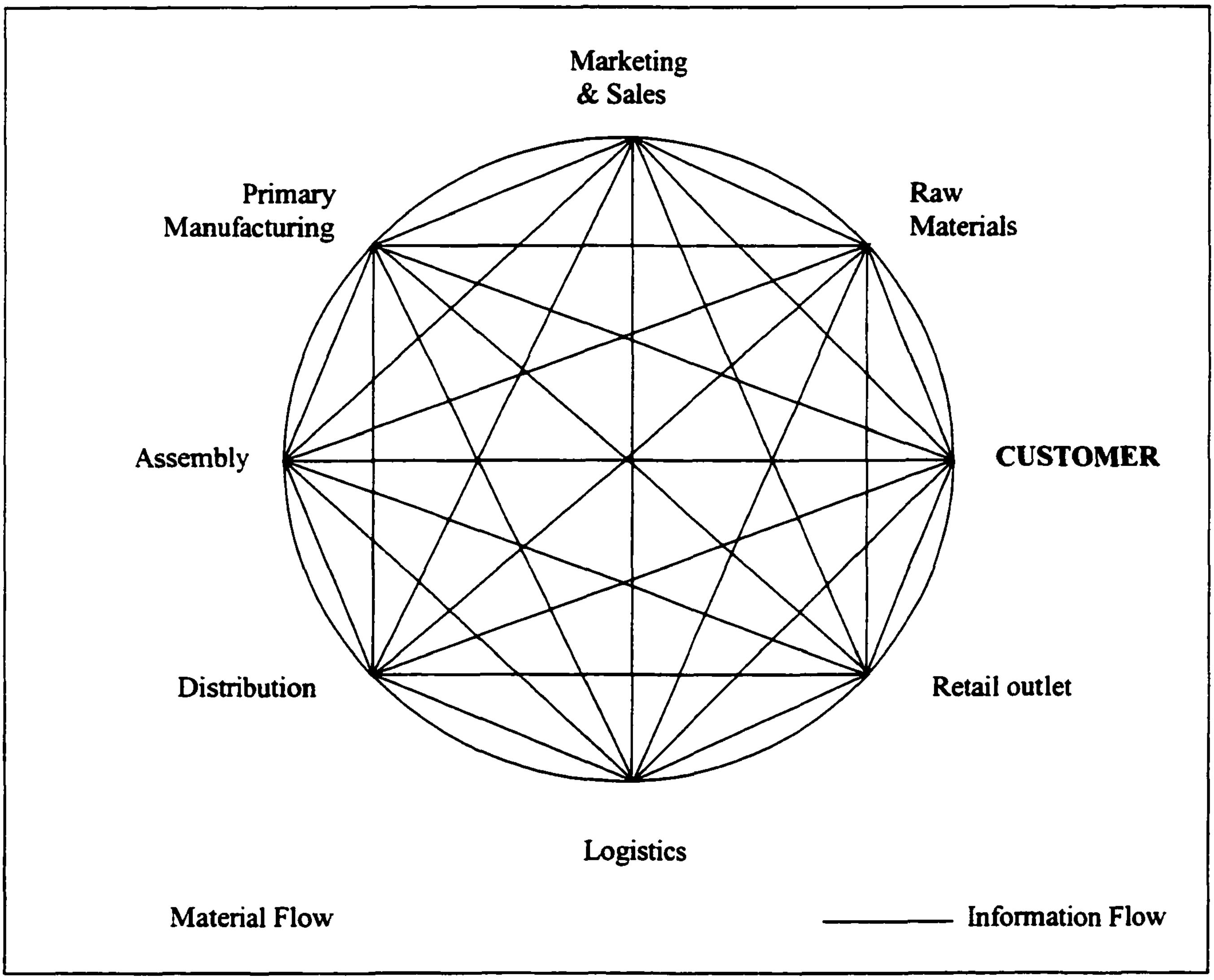


Figure 2.7
Web-based Supply Chain Infrastructure
(Adopted from Shaw, 2000)

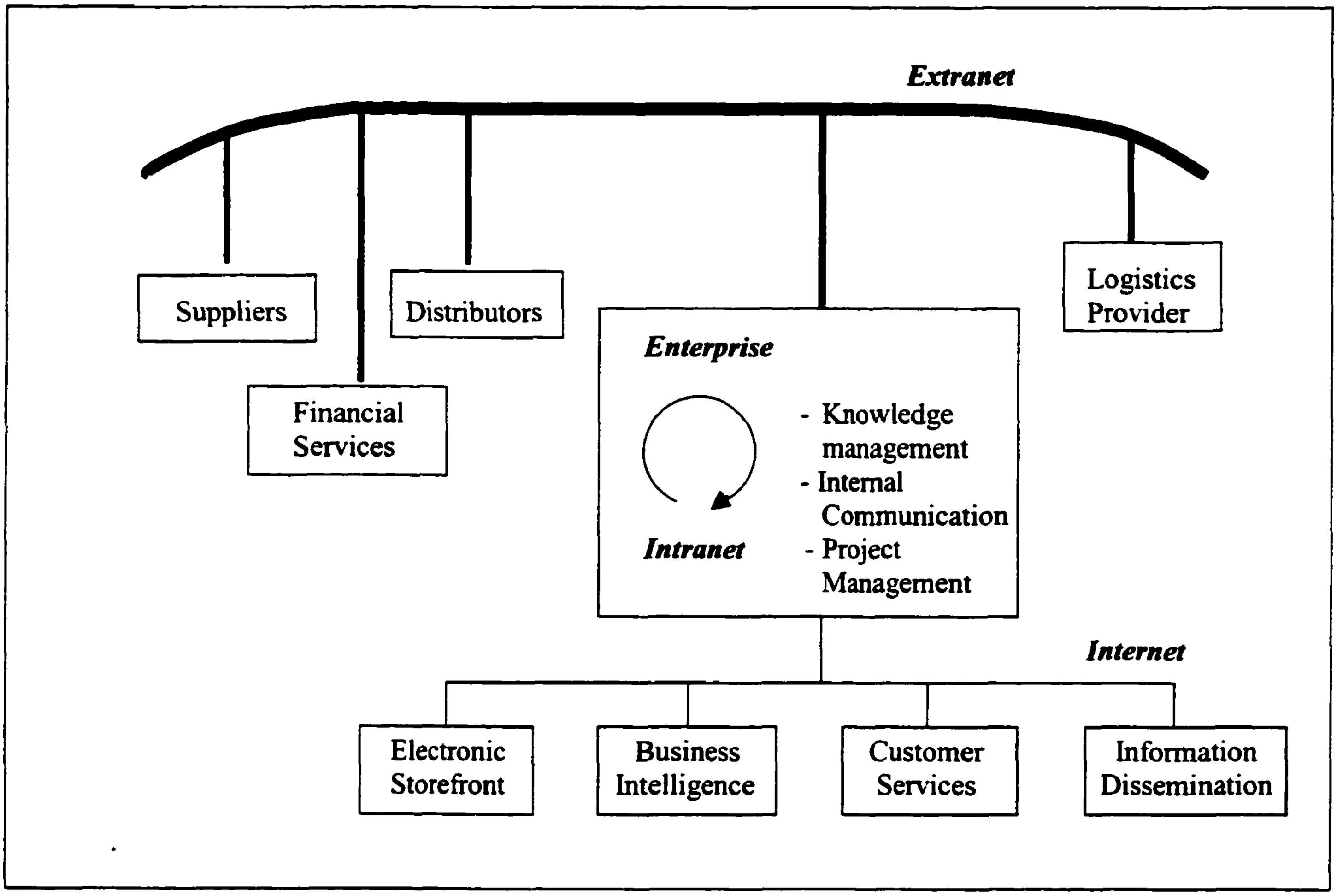


Figure 2.8

Strategic Purchasing within Supply Chain Management Context

(Adopted from Fung, 1999)

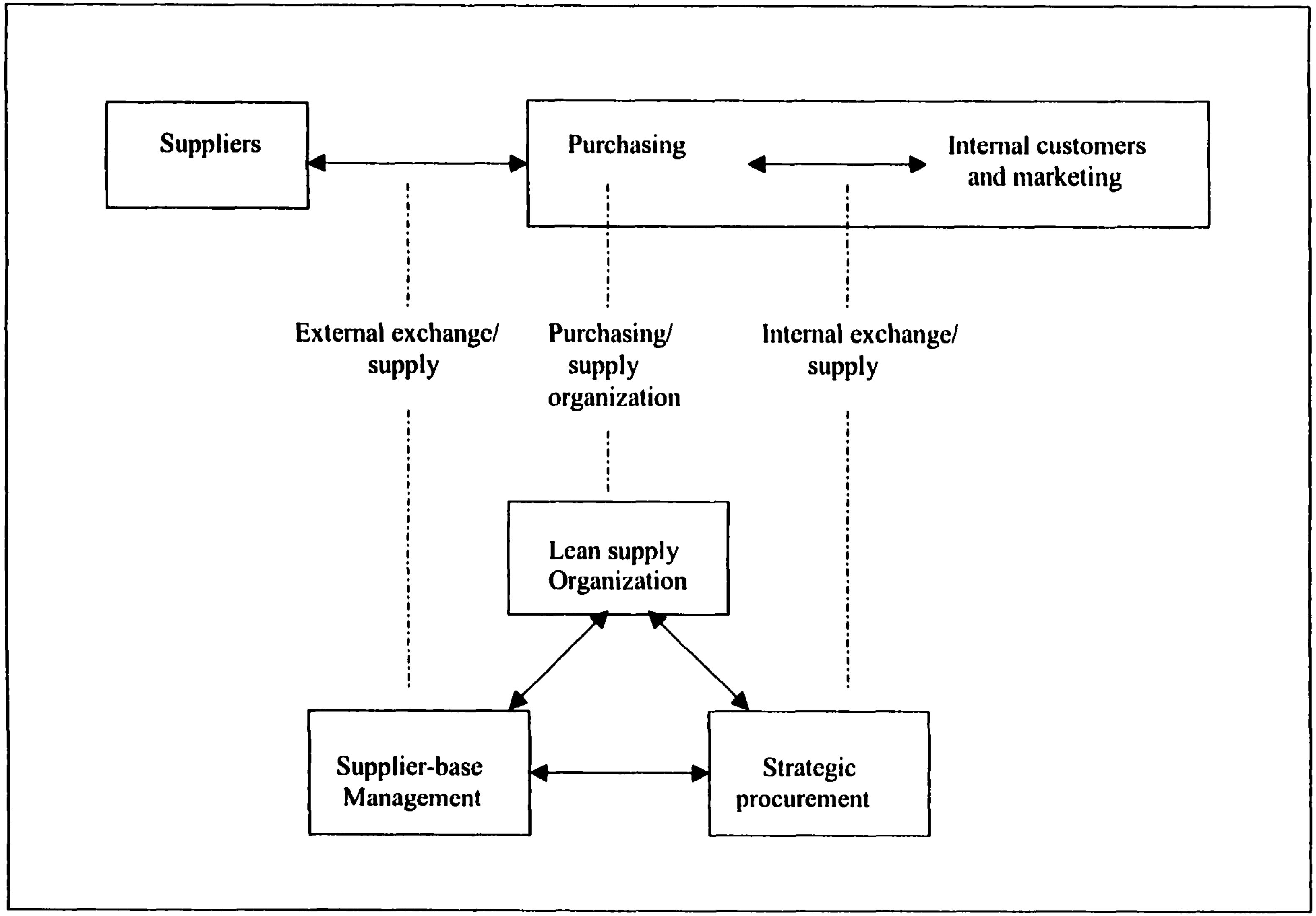


Figure 2.9
Key Transition to Becoming a Collaborative Supply Chain Partner
(Adopted from Spekman et al., 1998)

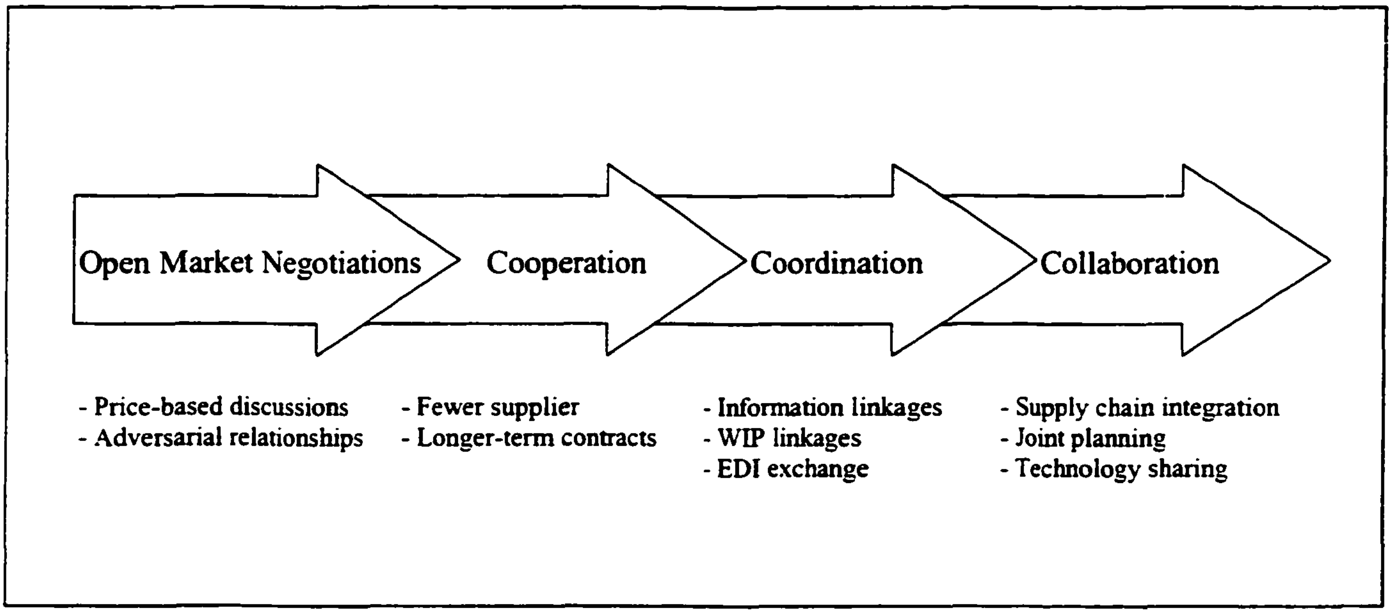


Figure 3.1

Model 1: Strategic Supply Management (Proposed Model)

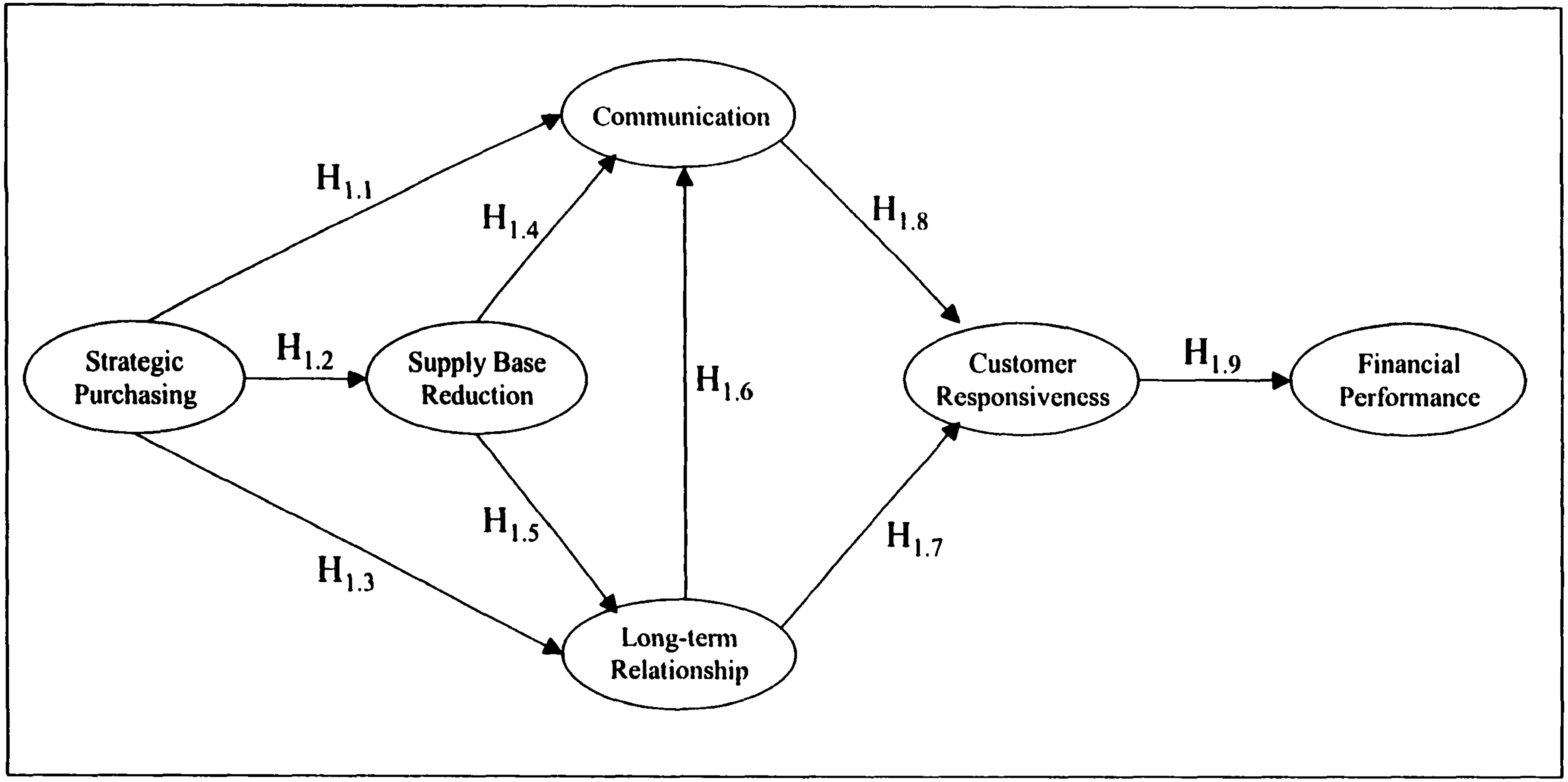


Figure 3.2

Model 2: Supply Uncertainty and Quality Performance (Proposed Model)

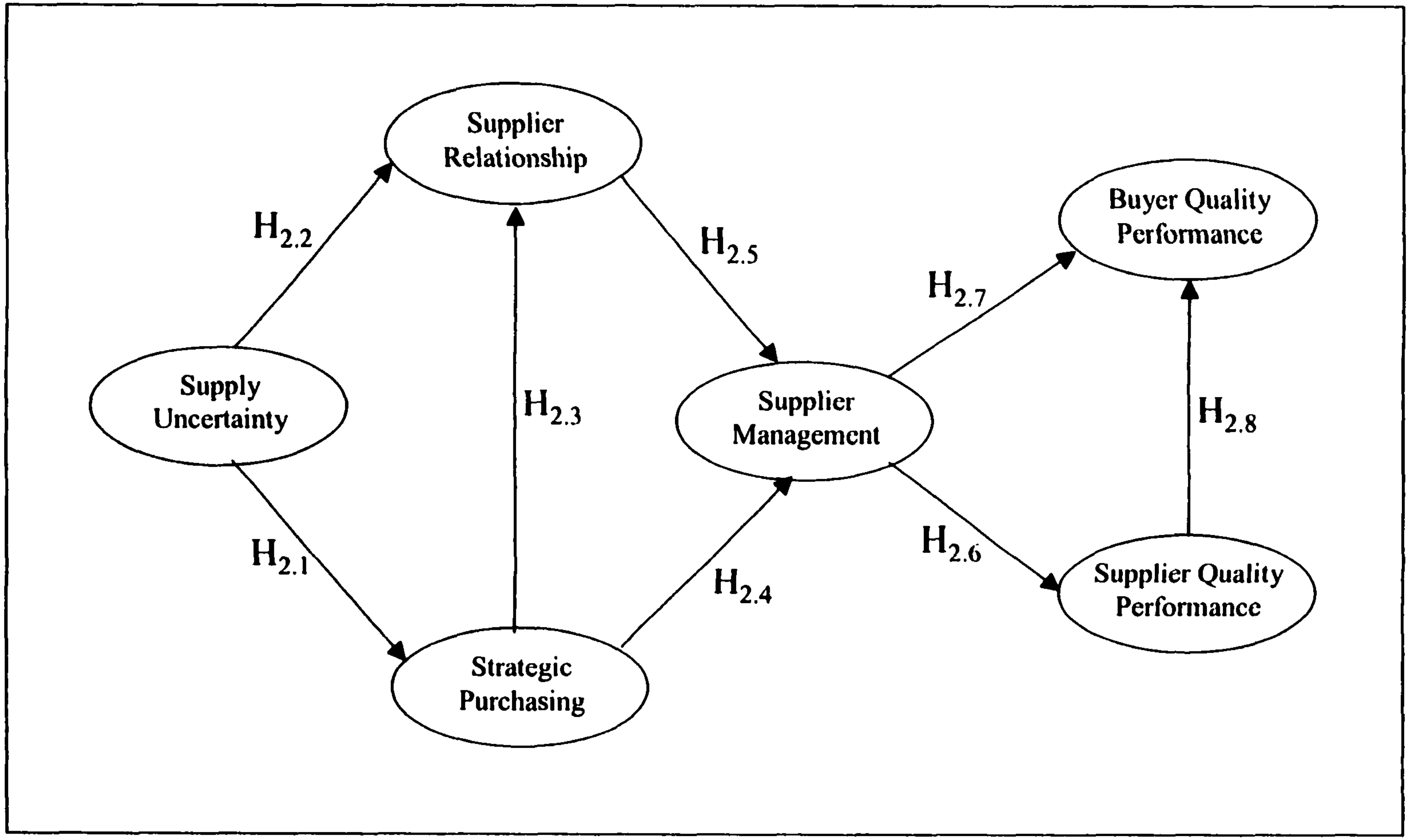


Figure 3.3

Model 3: Customer-oriented Supply Management (Proposed Model)

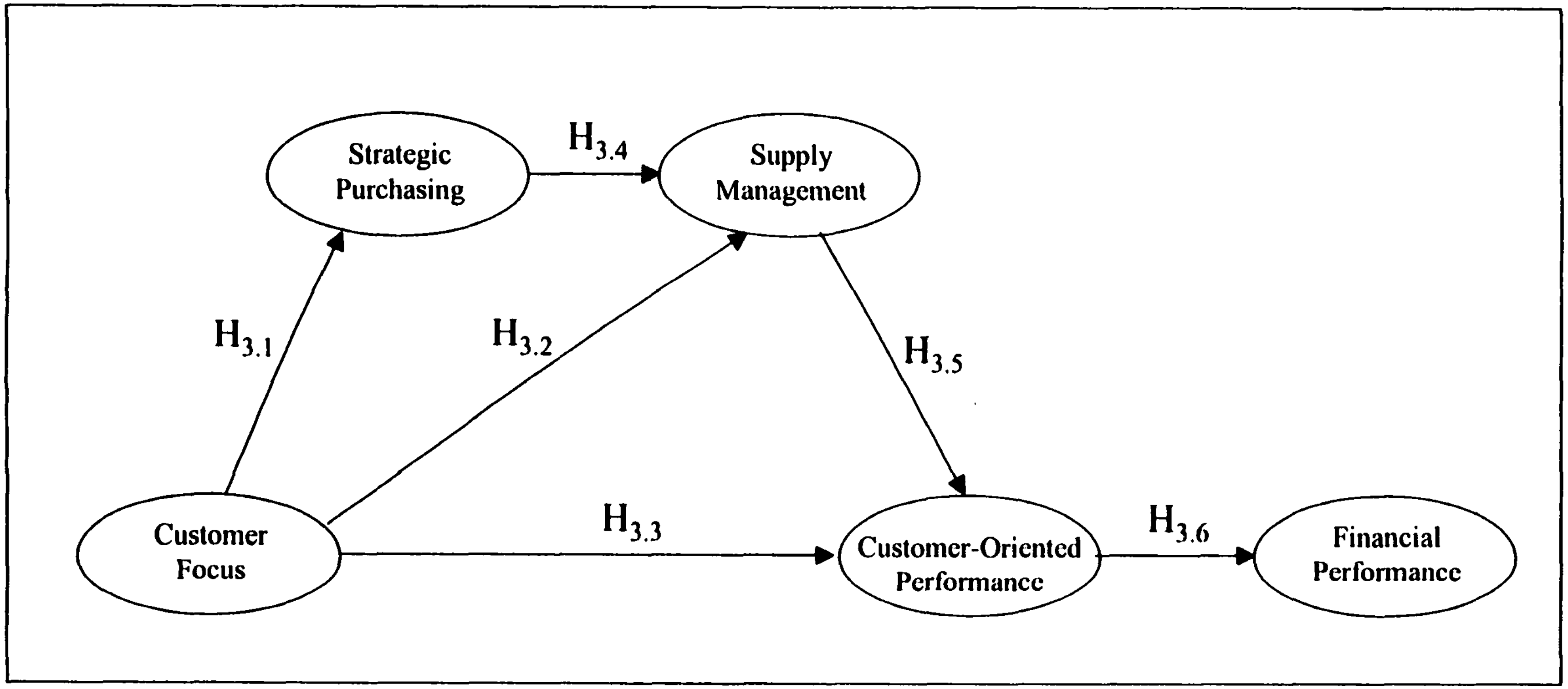


Figure 3.4

Model 4: Strategic Supply Management: Effect of Supplier Integration on Cost-based Performance (Proposed Model)

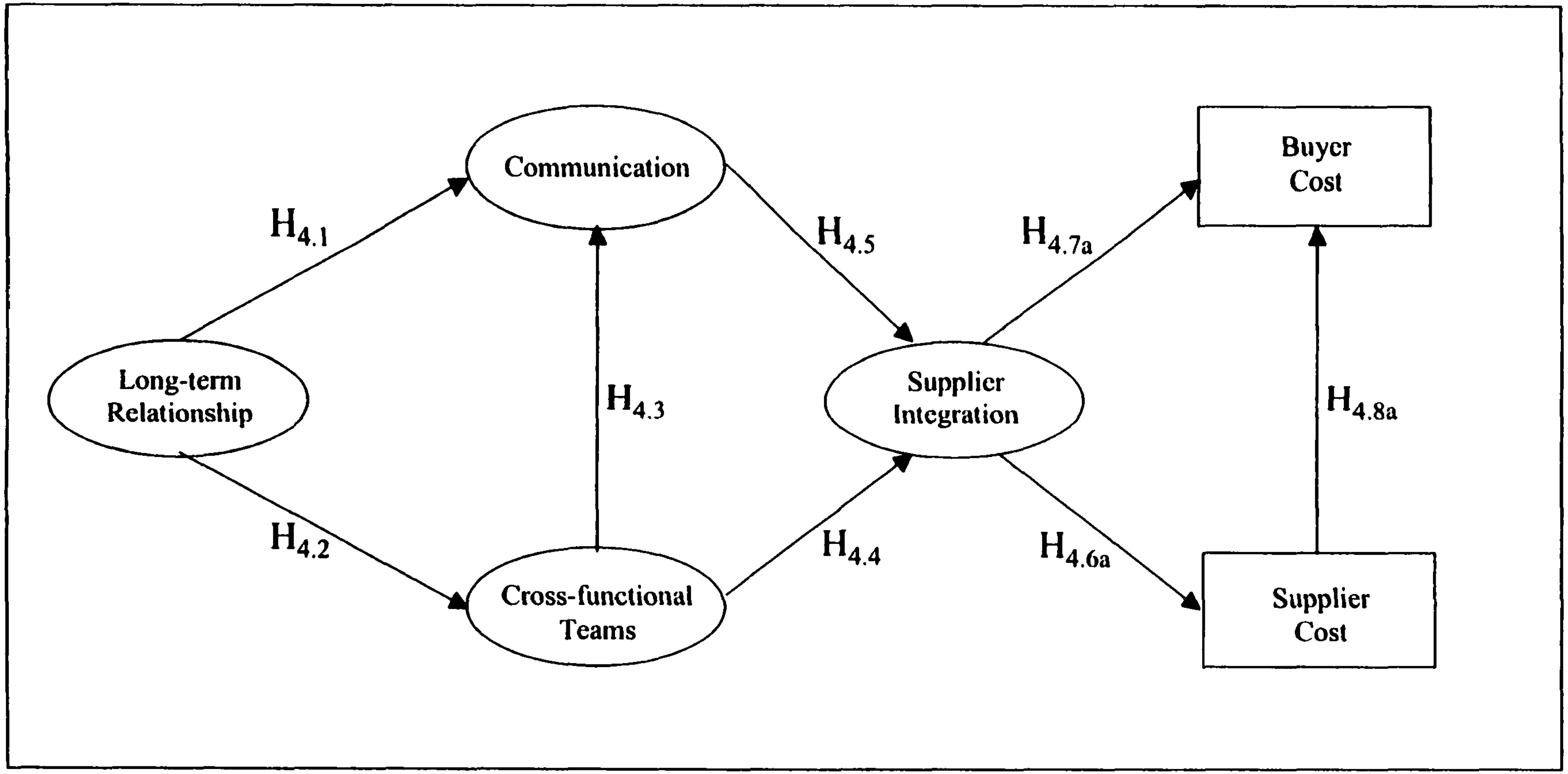


Figure 3.5

Model 4: Strategic Supply Management: Effect of Supplier Integration on Quality-based Performance (Proposed Model)

