A Dissertation

entitled

Logistics/Purchasing Effectiveness, Manufacturing Flexibility and Firm Performance: Instrument Development and Causal Model Analysis

by

Michael A. Tracey

as partial fulfillment of the requirements for
the Doctor of Philosophy Degree in
Manufacturing Management

Advisor: Jeen S. Lim

Advisor: Mark A. Vonderembse

Graduate School

The University of Toledo
August 1996

UMI Number: 9705656

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

Committee Members,

Date of Signature

Edward J. Bardi — July 21, 1996
Professor Emeritus,
Transportation and Marketing

Robert A. Bennett — July 21, 1996
Associate Professor,
Undergraduate Director,
MIME, Engineering

Thoung T. Le — July 21, 1996
Associate Professor of
Marketing and Logistics

An Abstract of

LOGISTICS/PURCHASING EFFECTIVENESS, MANUFACTURING FLEXIBILITY, AND FIRM PERFORMANCE: INSTRUMENT DEVELOPMENT AND CAUSAL MODEL ANALYSIS

Michael A. Tracey

Submitted in partial fulfillment of the requirements for

the Doctor of Philosophy Degree in

Manufacturing Management

The University of Toledo

August 1996

Successful manufacturing firms develop competitive capabilities which enable them to satisfy customers and enhance performance. Academicians and practitioners contend that logistics processes significantly influence the attainment of these objectives. However, little empirical research addresses the impact that logistics has on an organization's competitive position and performance, nor has it revealed which logistics activities are most consequential.

This study investigates the relationship between a

manufacturing organization's logistics processes, production flexibility, capacity to satisfy customers, and performance. It develops valid and reliable instruments to measure physical supply, physical distribution, logistics spanning processes, manufacturing flexibility, capacity to satisfy customers, and performance. This permitted the examination of causal relationships among these constructs.

An extensive literature review facilitated theory development. Interviews with practitioners, consultants, and academics helped to refine the questionnaire and ensured that the domain of each construct was addressed. A pilot study was executed with fifty respondents drawn from the targeted group of manufacturing managers from several industries including: furniture & fixtures, fabricated metal products, industrial & commercial machinery, and electronic & other electrical equipment. Firms with from 50 to 1,000 employees from across the United States are represented.

A large-scale mailing yielded 474 acceptable responses (a 14.5% response rate) that were used to test the generalizability of the results. The statistical methods employed include exploratory factor analysis in the instrument development phase, and LISREL to test hypothesized relationships.

This research confirms that the quality of a firm's logistics system has ramifications concerning the price it may offer, the quality of its products, the breadth of its product lines, and its delivery capabilities. The most influential area is logistics spanning processes. The utility of the logistics information systems, the degree to which logisticians participate in strategic decisions, and the proficiency of the purchasing function impact the firm's ability to satisfy customers.

It also establishes that manufacturers who do not insure their logistics processes are executed in a manner conducive to satisfying clients will experience a deterioration in performance. It was also found that the relationship between logistics processes and the organization's capacity to satisfy customers is influenced by the firm's level of manufacturing flexibility.

ACKNOWLEDGEMENTS

I am deeply grateful to many persons for their professional contributions and support during this study. I wish to thank Beverly Moharter (Marketing department), Susan Welch (ISOM department), and Mary Schneider (formerly of the MBA office, now in Admissions) for their help and understanding over the years.

Special acknowledgement is merited to Drs. Mark A. Vonderembse and Jeen S. Lim, co-chairs of the committee. Their wise counsel, straightforward feedback, and ongoing friendship made this dissertation possible. Special thanks also to Drs. Edward J. Bardi and Thuong T. Le who served on the committee and were in large part the reason behind my entering a Ph.D. program. Dr. Robert A. Bennett was also on the committee and deserves particular appreciation for his pertinent comments regarding survey research.

I am very appreciative for the high quality of the Manufacturing Management program at The University of Toledo. The faculty was at the same time demanding, helpful, and encouraging. My fellow graduate students -- past and present -- were also a source of continuous support and intellectual stimulation.

I am very grateful to the National Association of Purchasing Management for their willingness to co-sponsor this research. Their financial support as well as a letter signed by R. Jerry Baker (Executive Vice President) encouraging response to the survey undeniably cleared many obstacles from my path and contributed prominently to the quality of the final product.

I am also very appreciative of the funding received from the Academic Challenge Grant of the Information Systems and Operations Management department of the University of Toledo.

I wish to thank the Council of Logistics Management for the opportunity to attend two of their doctoral consortiums which I am certain contributed to my development as a scholar.

I am grateful for the sacrifice my father made in providing emergency financial support. My entire family deserves mention for their encouragement and support; especially my mother who among her many contributions proved herself to be an extraordinary survey assembler.

Finally, I thank my soul-mate, Chong Leng, for her understanding, help, love, and companionship during this stressful period. I simply could not have done it without her.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

Over twenty percent of the cost of a manufactured product goes to cover the expenses incurred before an item gets to, or after it exits the production line -- transportation, inventory management, materials handling, warehousing, and packaging (Coyle 1990; Lambert & Stock, 1993). In addition, purchasing is often considered as part of the logistics function and manufacturers on average spend sixty percent of their sales revenue on purchasing expenditures (Lambert & Stock, 1993). Nevertheless, logistics has long been overlooked as a potential area for efficiency improvements within manufacturing organizations[1]. For nearly a century, the U.S. was one of the few industrialized countries with a federally regulated transportation system. The inflexibility inherent in U.S. transportation strictly limited logistics managers in their operational alternatives. For a long period of time, this contributed to top management viewing logistics as simply a cost of doing business. The perception of logistics as being a means to competitive advantage has also been slow in

[1] This condensed history of logistics is based on the work of Farrell (1985), Bowersox, Closs, & Helferich (1986), Ackerman (1992), Coyle, Bardi, & Langley (1992), Lambert & Stock (1993), and Ploos van Amstel & Starreveld (1993).

developing.

The primary mission of logistics is to position inventory to satisfy customer demand. In the first half of the twentieth century this was thought to encompass little more than maintaining a flow of finished goods away from the factory. In the 1950s and 1960s, logistics' role expanded to pushing inventory into the entire materials/distribution pipeline in order to cope with any supply or demand uncertainty.

Companies in the 1970s and 1980s began to understand the tangible expense of carrying inventory and pressed their logistics departments to take a "systems" or "total cost analysis" approach. Under this concept, the logistics manager assumed a trade-off perspective in attempting to reach a *level of optimality* in balancing the costs and benefits associated with various logistical activities. For example, more money may have been spent on transportation to reduce inventory and warehousing expenses. The main objective was to reduce total logistics costs while maintaining a uniform level of service to both internal and external customers.

Throughout the time period reviewed to this point, manufacturers in the United States correctly considered themselves functioning in an "industrial" environment. This type of environment is characterized by expanding domestic markets and little competition for technology-based products coming from manufacturers outside the country (Link & Tassey, 1987). Strategy focuses on sustaining a technologically efficient mass-production organization that produces a narrow range of outputs (Huber 1984; Skinner 1985; Doll & Vonderembse, 1991).

Today, U.S. production companies are encountering a "post-industrial" environment exemplified by unprecedented technological, product, and market shifts (Skinner 1985; Doll & Vonderembse, 1991; Ramamurthy & King, 1992). Many foreign manufacturers have taken advantage of government support and cooperative industrial research to gain rapid advances with modern technology (Link & Tassey, 1987). In addition, countries around the globe have created more permissive political/legal conditions regarding international exchange (Bowersox, Daugherty, Dröge, Rogers, & Wardlow, 1989; Coyle 1990). This proliferation of global competitive alternatives allows modern customers to reject products and accompanying services which are not completely to their liking. Consequently, companies are finding that success is dependent on identifying and responding to unmet customer needs with unique products and delivery systems (Hall 1992; Lado, Boyd, & Wright, 1992; Porter 1992). Firms such as IBM, Kuppenheimer Men's Clothiers, and Nabisco Foods Company now consider a proficient logistics system as not only important to survival, but also instrumental to gaining strategic competitive advantage (Bowersox, et al., 1989; Bowersox, Daugherty, Dröge, Germain, & Rogers, 1992; Hays 1994).