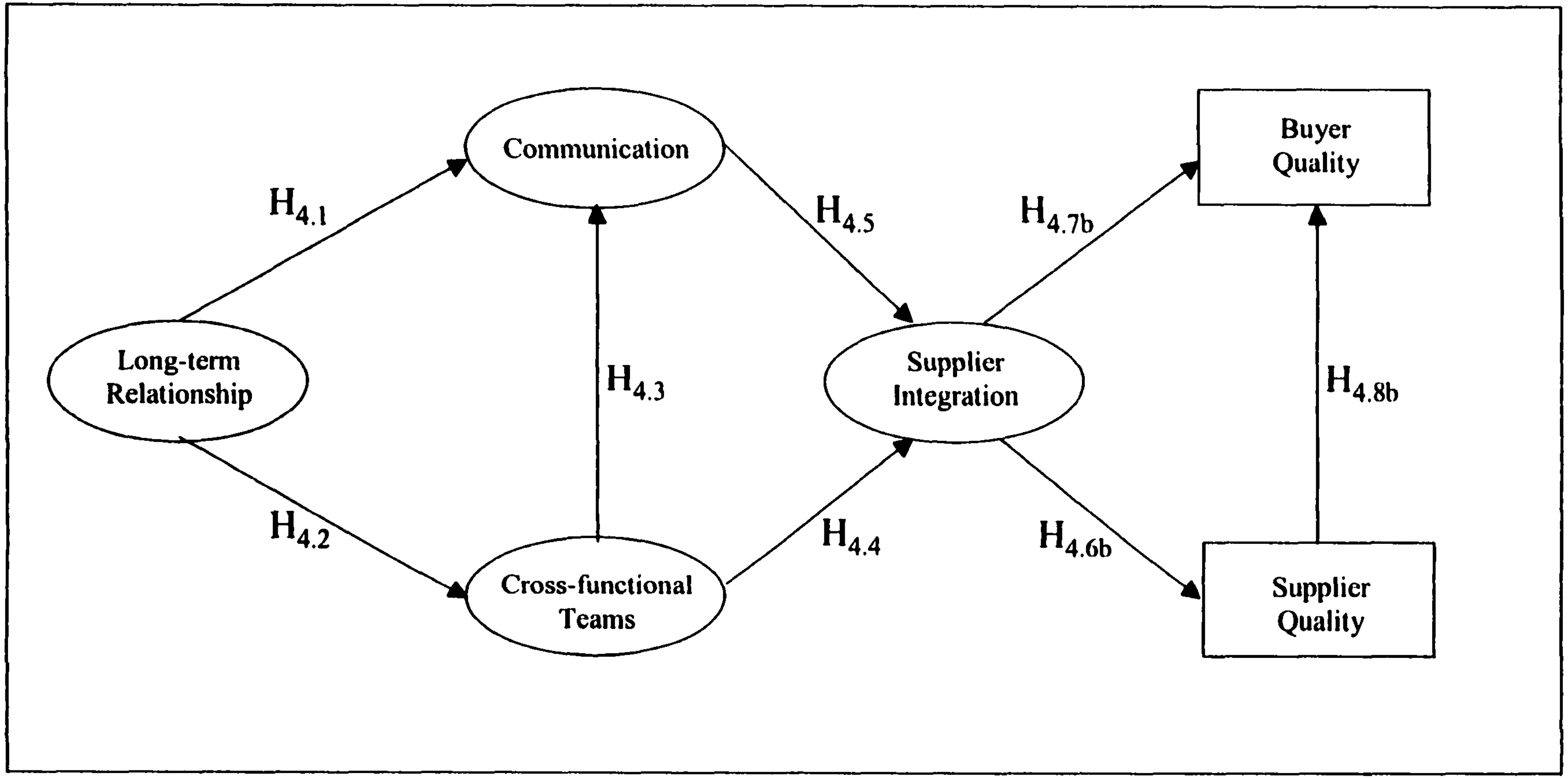


Figure 3.6

Model 4: Strategic Supply Management: Effect of Supplier Integration on Delivery-based Performance (Proposed Model)

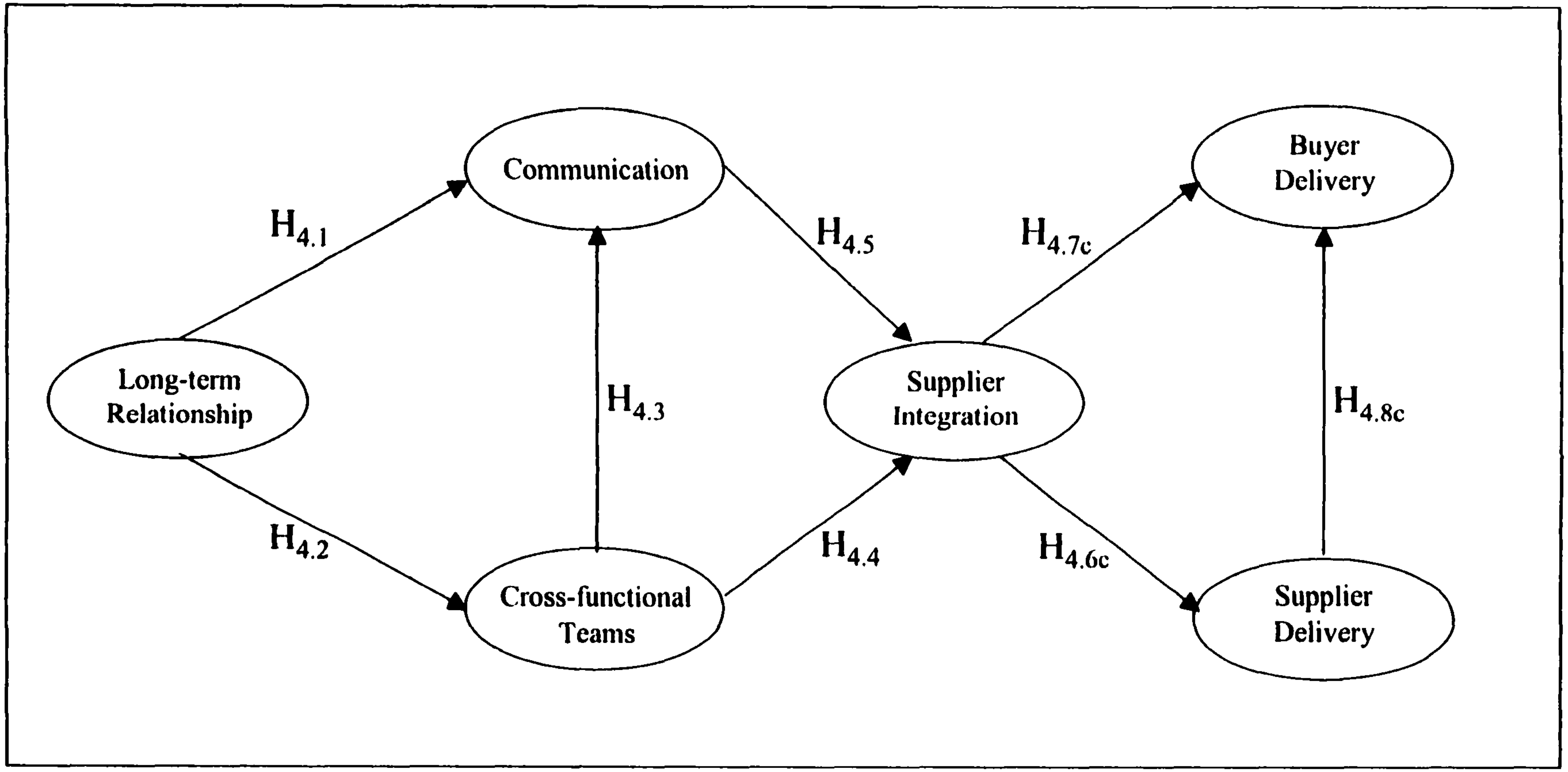


Figure 3.7

Model 4: Strategic Supply Management: Effect of Supplier Integration on Flexibility-based Performance (Proposed Model)

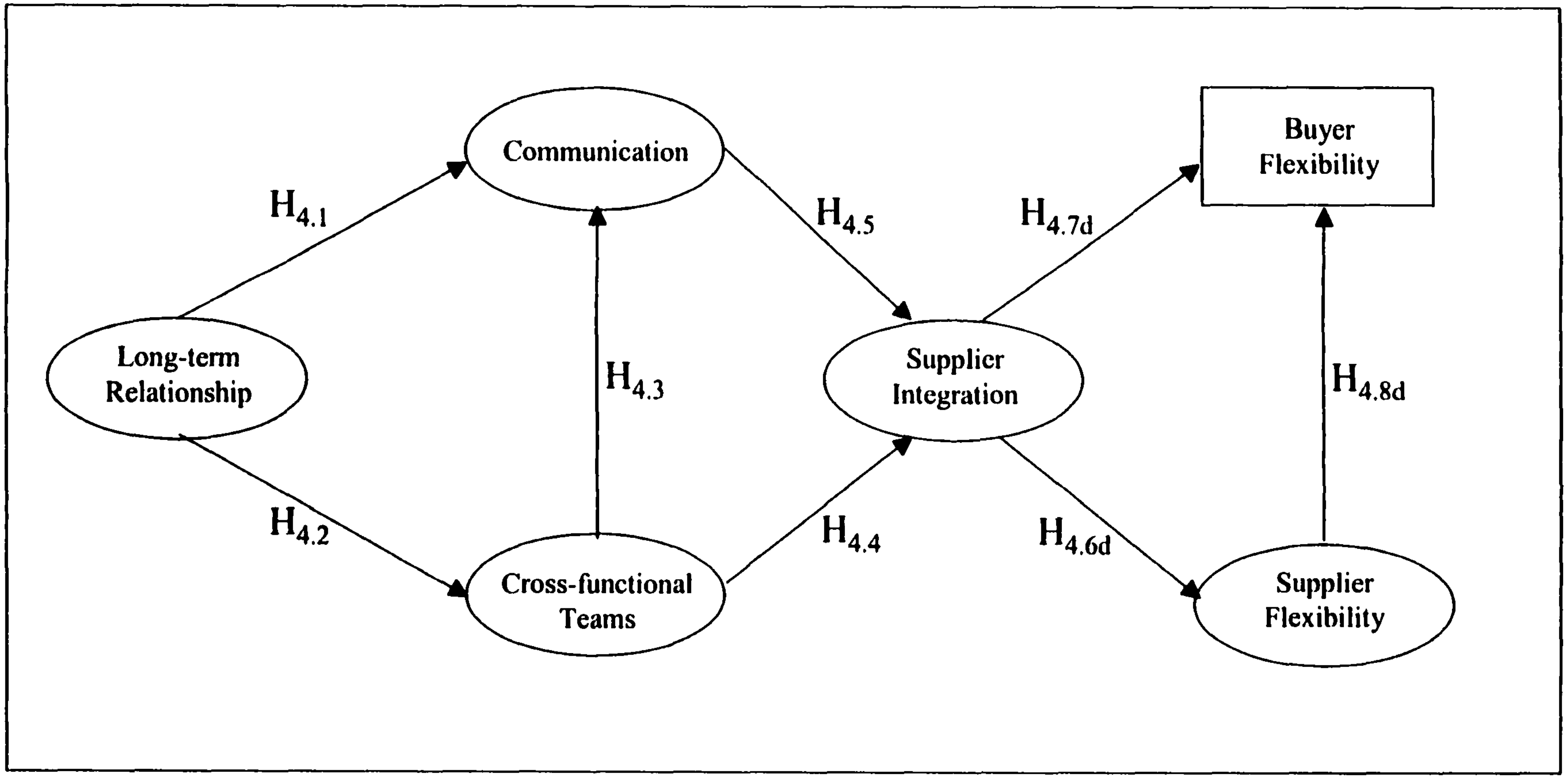


Figure 3.8

Model 4: Strategic Supply Management: Effect of Supplier Integration on Responsiveness-based Performance (Proposed Model)

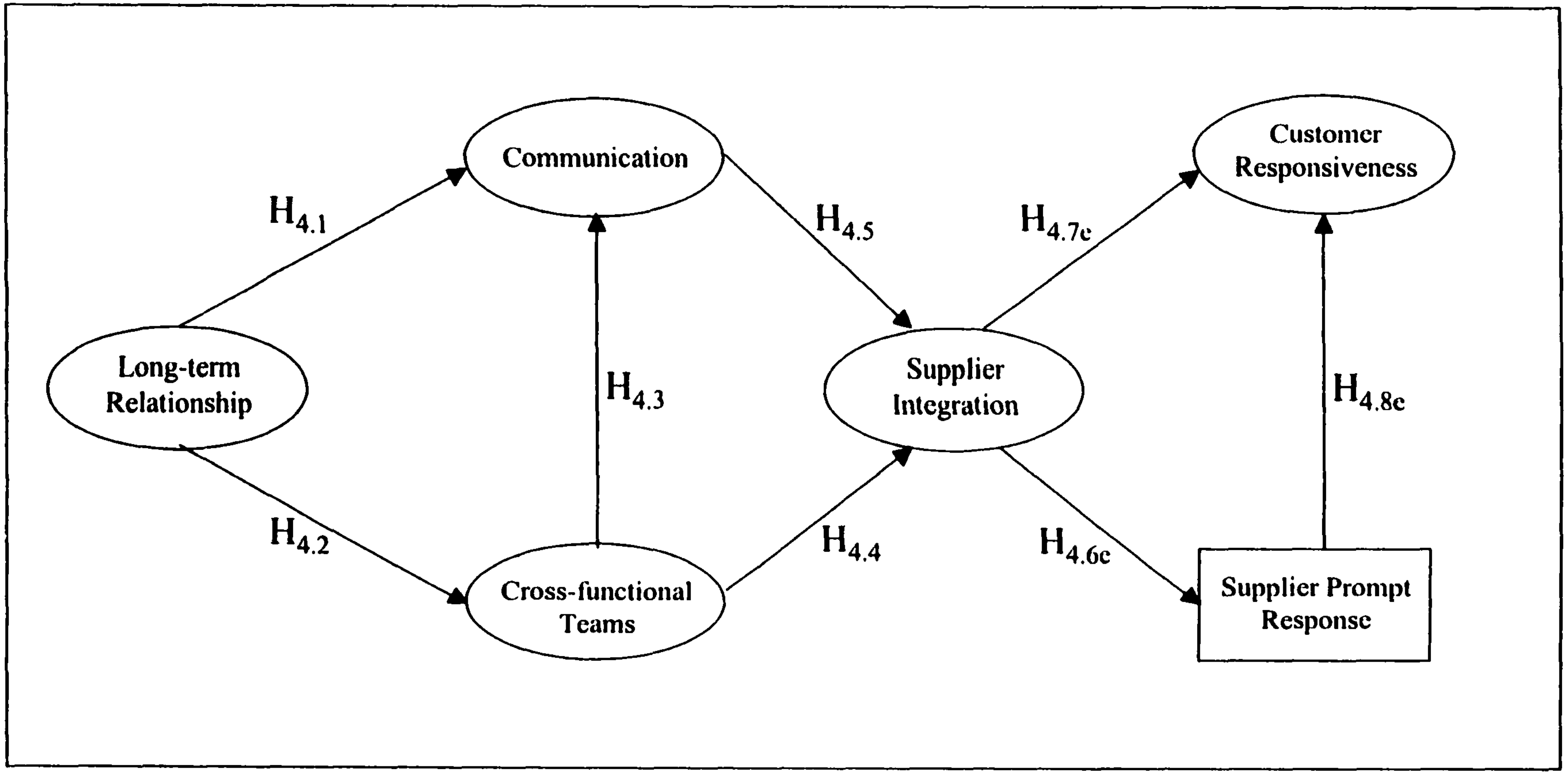


Figure 3.9

Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time (Proposed Model)

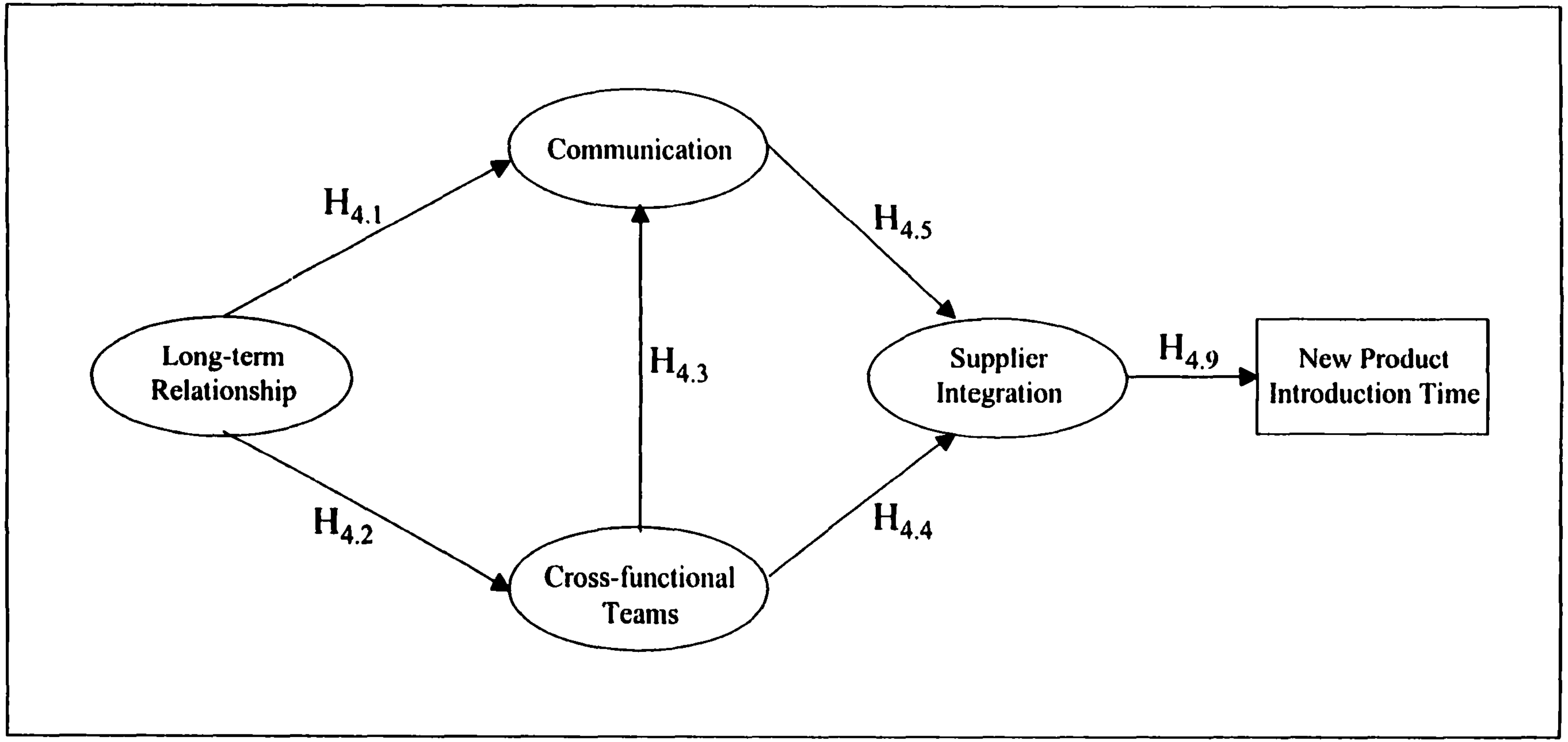


Figure 3.10

Model 5: Supply Management and Performance: Effects of Business and Purchasing Strategy (Proposal Model)

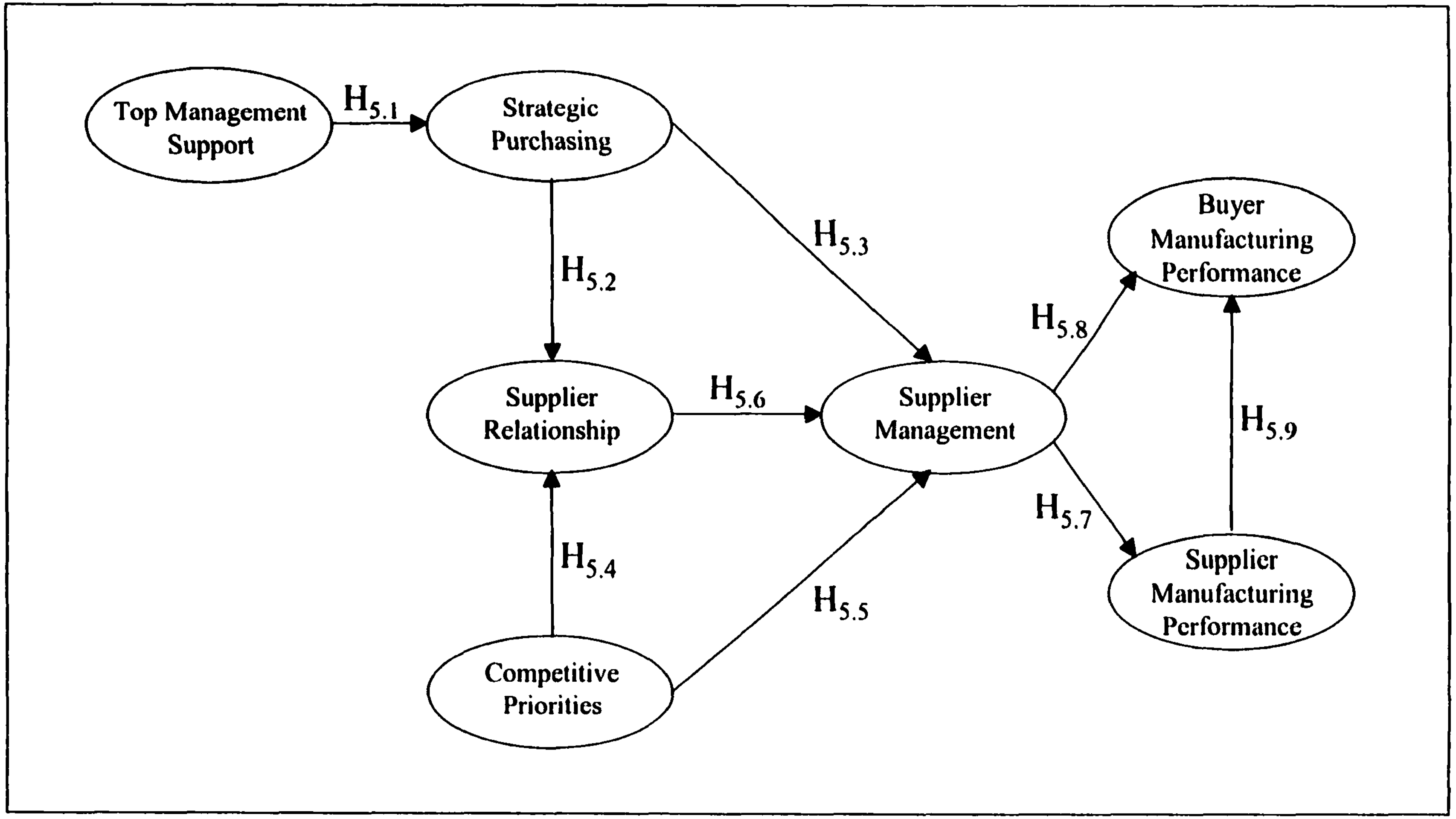


Figure 3.11

Model 6: Impact of Supply Network Structure on Supplier Management and Performance (Proposed Model)

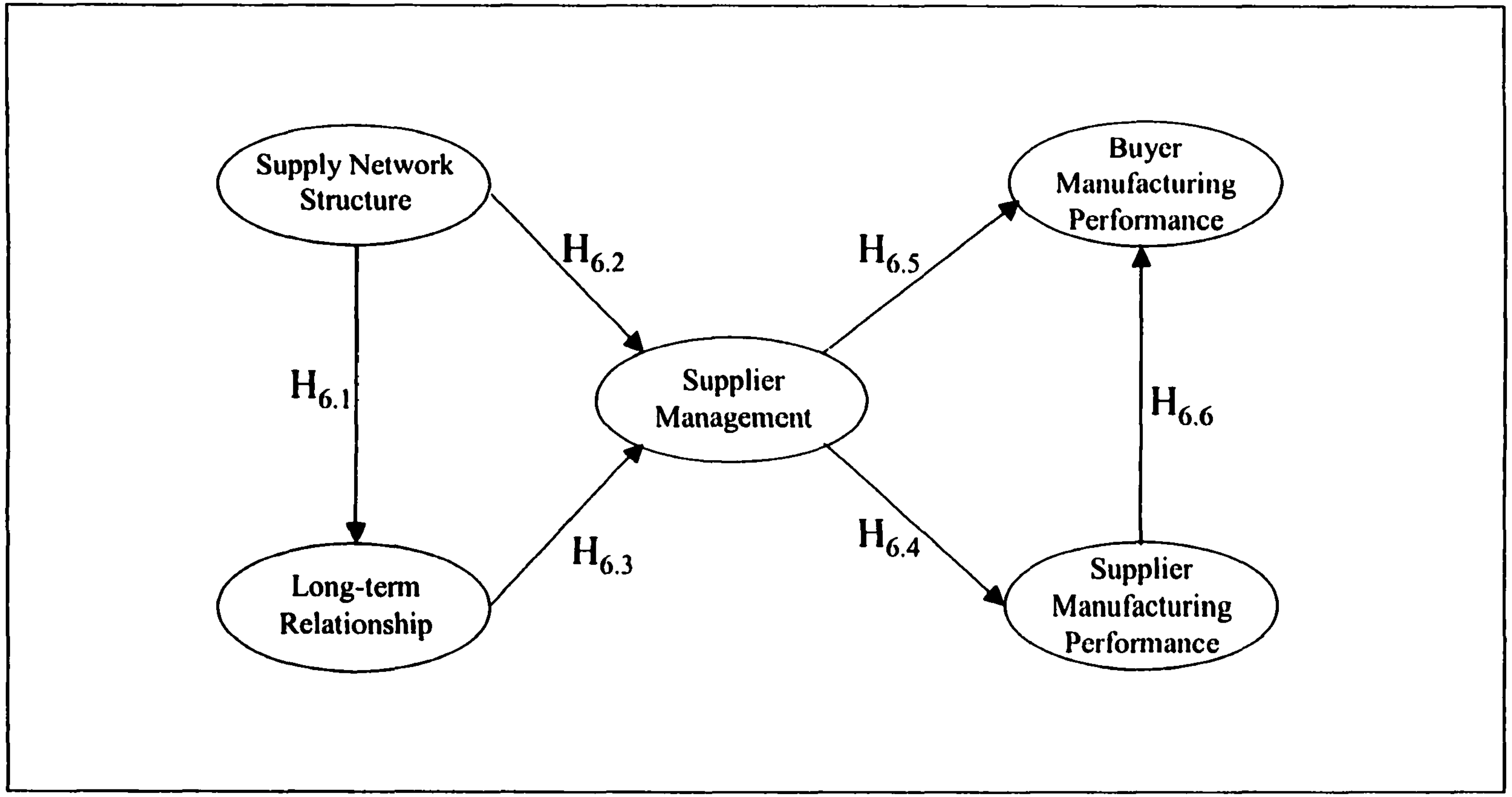


Figure 3.12
Model 7: Agile Supply Chain: Benefits of Information Technology (Proposed Model)

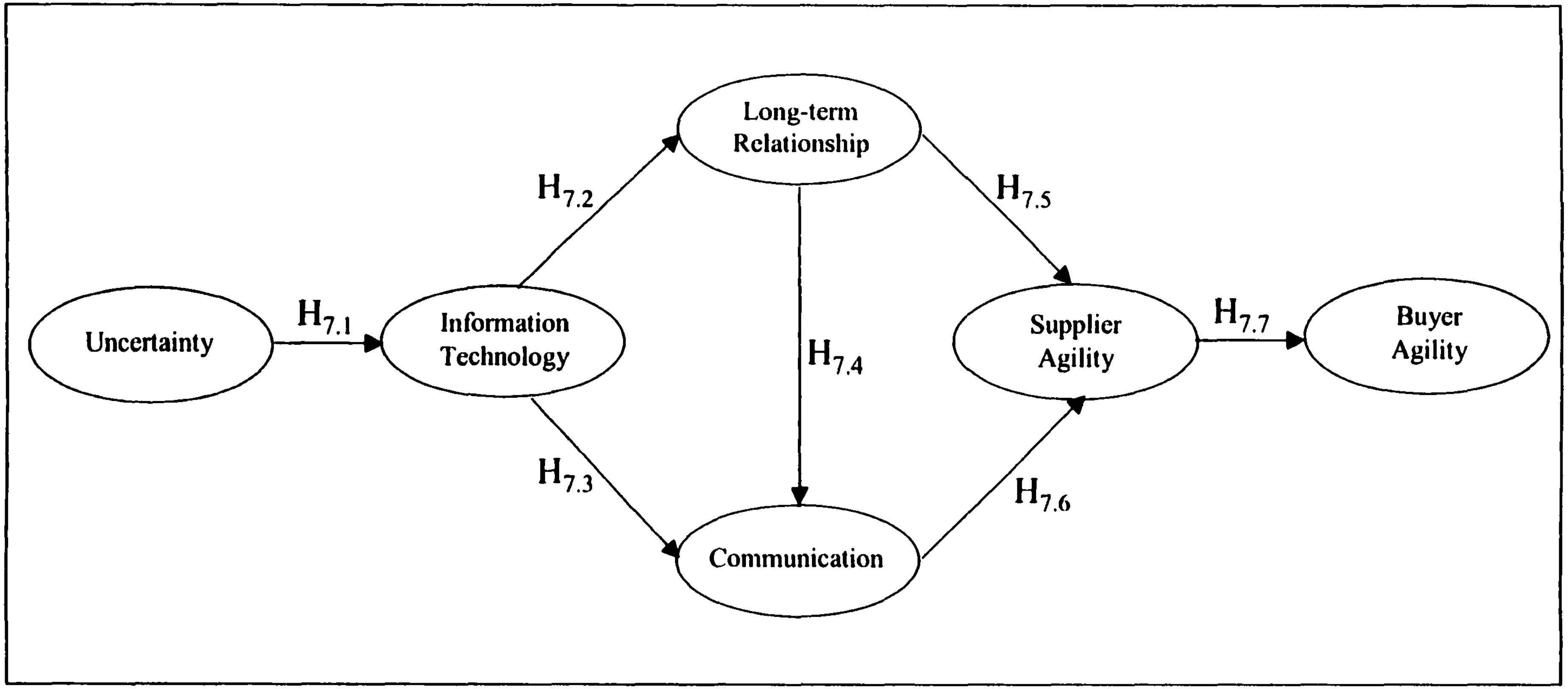


Figure 3.13

Model 8: Supply Strategy-Structure Fit – Effect on Supply Management (Proposed Model)

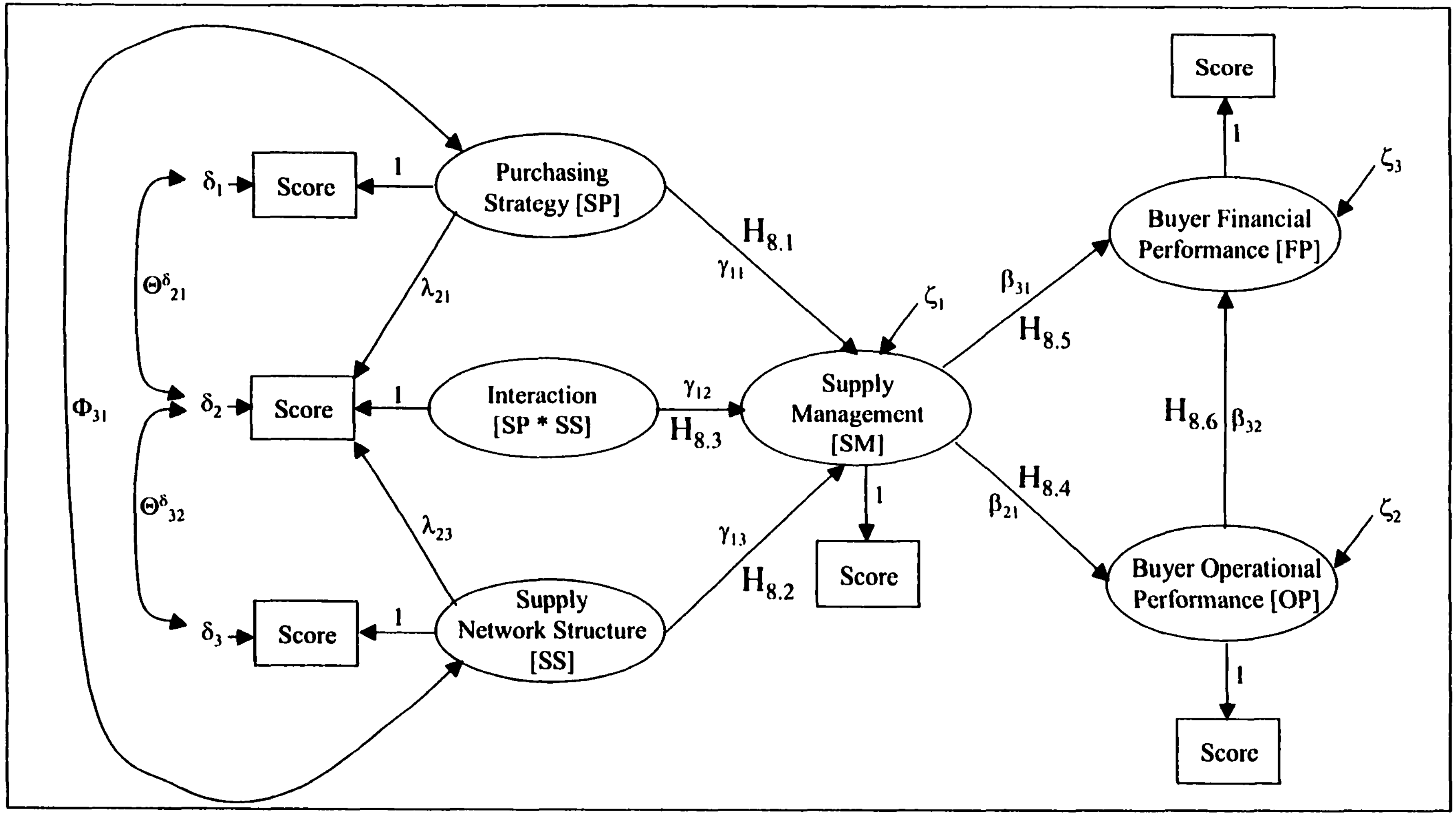


Figure 3.14

Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility (Proposed Model)

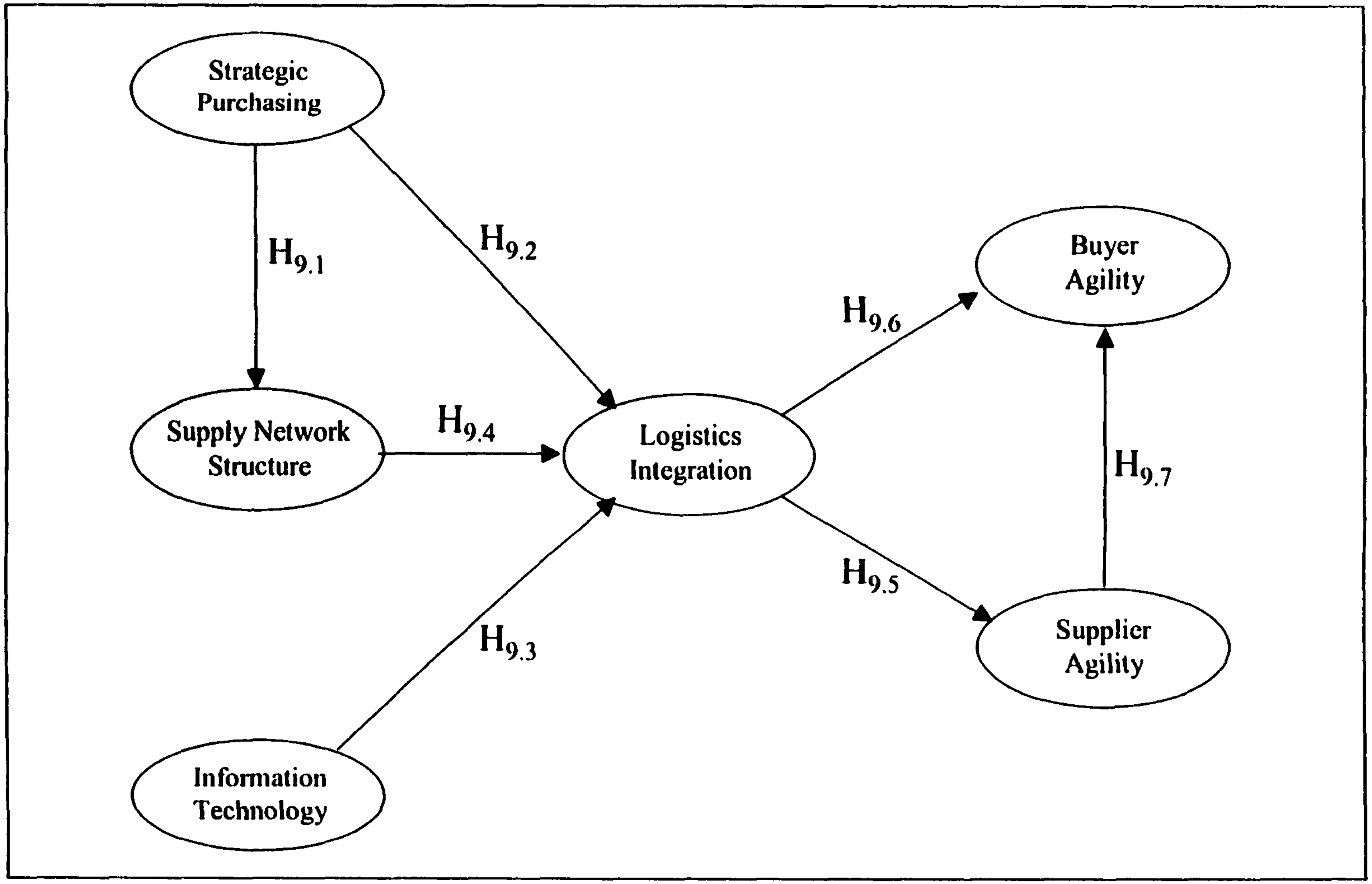


Figure 3.15

Model 10: Information Technology-Communication Fit – Effect on Logistics Integration (Proposed Model)

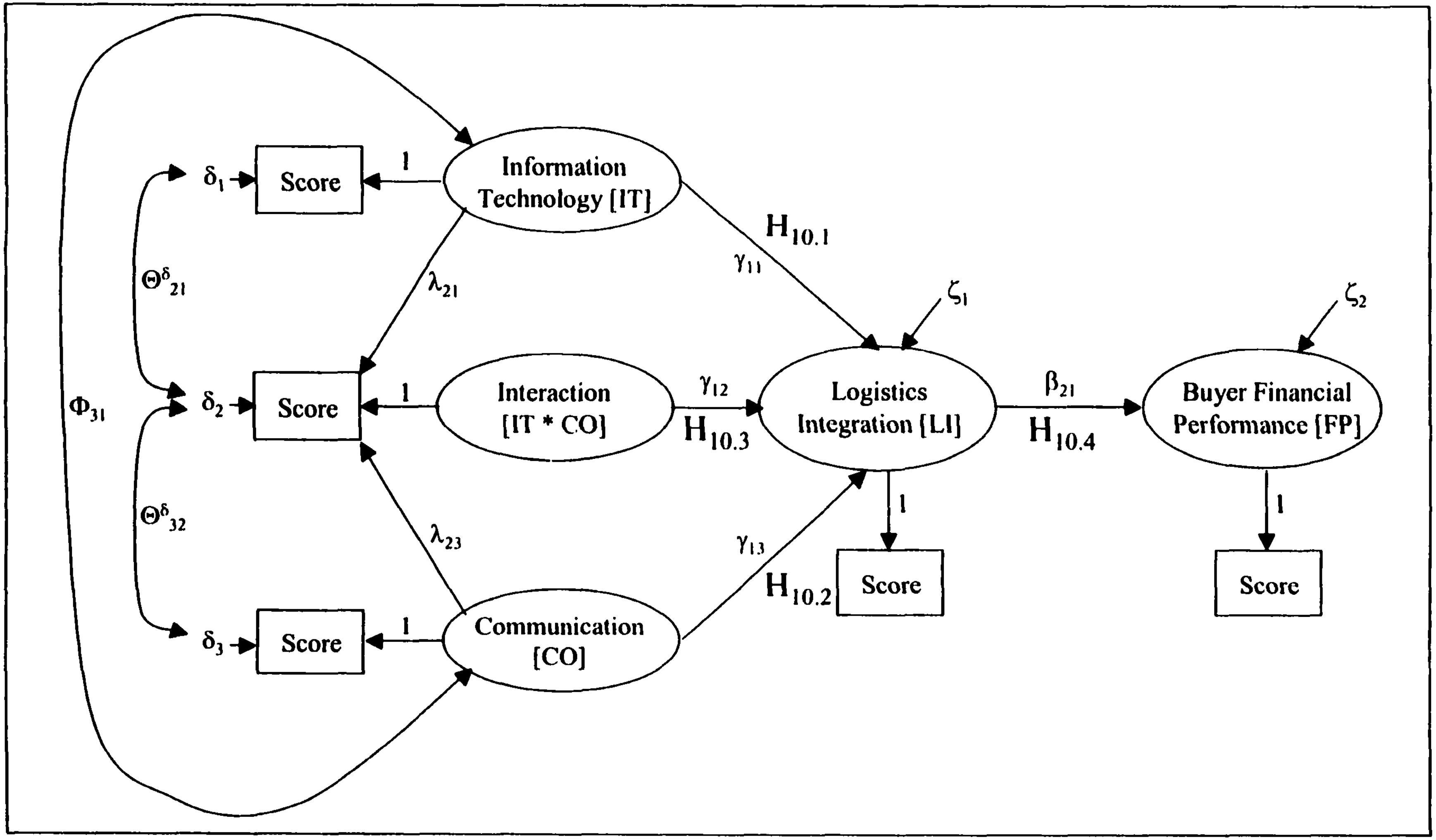


Figure 3.16

Illustration of Supply Chain Data Acquisition Process

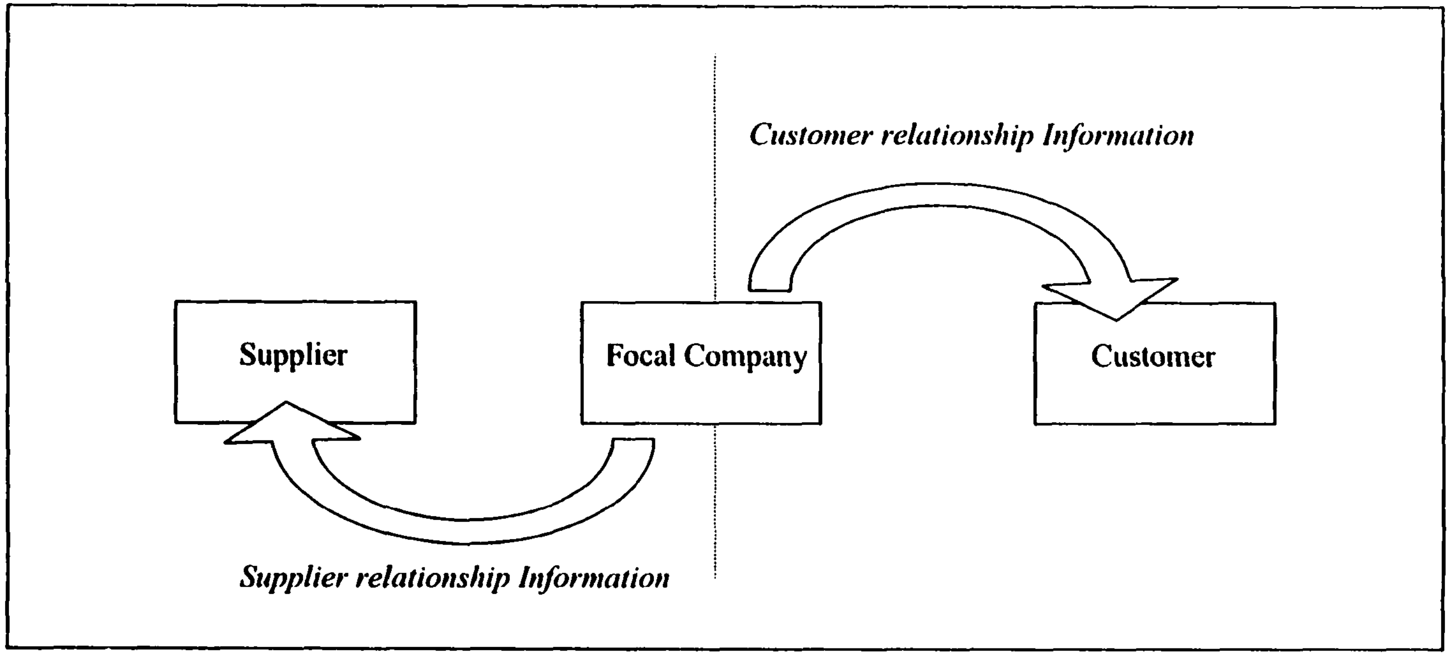


Figure 3.17
The Instrument Development Process

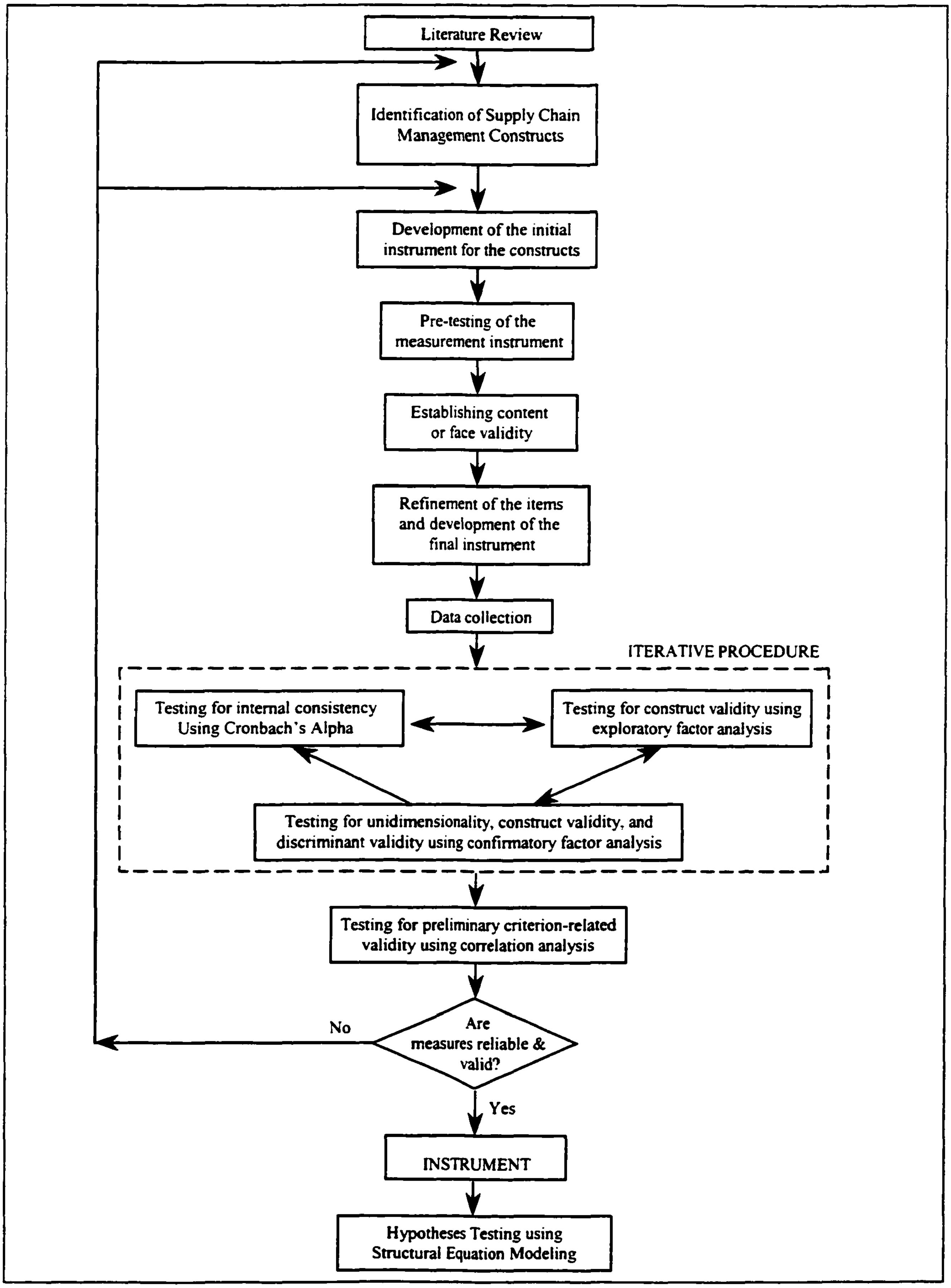


Figure 3.18a
Summary of General SEM (Adopted from Hayduk, 1987)
Structural Equation

A vector of endogenous concepts

Matrices of structural coefficients

A vector of exogenous concepts

The covariances among those exogenous concepts constitute Φ

$$\eta \quad = \quad \beta\eta \quad + \quad \Gamma\xi \quad + \quad \zeta$$

$$\begin{bmatrix} \eta_1 \\ \cdot \\ \cdot \\ \cdot \\ \eta_m \end{bmatrix} = \begin{bmatrix} 0 & & & & \\ & - & & & \\ & & - & & \\ & & & - & \\ & & & & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \cdot \\ \cdot \\ \cdot \\ \eta_m \end{bmatrix} + \begin{bmatrix} - & - & - & - & - \\ \cdot & & & & \\ \cdot & & & & \\ \cdot & & & & \\ - & & & & \end{bmatrix} \begin{bmatrix} \xi_1 \\ \cdot \\ \cdot \\ \cdot \\ \xi_n \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \cdot \\ \cdot \\ \cdot \\ \zeta_m \end{bmatrix}$$

$(m \times 1)$ $\quad$ $(m \times m)$ $\quad$ $(m \times 1)$ $\quad$ $(m \times n)$ $\quad$ $(n \times 1)$ $\quad$ $(m \times 1)$

$$\begin{bmatrix} - & & & & \\ - & - & & & \\ - & - & - & & \\ - & - & - & - & \\ - & - & - & - & - \end{bmatrix}$$

$(n \times n)$

a vector of "errors" in the conceptual model. The covariances among these errors constitute Ψ

$$\begin{bmatrix} - & & & & \\ - & - & & & \\ - & - & - & & \\ - & - & - & - & \\ - & - & - & - & - \end{bmatrix}$$

$(m \times m)$

Figure 3.18b

Summary of General SEM (Adopted from Hayduk, 1987)

Measurement Equations

A vector of observed endogenous indicators

A matrix of structural coefficients

The vector of endogenous concepts

$$\mathbf{Y} = \Lambda_Y \eta + \varepsilon$$

a vector of "errors" in the measurement model. The covariances among these errors constitute Θ_ε

$$\underset{(p \times 1)}{\begin{bmatrix} Y_1 \\ \cdot \\ \cdot \\ \cdot \\ Y_p \end{bmatrix}} = \underset{(p \times m)}{\begin{bmatrix} - & - & - & - & - \\ \cdot & & & & \\ \cdot & & & & \\ \cdot & & & & \\ - & & & & \end{bmatrix}} \underset{(m \times 1)}{\begin{bmatrix} \eta_1 \\ \cdot \\ \cdot \\ \cdot \\ \eta_m \end{bmatrix}} + \underset{(p \times 1)}{\begin{bmatrix} \varepsilon_1 \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_p \end{bmatrix}}$$

$$\underset{(p \times p)}{\begin{bmatrix} - & & & & \\ - & - & & & \\ - & - & - & & \\ - & - & - & - & \\ - & - & - & - & - \end{bmatrix}}$$

A vector of observed exogenous indicators

A matrix of structural coefficients

The vector of exogenous concepts

$$\mathbf{X} = \Lambda_X \xi + \delta$$

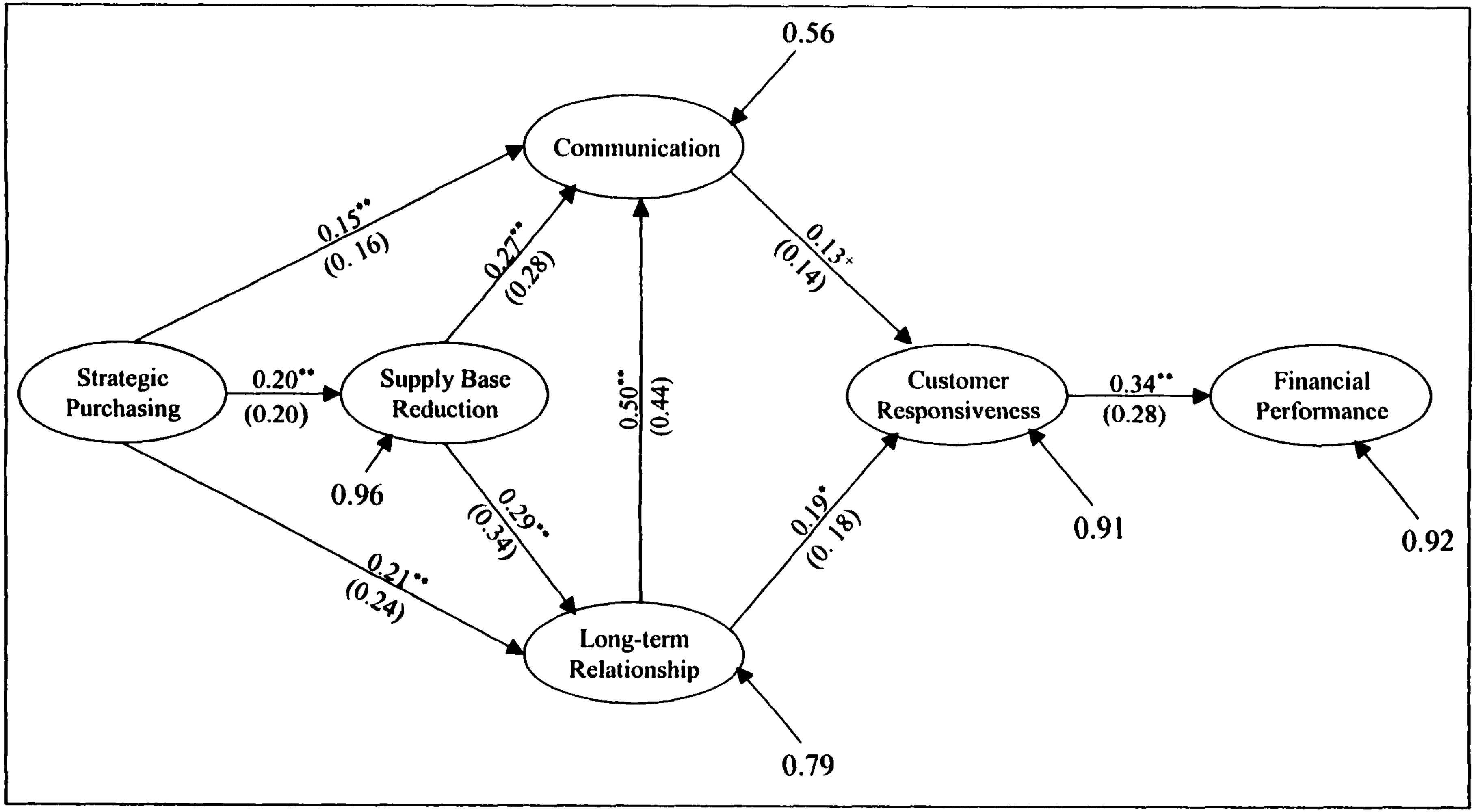
a vector of "errors" in the measurement model. The covariances among these errors constitute Θ_δ

$$\underset{(q \times 1)}{\begin{bmatrix} X_1 \\ \cdot \\ \cdot \\ \cdot \\ X_q \end{bmatrix}} = \underset{(q \times n)}{\begin{bmatrix} - & - & - & - & - \\ \cdot & & & & \\ \cdot & & & & \\ \cdot & & & & \\ - & & & & \end{bmatrix}} \underset{(n \times 1)}{\begin{bmatrix} \xi_1 \\ \cdot \\ \cdot \\ \cdot \\ \xi_n \end{bmatrix}} + \underset{(q \times 1)}{\begin{bmatrix} \delta_1 \\ \cdot \\ \cdot \\ \cdot \\ \delta_q \end{bmatrix}}$$

$$\underset{(q \times q)}{\begin{bmatrix} - & & & & \\ - & - & & & \\ - & - & - & & \\ - & - & - & - & \\ - & - & - & - & - \end{bmatrix}}$$