Cost effectiveness, operational flexibility, functional area integration, and information dissemination have evolved into the keys for successful manufacturing (Nemetz & Fry, 1988; Hall 1992; Gerwin 1993) and logistics influences all these areas. Deregulation of the U.S. transportation industry in 1980 enabled logistics managers and transportation suppliers to add innovativeness and flexibility to their relationships (LaLonde & Cooper, 1989; Delaney 1991). The result has been that logistics management has seen its role shift from an emphasis on passive cost control, to taking a proactive stance in contributing to overall company competitiveness and profitability (Traffic Management 1990; Holcomb 1994b). Many enterprises which in the past may have focused exclusively on reducing manufacturing and/or marketing expenses are now scrutinizing logistics expenditures.

A more philosophical development has also affected logistics management. Buoyed by the "value chain" concept (Porter 1985; Porter & Millar, 1985), both top managers and leading researchers have grasped the notion of logistics as being critically important to competitive positioning. The value chain perspective stipulates that five "primary" activities -- including inbound and outbound logistics -- have a meaningful effect on competitive advantage. Originally the significance of these activities was thought to be based in the benefits which could be gained by performing them at a lower cost, or in a manner which led to differentiation (Porter & Millar, 1985: 150). The current view is that a manufacturing firm managed as a value or "supply" chain is capable of concurrently lowering cost and increasing service to achieve differentiation (Bowersox, et al., 1989; Davis, 1993; Hewitt, 1994).

Service is the main output of the logistics process, and the most important characteristic of a successful system is the capability to support a high level of operational flexibility (Muller 1988; Perry 1991). This translates to effectively purchasing and disseminating materials in support of manufacturing, administering dynamic finished goods deployment, and reacting positively to special requests from within the organization and from the ultimate customer (LaLonde, Cooper, & Noordewier, 1988; Bowersox & Daugherty, 1989; Capacino & Britt, 1991; Kallock & Robinson, 1990; Langley & Holcomb, 1992).

Logistics is now often perceived as a strategic process of integration (Holcomb 1994b). That is, as managing the purchasing, storage, and flow of materials from point of acquisition, through the conversion process, and on to the ultimate customer (Ackerman 1992). Logistics when viewed in this manner is one of the most information intensive processes of the firm (LaLonde & Masters, 1990). Adjusting to changing environmental conditions requires effective information acquisition and processing (Miller & Friesen, 1983; Huber 1984; Boynton 1993). Logisticians, therefore, are well-positioned in the 1990s to be key players in the firm's boundary-spanning and integration endeavors (Cooper & Ellram, 1993; LaLonde & Powers, 1993)[2].

The Council of Logistics Management (CLM) provides this contemporary definition of logistics: "the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements" (CLM 1994: 2). A pictorial representation of the CLM's updated definition of logistics based on the work of Bowersox, Carter, & Monczka (1985) and Tyndall & Zivan (1989) is shown in Figure 1.1.

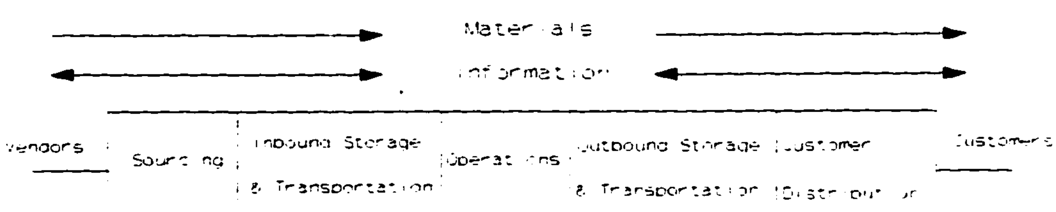


FIGURE 1.1 SUPPLY CHAIN MANAGEMENT

Purchasing in its own right is important to a company's success (Burt & Soukup, 1985; Reck & Long, 1988; Fawcett & Birou, 1992; Ellram 1994; Ellram & Krause, 1994; Pooley & Dunn, 1994). However, because of the high level of interdependency between purchasing, transportation,

[2] For more on the importance of the roles of boundary-spanning and integrators in the organization, see Jemison (1984) and Lawrence & Lorsch (1969), respectively.

warehousing, and inventory control, many consumer good and industrial manufacturers are placing the overall responsibility for purchasing with logistics management (Coyle, Bardi, & Langley, 1992: 20, 55; Lambert & Stock, 1993: 17). For the purposes of this research, purchasing will be considered an integral part of the logistics function.

1.1 PROBLEM STATEMENT AND RESEARCH OBJECTIVES

Researchers contend that logistics impacts a manufacturer's total costs, service levels, and integration efforts, and therefore significantly influence the organization's capacity to compete. However, we do not yet understand thoroughly the relationship between logistics processes, the organization's capacity to compete, and performance.

Four questions need to be addressed to enable the management of manufacturing companies to make sound strategic decisions regarding logistics.

1. ***Does logistics affect the firm's capacity to satisfy customers?*** Fawcett & Closs (1993) document that logistics affect a manufacturing firm's capacity to compete on an international basis, and Innis & LaLonde (1994) conclude that physical distribution can influence the attainment of company goals. It needs to be determined more specifically if logistics processes impact customer satisfaction.
2. ***What aspects of the logistics function most influence this***

relationship? Novack, Rinehart, and Langley (1994) established that logistics executives perceive that logistics adds value to the organization's product and provides a competitive advantage. They also found that logistics executives do not know exactly how logistics creates value for customers because this phenomenon has not been examined and quantified.

3. ***Does logistics affect organizational performance?*** Researchers at Michigan State University (Bowersox, et al., 1989) propose that manufacturing firms which do not choose to strategically exploit logistics competency will eventually find themselves at a competitive disadvantage. This research will attempt to prove or disprove this proposition.

4. ***Does the level of manufacturing flexibility present in the firm affect logistics' ability to be a positive influence?*** Skinner (1988), Goldhar, et al., (1991), Fawcett & Closs, (1993), and Davenport (1993) assert the competitive advantages gained through flexible manufacturing is affected by the quality of the logistics system. It is possible the opposite is also true. That is, logistics' capacity to satisfy customers may be influenced by manufacturing's ability to produce a variety of high-quality goods in a timely manner.

This research proposes to utilize the previous literature to develop an instrument that provides reliable and valid measures of the constructs of interest. This will permit testing causal relationships among these constructs and identifying those which are significant. In this way it will offer a better understanding of the relationship between logistics processes, the organization's capacity to satisfy customers, and firm performance. The possibility of manufacturing flexibility influencing this relationship will also be examined.

1.2 CONTRIBUTION OF THE RESEARCH

Manufacturing in the U.S. has improved in the areas of quality, flexibility, and throughput time. It has been asserted that these advancements in production practices need to be supported by the implementation of suitable logistics systems if they are to have their full impact in the marketplace (Skinner 1988; Goldhar, Jelinek, & Schlie, 1991; Davenport 1993). The development of a reliable instrument to measure logistics effectiveness and customer satisfaction capabilities will be a valuable contribution.

Though it is agreeable intuitively, it has yet to be substantiated that the quality of a firm's logistics processes has clear repercussions on the organization's competitive position and performance. The revealing of which logistics processes are central to this relationship will also be a contribution. Traditional logistical activities such as transportation, warehousing, and inventory control may be important. However, it is possible that some of the more recently recognized components of logistics administration, including strategy development and information dissemination, are just as, or may even be more critical in the current environment.

Another contribution will be the determination of the combined affect of logistics and manufacturing on firm performance. The relationship between logistics processes and the organization's capacity to satisfy customers may be influenced by manufacturing's ability to promptly produce a variety of high-quality goods.

CHAPTER 2: LITERATURE REVIEW, MODEL AND HYPOTHESIS DEVELOPMENT

The shift from "industrial" to "post-industrial" manufacturing requires changes in the organization that facilitate responding quickly and efficiently with products and services that provide value to customers (Huber 1984; Skinner 1985; Doll & Vonderembse, 1991; Goldhar, et al., 1991; Lewin & Stephens, 1993; Mesher & Rybeck, 1994). A pivotal modification is viewing the company as an enterprise focused simultaneously on cost reduction and flexibility. This entails embracing not only manufacturing, but also marketing, engineering, and logistics as essential to competitive advantage (Hayes & Pisano, 1994).

Day (1994) asserts that every company which aspires to be a "market-driven organization" must sustain certain types of capabilities regardless of the industry in which it competes. Figure 2.1 displays his framework for classifying these capabilities. Each category is explained briefly below.

Outside-In Processes. This group of capabilities allow the organization to foresee changes in markets through the development of sound relationships with suppliers, channel members, and customers. This enables the firm to gather and

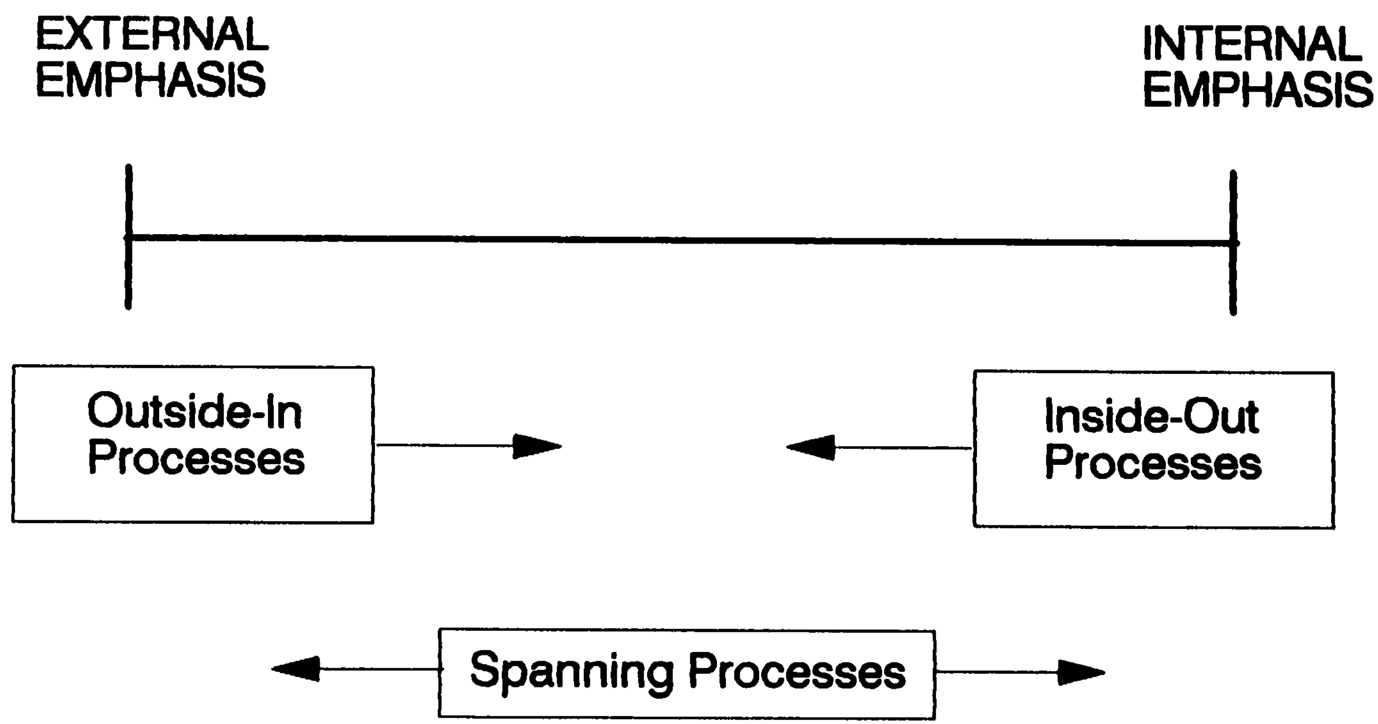


FIGURE 2.1: A FRAMEWORK FOR CLASSIFYING CAPABILITIES

(Adapted from: George S. Day, "The Capabilities of Market-Driven Organizations", Journal of Marketing, Vol. 58, October 1994, p. 41.)

interpret information regarding technological advancements, competitors, distribution channels, and clients. It is able to be more responsive and anticipatory in satisfying the needs of customers regarding quality, product features, and delivery arrangements. Two examples of outside-in processes are *market sensing* and *customer linking*.

Inside-Out Processes. These internal capabilities enable the firm to exploit the opportunities in the environment detected by the outside-in processes. In other words, they facilitate the company acting on information concerning competitors, changing customer requirements, and other variables in the environment in a manner which brings value to customers and assures the organization viability in the long-run. Examples include: *integrated logistics*, *manufacturing systems*, and *cost control*.

Spanning Processes. This set of capabilities includes *purchasing*, *customer order fulfillment*, and *strategy development*. Proficiency in these areas is necessary to integrate or link the inside-out and outside-in capabilities. Spanning processes are activities that support the anticipated needs of patrons identified by the outside-in processes being fulfilled by the inside-out processes. For example, purchasing is involved in providing the materials, machinery, supplies, and outside services needed throughout the organization to collect and act on information regarding customer needs: component parts, drill presses, copy machines, transportation, temporary help, etc. (Coyle, et al., 1994).

Day's (1994) classification scheme supports logistics being considered a critical element as the firm strives to become a post-industrial, market-driven manufacturing organization. Figure 2.2 utilizes a variation of the representation of supply chain management shown in Figure 1.1 to display logistical processes as important inside-out and spanning capabilities.

Ernst & Whinney (1987) arrange the many logistical activities into two groups as displayed in Exhibit 1. Inbound logistics, also referred to as materials management or ***physical supply***, designates those logistics activities that transpire before or during the manufacturing/assembly process. Outbound logistics or ***physical distribution***, stipulates those activities taking place in the latter portion of the supply chain. That is, after the raw materials/component parts have been transformed into the finished product.

Exhibit 1: The logistics function when separated into two primary sets of business activities.

- **Physical Supply**. Activities associated with receiving, storing, and disseminating inputs to the product, such as warehousing, inventory control, and incoming vehicle scheduling.
- **Physical Distribution.** Activities associated with collecting, storing, and physically distributing the product to buyers, such as packaging, warehousing, inventory management, and outgoing transportation.