Figure 4.1

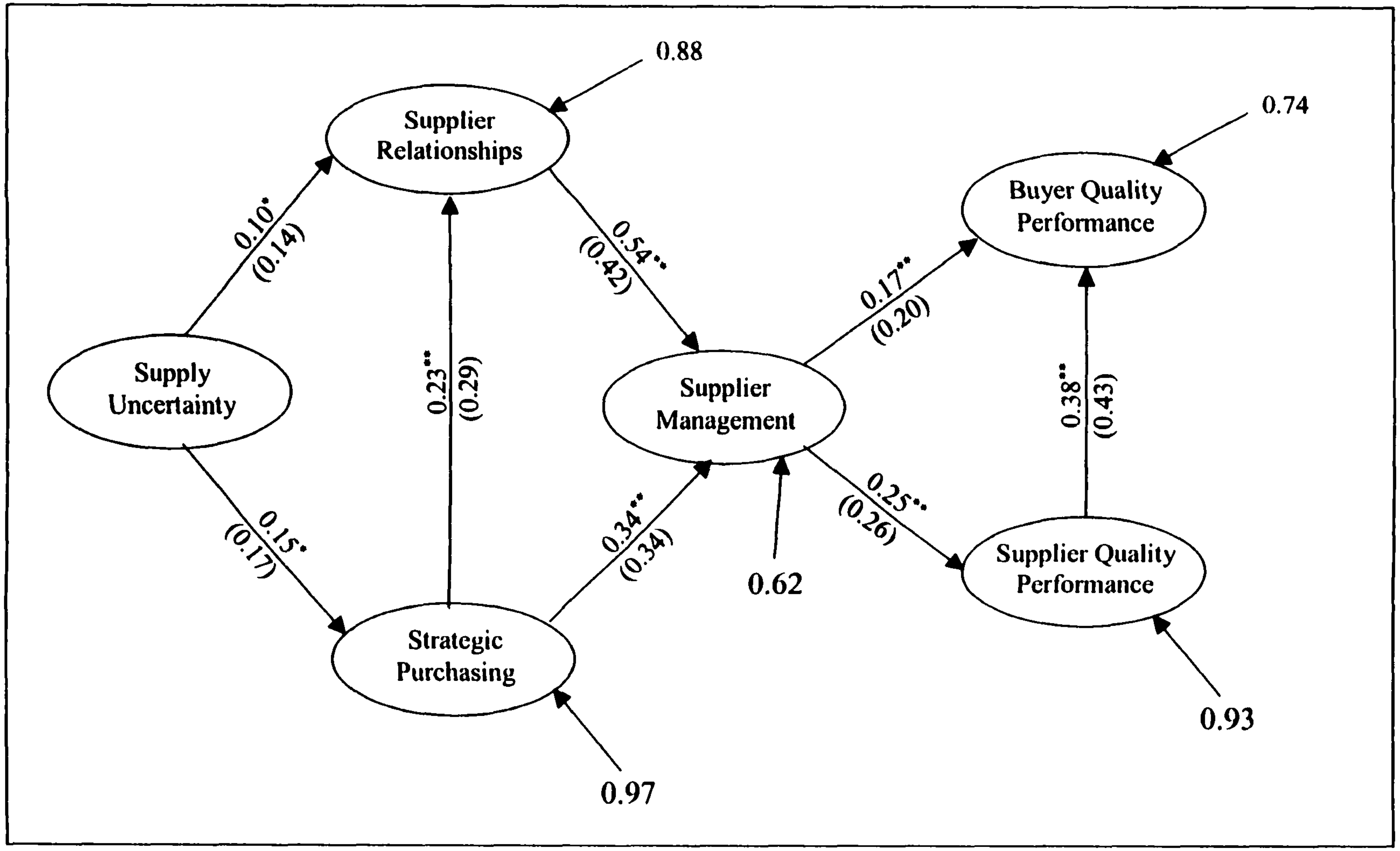
Model 1: Strategic Supply Management (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, + t-values significant at p ≤ 0.10 level

Figure 4.2

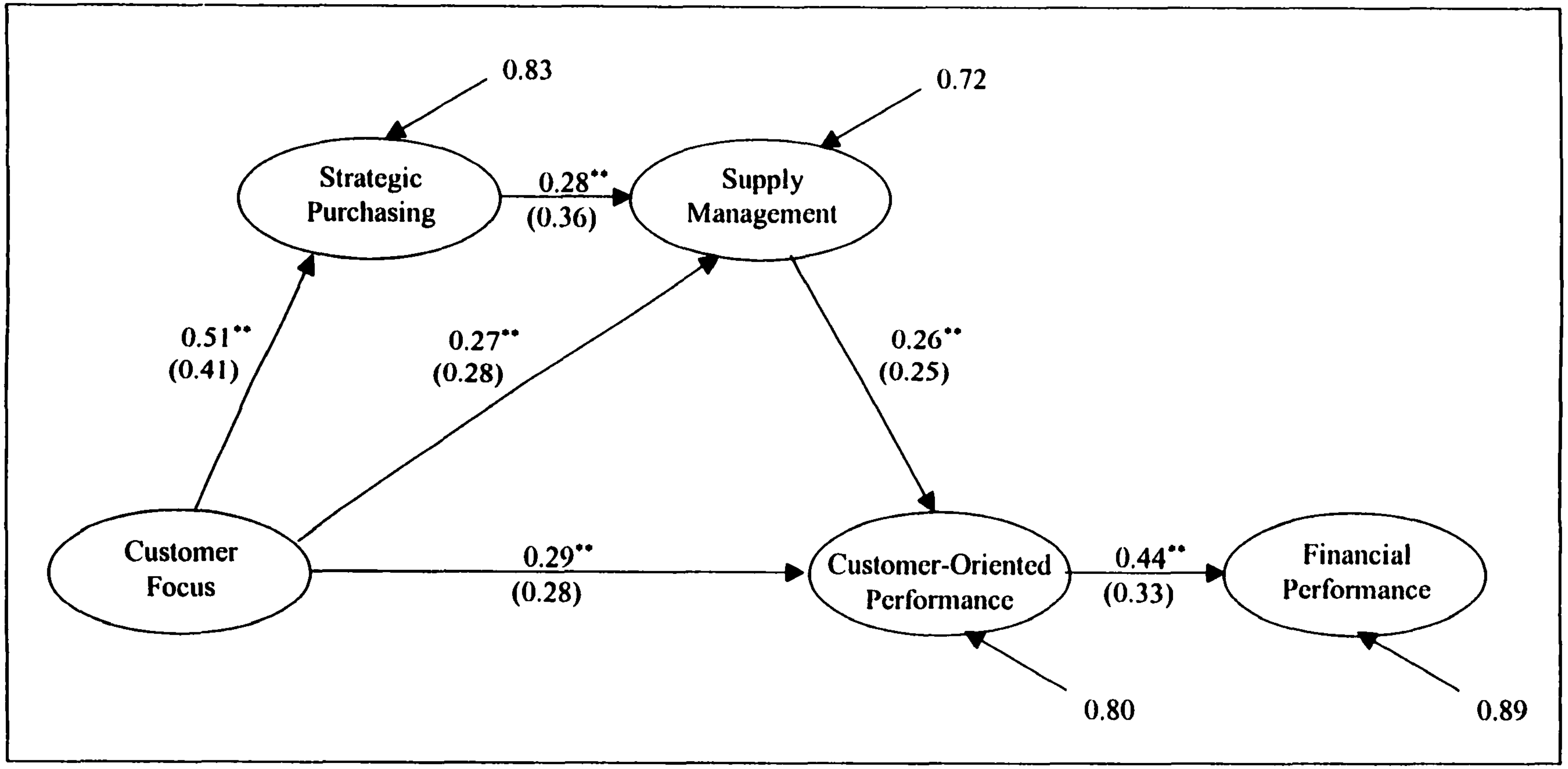
Model 2: Supply Uncertainty and Quality Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, † t-values significant at p ≤ 0.10 level

Figure 4.3

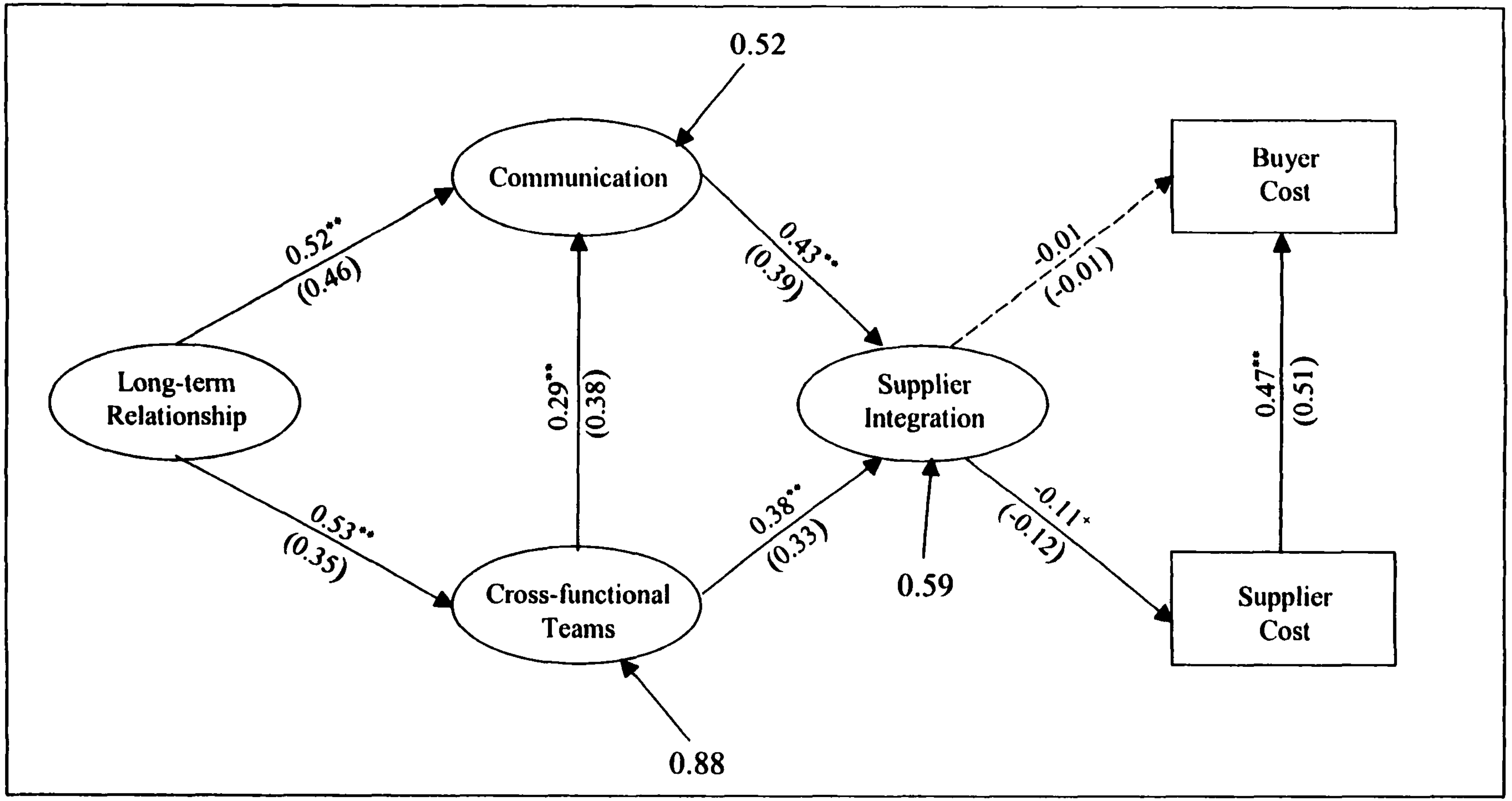
Model 3: Customer-oriented Supply Management (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.4

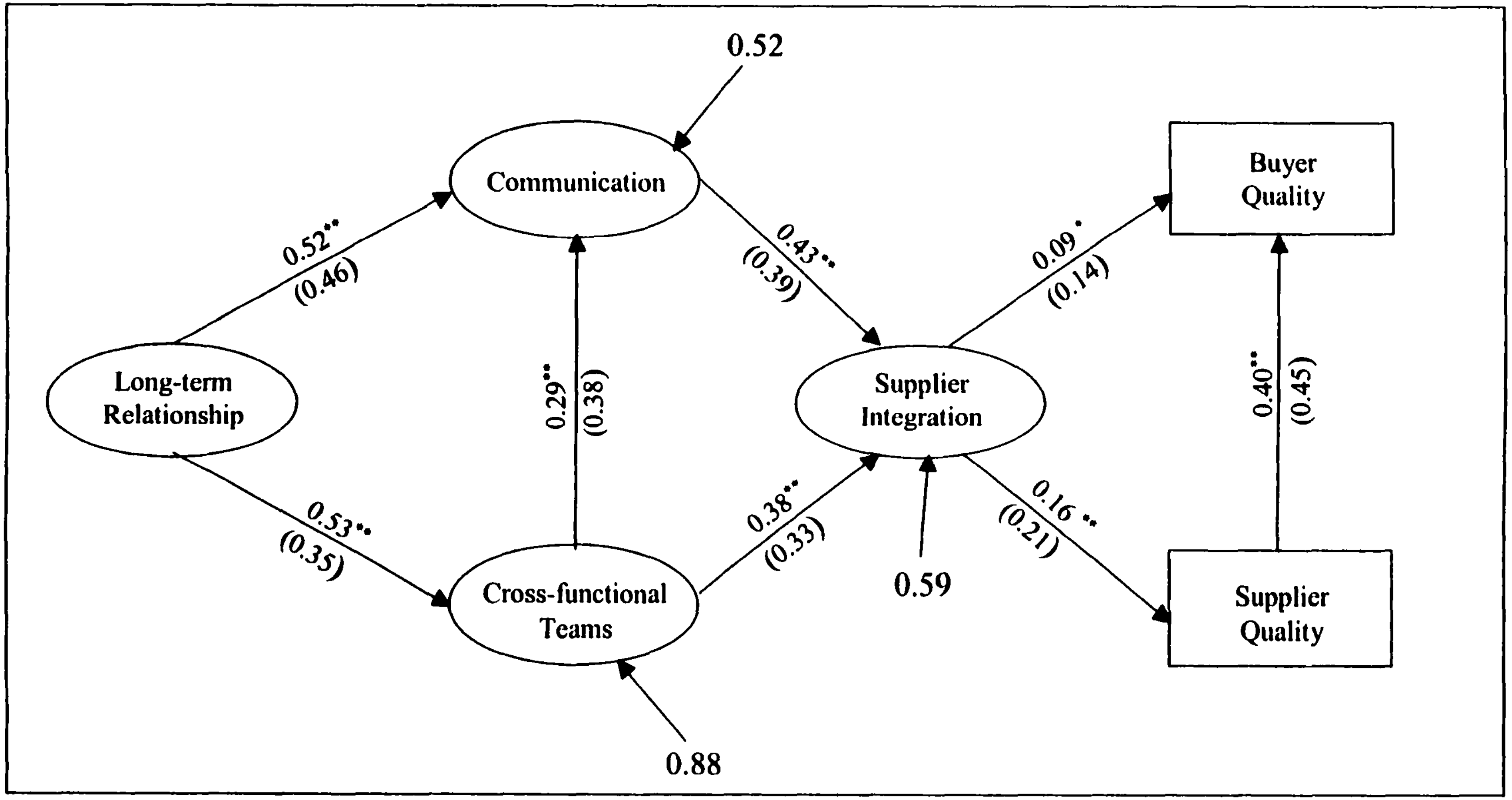
Model 4: Strategic Supply Management: Effect of Supplier Integration on Cost-based Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.5

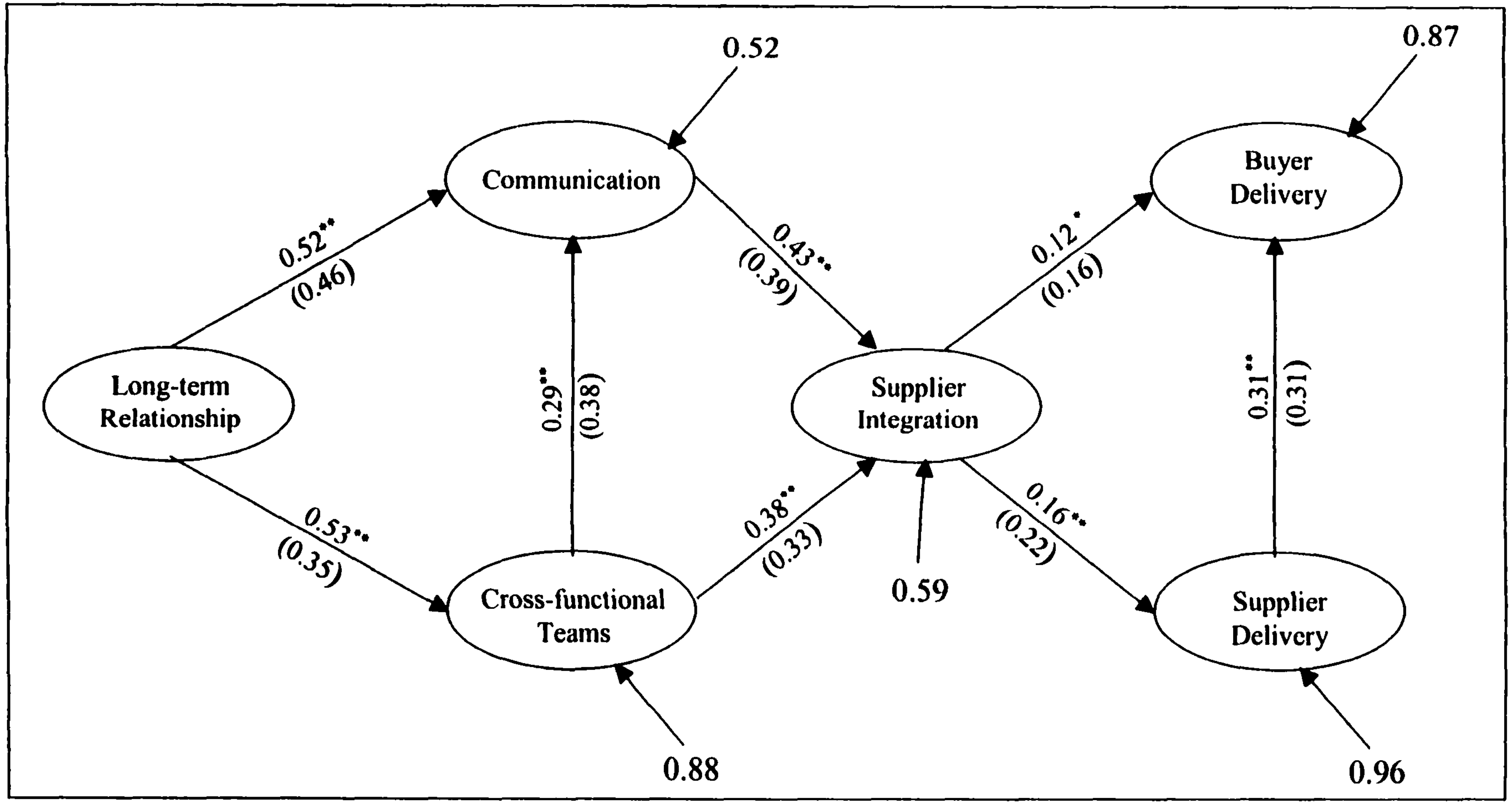
Model 4: Strategic Supply Management: Effect of Supplier Integration on Quality-based Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.6

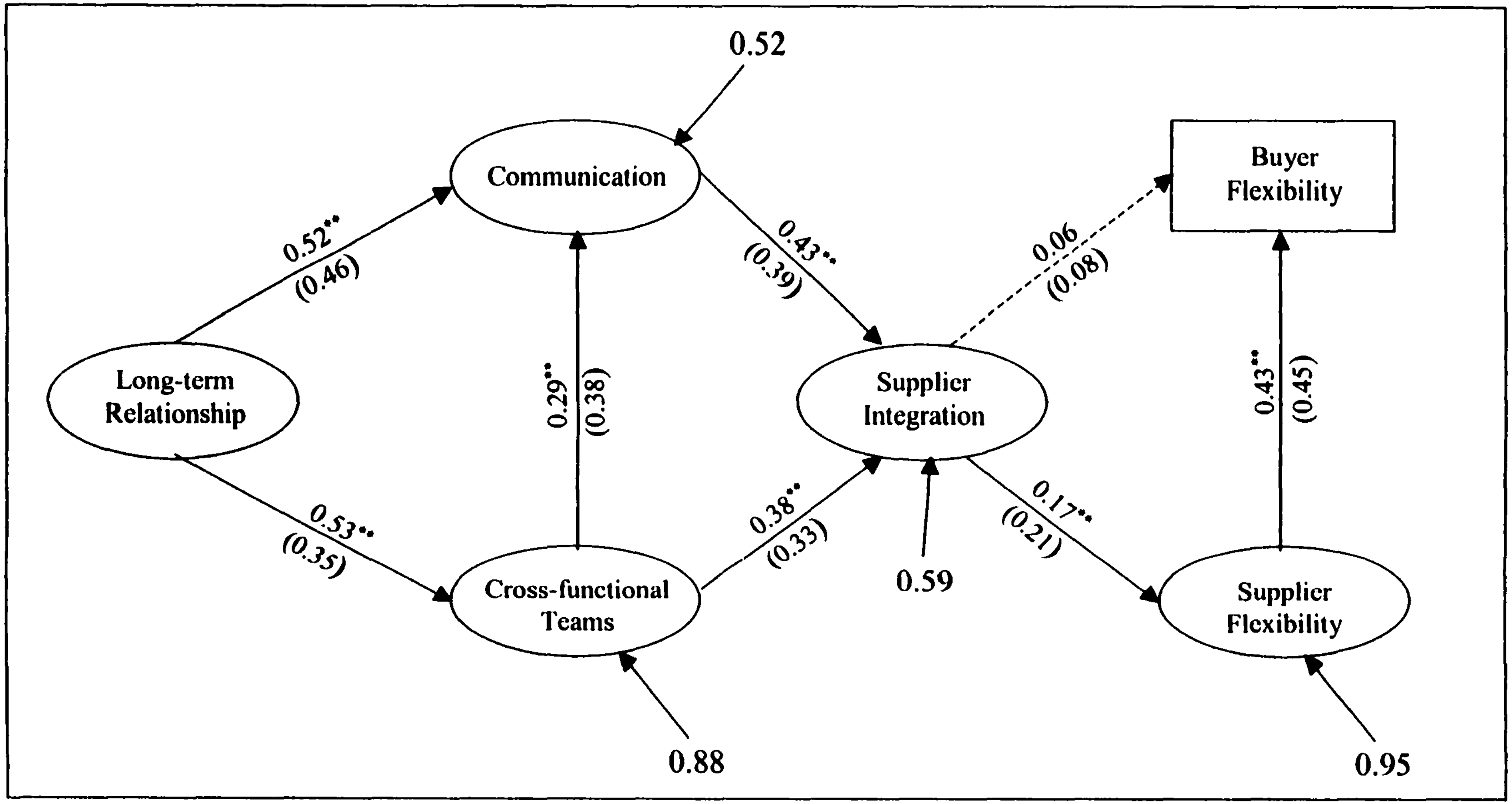
Model 4: Strategic Supply Management: Effect of Supplier Integration on Delivery-based Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, † t-values significant at p ≤ 0.10 level

Figure 4.7

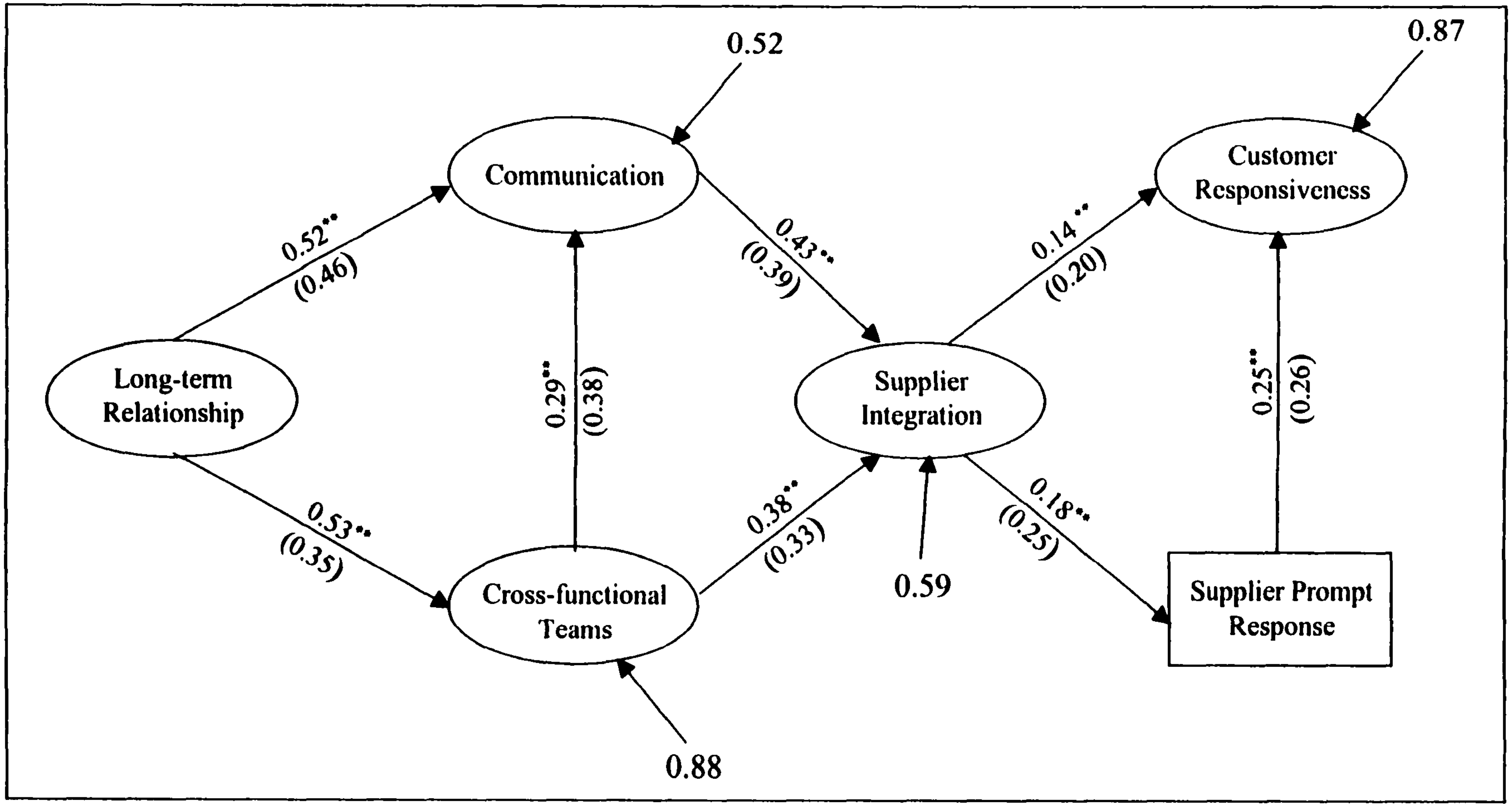
Model 4: Strategic Supply Management: Effect of Supplier Integration on Flexibility-based Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.8

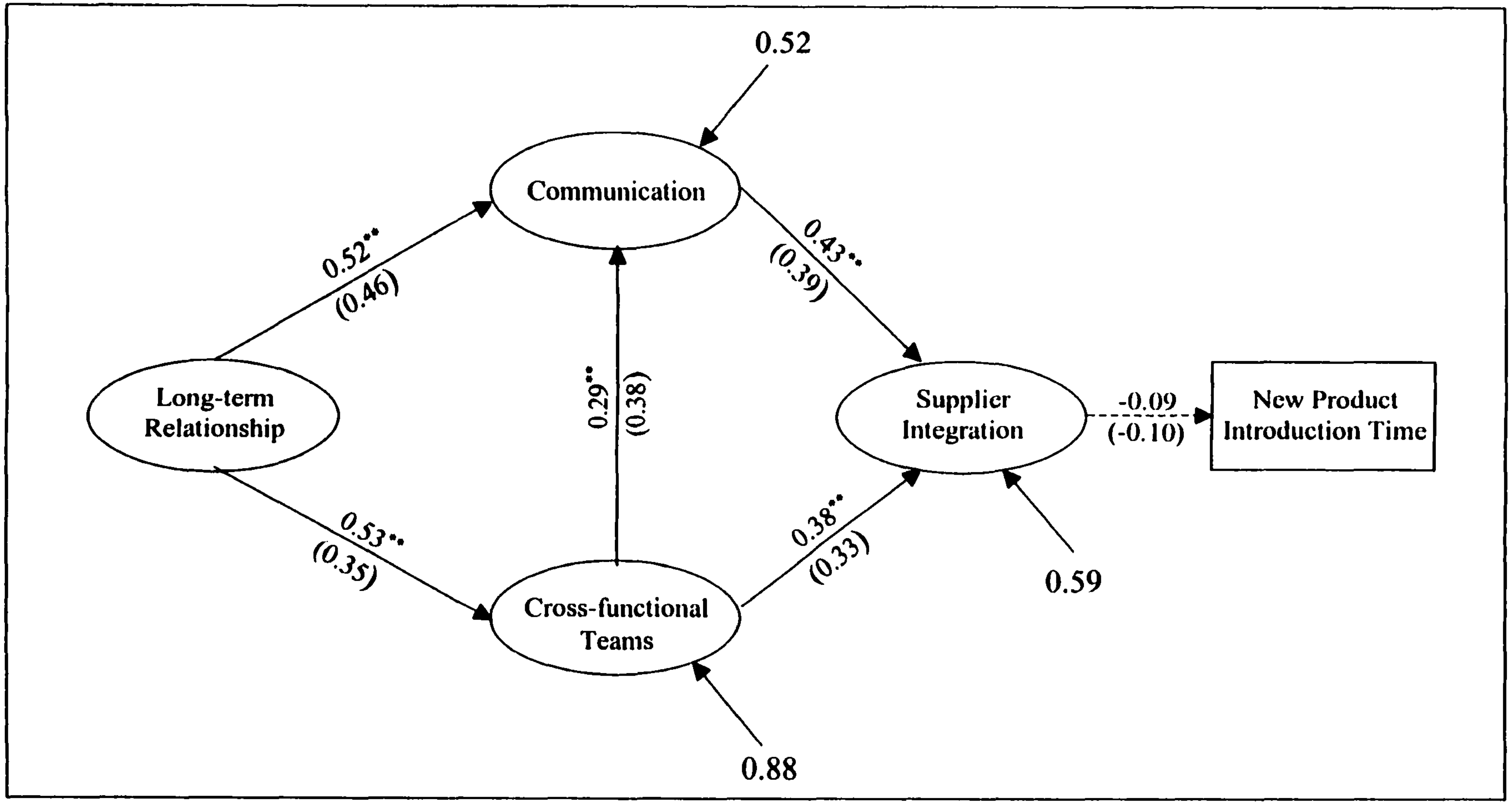
Model 4: Strategic Supply Management: Effect of Supplier Integration on Responsiveness-based Performance (Final Model)