Day (1994) refers to **integrated logistics** as an internal

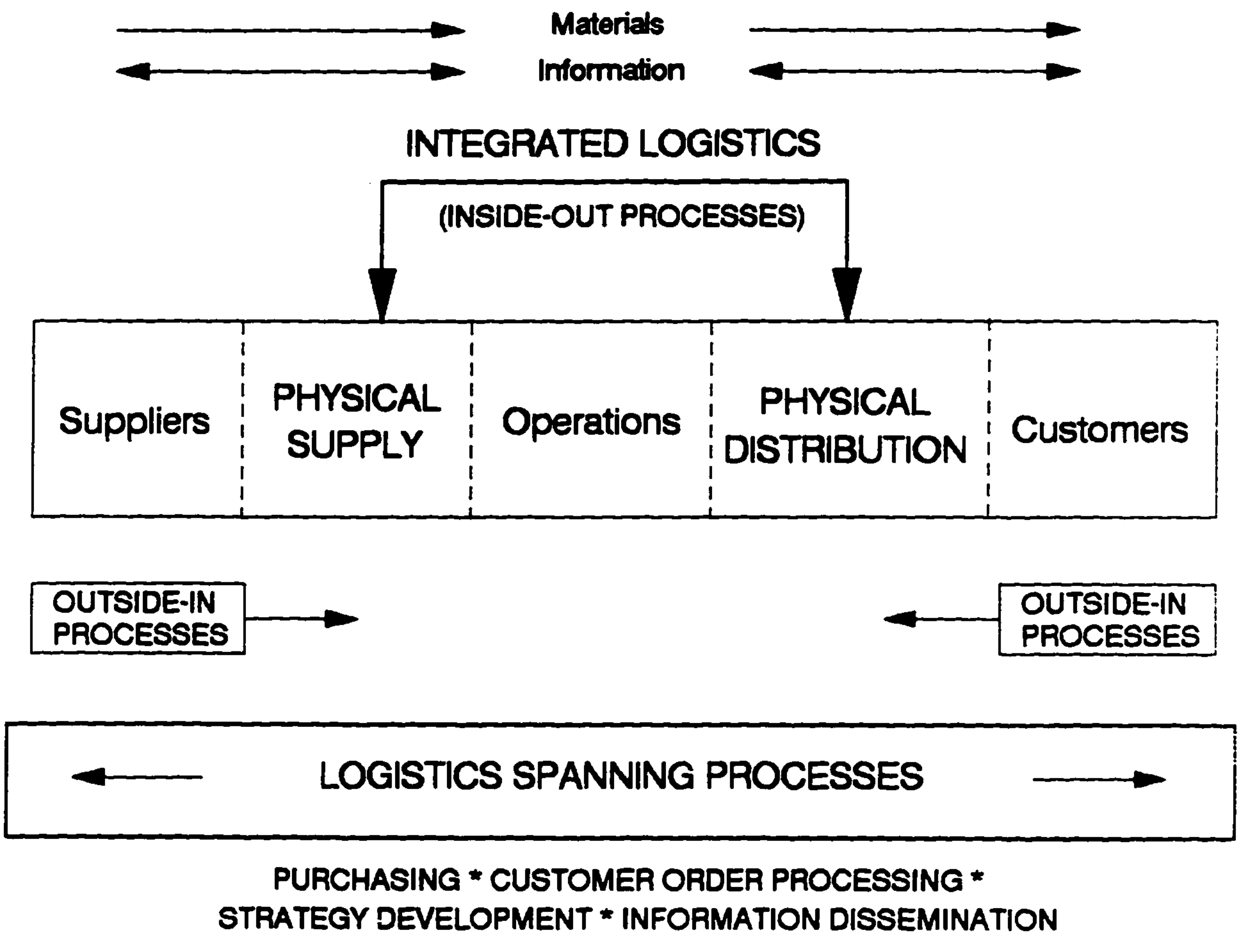


FIGURE 2.2: VIEWING LOGISTICS ACTIVITIES AS CRITICAL CAPABILITIES

capability which permits the firm to deliver value to customers.

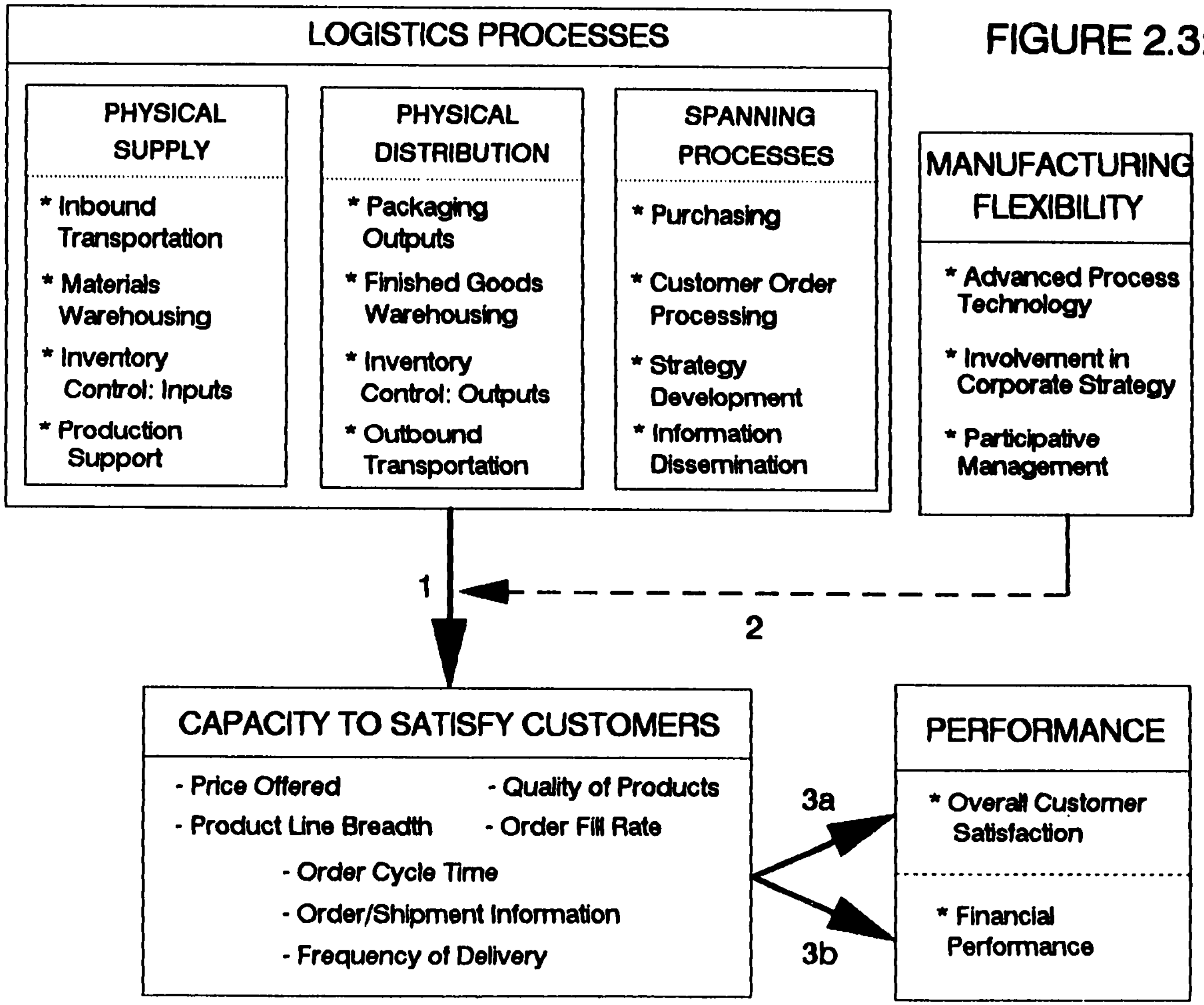
This concept is characterized by Bowersox, et al., (1986: 14-15) and Lambert and Stock (1993: 39-41) as managing the total movement/storage network as a single mechanism. That is, all of the processes encompassed by physical supply and physical distribution are administered as one system. This perspective encourages greater logistics efficiency across the value chain.