Note. ** t-values significant at p $\leq$ 0.01 level, * t-values significant at p $\leq$ 0.05 level, ' t-values significant at p $\leq$ 0.10 level

Figure 4.9

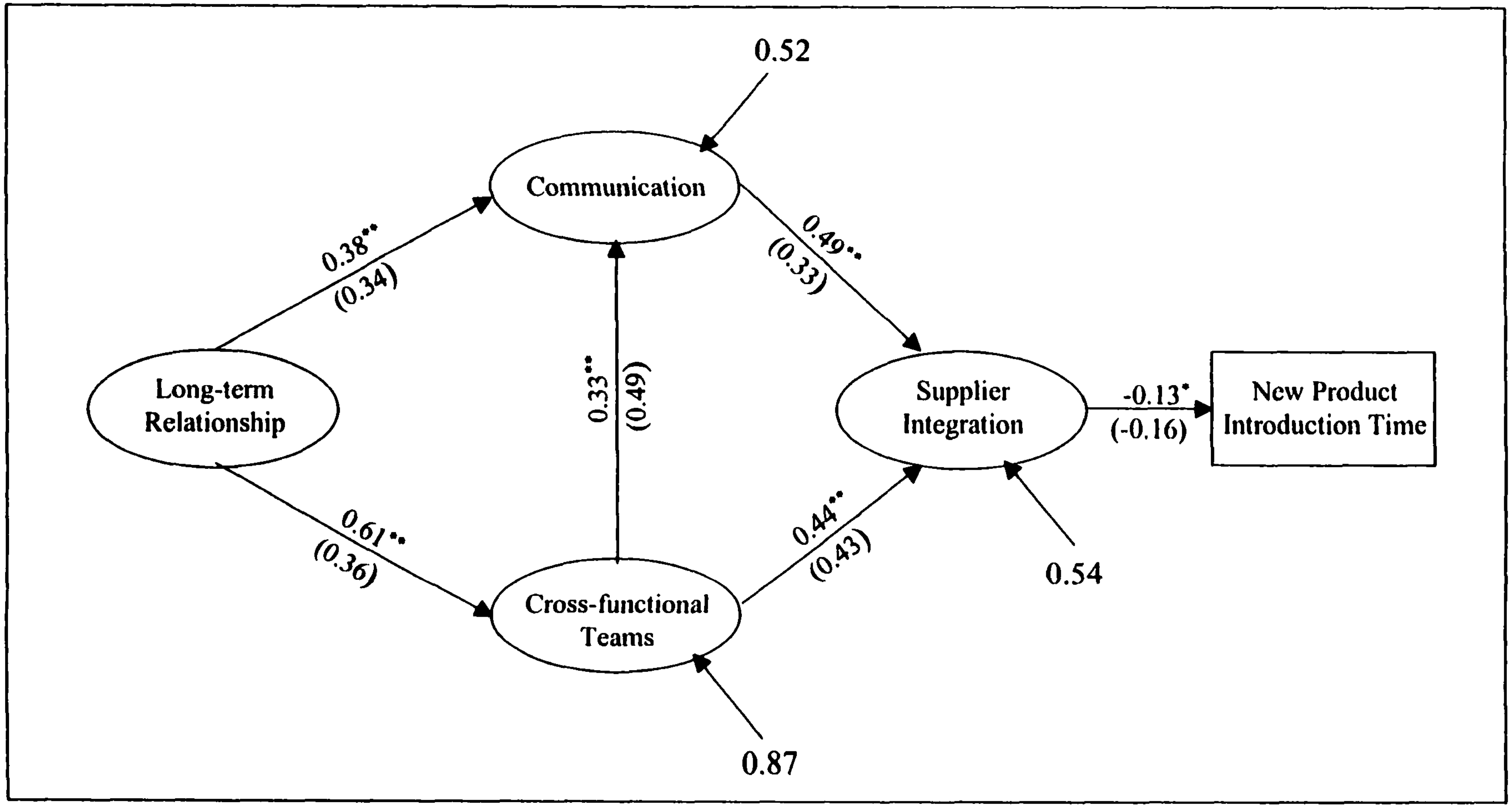
Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.10a

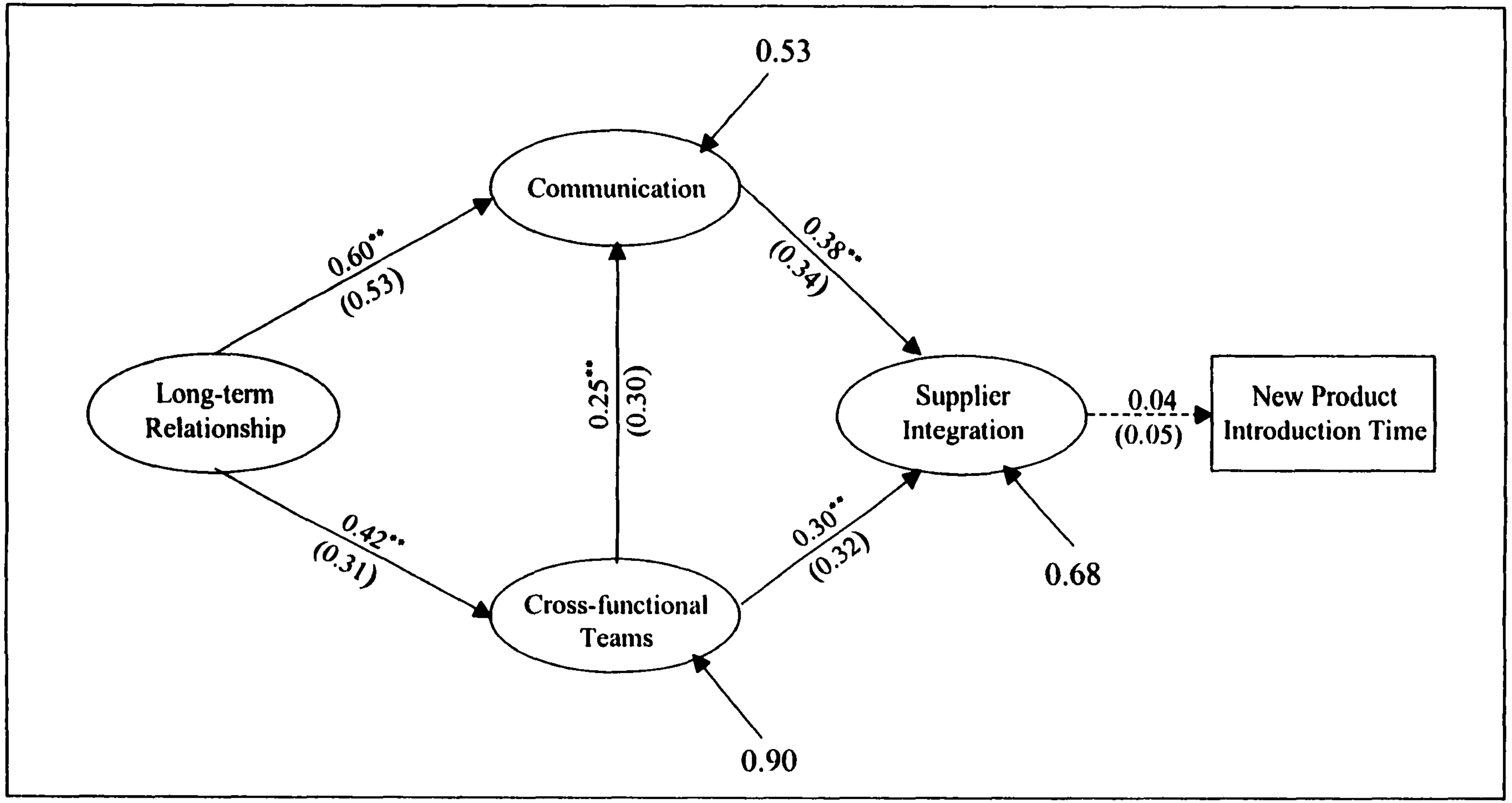
Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time (Higher Performance Group - Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.10b

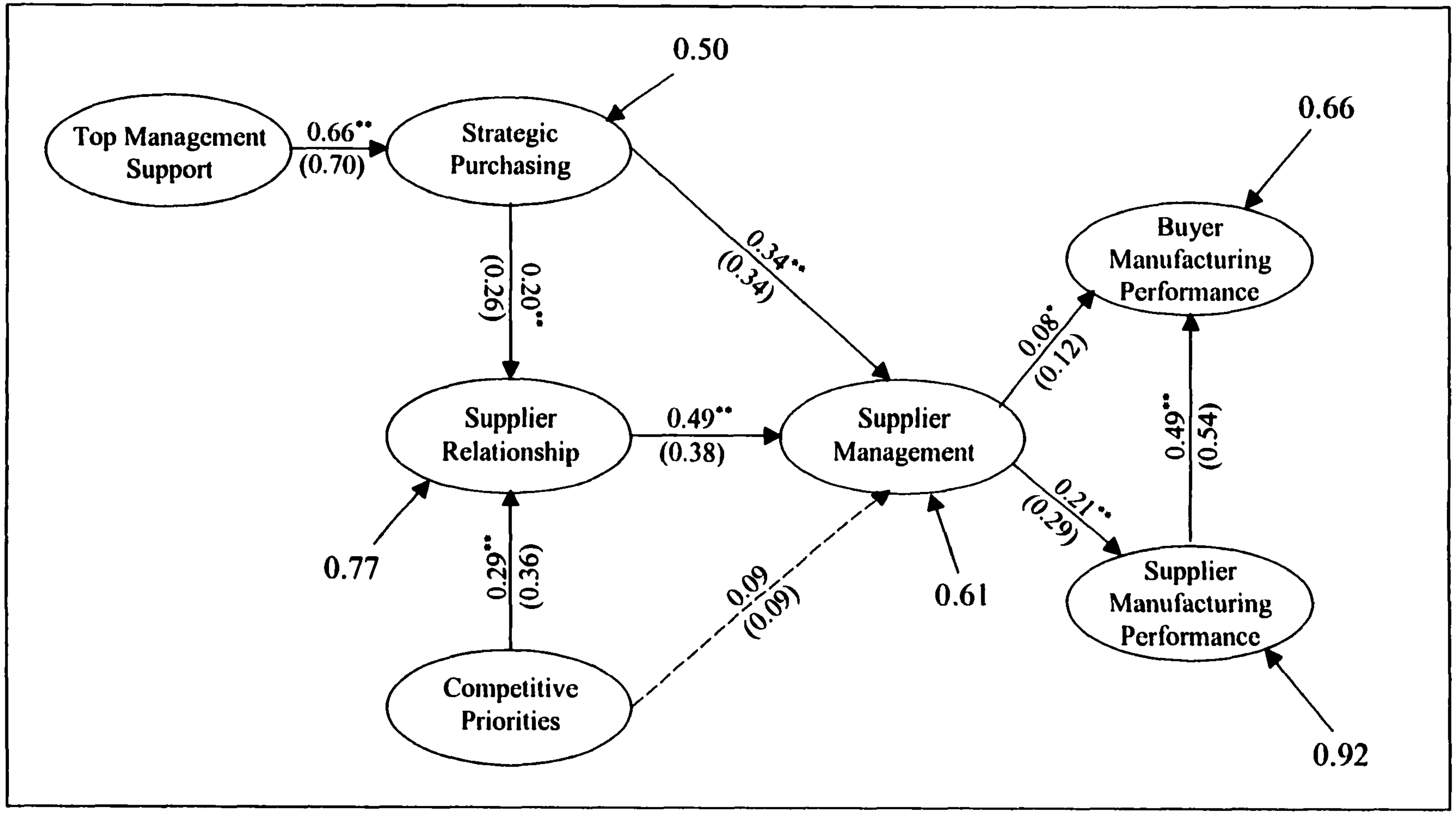
Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time (Lower Performance Group - Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.11

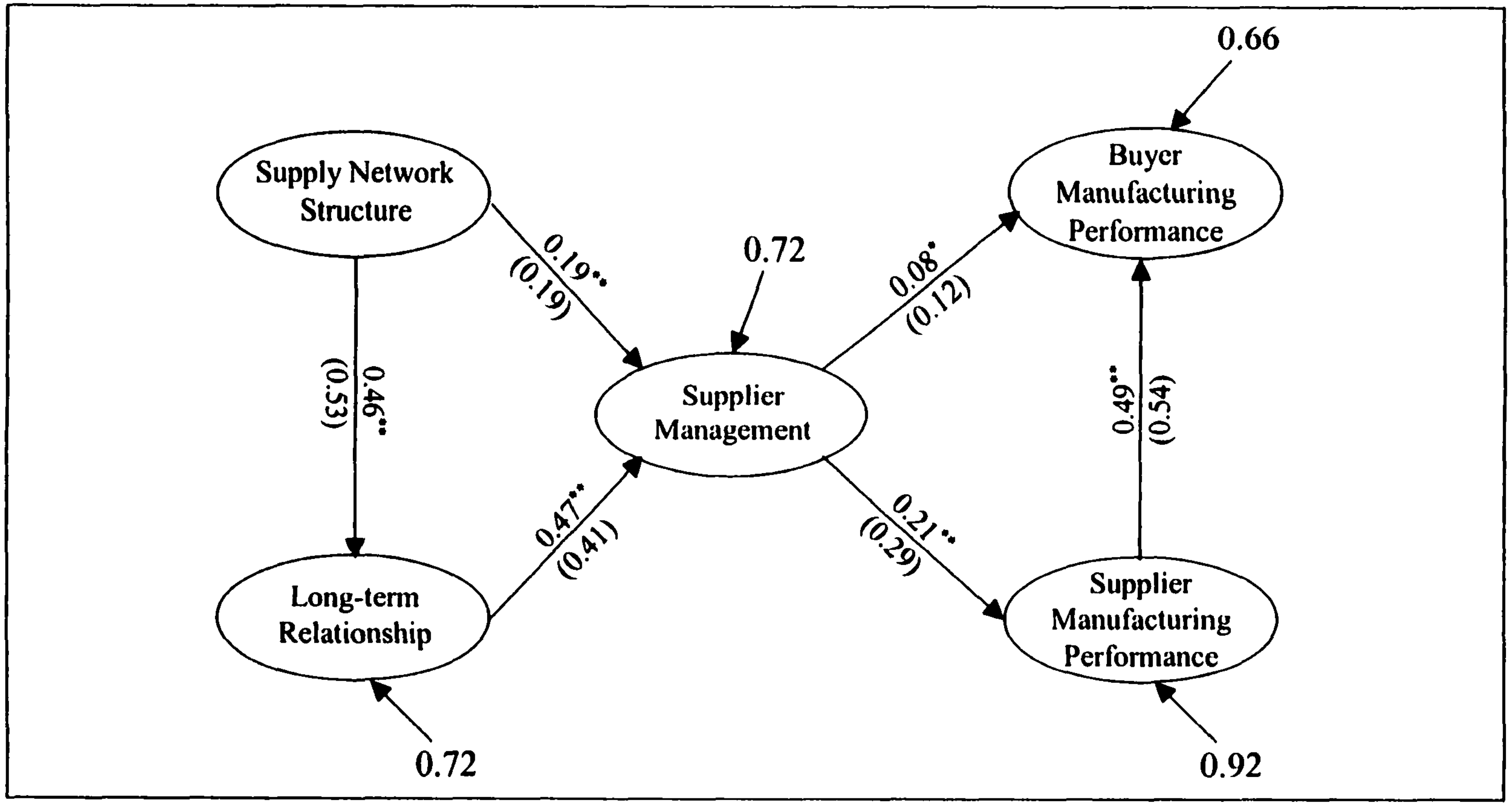
Model 5: Supply Management and Performance: Effects of Business and Purchasing Strategy (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.12

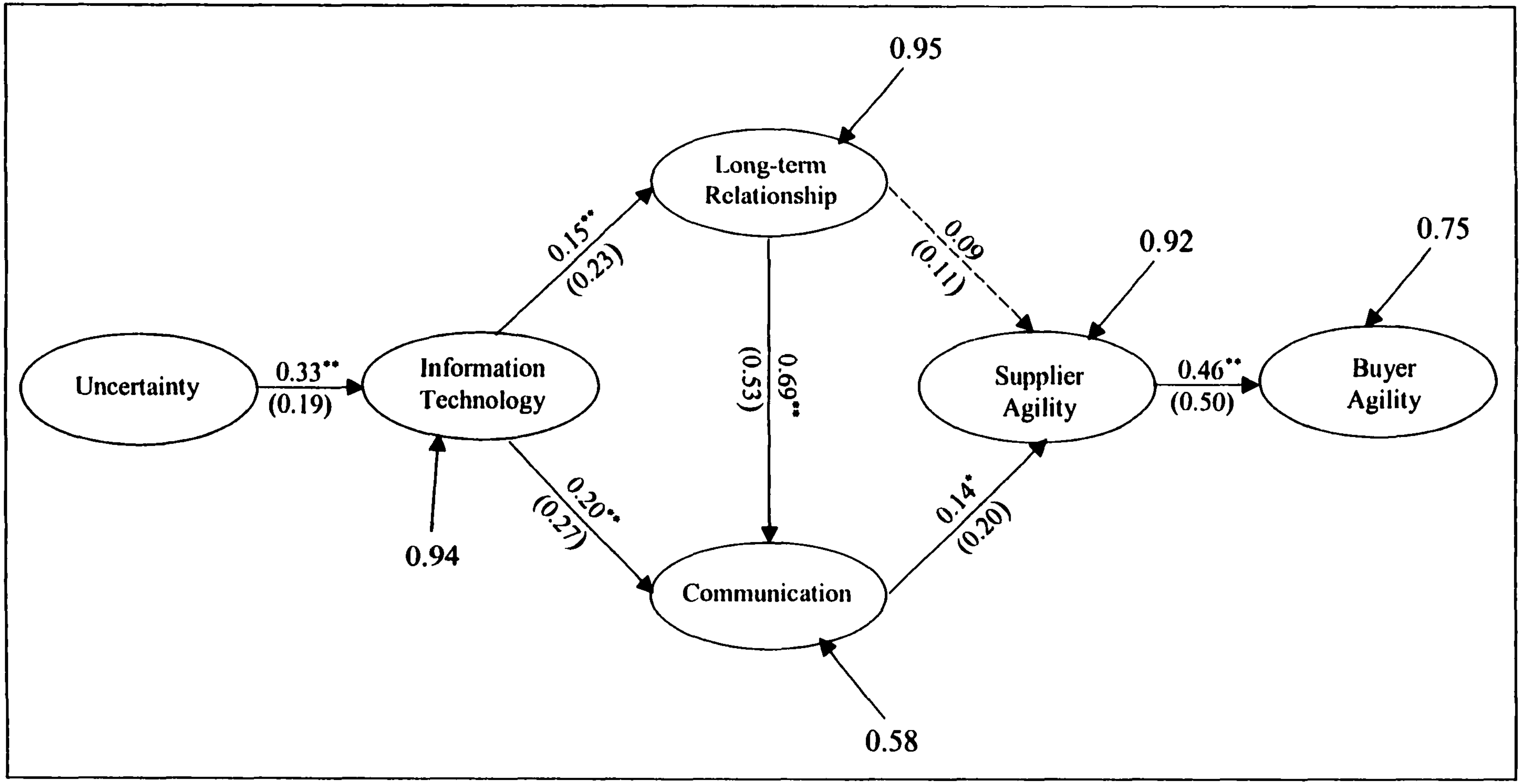
Model 6: Impact of Supply Network Structure on Supplier Management and Performance (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.13

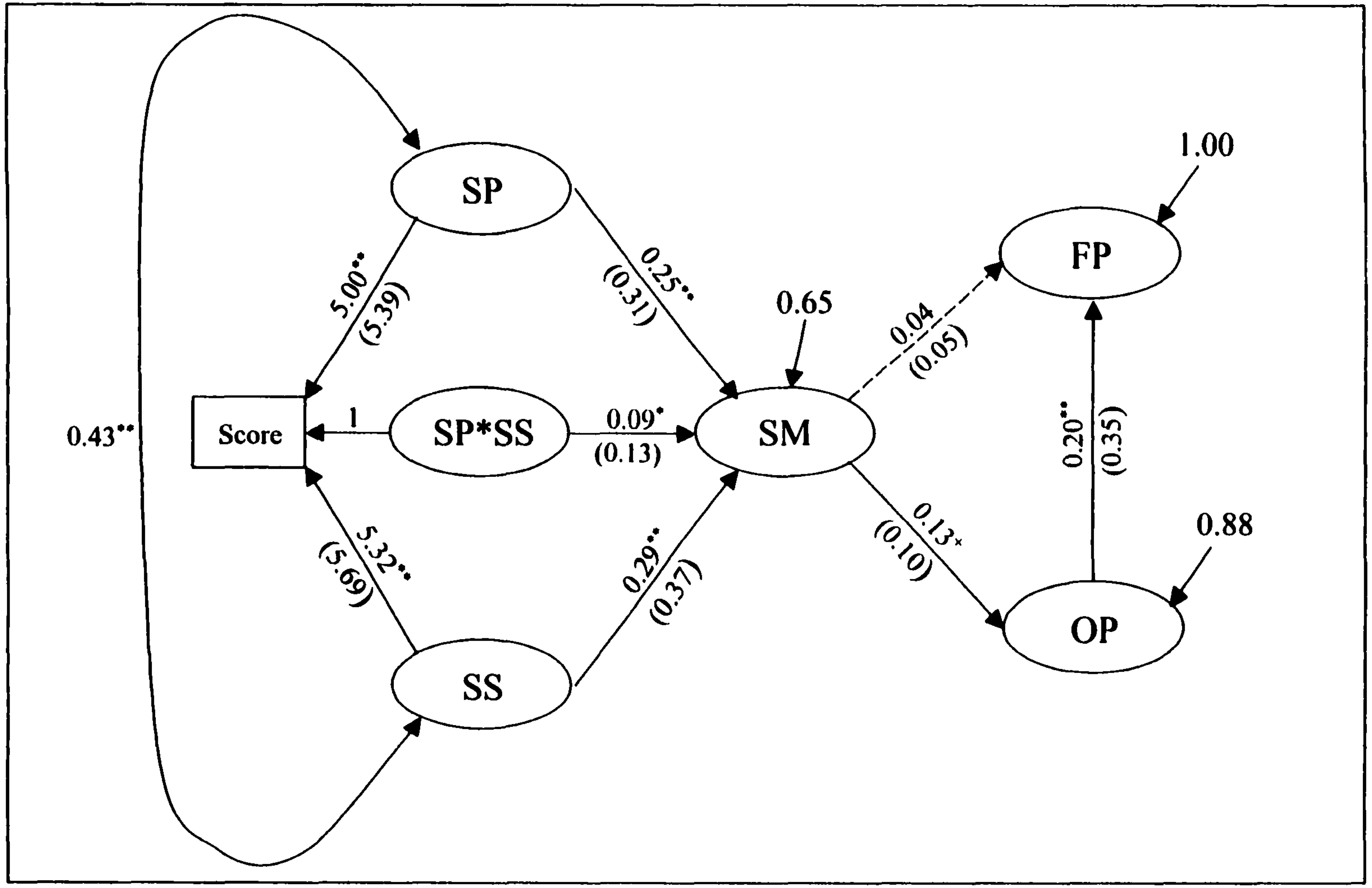
Model 7: Agile Supply Chain: Benefits of Information Technology (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.14

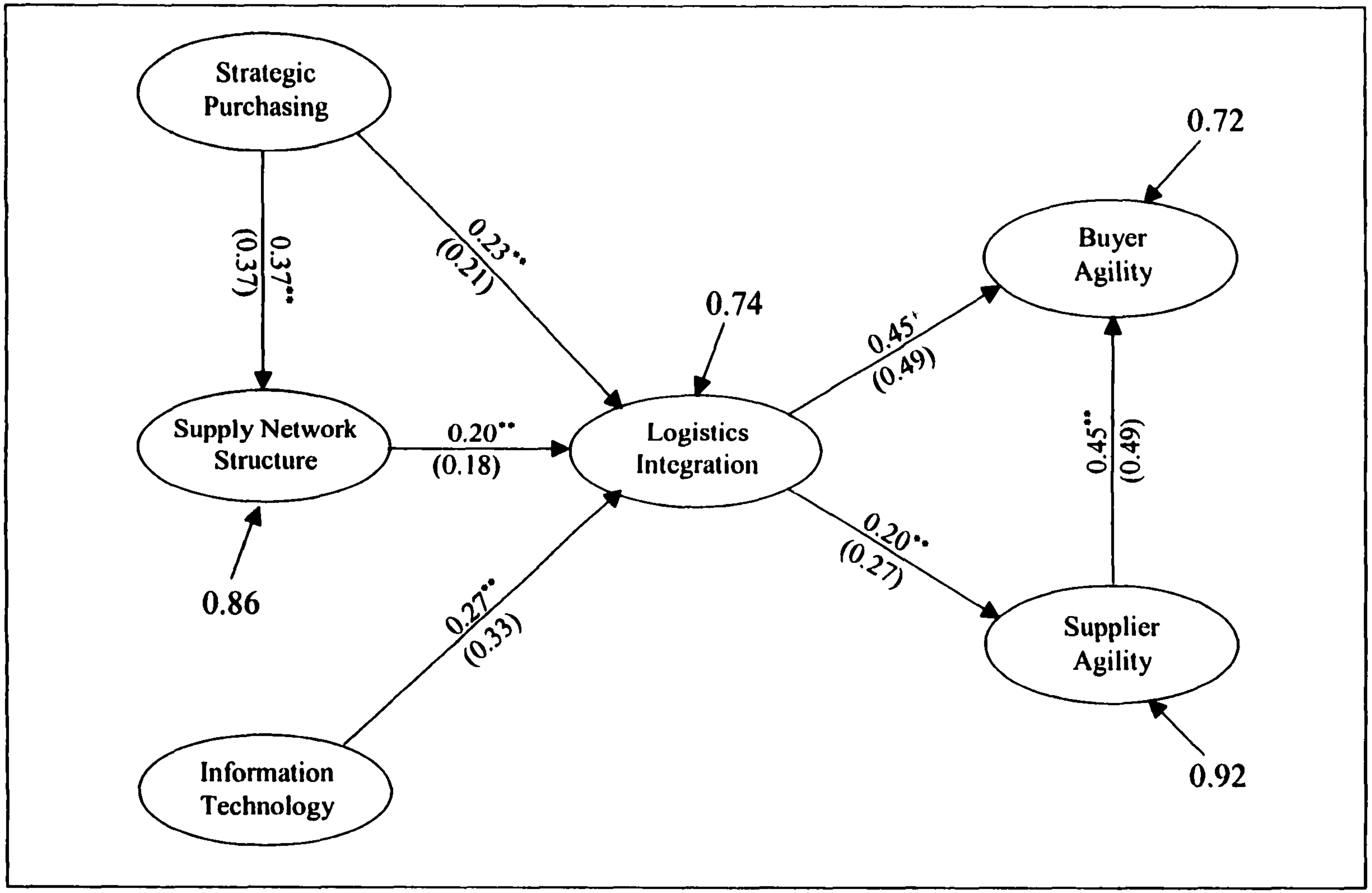
Model 8: Supply Strategy-Structure Fit – Effect on Supply Management (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ⁺ t-values significant at p ≤ 0.10 level