Purchasing, customer order processing, and strategy development categorized by Day (1994) as **spanning processes.** Information dissemination has recently been recognized as an important component of logistics management as logisticians focus on providing superior service to both internal and external clients (Persson 1991; Manheim 1992; Bowersox, et al., 1992). Figure 2.2 displays information dissemination as a spanning process. The timely dispersement of information across an organization's supply-chain helps it to respond positively to opportunities uncovered in the environment. However, information dissemination is also an outside-in process as it has an external information gathering component.

2.1 MODEL AND HYPOTHESIS DEVELOPMENT

The model in Figure 2.3 expands Figure 2.2 to include the proposed relationships between constructs which are of central

FIGURE 2.3: ROLE OF LOGISTICS



interest to this research. These constructs (i.e., Physical Supply, Physical Distribution, Logistics Spanning Processes, Capacity To Satisfy Customers, Manufacturing Flexibility, and Performance) are defined in the next sections. The numbers next to the lines in Figure 2.3 correspond to three hypotheses that will also be specified throughout subsequent sections. The central relationships to be examined pertain to the effect of *LOGISTICS PROCESSES* (i.e., Physical Supply, Physical Distribution, Spanning Processes) on the *FIRM'S CAPACITY TO SATISFY CUSTOMERS* which in turn may influence *(FIRM) PERFORMANCE*. The possibility of *MANUFACTURING FLEXIBILITY* acting as a moderating variable will also be examined as the capacity of logistics to satisfy customers may be influenced by manufacturing's ability to produce a variety of goods.

2.1.1 Logistics Processes

Logistics processes may be considered as a function of the three constructs delineated earlier: physical supply, physical distribution, and logistical spanning processes. Each of these constructs in turn may be regarded as a function of twelve distinct logistics processes evenly distributed across these three constructs. A consequence of the philosophy of supply chain management is that logistics management now frequently administers business functions which were formerly spread throughout the company, e.g., production planning and sales forecasting (Braithwaite & Christopher, 1991).

Nevertheless, logistics as it pertains to manufacturing companies may be envisioned as involving twelve key processes[3].

2.1.1.1 Physical Supply

Physical Supply is generally considered as consisting of those logistics processes that take place before or during the production process (Ernst & Whinney, 1987) -- inbound transportation, material warehousing, inventory control: inputs, and outbound transportation.

(1) Inbound Transportation. If one excludes the actual buying of materials, transportation overall is the largest component of logistics cost (Delaney 1991). To be effective, transportation management must interact well with their counterparts in production, marketing, warehousing, inventory control, finance, and with suppliers and carriers (Coyle, Bardi, & Novack, 1994).

Inbound transportation may be defined as managing the movement of goods (i.e., components, raw materials, supplies, equipment) from the points-of-origin (the suppliers) to the manufacturer via truck, air, rail, water, pipeline, or some combination thereof (Coyle, et al., 1992). This freight may be delivered to a warehouse or to the factory itself (Johnson &

---

[3] The following listing and description of key logistics processes is based on the work of Ernst & Whinney (1987), Coyle, et al. (1992), Johnson & Wood (1993), Lambert & Stock (1993), Novack, et al. (1994), and the author's fifteen years of logistics-related industry experience.

Wood, 1993). Once the goods have been unloaded, the inbound transportation function is considered physically complete.

Many companies today are giving considerable attention to inbound transportation whether the firm monitors the transportation choices of vendors, manages its own transportation equipment, employs outside transportation providers, or utilizes some combination of these alternatives (Byrne & Markham, 1991; Coyle, et al., 1992). Inbound transportation may vary regarding in-transit time, frequency of delivery, cost, and the occurrence of damage and/or lost freight. The quality of incoming transportation service impacts a manufacturer's inventory levels, the frequency of stockouts and shutdowns, and the utilization of material handling equipment and labor (Bowersox, et al., 1986). Consequently, the caliber of this function has far-reaching ramifications regarding the organization's ability to satisfy customers.

(2) Material Warehousing. In supporting manufacturing operations, warehouses function as an inbound consolidation and holding point for raw materials and component parts (Lambert & Stock, 1993). A main benefit for manufacturers is that warehousing facilitates *supply mixing*. This is the consolidation of the various materials required for production which are then moved economically to the factory as needed (Coyle, et al., 1992). Just-in-time based systems at times take advantage of volume discounts by using "feeder" warehouses which receive supplier shipments in bulk and then organizes the components to match manufacturing requirements (Bowersox, et al., 1989).

Key materials warehousing activities include: receiving, data entry, put away, picking, and assembly. Any malfunction in this process can have negative consequences for the entire value chain and may adversely affect the level of customer satisfaction offered by the company (Coyle, et al., 1992).

(3) Inventory Control: Inputs. Precise, real time information concerning material inventories is essential to manufacturing firms and is usually the responsibility of an inventory control section. This unit verifies the quantity, identification, and quality of the items received, data entry, location assignments in the warehouse, picking activity, and on-hand amounts. Inventory control must coordinate well with purchasing, warehousing, manufacturing, finance, and other areas to maintain the integrity of the inventory while minimizing overall expense. This coordination is necessary to insure sensible decisions concerning purchase lot sizes, delivery timings, and stock levels (Coyle, et al., 1992; Lambert & Stock, 1993) which in turn will promote customer satisfaction.

(4) Production Support. This research uses the term *production support* to delineate the conveying of components/materials to production. Dispersement of the elements required at various points of the manufacturing process -- as they are needed -- is the final physical supply activity (Ernst & Whinney, 1987). This movement may be classified into two types. Some items are received and then directly transferred to production. Others are picked and assembled at a warehouse (or warehouses) controlled by the firm and then transported to production (Johnson & Wood, 1993). Either type of movement entails logistics decisions which impact the efficiency of manufacturing operations as well as logistics and production expenditures. Poor performance can lead to lost or damaged materials, production delays, idle time, additional expense, and ultimately -- customer dissatisfaction.

2.1.1.2 Physical Distribution

Physical Distribution is generally considered as consisting of those logistics processes that transpire after the raw materials/component parts have been transformed into the finished product (Ernst & Whinney, 1987) -- packaging, finished goods warehousing, inventory control: outputs, and outbound transportation.

(1) **Packaging.** Packaging is the first physical distribution process to occur. Once the conversion/assembly operation is complete, the finished output must be packaged (which includes labeling) to prevent damage and to facilitate efficiency during storage and movement of the product (Coyle, et al., 1992). While packaging often serves a marketing

function, decisions in this area significantly affect warehousing and transportation operations and costs (Lambert & Stock, 1993). Therefore, the ultimate responsibility for packaging usually rests with logistics management as they have the broad vision to insure the packaging function contributes to overall customer satisfaction.

(2) Finished Goods Warehousing. Products which have been packaged are normally stored at or near the production facility, and then throughout a distribution network if they are not sent directly to customers. A well-managed finished goods warehousing system promotes customer satisfaction by making the precise goods available when and where customers demand them at a reasonable expense (Bowersox, et al., 1989; Coyle, et al., 1992; Lambert & Stock, 1993).

(3) Inventory Control: Outputs. Controlling materials inventory is very important, but excellent inventory management regarding finished goods is perhaps even more consequential to a manufacturer's success. Finished goods are typically more valuable and therefore consume premium storage space and capital (Coyle, et al., 1992). Although it varies from firm to firm, finished goods inventory investment may account for fifty percent of the company's asset base (Lambert & Stock, 1993). In addition, customers are demanding product line variety and are often unwilling to postpone delivery. This makes the correct placement and control of specific items essential to customer satisfaction (Bowersox, et al., 1989).

Because of the preceding reasons, the finished goods inventory control unit must coordinate well with warehousing, manufacturing, finance, and other departments to maintain an adequate inventory while minimizing overall expense. The inventory control unit works with these areas to insure sensible decisions concerning production run lengths and stock levels.