Figure 4.15

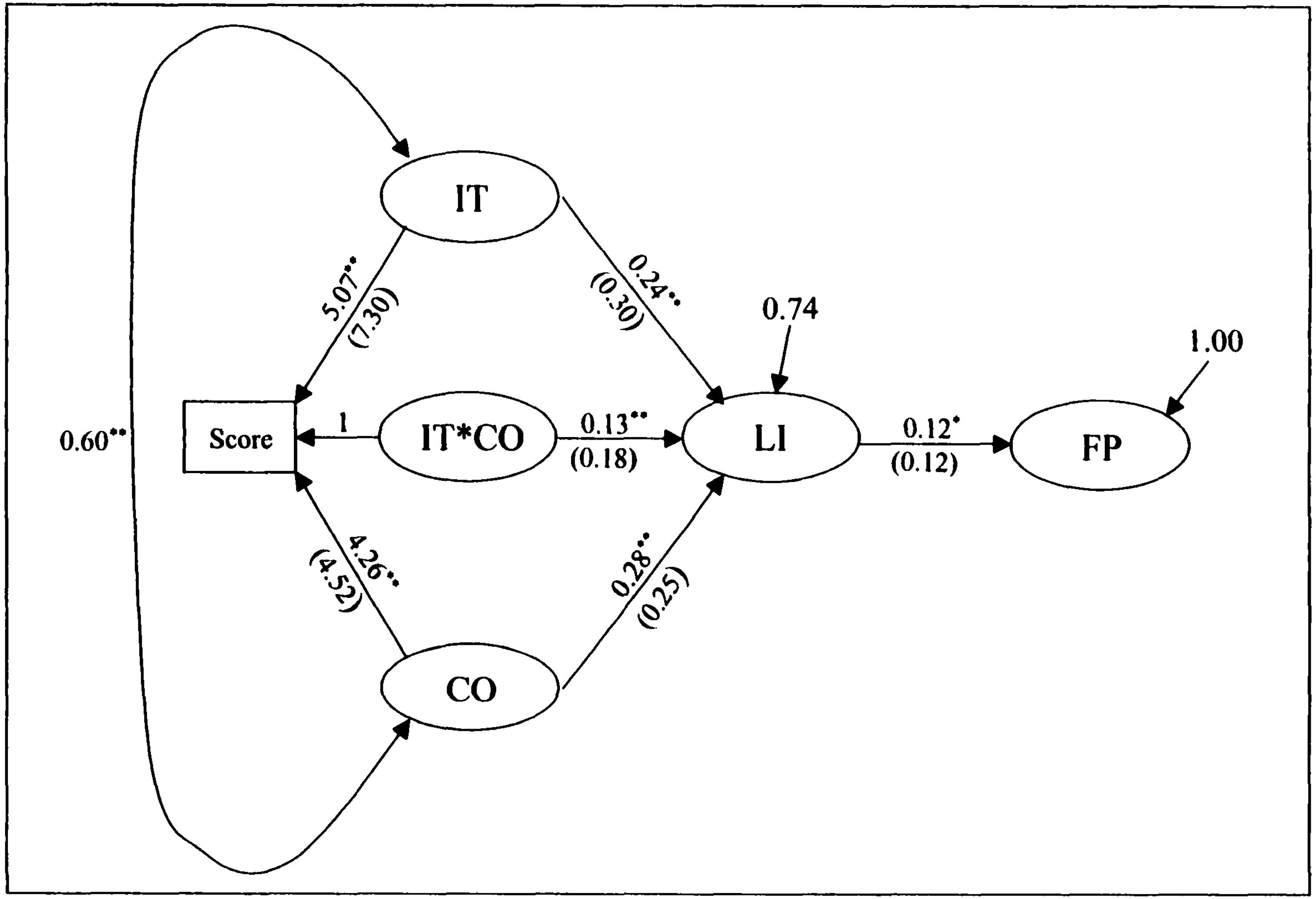
Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.16

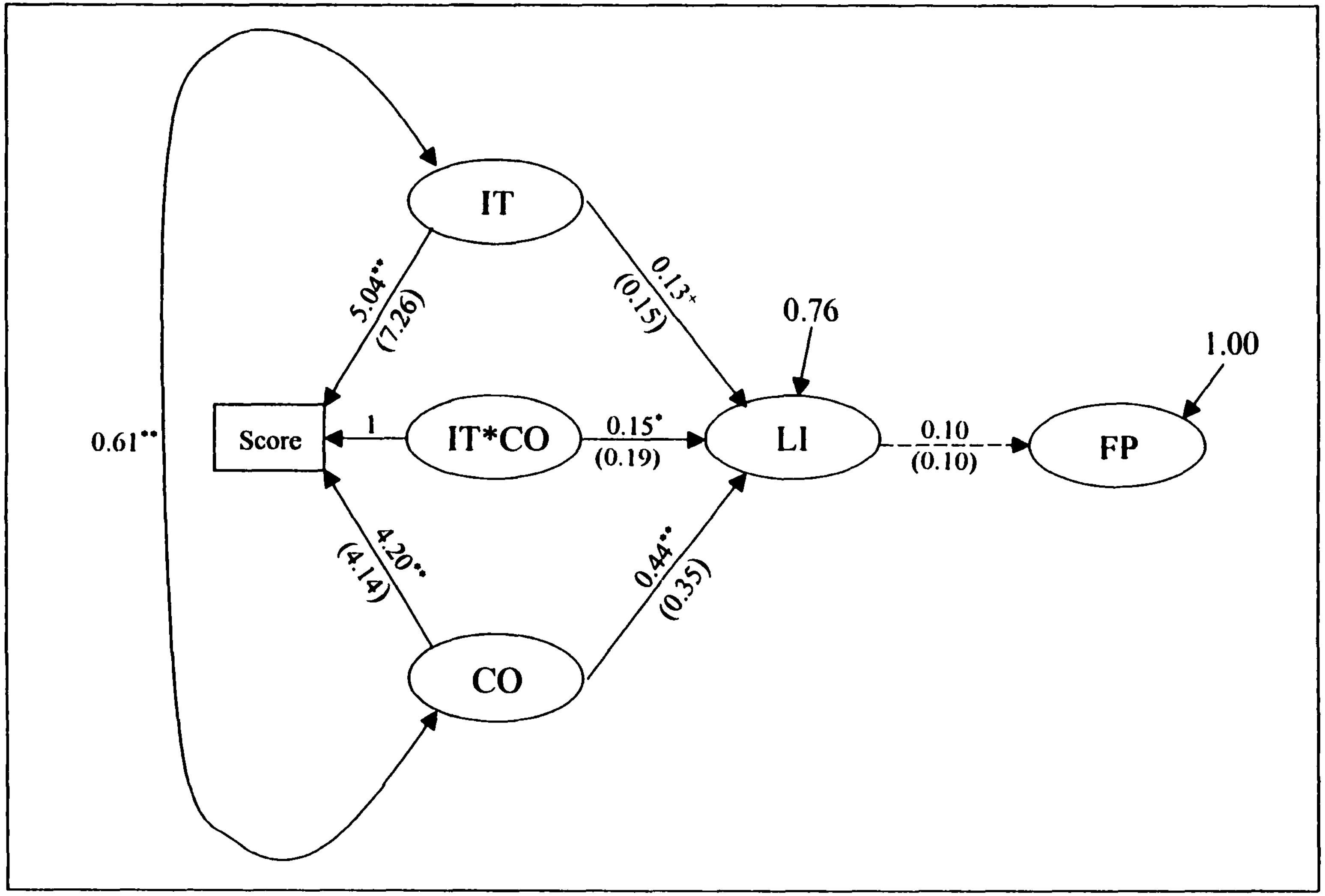
Model 10: Information Technology-Communication Fit – Effect on Logistics Integration (Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, ' t-values significant at p ≤ 0.10 level

Figure 4.17a

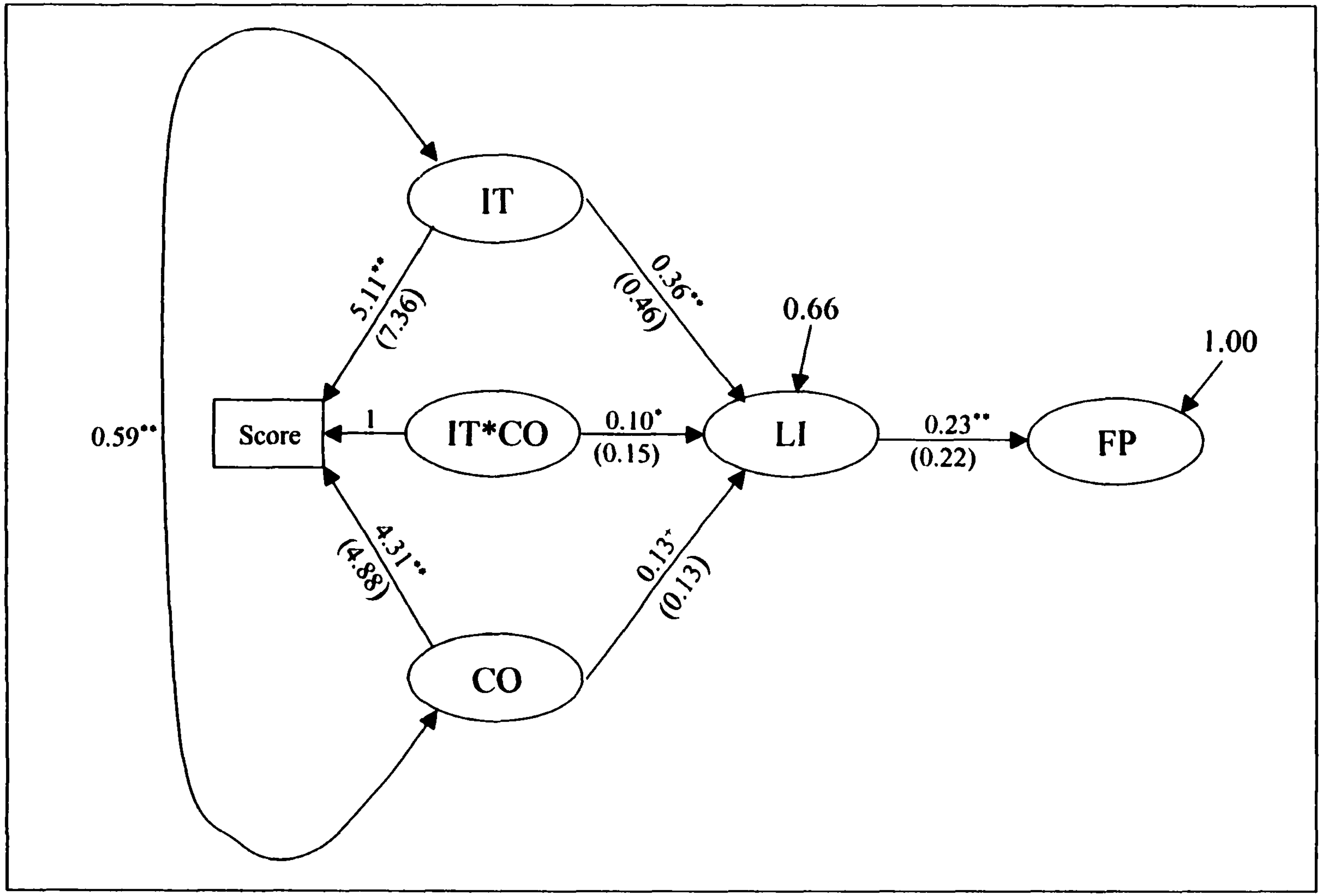
Model 10: Information Technology-Communication Fit – Effect on Logistics Integration (Less than 5% Global Suppliers - Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, + t-values significant at p ≤ 0.10 level

Figure 4.17b

Model 10: Information Technology-Communication Fit – Effect on Logistics Integration (Greater than 10% Global Suppliers - Final Model)



Note. ** t-values significant at p ≤ 0.01 level, * t-values significant at p ≤ 0.05 level, + t-values significant at p ≤ 0.10 level

Table 2.1

Dimensions of Bureaucratic and Network Organizations
Adopted from Harland et al.(1999)

Dimension	Bureaucratic (Vertical) Organization	Network Organization
Critical Tasks	Physical	Mental
Relationships	Hierarchical	Peer-to-peer
Levels	Many	Few
Structures	Functional	Multi-disciplinary
teams		
Boundaries	Fixed	Permeable
Competitive thrust	Vertical integration	Outsourcing and
alliances		
Management style	Autocratic	Participative
Culture	Complaince and tradition	Commitment and
results		
People	Homogeneous	Diverse
Strategic focus	Efficiency	Innovation

Table 3.1
Notation used in LISREL and EQS

Description	LISREL	EQS
Variables and vectors		
Latent dependent variables	η	F
Latent independent variables	ξ	F
Observed dependent variables	Y	V
Observed independent variables	X	V
Error term (Disturbance)	ζ	D
Measurement errors for the dependent variables	ε	E
Measurement errors for the independent variables	δ	E
Matrices		
Structural coefficients relating latent dependent variables	β	F, F
Structural coefficients relating latent independent And dependent variables	γ	F, F
Relationship between observed and latent dependent variables	λ_Y	V, F
Relationship between observed and latent independent variables	λ_X	V, F
Variances and covariances among the latent independent variables	ϕ	-
Variances and covariances among the latent dependent prediction errors or disturbance terms	ψ	-
Variances and covariances among the observed dependent prediction errors or disturbance terms	θ_ε	-
Variances and covariances among the observed dependent prediction errors or disturbance terms	θ_δ	-

Table 3.2
Widely-used Indices of Model Fit

Index	Reference	Acceptable level
Absolute fit indices		
χ^2 (Chi-square)	Bollen (1989) Satorra and Bentler (1994)	Tabled χ^2 value
GFI, AGFI	Joreskog and Sorbom (1999) Tanaka and Huba (1985)	0 to 1
RMSR	Joreskog and Sorbom (1999)	< 0.10
Incremental fit indices		
TLI	Tucker and Lewis (1973)	0 to 1
NFI	Bentler and Bonnet (1980, 1982) Loehlin (1992)	0 to 1
Parsimony-based fit indices		
NC (Chi-square/d.f.)	Joreskog (1969)	0 to 5
PFI	James et al. (1982)	0 to 1

Table 4.1
Respondent Profile

Title	Count	Percent
President/Vice President	35	15.8
Supply Chain Management		
Materials Management		
Purchasing		
Director	138	62.5
Purchasing		
Procurement		
Materials Management		
Supply Management		
Operations		
Manager	33	14.9
Purchasing		
Supplier Development		
Operations		
Others	15	6.8
Purchasing Supervisors		
Purchasing Agents		
Senior Buyers		

Table 4.2
Company Profile

SIC Code	Count	Percent
34 - Fabricated Metal Industries	49	22.2
35 - Industrial Machinery and Equipment	31	14.0
36 - Electronic & Other Electric Equipment	49	22.2
37 - Transportation Equipment	21	9.5
38 - Instruments and Related Products	16	7.2
39 - Miscellaneous Manufacturing Industries	55	24.9

Number of Employees	Count	Percent
Less Than 25	9	4.1
25 – 100	29	13.1
101 – 250	29	13.1
251 – 500	38	17.2
501 – 1000	34	15.4
More than 1000	80	36.2
No Response	2	0.9

Annual Sales Volume (In Millions)	Count	Percent
Less Than $1	4	1.8
$1 – $49	56	25.3
$50 – $99	28	12.7
$100 – $499	62	28.1
$500 – $999	21	9.5
More than $1000	45	20.4
No Response	5	2.3

Firm Type	Count	Percent
Machining	29	13.1
Fabricating	69	31.2
Assembly	87	39.4
Processing	22	10.0
Service	14	6.3
Other	62	28.1
No Response	4	1.8

Note. The total percent for different firm types is greater than 100 because 19% of the respondents selected more than 1 choice.

Table 4.3
Descriptive Statis:ics (Mean and Standard Deviation)

Supply Uncertainty							
Question	**1**	**2**	**3**	**4**			
Mean	4.13	5.80	5.44	5.32			
Std. Deviation	2.030	1.375	1.200	1.254			
Demand Uncertainty							
Question	**1**	**2**	**3**	**4**	**5**		
Mean	5.12	4.44	4.11	4.17	4.66		
Std. Deviation	1.676	1.682	1.715	1.948	1.695		
Technology Uncertainty							
Question	**1**	**2**	**3**	**4**			
Mean	3.99	5.00	3.44	3.48			
Std. Deviation	1.841	1.660	1.635	1.432			
Customer Focus							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mean	6.13	5.72	5.80	5.62	5.60	6.15	6.00
Std. Deviation	0.790	1.071	1.160	1.207	1.170	1.070	1.118
Strategic Purchasing							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mean	5.38	5.65	4.09	5.21	4.85	5.94	4.75
Std. Deviation	1.555	1.287	1.866	1.602	1.523	1.021	1.461
Competitive Priorities							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	5.31	5.27	4.71	4.32	5.18	5.90	
Std. Deviation	1.451	1.344	1.543	1.552	1.309	1.124	
Orgamizational/Supply Structure							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	5.41	5.23	4.39	5.11	5.09	4.81	
Std. Deviation	1.439	1.344	1.782	1.272	1.285	1.426	

Table 4.3. (continued)
Descriptive Statistics (Mean and Standard Deviation)

Top Management Support							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mean	5.68	5.69	5.37	5.69	5.36	4.69	5.22
Std. Deviation	1.272	1.282	1.344	1.497	1.403	1.479	1.355
Information Technology							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	3.52	4.70	4.54	5.37	3.92	4.16	
Std. Deviation	2.048	1.859	1.877	1.843	2.065	1.935	
Long-term Relationship							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	5.22	5.94	5.84	5.10	5.63	5.35	
Std. Deviation	1.374	0.907	1.043	1.436	1.081	1.398	
Supplier Base							
Question	**1**	**2**	**3**	**4**	**5**		
Mean	5.18	3.56	3.71	4.95	5.50		
Std. Deviation	1.411	1.695	1.607	1.627	1.119		
Communication							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	4.62	5.25	5.31	5.29	4.94	5.19	
Std. Deviation	1.676	1.351	1.162	1.144	1.290	1.420	
Cross-functional Teams							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	5.61	4.17	4.19	4.20	4.41	3.95	
Std. Deviation	1.181	1.723	1.635	1.659	1.651	1.616	
Supplier Involvement							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	5.03	4.30	3.39	3.82	3.91	4.49	
Std. Deviation	1.428	1.738	1.602	1.673	1.659	1.683	

Table 4.3. (continued)
Descriptive Statistics (Mean and Standard Deviation)

External Logistics Integration							
Question	**1**	**2**	**3**	**4**	**5**	**6**	
Mean	4.27	4.06	3.72	4.10	4.33	4.76	
Std. Deviation	1.446	1.418	1.472	1.489	1.438	1.230	
Information Technology Usage							
Question	**1**	**2**	**3**	**4**	**5**		
Mean	3.12	3.95	4.93	3.93	6.15		
Std. Deviation	2.106	2.269	1.818	2.259	1.335		
Supplier Performance							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mean	4.76	4.95	5.11	5.09	3.63	5.08	3.70
Std. Deviation	1.116	1.171	1.087	1.047	1.341	1.046	1.312
Question	**8**	**9**					
Mean	5.02	4.40					
Std. Deviation	1.011	1.146					
Buyer Performance - Financial							
Question	**1**	**2**	**3**	**4**			
Mean	4.53	4.46	4.46	4.64			
Std. Deviation	1.193	1.267	1.295	1.354			
Buyer Performance - Operational							
Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mean	5.15	3.72	4.92	4.63	3.66	4.01	4.06
Std. Deviation	0.934	1.161	1.076	1.250	1.368	1.206	1.283
Question	**8**	**8**	**10**	**11**	**12**		
Mean	4.02	4.57	4.83	4.92	5.22		
Std. Deviation	1.401	1.019	1.042	1.028	1.044		

Note. The order of indicators follows the survey questionnaire in Appendix 2

Table 4.4a
Scale Reliability

FACTORS	Exploratory Factor Analysis Before	Exploratory Factor Analysis After	After Confirmatory Factor Analysis
Supply Uncertainty	0.524	0.651 (1)	0.882 (1)
Demand Uncertainty	0.807	0.848 (1)	0.836 (1)
Technology Uncertainty	0.830	0.830 (0)	0.830 (0)
Customer Focus	0.863	0.863 (0)	0.864 (1)
Competitive Priorities	0.812	0.829 (1)	0.829 (0)
Strategic Purchasing	0.848	0.848 (1)	0.823 (1)
Top Management Support	0.909	0.916 (1)	0.916 (0)
Information Technology	0.839	0.839 (0)	0.839 (0)
Supply Structure	0.766	0.809 (1)	0.823 (1)
Long-term Relationship	0.842	0.838 (1)	0.852 (1)
Supply Base Reduction	0.572	0.652 (3)	0.652 (0)
Communication	0.861	0.857 (1)	0.857 (0)
Cross-functional Teams	0.890	0.902 (1)	0.902 (0)
Supplier Integration	0.881	0.859 (2)	0.859 (0)
Logistics Integration	0.917	0.917 (0)	0.917 (0)

Note. The number of item deleted are given in parenthesis

Table 4.4b
Supply Chain Performance Scale Reliability

FACTORS	Cronbach's Alpha
Supplier Performance	
Flexibility	0.839
Delivery	0.918
Quality	--
Cost	--
Buyer Performance	
Financial	0.951
Flexibility	--
Delivery	0.707
Quality	--
Cost	--
Customer Responsiveness	0.820

Table 4.5a
Environmental Uncertainty Measurement Model - Assessment of Undimensionality

Model Fit Statistics	Value	Recommended
Chi-square:	34.130	
Chi-square/degrees of freedom:	1.484	≤2.0
Adjusted goodness of fit index (AGFI)	0.930	≥0.80
Bentler and Bonett's Non-normed fit index (NNFI)	0.980	≥0.90
Bentler Comparative fit index (CFI)	0.990	≥0.90
Root Mean Square Residual (RMSR):	0.035	≤0.10

Table 4.5b
Driving Forces Measurement Model - Assessment of Undimensionality

Model Fit Statistics	Value	Recommended
Chi-square:	444.010	
Chi-square/degrees of freedom:	1.383	≤2.0
Adjusted goodness of fit index (AGFI)	0.840	≥0.80
Bentler and Bonett's Non-normed fit index (NNFI)	0.960	≥0.90
Bentler Comparative fit index (CFI)	0.960	≥0.90
Root Mean Square Residual (RMSR):	0.057	≤0.10

Table 4.5c
Supply Chain Measurement Model - Assessment of Undimensionality

Model Fit Statistics	Value	Recommended
Chi-square:	736.010	
Chi-square/degrees of freedom:	1.940	≤2.0
Adjusted goodness of fit index (AGFI)	0.820	≥0.80
Bentler and Bonett's Non-normed fit index (NNFI)	0.900	≥0.90
Bentler Comparative fit index (CFI)	0.920	≥0.90
Root Mean Square Residual (RMSR):	0.076	≤0.10

Table 4.5d
Supply Chain Performance Measurement Model - Assessment of Undimensionality

Model Fit Statistics	Value	Recommended
Chi-square:	113.090	
Chi-square/degrees of freedom:	1.450	≤2.0
Adjusted goodness of fit index (AGFI)	0.890	≥0.80
Bentler and Bonett's Non-normed fit index (NNFI)	0.970	≥0.90
Bentler Comparative fit index (CFI)	0.980	≥0.90
Root Mean Square Residual (RMSR):	0.035	≤0.10

Table 4.6

Assessment of Construct Validity (Exploratory Factor Analysis)

Factors	*Eigen values*	Loading for Items *#1*	*#2*	*#3*	*#4*	*#5*	*#6*
Supply Uncertainty	1.793	0.942	0.945				
Demand Uncertainty	2.273	0.812	0.921	0.867			
Technology Uncertainty	2.668	0.867	0.767	0.823	0.802		
Customer Focus	3.740	0.599	0.807	0.815	0.802	0.681	0.759
Competitive Priorities	3.060	0.722	0.867	0.783	0.699	0.692	
Strategic Purchasing	2.932	0.753	0.676	0.546	0.582	0.658	
Top Management Support	4.424	0.769	0.829	0.816	0.754	0.738	0.763
Information Technology	3.485	0.765	0.750	0.807	0.634	0.662	0.766
Supply Structure	2.821	0.676	0.803	0.672	0.841		
Long-term Relationship	2.814	0.847	0.623	0.797	0.700		
Supply Base Reduction	1.566	0.800	0.793				
Communication	3.236	0.514	0.698	0.802	0.740	0.629	
Cross-functional Teams	4.038	0.650	0.845	0.866	0.828	0.746	
Supplier Integration	2.745	0.705	0.657	0.811	0.776		
Logistics Integration	4.450	0.786	0.839	0.847	0.834	0.854	0.685
Supplier Performance - Flexibility	1.737	0.903	0.861				
Supplier Performance - Delivery	1.881	0.905	0.900				
Buyer Performance - Financial	3.514	0.940	0.943	0.945	0.854		
Buyer Performance - Delivery	1.578	0.820	0.855				
Buyer Performance - Customer Responsiveness	1.699	0.873	0.872				

Table 4.7a
Environmental Uncertainty Measurement Model
Assessment of Construct Validity (Confirmatory Factor Analysis)

Factors and items	Standardized Loading	Error term	t-values	R^2
Supply Uncertainty				
SU1	0.85	0.130	6.45	0.72
SU2	0.99	0.150	6.70	0.99
Demand Uncertainty				
DU1	0.69	0.062	11.05	0.47
DU2	0.99	0.056	17.90	0.99
DU3	0.78	0.060	12.99	0.61
Technology Uncertainty				
TU1	0.76	0.063	12.07	0.57
TU2	0.59	0.068	8.75	0.35
TU3	0.84	0.061	13.63	0.70
TU4	0.79	0.062	12.80	0.63

Note. All t-values are significant as $p <= 0.001$ level

Table 4.7b

Driving Forces Measurement Model

Assessment of Construct Validity (Confirmatory Factor Analysis)

Factors and items	Standardized Loading	Error term	t-values	R^2
Customer Focus				
CF1	0.61	0.072	8.45	0.32
CF2	0.68	0.079	8.64	0.35
CF3	0.80	0.077	10.31	0.45
CF4	0.85	0.075	11.38	0.53
CF5	0.75	0.068	10.92	0.49
CF6	0.90	0.067	13.50	0.64
Competitive Priorities				
CP1	0.85	0.094	9.06	0.34
CP2	1.13	0.078	14.50	0.70
CP3	1.13	0.095	11.87	0.53
CP4	0.98	0.081	12.11	0.54
CP5	0.78	0.070	11.07	0.48
Strategic Purchasing				
SP1	1.14	0.095	12.03	0.53
SP2	0.99	0.081	12.15	0.58
SP3	1.12	0.097	11.57	0.50
SP4	1.16	0.092	12.62	0.58
SP5	0.58	0.065	8.88	0.32
Top Management Support				
TM1	0.89	0.076	11.74	0.49
TM2	1.06	0.071	14.93	0.68
TM3	1.24	0.071	17.36	0.85
TM4	1.23	0.083	14.72	0.67
TM5	1.30	0.074	17.69	0.86
TM6	0.90	0.091	9.84	0.37
Information Technology				
IT1	1.41	0.120	11.42	0.48
IT2	1.40	0.120	12.14	0.56
IT3	1.50	0.110	13.18	0.64
IT4	1.01	0.120	8.43	0.30
IT5	1.47	0.140	10.76	0.51
IT6	1.35	0.120	11.33	0.48

Note. All t-values are significant as $p <= 0.001$ level

Table 4.7c
Supply Chain Measurement Model
Assessment of Construct Validity [Confirmatory Factor Analysis]

Factors and items	Standardized Loading	Error term	t-values	R^2
Supply Structure				
SS1	0.95	0.085	11.21	0.50
SS2	1.00	0.077	12.97	0.62
SS3	0.91	0.081	11.23	0.50
SS4	1.05	0.089	11.88	0.52
Long-term Relationship				
LR1	0.65	0.055	11.83	0.52
LR2	0.75	0.064	11.79	0.52
LR3	0.91	0.062	14.79	0.71
LR4	1.17	0.080	14.58	0.70
Supply Base Reduction				
SB1	0.99	0.110	9.17	0.50
SB2	0.79	0.088	9.17	0.50
Communication				
CO1	1.03	0.110	9.67	0.38
CO2	0.93	0.084	11.01	0.47
CO3	0.99	0.065	15.09	0.72
CO4	0.99	0.064	15.48	0.74
CO5	0.96	0.077	12.46	0.55
Cross-functional Teams				
CT1	0.95	0.110	8.65	0.31
CT2	1.35	0.091	14.73	0.68
CT3	1.53	0.086	17.69	0.85
CT4	1.52	0.086	17.58	0.84
CT5	1.25	0.093	13.37	0.60
Supplier Integration				
SI1	1.12	0.085	13.17	0.61
SI2	1.37	0.100	13.33	0.62
SI3	1.25	0.100	12.47	0.57
SI4	1.33	0.099	13.41	0.63
Logistics Integration				
LI1	1.10	0.083	13.31	0.58
LI2	1.32	0.075	17.70	0.88
LI3	1.27	0.080	15.82	0.74
LI4	1.26	0.084	15.03	0.71
LI5	1.21	0.080	15.15	0.72
LI6	0.71	0.077	9.31	0.34

Note. All t-values are significant as $p <= 0.001$ level

Table 4.7d
Supply Chain Performance Measurement Model
Assessment of Construct Validity (Confirmatory Factor Analysis)

Factors and items	Standardized Loading	Error term	t-values	R^2
Supplier Performance				
Flexibility				
PP1	0.91	0.070	13.03	0.66
PP2	1.04	0.072	14.46	0.79
Delivery				
PP3	0.99	0.060	16.52	0.83
PP4	0.98	0.057	17.20	0.87
Quality				
PP5	1.05	0.050	20.98	1.00
Cost				
PP6	1.31	0.063	20.98	1.00
Buyer Performance				
Financial				
BP1	1.08	0.063	17.25	0.82
BP2	1.17	0.066	17.65	0.85
BP3	1.27	0.064	19.84	0.97
BP4	1.08	0.076	14.24	0.64
Flexibility				
BP5	1.02	0.049	20.98	1.00
Delivery				
BP6	0.75	0.073	10.27	0.48
BP7	1.00	0.084	11.80	0.63
Quality				
BP8	0.93	0.045	20.98	1.00
Cost				
BP9	1.21	0.057	20.98	1.00
Customer Responsiveness				
BP10	0.88	0.066	13.33	0.71
BP11	0.86	0.065	13.13	0.69

Note. All t-values are significant as p <= 0.001 level

Table 4.8

Assessment of Discriminant Validity

Chi-Square Differences Between Fixed and Free Models

Factors	SU	DU	TU	CF	CP	SP	TM	IT	SS	LR	SB	CO	CT	SI	LI
Supply Uncertainty (SU)	-														
Demand Uncertainty (DU)	135.19	-													
Technology Uncertainty (TU)	164.66	266.88	-												
Customer Focus (CF)	140.46	259.13	372.35	-											
Competitive Priorities (CP)	142.07	272.85	399.87	490.92	-										
Strategic Purchasing (SP)	136.33	502.51	389.76	374.14	494.24	-									
Top Management Support (TM)	139.38	269.91	382.29	770.59	521.14	112.56	-								
Information Technology (IT)	135.63	269.14	370.07	642.89	524.03	440.99	676.37	-							
Supply Structure (SS)	138.17	270.43	384.84	268.35	329.96	314.79	315.18	366.83	-						
Long-term Relationship (LR)	135.43	267.06	380.71	402.00	445.94	432.38	420.74	466.12	208.39	-					
Supply Base (SB)	50.31	58.92	56.83	51.78	48.09	54.85	50.18	50.45	41.60	41.61	-				
Communication (CO)	136.52	265.75	373.79	722.30	483.17	459.15	619.30	540.66	253.99	234.57	32.63	-			
Cross-functional Teams (CT)	135.12	264.00	358.28	739.48	534.15	380.63	869.61	472.69	347.91	429.65	47.08	460.75	-		
Supplier Integration (SI)	142.78	266.32	363.03	442.89	513.34	380.59	389.86	420.35	332.02	444.27	49.86	307.69	284.02	-	
Logistics Integration (LI)	151.57	264.26	377.61	808.96	514.61	380.66	1270.17	535.06	345.69	464.63	52.75	633.25	832.42	396.08	-

Note. All chi-square differences were significant at the 0.001 level (for 1 d.f.)