(4) Outbound Transportation. Customer satisfaction is influenced by the caliber of the manufacturer's outbound transportation service. It maintains the flow of finished goods from the plant, through the distribution network, and often concluding with delivery to the final customer. Its effectiveness depends on choices made concerning the method of shipment, the specific carrier(s) used, the route, and compliance with local, state, federal, and international regulations (Coyle, et al., 1992; Lambert & Stock, 1993).

2.1.1.3 (Logistics) Spanning Processes

Spanning processes provide horizontal connections (Day 1994) across the value chain. Logistics Spanning Processes may be considered as consisting of those logistics processes which directly support market sensing, customer linking, and customer satisfaction -- purchasing, customer order processing, strategy development, and information dissemination.

(1) Purchasing. Porter (1985) specifies procurement (purchasing) as a critical "support" activity. From a spanning perspective, purchasing provides the materials, machinery, supplies, and outside services the organization requires to act on information regarding customer needs. Manufacturing firms on average spend sixty percent of their sales revenue on these types of expenditures (Lambert & Stock, 1993). This function determines how much to buy, the supplier(s) chosen, the level of quality delivered, the price paid, and when and where the goods will be presented (Coyle, et al., 1992).

Purchasing's impact on a manufacturer, however, goes beyond the obvious cost aspects. Purchasing personnel serve in an important boundary-spanning role for the organization as they are the main link to outside suppliers (Cooper & Ellram, 1993). They also function as integrators in that they interface extensively with other areas of the firm, including operations, engineering, and finance (Vonderembse, Tracey, Tan, & Bardi, 1995). How well purchasing performs regarding all of these areas has important ramifications concerning the firm's ability to satisfy clients.

(2) Customer Order Processing. Directing the activities which take place from the time the firm receives an order until the order is physically received by the customer and payment is secured are referred to collectively as *order processing* (Coyle, et al., 1992; Lambert & Stock, 1993) or *order cycle management* (Shapiro, Rangan, & Sviokla, 1992). Decisions regarding inventory levels (materials and finished goods), production scheduling, material handling, transportation, and billing greatly affect this process.

As the manufacturer administers to each order it receives, in reality it is managing customer service (Shapiro, et al., 1992). This is true whether the order is for a finished product or a spare part (Cohen & Lee, 1990). The quality of this service is most obvious at the point of final interaction (product delivery) to the customer (Schary, 1992). Nevertheless, exceptional customer service is the end result of taking a systems, process, or supply chain approach to order cycle management (Schary, 1992; Parasuraman, Berry, & Zeithaml, 1991; Kumar & Sharman, 1992; Shapiro, et al., 1992). Many logistics, manufacturing, and other activities must be coordinated to produce a flow of completed orders which correspond to customer demand and also result in the maximum profit for the firm. This may best be accomplished by establishing logistics management as the identifiable owner of the overall process.

(3) Strategy Development. Heskett (1977) argued that logistics can mean the difference between success and failure in business and should be factored into the design of strategy on a continuing basis. Contemporary researchers (e.g. Schary 1992; Fuller, et al., 1993) contend that with the increased emphasis on customer service along with cost containment, it is even more important today that a firm expressly develops a logistics strategy that responds to customer requirements.

Logistics executives who participate in business unit strategic planning can guarantee that logistics operations are directly linked to the corporate plan. Logistics strategy can then complement business unit strategies by providing a comprehensive program that insures all logistical functions are integrated and sensitive to the overall goals of the corporation (Ernst & Whinney, 1987; LaLonde, et al., 1988; Bowersox, et al., 1989; Coyle 1990; Persson 1991; Fawcett & Closs, 1993; Lambert & Stock, 1993).

Leading edge companies realize that some of the tools for achieving competitive advantage in the 1990s will come from non-traditional sources such as logistics (LaLonde & Masters, 1990; Fuller, et al., 1993; Holcomb 1994b). Accordingly, they have begun to include logistics management in the corporate planning process (Cooper, Innis, & Dickson, 1992). Recent literature supports this involvement.

Empirical research has shown that including functional managers with differing viewpoints in the strategy process encourages diversity in vision, congruence between actual and perceived environmental uncertainty, the fostering of new ideas, and better business performance (Bourgeois 1985; Miller & Friesen, 1983; Nutt 1993). Regarding manufacturing firms more specifically, Wheelwright and Clark (1992) maintain that cross-functional discussion and resolution of strategic issues is essential to providing the organizational support necessary for making available a stream of profitable products.

The growing emphasis on a resource-based view of the firm, supply chain management, information processing (Amstel & Farmer, 1990; Bardi, Raghunathan, & Bagchi, 1994), globalization (Bowersox 1992; McGrath & Hoole, 1992; Boynton 1993; Naumann 1994), and outsourcing (Coyle 1990; Bardi & Tracey, 1991) all support logistics being accorded sufficient attention in the process and content of business strategy (Novack, Rinehart, & Wells, 1992; McGinnis & Kohn, 1993).

For example, a well-managed manufacturer displays a team approach when contemplating expansion domestically or internationally (Trunick 1989; Fawcett & Closs, 1993). In formulating strategy, it solicits logisticians inputs regarding what markets should be chosen and how they might be entered. It would not expect them to implement less than optimal plans conceived without their participation.

(4) Information Dissemination. The hard data generated by modern information technology in combination with the "soft" or "qualitative" (Mintzberg 1989; Cooper, et al., 1992) information (i.e., gossip, rumors) collected by a supply-chain management arrangement provides the means for cross-functional teams to respond resourcefully to the environment (Manheim 1992). This intelligence facilitates real-time, cost-effective adjustments in inbound materials flows, product volumes and mix, distribution schemes, and delivery timings (Sheffi 1990; Bowersox, et al., 1992).

Modern information systems are based on material flows.

Logisticians consequently are in a unique position to utilize this information to improve customer satisfaction and firm performance. The logistics department can become an important coordinating mechanism for the firm when its managers are allowed to evolve into lateral managers with the overall visibility to insure a balance between customer service levels and costs (Persson 1991; Manheim 1992).

2.1.2 (The Firm's) Capacity To Satisfy Customers

The fourth construct to be discussed from the model shown in Figure 2.3 concerns the firm's capacity to satisfy customers. Building a market-driven organization necessitates developing the underlying processes (e.g., responsive logistics and manufacturing systems) that yield superior value to the company's clients (Day 1994). The following list of important customer service attributes is based on the research of Innis & LaLonde (1994). A case can be made that each is affected by logistics processes.

(1) Price Offered. Price received the highest ranking among the thirty-two customer service attributes included in Innis & LaLonde's (1994) study. A manufacturer's ability to offer competitive prices and/or command premium prices is influenced by the costs it incurs across the supply chain as well as the level of accompanying service it is able to offer. Overall costs includes the purchase price of materials and logistics costs (Ellram 1994; Kenderdine & Larson, 1988). The quality of a firm's integration efforts -- which is influenced by logistics -- also affects costs (Larson 1994).

(2) Quality of Products. Quality management has become a key competitive issue in the modern marketplace, both domestically and internationally (Garvin 1988; Petersen 1991; Anderson, Rungtusanatham, Schroeder, & Devaraj; 1995). Manufacturing obviously affects product quality. However, it also is dependent on the quality of incoming materials and how well the product is packaged, stored, and transported (Novack, et al., 1992).

(3) Product Line Breadth. Modern customers expect a variety of products and features that satisfy their individual requirements to be readily available. Flexible manufacturing systems enable the ongoing production of customized products at reasonable expense (Goldhar & Jelinek, 1983; Ramamurthy & King, 1992). Nevertheless, this flexibility is contingent on a logistics system that can supply the required materials as needed without incurring exorbitant costs (Bowersox, et al., 1992).