Table 4.9
Model 1: Strategic Supply Management - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	5.50 [p = 0.50]	
Chi-square/degrees of freedom:	0.90	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.97	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.98	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.01	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.04	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.10

Model 1: Strategic Supply Management - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	SB		LR		CO		CR		FP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Strategic Purchasing (SP)	0.00	0.20** (0.20)	0.06** (0.07)	0.27** (0.31)	0.19** (0.18)	0.34** (0.34)	0.09** (0.11)	0.09** (0.11)	0.03** (0.03)	0.03** (0.03)
Endogenous Variables:										
Supplier Base (SB) Reduction	---		0.00	0.29** (0.34)	0.15** (0.15)	0.42** (0.43)	0.11** (0.12)	0.11** (0.12)	0.04** (0.03)	0.04** (0.03)
Long-term Relationship (LR)	---		---		0.00	0.50** (0.44)	0.06' (0.07)	0.25** (0.25)	0.09** (0.07)	0.09** (0.07)
Communication (CO)	---		---		---		0.00	0.13' (0.14)	0.04' (0.04)	0.04' (0.04)
Buyer Performance Customer Responsiveness (CR)	---		---		---		---		0.00	0.34** (0.28)
Buyer Performance Financial (FP)	---		---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.11

Model 2: Supply Uncertainty and Quality Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	14.88 [p = 0.04]	
Chi-square/degrees of freedom:	2.13	≤ 3.00
Goodness of fit index (GFI)	0.98	≥ 0.90
djusted goodness of fit index (AGFI)	0.93	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.94	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.92	≥ 0.90
Bentler Comparative fit index (CFI)	0.96	≥ 0.90
Root Mean Square Residual (RMSR):	0.05	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.07	≤ 0.10

Table 4.12

Model 2: Supply Uncertainty and Quality Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	SP		SR		SM		SQ		BQ	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Supply Uncertainty (SU)	0.00	0.15*	0.03*	0.13**	0.12**	0.12**	0.03*	0.03*	0.03**	0.03**
		(0.17)	(0.05)	(0.18)	(0.13)	(0.13)	(0.03)	(0.03)	(0.04)	(0.04)
Endogenous Variables:										
Strategic Purchasing (SP)	---		0.00	0.23**	0.12**	0.46**	0.12**	0.12**	0.12**	0.12**
				(0.29)	(0.12)	(0.47)	(0.12)	(0.12)	(0.14)	(0.14)
Supplier Relationship (SR)	---		---		0.00	0.54**	0.13$^{'}$	0.13**	0.14**	0.14**
						(0.42)	(0.11)	(0.11)	(0.13)	(0.13)
Supplier Management (SM)	---		---		---		0.00	0.25**	0.10**	0.27**
								(0.26)	(0.11)	(0.31)
Supplier Quality Performance (SQ)	---		---		---		---		0.00	0.38**
										(0.43)
Buyer Quality Performance (BQ)	---		---		---		---		---	

Note. ** t-values significant at $p \leq 0.01$ level, * t-values significant at $p \leq 0.05$ level, $^{'}$ t-values significant at $p \leq 0.10$ level

Table 4.13

Model 3: Customer-oriented Supply Management - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	3.37 [p = 0.50]	
Chi-square/degrees of freedom:	0.84	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.98	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.98	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.01	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.03	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.14

Model 3: Customer-oriented Supply Management - Indirect and Total Effects

	ENDOGENOUS VARIABLES							
	Strategic Purchasing		Supply Management		Customer-oriented Performance		Financial Performance	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:								
Customer Focus (CF)	0.00	0.51^{**} (0.41)	0.14^{**} (0.15)	0.42^{**} (0.42)	0.11^{**} (0.10)	0.39^{**} (0.39)	0.17^{**} (0.13)	0.17^{**} (0.13)
Endogenous Variables:								
Strategic Purchasing (SP)	---		0.00	0.28^{**} (0.36)	0.07^{**} (0.09)	0.07^{**} (0.09)	0.03^{**} (0.03)	0.03^{**} (0.03)
Supply Management (SM)	---		---		0.00	0.26^{**} (0.25)	0.11^{**} (0.08)	0.11^{**} (0.08)
Customer-oriented Performance (CP)	---		---		---		0.00	0.44^{**} (0.33)

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.15

Model 4: Strategic Supply Management: Effect of Supplier Integration on Cost-based Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	4.59 [p = 0.71]	
Chi-square/degrees of freedom:	0.66	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.98	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.99	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.01	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.03	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.16

Model 4: Strategic Supply Management: Effect of Supplier Integration on Cost-based Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	CT		CO		SI		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Long-time Relationship (LR)	0.00	0.53** (0.35)	0.15** (0.13)	0.68** (0.59)	0.49** (0.34)	0.49** (0.34)	-0.05$^{'}$ (-0.04)	-0.05$^{'}$ (-0.04)	-0.03 (-0.02)	-0.03 (-0.02)
Endogenous Variables:										
Cross-functional Teams (CT)	---		0.00	0.29** (0.38)	0.12** (0.13)	0.51** (0.52)	-0.06* (-0.06)	-0.06* (-0.06)	-0.03 (-0.03)	-0.03 (-0.03)
Communication (CO)	---		---		0.00	0.43** (0.33)	-0.05$^{'}$ (-0.04)	-0.05$^{'}$ (-0.04)	-0.02 (-0.02)	-0.02 (-0.02)
Supplier Integration (SI)	---		---		---		0.00	-0.11$^{'}$ (-0.12)	-0.05$^{'}$ (-0.06)	-0.06 (-0.06)
Supplier Performance	---		---		---		---		0.00	0.47** (0.51)
Buyer Performance	---		---		---		---		---	

Note. ** t-values significant at p $\leq$0.01 level, * t-values significant at p $\leq$0.05 level, $^{'}$ t-values significant at p $\leq$0.10 level

Table 4.17

Model 4: Strategic Supply Management: Effect of Supplier Integration on Quality-based Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	18.05 [p = 0.012]	
Chi-square/degrees of freedom:	2.58	≤ 3.00
Goodness of fit index (GFI)	0.97	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.92	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.95	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.93	≥ 0.90
Bentler Comparative fit index (CFI)	0.97	≥ 0.90
Root Mean Square Residual (RMSR):	0.07	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.09	≤ 0.10

Table 4.18

Model 4: Strategic Supply Management: Effect of Supplier Integration on Quality-based Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	CT		CO		SI		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Long-time Relationship (LR)	0.00	0.53^{**} (0.35)	0.15^{**} (0.13)	0.68^{**} (0.59)	0.49^{**} (0.34)	0.49^{**} (0.34)	0.08^{**} (0.07)	0.08^{**} (0.07)	0.08^{**} (0.08)	0.08^{**} (0.08)
Endogenous Variables:										
Cross-functional Teams (CT)	---		0.00	0.29^{**} (0.38)	0.12^{**} (0.13)	0.51^{**} (0.52)	0.08^{**} (0.11)	0.08^{**} (0.11)	0.08^{**} (0.12)	0.08^{**} (0.12)
Communication (CO)	---		---		0.00	0.43^{**} (0.33)	0.07^{**} (0.07)	0.07^{**} (0.07)	0.07^{**} (0.08)	0.07^{**} (0.08)
Supplier Integration (SI)	---		---		---		0.00	0.16^{**} (0.21)	0.06^{**} (0.09)	0.16^{**} (0.23)
Supplier Performance (SP)	---		---		---		---		0.00	0.40^{**} (0.45)
Buyer Performance (BP)	---		---		---		---		---	

Note. ** t-values significant at p $\leq$0.01 level, * t-values significant at p $\leq$0.05 level, † t-values significant at p $\leq$0.10 level

Table 4.19

Model 4: Strategic Supply Management: Effect of Supplier Integration on Delivery-based Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	8.56 [p = 0.29]	
Chi-square/degrees of freedom:	1.22	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.96	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.97	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.99	≥ 0.90
Bentler Comparative fit index (CFI)	0.99	≥ 0.90
Root Mean Square Residual (RMSR):	0.05	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.03	≤ 0.10

Table 4.20

Model 4: Strategic Supply Management: Effect of Supplier Integration on Delivery-based Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	CT		CO		SI		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Long-time Relationship (LR)	0.00	0.53^{**}	0.15^{**}	0.68^{**}	0.49^{**}	0.49^{**}	0.08^{**}	0.08^{**}	0.08^{**}	0.08^{**}
		(0.35)	(0.13)	(0.59)	(0.34)	(0.34)	(0.07)	(0.07)	(0.08)	(0.08)
Endogenous Variables:										
Cross-functional Teams (CT)	---		0.00	0.29^{**}	0.12^{**}	0.51^{**}	0.08^{**}	0.08^{**}	0.09^{**}	0.09^{**}
				(0.38)	(0.13)	(0.52)	(0.11)	(0.11)	(0.12)	(0.12)
Communication (CO)	---		---		0.00	0.43^{**}	0.07^{**}	0.07^{**}	0.07^{**}	0.07^{**}
						(0.33)	(0.07)	(0.07)	(0.08)	(0.08)
Supplier Integration (SI)	---		---		---		0.00	0.16^{**}	0.05^{**}	0.17^{**}
								(0.22)	(0.09)	(0.23)
Supplier Performance (SP)	---		---		---		---		0.00	0.31^{**}
										(0.31)
Buyer Performance (BP)	---		---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.21
Model 4: Strategic Supply Management: Effect of Supplier Integration on Flexibility-based Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	11.44 [p = 0.12]	
Chi-square/degrees of freedom:	1.63	≤ 3.00
Goodness of fit index (GFI)	0.98	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.95	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.97	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.97	≥ 0.90
Bentler Comparative fit index (CFI)	0.99	≥ 0.90
Root Mean Square Residual (RMSR):	0.06	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.05	≤ 0.10

Table 4.22

Model 4: Strategic Supply Management: Effect of Supplier Integration on Flexibility-based Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	CT		CO		SI		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Long-time Relationship (LR)	0.00	0.53** (0.35)	0.15** (0.13)	0.68** (0.59)	0.49** (0.34)	0.49** (0.34)	0.08** (0.07)	0.08** (0.07)	0.07* (0.06)	0.07* (0.06)
Endogenous Variables:										
Cross-functional Teams (CT)	---		0.00	0.29** (0.38)	0.12** (0.13)	0.51** (0.52)	0.08** (0.11)	0.08** (0.11)	0.07** (0.09)	0.07** (0.09)
Communication (CO)	---		---		0.00	0.43** (0.33)	0.07** (0.07)	0.07** (0.07)	0.06* (0.06)	0.06* (0.06)
Supplier Integration (SI)	---		---		---		0.00	0.17** (0.21)	0.07** (0.10)	0.13** (0.18)
Supplier Performance (SP)	---		---		---		---		0.00	0.43** (0.45)
Buyer Performance (BP)	---		---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.23

Model 4: Strategic Supply Management: Effect of Supplier Integration on Responsiveness-based Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	22.07 [p = 0.00]	
Chi-square/degrees of freedom:	3.15	≤ 3.00
Goodness of fit index (GFI)	0.97	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.90	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.93	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.90	≥ 0.90
Bentler Comparative fit index (CFI)	0.95	≥ 0.90
Root Mean Square Residual (RMSR):	0.08	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.10	≤ 0.10

Table 4.24
Model 4: Strategic Supply Management: Effect of Supplier Integration on Responsiveness-based Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	CT		CO		SI		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Long-time Relationship (LR)	0.00	0.53** (0.35)	0.15** (0.13)	0.68** (0.59)	0.49** (0.34)	0.49** (0.34)	0.09** (0.08)	0.09** (0.08)	0.09** (0.09)	0.09** (0.09)
Endogenous Variables:										
Cross-functional Teams (CT)	---		0.00	0.29** (0.38)	0.12** (0.13)	0.51** (0.52)	0.09** (0.13)	0.09** (0.13)	0.09** (0.14)	0.09** (0.14)
Communication (CO)	---		---		0.00	0.43** (0.33)	0.08** (0.08)	0.08** (0.08)	0.08** (0.09)	0.08** (0.09)
Supplier Integration (SI)	---		---		---		0.00	0.18** (0.25)	0.05** (0.06)	0.18** (0.26)
Supplier Performance (SP)	---		---		---		---		0.00	0.25** (0.26)
Buyer Performance (BP)	---		---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.25a

Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	3.18 [p = 0.53]	
Chi-square/degrees of freedom:	0.80	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.98	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.99	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.01	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.02	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.25b

Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time Performance (Lower Performance Group) - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	5.22 [p = 0.27]	
Chi-square/degrees of freedom:	1.31	≤ 3.00
Goodness of fit index (GFI)	0.98	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.93	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.96	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.97	≥ 0.90
Bentler Comparative fit index (CFI)	0.99	≥ 0.90
Root Mean Square Residual (RMSR):	0.05	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.05	≤ 0.10

Table 4.25c

Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time Performance (Higher Performance Group) - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	1.41 [p = 0.84]	
Chi-square/degrees of freedom:	0.35	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.98	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.99	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.04	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.02	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.26

Model 4: Strategic Supply Management: Effect of Supplier Integration on New Product Introduction Time Performance (Higher Performance Group) - Indirect and Total Effects

	ENDOGENOUS VARIABLES							
	CT		CO		SI		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:								
Long-time Relationship (LR)	0.00	0.61** (0.35)	0.20** (0.13)	0.59** (0.59)	0.55** (0.34)	0.55** (0.34)	-0.07 (-0.03)	-0.07 (-0.03)
Endogenous Variables:								
Cross-functional Teams (CT)	---		0.00	0.33** (0.49)	0.16** (0.16)	0.60** (0.59)	-0.08$^{'}$ (-0.09)	-0.08$^{'}$ (-0.09)
Communication (CO)	---		---		0.00	0.49** (0.33)	-0.07 (-0.05)	-0.07 (-0.05)
Supplier Integration (SI)	---		---		---		0.00	-0.13$^{'}$ (-0.16)
Buyer Performance	---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, $^{'}$ t-values significant at p ≤0.10 level

Table 4.27
Model 5: Supply Management and Performance: Effects of Business and Purchasing Strategy - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	20.96 [p = 0.03]	
Chi-square/degrees of freedom:	1.91	≤ 3.00
Goodness of fit index (GFI)	0.97	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.93	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.95	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.96	≥ 0.90
Bentler Comparative fit index (CFI)	0.98	≥ 0.90
Root Mean Square Residual (RMSR):	0.05	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.06	≤ 0.10

Table 4.28

Model 5: Supply Management And Performance: Effects of Business and Purchasing Strategy - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	SP		SR		SM		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Top Management Support (TM)	0.00	0.66^{**} (0.70)	0.13^{**} (0.18)	0.13^{**} (0.18)	0.29^{**} (0.31)	0.29^{**} (0.31)	0.06^{**} (0.09)	0.06^{**} (0.09)	0.05^{**} (0.08)	0.05^{**} (0.08)
Competitive Priorities (CP)	---		0.00	0.29^{**} (0.36)	0.14^{**} (0.14)	0.23^{**} (0.23)	0.05^{**} (0.07)	0.05^{**} (0.07)	0.04^{**} (0.06)	0.04^{**} (0.06)
Endogenous Variables:										
Strategic Purchasing (SP)	---		0.00	0.20^{**} (0.26)	0.10^{**} (0.10)	0.44^{**} (0.44)	0.09^{**} (0.13)	0.09^{**} (0.13)	0.08^{**} (0.12)	0.08^{**} (0.12)
Supplier Relationship (SR)	---		---		0.00	0.49^{**} (0.38)	$0.10'$ (0.11)	0.10^{**} (0.11)	0.09^{**} (0.11)	0.09^{**} (0.11)
Supplier Management (SM)	---		---		---		0.00	0.21^{**} (0.29)	0.10^{**} (0.16)	0.18^{**} (0.28)
Supplier Manufacturing Performance (SP)	---		---		---		---		0.00	0.49^{**} (0.54)
Buyer Manufacturing Performance (BP)	---		---		---		---		---	

Note. ** t-values significant at p $\leq$0.01 level, * t-values significant at p $\leq$0.05 level, $'$ t-values significant at p $\leq$0.10 level

Table 4.29

Model 6: Impact of Supply Network Structure on Supplier Management and Performance - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	4.91 [p = 0.30]	
Chi-square/degrees of freedom:	1.23	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.97	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.98	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.99	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.04	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.03	≤ 0.10

Table 4.30

Model 6: Impact of Supply Network Structure on Supplier Management and Performance - Indirect and Total Effects

	ENDOGENOUS VARIABLES							
	LR		SM		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:								
Supply Network Structure (SS)	0.00	0.46** (0.53)	0.21** (0.22)	0.40** (0.41)	0.08** (0.12)	0.08** (0.12)	0.07** (0.11)	0.07** (0.11)
Endogenous Variables:								
Long-term Relationship (LR)	---		0.00	0.47** (0.41)	0.10** (0.12)	0.10** (0.12)	0.08** (0.11)	0.08** (0.11)
Supplier Management (SM)	---		---		0.00	0.21** (0.29)	0.10** (0.16)	0.18** (0.28)
Supplier Manufacturing Performance (SP)	---		---		---		0.00	0.49** (0.54)
Buyer Manufacturing Performance (BP)	---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.31

Model 7: Agile Supply Chain: Benefits of Information Technology - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	5.92 [p = 0.66]	
Chi-square/degrees of freedom:	0.74	≤ 3.00
Goodness of fit index (GFI)	0.99	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.98	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.97	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.02	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.04	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.00	≤ 0.10

Table 4.32

Model 7: Agile Supply Chain: Benefits of Information Technology - Indirect and Total Effects

	ENDOGENOUS VARIABLES									
	IT		LR		CO		SP		BP	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:										
Technology Uncertainty (TU)	0.00	0.33^{**} (0.19)	0.05^{*} (0.04)	0.05^{*} (0.04)	0.10^{*} (0.07)	0.10^{*} (0.07)	0.02^{*} (0.02)	0.02^{*} (0.02)	0.01^{*} (0.01)	0.01^{*} (0.01)
Endogenous Variables:										
Information Technology (IT)	---		0.00	0.15^{**} (0.23)	0.09^{*} (0.12)	0.29^{**} (0.39)	0.06^{**} (0.10)	0.06^{**} (0.10)	0.03^{**} (0.05)	0.03^{**} (0.05)
Long-term Relationship (LR)	---		---		0.00	0.60^{**} (0.53)	0.09^{**} (0.10)	0.18^{**} (0.21)	0.08^{**} (0.11)	0.08^{**} (0.11)
Communication (CO)	---		---		---		0.00	0.14^{*} (0.20)	0.07^{*} (0.10)	0.07^{*} (0.10)
Supplier Performance Inventory Reduction (SP)	---		---		---		---		0.00	0.46^{**} (0.50)
Buyer Performance Inventory Reduction (BP)	---		---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.33
Model 8: Supply Strategy-Structure Fit: Effect on Supply Management - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	14.50 [p = 0.15]	
Chi-square/degrees of freedom:	1.45	≤ 3.00
Goodness of fit index (GFI)	0.98	≥ 0.90
Adjusted goodness of fit index (AGFI)	0.96	≥ 0.80
Bentler and Bonett's Normed fit index (NFI)	0.99	≥ 0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.99	≥ 0.90
Bentler Comparative fit index (CFI)	1.00	≥ 0.90
Root Mean Square Residual (RMSR):	0.09	≤ 0.10
Root Mean Square Error of Approximation (RMSEA):	0.05	≤ 0.10

Table 4.34

Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	14.44 [p = 0.07]	
Chi-square/degrees of freedom:	1.81	≤3.00
Goodness of fit index (GFI)	0.98	≥0.90
Adjusted goodness of fit index (AGFI)	0.94	≥0.80
Bentler and Bonett's Normed fit index (NFI)	0.94	≥0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.94	≥0.90
Bentler Comparative fit index (CFI)	0.97	≥0.90
Root Mean Square Residual (RMSR):	0.07	≤0.10
Root Mean Square Error of Approximation (RMSEA):	0.06	≤0.10

Table 4.35

Model 9: The Driving Forces of Effective External Logistics Integration: Impact on Agility - Indirect and Total Effects

	ENDOGENOUS VARIABLES							
	SS		LI		SA		BA	
	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
Exogenous Variables:								
Strategic Purchasing (SP)	0.00	0.37** (0.37)	0.07** (0.07)	0.30** (0.28)	0.06** (0.08)	0.06** (0.08)	0.05** (0.07)	0.05** (0.07)
Information Technology (IT)	---		0.00	0.27** (0.33)	0.05** (0.09)	0.05** (0.09)	0.04** (0.08)	0.04** (0.08)
Endogenous Variables:								
Supply Structure (SS)	---		0.00	0.20** (0.18)	0.04* (0.05)	0.04* (0.05)	0.03' (0.04)	0.03' (0.04)
Logistics Integration (LI)	---		---		0.00	0.20** (0.27)	0.09** (0.16)	0.16** (0.25)
Supplier Agility Performance (SA)	---		---		---		0.00	0.45** (0.49)
Buyer Agility Performance (BA)	---		---		---		---	

Note. ** t-values significant at p ≤0.01 level, * t-values significant at p ≤0.05 level, ' t-values significant at p ≤0.10 level

Table 4.36
Model 10: Information Technology-Communication Fit: Effect on Logistics Integration - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	12.75 [p = 0.08]	
Chi-square/degrees of freedom:	1.82	$\leq$3.00
Goodness of fit index (GFI)	0.98	$\geq$0.90
Adjusted goodness of fit index (AGFI)	0.96	$\geq$0.80
Bentler and Bonett's Normed fit index (NFI)	0.99	$\geq$0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.99	$\geq$0.90
Bentler Comparative fit index (CFI)	0.99	$\geq$0.90
Root Mean Square Residual (RMSR):	0.07	$\leq$0.10
Root Mean Square Error of Approximation (RMSEA):	0.06	$\leq$0.10

Table 4.37a

Model 10: Information Technology-Communication Fit: Effect on Logistics Integration (Less than 5% Global Suppliers) - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	7.10 [p = 0.42]	
Chi-square/degrees of freedom:	1.02	≤3.00
Goodness of fit index (GFI)	0.98	≥0.90
Adjusted goodness of fit index (AGFI)	0.95	≥0.80
Bentler and Bonett's Normed fit index (NFI)	0.98	≥0.90
Bentler and Bonett's Non-normed fit index (NNFI)	1.00	≥0.90
Bentler Comparative fit index (CFI)	1.00	≥0.90
Root Mean Square Residual (RMSR):	0.07	≤0.10
Root Mean Square Error of Approximation (RMSEA):	0.01	≤0.10

Table 4.37b

Model 10: Information Technology-Communication Fit: Effect on Logistics Integration (Greater than 10% Global Suppliers) - Assessment of Model Fit

Model Fit Statistics	Value	Recommended
Chi-square:	11.07 [p=0.14]	
Chi-square/degrees of freedom:	1.58	≤3.00
Goodness of fit index (GFI)	0.97	≥0.90
Adjusted goodness of fit index (AGFI)	0.93	≥0.80
Bentler and Bonett's Normed fit index (NFI)	0.98	≥0.90
Bentler and Bonett's Non-normed fit index (NNFI)	0.99	≥0.90
Bentler Comparative fit index (CFI)	0.99	≥0.90
Root Mean Square Residual (RMSR):	0.09	≤0.10
Root Mean Square Error of Approximation (RMSEA):	0.07	≤0.10

Table 4.38a

Assessment of Information Technology Usage (Number of Employees) - Description Statistics

Type of Information Technology	Sample	N	Mean	Std. Deviation
Electronic Data Interchange (EDI)	1	152	3.45	2.165
	2	69	2.39	1.776
Enterprise Resource Planning (ERP) Systems	1	152	4.24	2.184
	2	69	3.30	2.335
Internet, Intranet, and/or Extranet	1	152	5.02	1.850
	2	69	4.72	1.740
Business-to-Business E-Commerce tools	1	152	4.24	2.261
	2	69	3.23	2.108
Electronic Mail	1	152	6.24	1.285
	2	69	5.96	1.429

Note. Sample 1 – Less than or equal to 250 Employees, Sample 2 – Greater than 250 Employees

Table 4.38b

Assessment of Information Technology Usage (Number of Employees) – T-Test for Equality of Means

Type of Information Technology	Mean Diff.	T-value	D.F.	Significance [2-tailed]
Electronic Data Interchange (EDI)	1.06**	3.568	219	0.000
Enterprise Resource Planning (ERP) Systems	0.94**	2.899	219	0.004
Internet, Intranet, and/or Extranet	0.30	1.119	219	0.264
Business-to-Business E-Commerce tools	1.01**	3.146	219	0.002
Electronic Mail	0.28	1.450	219	0.148

Table 4.39a
Assessment of Information Technology Usage (Annual Sales Volume) - Descriptive Statistics

Type of Information Technology	Sample	N	Mean	Std. Deviation
Electronic Data Interchange (EDI)	1	128	3.64	2.154
	2	93	2.41	1.819
Enterprise Resource Planning (ERP) Systems	1	128	4.38	2.137
	2	93	3.37	2.326
Internet, Intranet, and/or Extranet	1	128	5.20	1.744
	2	93	4.56	1.862
Business-to-Business E-Commerce tools	1	128	4.38	2.266
	2	93	3.31	2.111
Electronic Mail	1	128	6.40	1.104
	2	93	5.81	1.541

Note. Sample 1 – Less than 100 Million Dollars, Sample 2 – Greater than or Equal to 100 Million Dollars

Table 4.39b
Assessment of Information Technology Usage (Annual Sales Volume) – T-Test for Equality of Means

Type of Information Technology	Mean Diff.	T-value	D.F.	Significance [2-tailed]
Electronic Data Interchange (EDI)	1.23**	4.475	219	0.000
Enterprise Resource Planning (ERP) Systems	1.01**	3.340	219	0.001
Internet, Intranet, and/or Extranet	0.64**	2.602	219	0.010
Business-to-Business E-Commerce tools	1.06**	3.543	219	0.000
Electronic Mail	0.59**	3.328	219	0.001

APPENDIX

Appendix 1
Cover Letter

<Date>

«FullName»
«Title»
«Company»
«Address1»
«Address2»
«Custom1»

Dear «FullName»:

For the development of a coherent supply chain management discipline, advances in theoretical models are needed to better understand the supply chain phenomena. Therefore, this doctoral dissertation focuses on bringing together earlier supply chain research to provide a comprehensive theoretical model. In order to validate theoretical factors with real-world practices, I am collecting extensive empirical data. Your help in providing this information, as relevant to your supply chain management practices, will be of great importance to this study as well as the growing need for a cohesive supply chain management theory.