(4) Order Fill Rate. Providing an adequate number of product offerings requires a logistics network which can react quickly to changing finished good demand (Davis & Gibson, 1993). This includes ensuring the products are available so that orders may be filled on time with a 90-100% level of completeness (Holcomb 1994a).

(5) Order Cycle Time. The order cycle is defined by

Lambert & Stock (1993: 116) as "the total elapsed time from the initiation of the order by the customer until delivery to the customer". Lowering cycle time is a primary issue in the current business environment for both industrial and consumer manufacturers (Stark 1989; Goldhar & Lei, 1991; LaLonde & Powers, 1993; Holcomb 1994a). Shortening the time it takes to bring a product from concept to market and also post-introduction order cycle times requires manufacturing <u>and</u> logistics playing key roles (Manheim 1992; Bockerstette & Shell, 1993).

(6) Order/Shipment Information. Innis & LaLonde's (1994) research reveals that customers desire meaningful information when they place an order: (1) information regarding inventory availability, (2) information on a projected shipping date, and (3) information on a projected delivery date. The ability to transmit accurate data in these areas is dependent in large part on the quality of the logistics network. Moreover, logistics personnel are in the best position to communicate this information (Persson 1991).

(7) Frequency of Delivery. In the 1980s, customers began to recognize the actual cost of carrying inventory and started to push it back toward the manufacturer (Coyle, et al., 1992). Today, customers as a matter of practice simply expect more frequent shipments and there is a strong tendency toward the reduction of incoming shipment sizes (Vonderembse, et al., 1995). The capacity to fulfill this service request while incurring reasonable expense is highly dependent on the quality of the manufacturer's logistics network.

2.1.3 Development Of Hypothesis 1

Companies are finding that customers are concerned not only with the product itself, but with the entire transaction process (Muller, 1988; Berry, Zeithaml, & Parasuraman (1990); Fuller, O'Conor, & Rawlinson, 1993; Innis & LaLonde, 1994). It is becoming increasingly obvious that long-term viability in the current environment depends on top management developing more expansive business philosophies and strategies (Bresticker 1992; Hammer & Champy, 1993; Lewin & Stephens, 1993; Ettlie & Penner-Hahn, 1994).

A steady stream of literature (Hofer & Schendel, 1978; Montanari 1978; Wernerfelt 1984; Barney 1986; Hansen & Wernerfelt, 1989; Cohen & Levinthal, 1990; Barney 1991; Collis 1991; Carlsson 1992; Hall 1992; Boynton 1993) has advanced the strategic importance of creating and maintaining an appropriate base of not only tangible assets, but also of intangible assets or *capabilities*. For example, Lenz (1980: 226, 227), Lado, et al., (1992: 80), and Russell & Russell (1992: 640) respectively define *strategic capability*, *strategic selection*, and *entrepreneurial strategy* in similar terms. These concepts refer to the firm's ability to create and grasp opportunities in its environment through utilizing the "resources" at its disposal in such a way that the firm grows and prospers over time.

Contemporary researchers continue to support and expand the notion of the firm as an accumulation of tangible and intangible assets. Hayes & Pisano (1994) maintain that a high level of *strategic flexibility* is necessary today which entails not only production, but every aspect of the corporation being considered as the firm attempts to find certain things it can do better than its competitors. Similarly, Lado & Wilson (1994: 720) contend that modern upper managers need to continuously reexamine their thinking as to what constitutes a distinctive competence/capability for their firm.

Prolonged success in the current environment is dependent on identifying and responding to unmet customer needs with unique products and delivery systems (Hall 1992; Lado, et al., 1992; Porter 1992). Previous sections (2.1.1, 2.1.2, 2.1.3) have described the influence of each of the twelve logistics processes have on the firm's ability to satisfy customers. It is not surprising then that capabilities with logistical connotations are often mentioned in the literature advocating a "resource-based" view of the firm.

Lado, et al. (1992) assert that sustaining a level of customer loyalty that promotes long-term prosperity requires a solid reputation based in part on "invisible" outputs (Itami 1987) such as superior logistics service. Manheim (1992) emphasizes that shortening the time it takes to bring a product to market and also post-introduction cycle times requires an integrated approach with logistics processes playing a key role. Lambert & Stock (1993: 12) specifically state that an effective logistics system is a proprietary, intangible asset which provides long-term advantages in the marketplace because it cannot be easily copied by the organization's competitors.

Hypothesis 1: There is a positive relationship between the quality of a firm's Logistics Processes and its Capacity to Satisfy Customers.

2.1.4 Manufacturing Flexibility

The fifth construct to be discussed from the model shown in Figure 2.3 is *MANUFACTURING FLEXIBILITY*. A goal of this research is to test for a possible moderating effect concerning the degree of manufacturing flexibility present in the company on the relationship between *LOGISTICS PROCESSES,* the *FIRM'S CAPACITY to SATISFY CUSTOMERS, and (FIRM) PERFORMANCE*. Empirical research by Swamidass & Newell (1987) and Ward, Leong, & Boyer (1994) has determined three prerequisites for genuine manufacturing flexibility.

(1) Advanced Process Technology. An investment is required in equipment that provides high levels of short-, medium-, and long-term flexibility (Carlsson 1992) including: computer-aided design and manufacturing (CAD/CAM), robotics, and computerized numerical control machines (CNC). This physically enables the production of an effective mix of platform and derivative products (Wheelwright & Sasser, 1989; Wheelwright & Clark, 1992).

(2) Involvement in Corporate Strategy. The companies which have successfully implemented advanced manufacturing technology allow manufacturing's evolving technological competencies to be a driving force in strategy formulation (Harrison 1990; Parthasarthy & Sethi, 1992). This encompasses involving manufacturing managers in strategic decision-making.

(3) Participative Management. To be efficient, modern production processes must be operated as customer-oriented "sociotechnical systems" (Susman & Chase, 1986) which necessitates a management style accentuating employee learning, involvement, autonomy, and growth (Zuboff 1988; Susman 1990; Weick 1990).

2.1.5 Development of Hypothesis 2

The current environment finds successful companies penetrating multiple application areas or markets (Link & Tassey, 1987). They have achieved a level of flexibility in manufacturing which enables them to quickly generate customized products for diverse customers. Skinner (1988), Goldhar, et al., (1991), Fawcett & Closs, (1993), and Davenport (1993) assert the competitive advantages gained through flexible manufacturing is affected by the quality of the logistics process.

It is possible the opposite is also true. Recent literature (Lado, et al., 1992; Manheim 1992; Novack, Grenoble, & Goodbread, 1992; Davenport 1993; McGinnis & Kohn, 1993) contends that modern conversion processes should be considered as the joint responsibility of manufacturing and logistics. Therefore, the ability of logistics to satisfy customers may be influenced by manufacturing's ability to produce a variety of high-quality goods in a timely manner.

Hypothesis 2: The level of Manufacturing Flexibility will moderate the relationship between Logistics Processes and the Firm's Capacity to Satisfy Customers.

2.1.6 (Firm) Performance, Development Of Hypothesis 3a and 3b

The last construct to be discussed from the model shown in Figure 2.3 is *(FIRM) PERFORMANCE*. Innis and LaLonde's (1994) list of important service attributes is agreeable intuitively, but is based on a study of one industry (auto glass after market). To validate the reliability of these elements as indicators of the firm's capacity to satisfy customers, the final box (construct) displayed in Figure 2.3 is designed to measure firm performance.