You are one of the few senior purchasing managers selected from a list provided by the NAPM Headquarters. In order for the results of this study to truly represent real-world practices, it is important that each questionnaire be completed and returned.

I assure you that you will be completing this questionnaire anonymously and that you and your company will not be identifiable. The results of this survey will be reported only in summary form. No mention of particular companies or participants will be given. If you have any questions about your rights as a research subject, you can contact the Cleveland State University's Review Board at (216) 687-3630.

Once you have completed the questionnaire, please return it directly to me in the enclosed postage-paid envelope. If you would like a copy of the findings from this research, you can check the box in the questionnaire and I will be happy to forward a copy of the report. Thank you very much for your great contribution to this significant study.

Sincerely,

S.C. Antony Paulraj
Doctoral Candidate
NAPM – Columbus Member

Appendix 2
Questionnaire
Cleveland State University
Supply Chain Management Survey

[ ] **Please check this box if you would like to receive a copy of the results from this study.**

Section A: Supply Chain Factors

Instructions: Your initial response to agreement or disagreement to each of the statements provided below is requested. Please circle the indicator which best describes your business environment.
Every supplier related indicator relates to the top one or two key suppliers. Key suppliers can be selected based on dollar amount and/or criticality of materials purchased.

1 - Strongly Disagree **4 - Neither Agree nor Disagree** **7 - Strongly Agree**

Supply Uncertainty							
1. We have extensive inspection of incoming critical materials from suppliers.	1	2	3	4	5	6	7
2. We have a high rejection rate of incoming critical materials from suppliers.	1	2	3	4	5	6	7
3. The suppliers consistently meet our requirements.	1	2	3	4	5	6	7
4. The suppliers produce materials with consistent quality.	1	2	3	4	5	6	7
Demand Uncertainty							
1. Our master production schedule has a high percentage of variation in demand.	1	2	3	4	5	6	7
2. Our demand fluctuates drastically from week to week.	1	2	3	4	5	6	7
3. Our supply requirements vary drastically from week to week.	1	2	3	4	5	6	7
4. We keep weeks of inventory of the critical material to meet the changing demand.	1	2	3	4	5	6	7
5. The volume and/or composition of demand is difficult to predict.	1	2	3	4	5	6	7
Technology Uncertainty							
1. Our industry is characterized by rapidly changing technology.	1	2	3	4	5	6	7
2. If we don't keep up with changes in technology, it will be difficult for us to remain competitive.	1	2	3	4	5	6	7
3. The rate of process obsolescence is high in our industry.	1	2	3	4	5	6	7
4. The production technology changes frequently and sufficiently.	1	2	3	4	5	6	7
Customer Focus							
1. We produce products that satisfy and/or exceed customer expectations.	1	2	3	4	5	6	7
2. We anticipate and respond to customers' evolving needs and wants.	1	2	3	4	5	6	7
3. We emphasize the evaluation of formal and informal customer complaints.	1	2	3	4	5	6	7
4. We follow-up with customers for quality/service feedback.	1	2	3	4	5	6	7
5. We interact with customers to set reliability, responsiveness, and other standards.	1	2	3	4	5	6	7
6. Satisfying customer needs is the central purpose of our business.	1	2	3	4	5	6	7
7. Customer focus is reflected in our business planning.	1	2	3	4	5	6	7
Strategic Purchasing							
1. Purchasing is included in the firm's strategic planning process.	1	2	3	4	5	6	7
2. The purchasing function has a good knowledge of the firm's strategic goals.	1	2	3	4	5	6	7
3. The purchasing function has a formally written long-range plan.	1	2	3	4	5	6	7
4. Purchasing performance is measured in terms of its contributions to the firm's success.	1	2	3	4	5	6	7
5. Purchasing professionals' development focuses on elements of the competitive strategy.	1	2	3	4	5	6	7
6. Purchasing department plays an integrative role in the purchasing function.	1	2	3	4	5	6	7
7. Purchasing's focus is on longer term issues that involve risk and uncertainty.	1	2	3	4	5	6	7

Instructions: Every supplier related indicator relates to the top one or two key suppliers. Key suppliers can be selected based on dollar amount and/or criticality of materials purchased.

1 - Strongly Disagree **4 - Neither Agree nor Disagree** **7 - Strongly Agree**

Competitive Priorities

1. Our strategy cannot be described as the one to offer products with the lowest price.	1	2	3	4	5	6	7
2. Our strategy is based on quality performance rather than price.	1	2	3	4	5	6	7
3. We place greater emphasis on innovation than price.	1	2	3	4	5	6	7
4. We place greater emphasis on launching new products quickly.	1	2	3	4	5	6	7
5. We place greater emphasis on customer service than price.	1	2	3	4	5	6	7
6. Our strategy places importance on delivering products with high performance.	1	2	3	4	5	6	7

Organizational/Supply Structure

1. We have few management levels in our relationship with suppliers.	1	2	3	4	5	6	7
2. We have a permeable organizational boundary that facilitates better communication and/or relationship with our key suppliers.	1	2	3	4	5	6	7
3. The decision making process in our organization is decentralized.	1	2	3	4	5	6	7
4. Our relation with the suppliers is based on interdependence rather than power.	1	2	3	4	5	6	7
5. Our organizational structure can be characterized as a flexible value-adding network.	1	2	3	4	5	6	7
6. Our organizational/supply structure does not involve power-based relationships.	1	2	3	4	5	6	7

Top Management Support

1. Top management is supportive to our efforts to improve the purchasing department.	1	2	3	4	5	6	7
2. Top management considers purchasing to be a vital part of our corporate strategy.	1	2	3	4	5	6	7
3. Purchasing's views are important to most top managers.	1	2	3	4	5	6	7
4. The chief purchasing officer has high visibility within top management.	1	2	3	4	5	6	7
5. Top management emphasizes the purchasing function's strategic role.	1	2	3	4	5	6	7
6. Requests for increased resources are mostly satisfied by top management.	1	2	3	4	5	6	7
7. Top management supports the need for interorganizational information systems.	1	2	3	4	5	6	7

Information Technology (Any kind of technology)

1. There are direct computer-to-computer links with key suppliers.	1	2	3	4	5	6	7
2. Interorganizational coordination is achieved using electronic links.	1	2	3	4	5	6	7
3. We use information technology enabled transaction processing.	1	2	3	4	5	6	7
4. We have electronic mailing capabilities with our key suppliers.	1	2	3	4	5	6	7
5. We use electronic transfer of purchase orders, invoices and/or funds.	1	2	3	4	5	6	7
6. We use advanced information systems to track and/or expedite shipments.	1	2	3	4	5	6	7

Long-term Relationship

1. The relationship we have with key suppliers is essentially evergreen.	1	2	3	4	5	6	7
2. We expect our relationship with key suppliers to last a long time.	1	2	3	4	5	6	7
3. We work with key suppliers to improve their quality in the long run.	1	2	3	4	5	6	7
4. We give a fair profit share to key suppliers.	1	2	3	4	5	6	7
5. The suppliers see our relationship as a long-term alliance.	1	2	3	4	5	6	7
6. We view our suppliers as an extension of our company.	1	2	3	4	5	6	7

Supplier Base

1. We rely on a small number of high quality suppliers.	1	2	3	4	5	6	7
2. We get multiple price quotes from suppliers before ordering.	1	2	3	4	5	6	7
3. We drop suppliers for price reasons.	1	2	3	4	5	6	7
4. We use hedging contracts in selecting our suppliers.	1	2	3	4	5	6	7
5. We maintain close relationship with a limited pool of suppliers.	1	2	3	4	5	6	7

> ***Instructions:*** Every supplier related indicator relates to the top one or two key suppliers. Key suppliers can be selected based on dollar amount and/or criticality of materials purchased.
>
> **1 - Strongly Disagree** **4 - Neither Agree nor Disagree** **7 - Strongly Agree**

Communication (With key suppliers)

1. We share sensitive information (financial, production, design, research, and/or competition).	1	2	3	4	5	6	7
2. Suppliers are provided with any information that might help them.	1	2	3	4	5	6	7
3. Exchange of information takes place frequently, informally and/or in a timely manner.	1	2	3	4	5	6	7
4. We keep each other informed about events or changes that may affect the other party.	1	2	3	4	5	6	7
5. We have frequent face-to-face planning/communication.	1	2	3	4	5	6	7
6. We exchange performance feedback.	1	2	3	4	5	6	7

Cross-functional Teams

1. We encourage teamwork between our suppliers and us.	1	2	3	4	5	6	7
2. We collocate employees to facilitate cross-functional integration.	1	2	3	4	5	6	7
3. We coordinate joint planning committees with our suppliers.	1	2	3	4	5	6	7
4. We promote task force teams with our suppliers.	1	2	3	4	5	6	7
5. We share ideas and information with our supplier through cross-functional teams.	1	2	3	4	5	6	7
6. We use supplier involved ad hoc teams based on our strategic objectives.	1	2	3	4	5	6	7

Supplier Integration

1. We involve key suppliers in the product design and development stage.	1	2	3	4	5	6	7
2. We have key supplier membership/participation in our project teams.	1	2	3	4	5	6	7
3. We involve our key suppliers in business and strategy planning.	1	2	3	4	5	6	7
4. We have joint planning committees/task forces on key issues with key suppliers.	1	2	3	4	5	6	7
5. Our key suppliers have major influence on the design of new products.	1	2	3	4	5	6	7
6. There is a strong consensus in our firm that supplier involvement is needed in our product design/development.	1	2	3	4	5	6	7

External Logistics Integration (With key supplier firms)

1. Interorganizational logistic activities are closely coordinated.	1	2	3	4	5	6	7
2. Our logistics activities are well integrated with the logistics activities of our suppliers.	1	2	3	4	5	6	7
3. We have a seamless integration of logistics activities with our key suppliers.	1	2	3	4	5	6	7
4. Our logistics integration is characterized by excellent distribution, transportation and/or warehousing facilities.	1	2	3	4	5	6	7
5. The inbound and outbound distribution of goods with our suppliers is well integrated.	1	2	3	4	5	6	7
6. Information and materials flow smoothly between our supplier firms and us.	1	2	3	4	5	6	7

Section B: Types of Information Technology used

> ***Instructions:*** This section questions you regarding the type of information technology used to communicate with your top one or two key suppliers. Key suppliers can be selected based on the dollar amount and/or criticality of materials purchased. Please circle the indicator which best describes your business environment.
>
> **1 – Do Not Use** **4 – Used Moderately** **7 – Used Extensively**

1. Electronic Data Interchange (EDI).	1	2	3	4	5	6	7
2. Enterprise Resource Planning (ERP) Systems.	1	2	3	4	5	6	7
3. Internet, Intranet, and/or Extranet.	1	2	3	4	5	6	7
4. Business-to-Business E-Commerce tools.	1	2	3	4	5	6	7
5. Electronic Mail.	1	2	3	4	5	6	7

***** Almost done... Please turn page *****

Section C: Performance

Instructions: Your initial response to the performance changes in the past 2-3 years along each of the statements provided below is requested. Please circle the indicator which best describes your business environment. *Supplier performance denotes the performance of top one or two key suppliers. Key suppliers can be selected based on the dollar amount and/or criticality of materials purchased.* *Business performance denotes the performance of your firm.* **1 – Decreased Significantly** **4 – Remained Constant** **7 – Increased Significantly**

Supplier (Procurement) Performance							
1. Volume flexibility	1	2	3	4	5	6	7
2. Scheduling flexibility	1	2	3	4	5	6	7
3. On-time delivery	1	2	3	4	5	6	7
4. Delivery reliability/consistency	1	2	3	4	5	6	7
5. Delivery lead-time	1	2	3	4	5	6	7
6. Quality	1	2	3	4	5	6	7
7. Cost	1	2	3	4	5	6	7
8. Prompt response	1	2	3	4	5	6	7
9. Inventory risk reduction	1	2	3	4	5	6	7
Business Performance - Financial							
1. Return on investment	1	2	3	4	5	6	7
2. Profits as a percent of sales	1	2	3	4	5	6	7
3. Firm's net income before tax	1	2	3	4	5	6	7
4. Present value of the firm	1	2	3	4	5	6	7
Business Performance - Operational							
1 Product conformance to specifications	1	2	3	4	5	6	7
2. New product introduction time	1	2	3	4	5	6	7
3. Delivery speed	1	2	3	4	5	6	7
4. Delivery reliability/dependability	1	2	3	4	5	6	7
5. Delivery lead-time	1	2	3	4	5	6	7
6. Production costs	1	2	3	4	5	6	7
7. Production lead-time	1	2	3	4	5	6	7
8. Inventory reduction	1	2	3	4	5	6	7
9. Volume flexibility	1	2	3	4	5	6	7
10. Rapid confirmation of customer orders	1	2	3	4	5	6	7
11. Rapid handling of customer complaints	1	2	3	4	5	6	7
12. Customer satisfaction	1	2	3	4	5	6	7

Section D: Company Profile Information

1. Number of employees at this division?	[ ] Less than 25	[ ] 25 to 100	[ ] 101 to 250
	[ ] 251 to 500	[ ] 501 to 1000	[ ] Over 1000
2. Annual sales volume at this division?	[ ] Less than $1	[ ] $1 to $49	[ ] $50 to $99
(In Millions)	[ ] $100 to $499	[ ] $500 to $999	[ ] Over $1000
3. Firm type?	[ ] Machining	[ ] Fabricating	[ ] Assembly
	[ ] Processing	[ ] Service	[ ] Other
4. Distribution of key suppliers based on locality?	[ ]% Local area		[ ]% Within the State
	[ ]% Within the Country		[ ]% Outside the Country

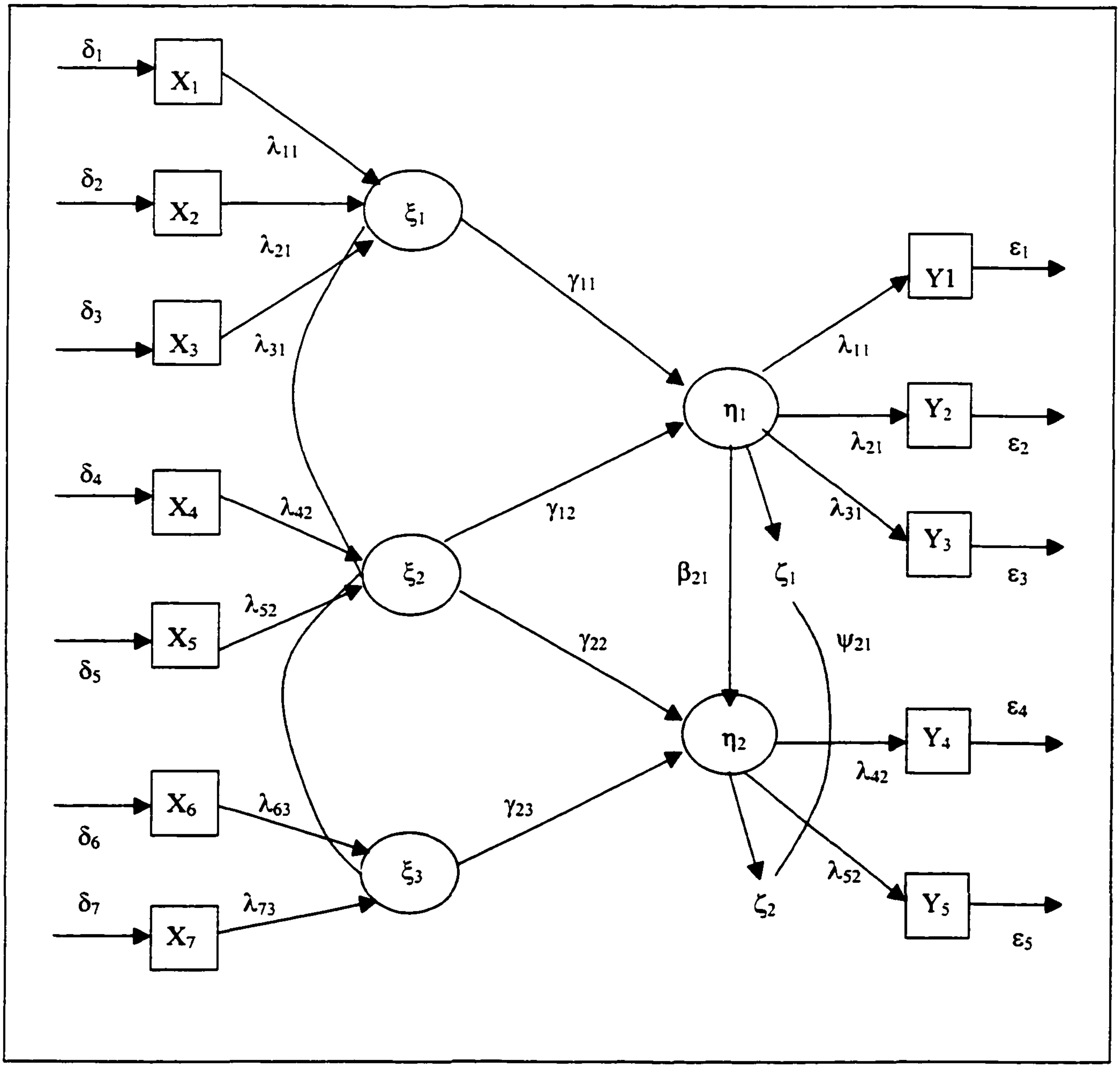
***** Thank you very much for your help *****

Appendix 3

Matrix Notation of a Structural Equation Model

In the figure below:

The number of observed independent variables	(q)	=	7
The number of observed dependent variables	(p)	=	5
The number of latent independent variables	(n)	=	3
The number of latent dependent variables	(m)	=	2



Beta matrix (B is an m x m matrix)

$$\begin{bmatrix} 0 & 0 \\ \beta_{21} & 0 \end{bmatrix}$$

Gamma matrix (Γ is an m x n matrix)

$$\begin{bmatrix} \gamma_{11} & \gamma_{12} & 0 \\ 0 & \gamma_{22} & \gamma_{23} \end{bmatrix}$$

Phi matrix (Φ is a n x n symmetric matrix. It is equivalent to correlation matrix when the diagonal elements are set to 1)

$$\begin{bmatrix} \phi_{11} & & \\ \phi_{21} & \phi_{22} & \\ 0 & \phi_{32} & \phi_{33} \end{bmatrix}$$

Psi matrix (Ψ is an m x m symmetric matrix)

$$\begin{bmatrix} 0 & 0 \\ \psi_{21} & 0 \end{bmatrix}$$

Lambda-X matrix (Λ_X is a q x n matrix)

$$\begin{bmatrix} \lambda_{11} & 0 & 0 \\ \lambda_{21} & 0 & 0 \\ \lambda_{31} & 0 & 0 \\ 0 & \lambda_{42} & 0 \\ 0 & \lambda_{52} & 0 \\ 0 & 0 & \lambda_{63} \\ 0 & 0 & \lambda_{73} \end{bmatrix}$$

Theta-Delta (Θ_δ is a n x n symmetric matrix with all elements being estimated)

Lambda-Y matrix (Λ_Y is a p x m matrix)

$$\begin{bmatrix} \lambda_{11} & 0 \\ \lambda_{21} & 0 \\ \lambda_{31} & 0 \\ 0 & \lambda_{42} \\ 0 & \lambda_{52} \end{bmatrix}$$

Theta-Epsilon (Θ_ε is an m x m symmetric matrix with all elements being estimated)

Appendix 4
Equations for Structural Equation Model Presented in Appendix 3

Measurement model

Dependent

$$\mathbf{Y} = \Lambda_Y * \eta + \varepsilon$$

$$
\begin{aligned}
Y_1 &= \lambda_{11} * \eta_1 + \varepsilon_1 \\
Y_2 &= \lambda_{21} * \eta_1 + \varepsilon_2 \\
Y_3 &= \lambda_{31} * \eta 1 + \varepsilon_3 \\
Y_4 &= \lambda_{42} * \eta_2 + \varepsilon_4 \\
Y_5 &= \lambda_{52} * \eta_2 + \varepsilon_5
\end{aligned}
$$

Independent

$$\mathbf{X} = \Lambda_X * \xi + \delta$$

$$
\begin{aligned}
X_1 &= \lambda_{11} * \xi_1 + \delta_1 \\
X_2 &= \lambda_{21} * \xi_1 + \delta_2 \\
X_3 &= \lambda_{31} * \xi_1 + \delta_3 \\
X_4 &= \lambda_{42} * \xi_2 + \delta_4 \\
X_5 &= \lambda_{52} * \xi_2 + \delta_5 \\
X_6 &= \lambda_{63} * \xi_3 + \delta_6 \\
X_7 &= \lambda_{73} * \xi_3 + \delta_7
\end{aligned}
$$

Structural model

$$\eta = \mathbf{B} * \eta + \Gamma * \xi + \zeta$$

$$
\begin{aligned}
\eta_1 &= \gamma_{11} * \xi_1 + \gamma_{12} * \xi_2 + \zeta_1 \\
\eta_2 &= \beta_{21} * \eta_1 + \gamma_{22} * \xi_2 + \gamma_{23} * \xi_3 + \zeta_2
\end{aligned}
$$

Appendix 5

Final Measurement Instrument

(* denotes items dropped after EFA; ** denotes items dropped after CFA)

Supply Uncertainty

SU1. The suppliers consistently meet our requirements.
SU2. The suppliers produce materials with consistent quality.
SU3. We have extensive inspection of incoming critical materials from suppliers. *
SU4. We have a high rejection rate of incoming critical materials from suppliers. **

Demand Uncertainty

DU1. Our master production schedule has a high percentage of variation in demand.
DU2. Our demand fluctuates drastically from week to week.
DU3. Our supply requirements vary drastically from week to week.
DU4. We keep weeks of inventory of the critical material to meet the changing demand. *
DU5. The volume and/or composition of demand is difficult to predict. **

Technology Uncertainty

TU1. Our industry is characterized by rapidly changing technology.
TU2. If we don't keep up with changes in technology, it will be difficult for us to remain competitive.
TU3. The rate of process obsolescence is high in our industry.
TU4. The production technology changes frequently and sufficiently.

Customer Focus

CF1. We anticipate and respond to customers' evolving needs and wants.
CF2. We emphasize the evaluation of formal and informal customer complaints.
CF3. We follow up with customers for quality/service feedback.
CF4. We interact with customers to set reliability, responsiveness, and other standards.
CF5. Satisfying customer needs is the central purpose of our business.
CF6. Customer focus is reflected in our business planning.
CF7. We produce products that satisfy and/or exceed customer expectations. **

Competitive Priorities

CP1. Our strategy cannot be described as the one to offer products with the lowest price.
CP2. Our strategy is based on quality performance rather than price.
CP3. We place greater emphasis on innovation than price.
CP4. We place greater emphasis on customer service than price.
CP5. Our strategy places importance on delivering products with high performance.
CP6. We emphasize launching new products quickly. *

Strategic Purchasing

SP1. Purchasing is included in the firm's strategic planning process.
SP2. The purchasing function has a good knowledge of the firm's strategic goals.
SP3. Purchasing performance is measured in terms of its contributions to the firm's success.
SP4. Purchasing professionals' development focuses on elements of the competitive strategy.
SP5. The purchasing department plays an integrative role in the purchasing function.
SP6. Purchasing's focus is on longer term issues that involve risk and uncertainty. *
SP7. The purchasing function has a formally written long-range plan. **

Top Management Support

TM1. Top management is supportive of our efforts to improve the purchasing department.

TM2. Top management considers purchasing to be a vital part of our corporate strategy.
TM3. Purchasing's views are important to most top managers.
TM4. The chief purchasing officer has high visibility within top management.
TM5. Top management emphasizes the purchasing function's strategic role.
TM6. Requests for increased resources are mostly satisfied by top management.
TM7. Top management supports the need for interorganizational information systems. *

Information Technology
IT1. There are direct computer-to-computer links with key suppliers.
IT2. Interorganizational coordination is achieved using electronic links.
IT3. We use information technology-enabled transaction processing.
IT4. We have electronic mailing capabilities with our key suppliers.
IT5. We use electronic transfer of purchase orders, invoices and/or funds.
IT6. We use advanced information systems to track and/or expedite shipments.

Supply Structure
SS1. We have a permeable organizational boundary that facilitates better communication and/or relationship with our key suppliers.
SS2. Our relation with the suppliers is based on interdependence rather than power.
SS3. Our organizational structure can be characterized as a flexible value-adding network.
SS4. Our organizational/supply structure does not involve power-based relationships.
SS5. The decision making process in our organization is decentralized. *
SS6. We have few management levels in our relationship with suppliers. **

Long-term Relationship
LR1. We expect our relationship with key suppliers to last a long time.
LR2. We work with key suppliers to improve their quality in the long run.
LR3. The suppliers see our relationship as a long-term alliance.
LR4. We view our suppliers as an extension of our company.
LR5. We give a fair profit share to key suppliers. *
LR6. The relationship we have with key suppliers is essentially evergreen. **

Supplier Base Reduction
SB1. We rely on a small number of high quality suppliers.
SB2. We maintain close relationships with a limited pool of suppliers.
SB3. We get multiple price quotes from suppliers before ordering. *
SB4. We drop suppliers for price reasons. *
SB5. We use hedging contracts in selecting our suppliers. *

Communication (with key suppliers)
CO1. We share sensitive information (financial, production, design, research, and/or competition).
CO2. Suppliers are provided with any information that might help them.
CO3. Exchange of information takes place frequently, informally and/or in a timely manner.
CO4. We keep each other informed about events or changes that may affect the other party.
CO5. We have frequent face-to-face planning/communication.
CO6. We exchange performance feedback. *

Cross-functional Teams
CT1. We collocate employees to facilitate cross-functional integration.
CT2. We coordinate joint planning committees with our suppliers.
CT3. We promote task force teams with our suppliers.

CT4. We share ideas and information with our supplier through cross-functional teams.
CT5. We use supplier involved ad hoc teams based on our strategic objectives.
CT6. We encourage teamwork between our suppliers and us. *

Supplier Involvement
SI1. We involve key suppliers in the product design and development stage.
SI2. We have key supplier membership/participation in our project teams.
SI3. Our key suppliers have major influence on the design of new products.
SI4. There is a strong consensus in our firm that supplier involvement is needed in product design/development.
SI5. We involve our key suppliers in business and strategy planning. *
SI6. We have joint planning committees/task forces on key issues with key suppliers. *

Logistics Integration
LI1. Interorganizational logistic activities are closely coordinated.
LI2. Our logistics activities are well integrated with the logistics activities of our suppliers.
LI3. We have a seamless integration of logistics activities with our key suppliers.
LI4. Our logistics integration is characterized by excellent distribution, transportation and/or warehousing facilities.
LI5. The inbound and outbound distribution of goods with our suppliers is well integrated.
LI6. Information and materials flow smoothly between our supplier firms and us.

Supplier (Procurement) Performance
Flexibility
PP1. Volume flexibility
PP2. Scheduling flexibility
Delivery
PP3. On-time delivery
PP4. Delivery reliability/consistency
Quality
PP5. Quality
Cost
PP6. Cost

Buyer Performance
Financial
BP1. Return on investment
BP2. Profits as a percent of sales
BP3. Firm's net income before tax
BP4. Present value of the firm
Flexibility
BP5. Volume flexibility
Delivery
BP6. Delivery speed
BP7. Delivery reliability/dependability
Quality
BP8 Product conformance to specifications
Cost
BP9. Cost
Customer Responsiveness
BP10. Rapid confirmation of customer orders
BP11. Rapid handling of customer complaints

Appendix 6
Performance Measures used in Research Models

Supplier Manufacturing Performance [$\alpha = 0.81$] (Used in models 5, 6)

Volume flexibility
Scheduling flexibility
On-time delivery
Delivery reliability/consistency
Delivery lead-time
Quality
Prompt Response

Buyer Manufacturing Performance [$\alpha = 0.80$] (Used in models 5, 6)

Quality
Delivery speed
Delivery reliability/consistency
Delivery lead-time
Production lead-time
Volume flexibility
Rapid confirmation of customer orders
Rapid handling of customer complaints
Customer satisfaction

Supplier Agility [$\alpha = 0.78$] (Used in model 7)

Volume Flexibility
Scheduling Flexibility
On-time Delivery
Delivery Reliability/Consistency
Delivery Lead-Time
Prompt Response

Buyer Agility [$\alpha = 0.78$] (Used in model 7)

New Product Introduction Time
Delivery Speed
Delivery Reliability/Dependability
Delivery Lead-Time
Production Lead-Time
Volume Flexibility
Rapid confirmation of customer orders
Rapid handling of customer complaints

Supplier Agility [$\alpha = 0.84$] (Used in model 9)

Volume Flexibility
Scheduling Flexibility
On-time Delivery
Delivery Reliability/Consistency
Prompt Response

Buyer Agility [$\alpha = 0.77$] (Used in model 9)

Delivery Speed
Delivery Reliability/Dependability
Volume Flexibility
Rapid confirmation of customer orders
Rapid handling of customer complaints

Buyer Operational Performance [$\alpha = 0.82$] (Used in model 8)

Quality
New Product Introduction Time
Delivery speed
Delivery reliability/consistency
Delivery lead-time
Production costs
Production lead-time
Volume flexibility
Inventory reduction
Rapid confirmation of customer orders
Rapid handling of customer complaints
Customer satisfaction