(1) Overall Customer Satisfaction. One of the primary goals of an organization is to satisfy customers, as a satisfied customer is more likely to repurchase (Innis & LaLonde, 1994). Exceptional customer service is the result of clients perceiving that they receive products and services commensurate with the price they pay (Parasuraman, et al., 1991).

Firms which satisfy customers build a reputation for providing value that promotes long-term prosperity through the creation of a base of steady clients (Lado, et al., 1992). These loyal customers over the years will account for a high proportion of the sales and profit growth of successful firms (Heskett, Jones, Loveman, Sasser, & Schlesinger, 1994). Firms which achieve the status of a "market-driven organization" can expect their ability to satisfy clients to result in a substantial foundation of loyal customers and high levels of reported customer satisfaction.

Hypothesis 3a: There is a positive relationship between the Firm's Capacity to Satisfy Customers and Overall Customer Satisfaction.

(2) Financial Performance. For a particular firm, high levels of reported customer satisfaction are not always supported by increases in sales or market share (Heskett, et al., 1994). Therefore, perceptual financial performance measures will also be utilized to determine the effects of logistics on the firm's capacity to compete. Although objective performance measures are preferable to perceived measures of performance, the latter are recommended as substitutes (Venketraman & Ramanujam, 1985) and were found to be valid predictors of more objective data by Ward, et al., (1994).

Hypothesis 3b: There is a positive relationship between the Firm's Capacity to Satisfy Customers and its Financial Performance.

CHAPTER 3: INSTRUMENT DEVELOPMENT PHASE ONE - ITEM GENERATION AND PILOT STUDY

Figure 2.3 illustrates that a principal goal of this research is to examine hypothesized relationships between six constructs: 1-3) physical supply, physical distribution, and logistics spanning processes, 4) the organization's capacity to satisfy customers, 5) manufacturing flexibility, and 6) firm performance. It was first necessary to develop an instrument that provides valid and reliable measurement of each of these constructs. Without such measures, testing the hypothesized relationships was not possible.

Several steps were taken during the first phase of instrument development to insure the formulation of reliable, valid measures of the constructs. First, an extensive literature review facilitated theory development, helped in defining the constructs, and uncovered useful measures employed in previous studies. Second, structured interviews were conducted with six practicing managers from manufacturing firms (two General Managers, three Logistics/Transportation Managers, and a Materials/Purchasing Manager) to further refine the definitions and constructs, and to ensure that the domain of each construct was thoroughly addressed. Third, input was requested from two leading consultants in the area of manufacturing logistics and from eight academic experts from the disciplines of logistics, operations management, marketing, and industrial engineering concerning the appropriateness of the constructs, and the methods to be used in their measurement. Finally, a pilot study was executed utilizing respondents similar to the target respondents. As described in the following sections, these steps were taken to insure the content validity, reliability, brevity, and the internal, external, and predictive validity of the instrument.

3.1 ITEM GENERATION

A measure has content validity if there is general agreement among the subjects and researchers that the instrument has measurement items that cover all the important aspects of the variable being measured. In other words, content validity depends on the researcher formulating measurement items that encompass the entire content domain of the variable (Nunnally 1967).

Four steps were taken to insure the content validity of each variable. First, the initial list of potential items (questions) was compiled after an extensive review of the manufacturing, logistics, and marketing literature/theory. The questions were devised to measure a particular dimension (e.g., inbound transportation) of an individual construct (e.g., Physical Supply).

Possible items for LOGISTICS PROCESSES were adapted from questionnaires or other literature published by leading logistics researchers including: Bowersox, Daugherty, Drôge, Rogers, and Wardlow (1989); Byrne & Markham (1991); Innis & LaLonde (1994); LaLonde & Cooper (1989); Lambert and Stock (1993); and Novack, Rinehart, & Langley (1994). In addition, items previously used within a manufacturing context (Swamidass & Newell, 1987; Ward, Leong, & Boyer, 1994) were modified to apply to logistics, particularly in the area of Strategy Development.

Potential items regarding THE FIRM'S CAPACITY TO SATISFY CUSTOMERS were drawn from additional logistics literature including Cooper, Innis, & Dickson (1992) and Holcomb (1994a) as well as the work of Koufteros (1995) and Swamidass & Newell (1987). Previously published research by Swamidass & Newell (1987) and Ward, Leong, & Boyer (1994) provided the items for MANUFACTURING FLEXIBILITY. The (FIRM) PERFORMANCE items were extracted from the logistics and manufacturing literature as well as the work of Heskett, Jones, Loveman, Sasser, & Schlesinger (1994). Five-point Likert scales were utilized in each of the questions. Possible responses ranged from 1 (= Unacceptable) to 5 (= Superior); and from 1(= Strongly Disagree) to 5 (= Strongly Agree). The response X = Not Relevant/Do Not Know was also made available to complete the possible response set.

The second procedure to promote content validity involved presenting the entire list of potential items to the six practicing managers from manufacturing firms. They were given several days to examine the model (i.e., Figure 2.3) to be tested and were also given information regarding the types of executives who would be the target respondents. They were asked to review the questionnaire and to comment on the language and clarity of each question as well as the overall format of the instrument. These experts were given the opportunity to keep, modify, and/or drop items. They were also encouraged to provide suggestions for additional items if they perceived the items offered did not cover the intended domain of the variable. Their input was gained through structured interviews and was helpful in improving the questionnaire in regards to its wording, clarity, and relevance.

The third step taken in support of content validity involved employing the procedure described above involving the two consultants and eight academics. They were also given the opportunity to keep, modify, and/or drop items and to provide suggestions for additional questions.

Finally, a pilot test was conducted using respondents similar to the target respondents. Appendix A displays the entire list of items which evolved after a number of modifications suggested by the industry and academic experts. It was sent in the form of a questionnaire to 520 various managers in manufacturing firms including: General Managers/Presidents, Operations/Manufacturing Managers, Facility/Plant Managers, and Materials/Purchasing Managers. Five hundred of the subjects were systematically drawn from a mailing list of 3,833 potential respondents purchased from American Business Lists®, a division of Dunn & Bradstreet. These executives were drawn from four SIC codes: #25 -- Furniture & Fixtures; #34 -- Fabricated Metal Products; #35 -- Industrial & Commercial Machinery; and #36, -- Electronic & Other Electrical Equipment and represented manufacturing firms with from 50 to 1,000 employees. The remaining twenty names were members of the Toledo Chapter of the Council of Logistics Management. A letter signed by R. Jerry Baker, Executive Vice President of the National Association of Purchasing Management encouraging response to the survey was mailed along with a cover letter on a University of Toledo letterhead and the questionnaire.

Fifty usable responses were received from the pilot study mailing. This was a large enough sample to perform some initial statistical analysis. In this way the pilot test provided a means for assessing the preliminary reliability and validity of the instrument. Consequently, the limitations inherent in developing the instrument, and then testing the hypothesized relationships between the constructs with the same data was diminished. Nonetheless, it was appreciated that these assessments were made utilizing a small sample.

3.2 PILOT STUDY METHODOLOGY

The responses from the pilot study were used to explore the instrument with several objectives in mind: purification, reliability, brevity, and internal, external, and predictive validity. As described by Churchill (1979), the instrument was purified by examining the corrected-item total correlations of the items with respect to a particular dimension (e.g., inbound transportation) of a specific construct (e.g., Physical Supply). The item inter-correlation matrices provided by SPSS® were utilized to drop items if they did not strongly contribute to Cronbach's alpha for the dimension under consideration (Flynn, Schroeder, & Sakakibara, 1995). Some items which did not contribute strongly to alpha, but whose content was considered important to the research, were designated for modification.

The items related to a specific dimension (e.g., inbound transportation) were also submitted as a group to exploratory factor analysis to assess its internal consistency. Maximum likelihood was chosen as the extraction procedure and the varimax method was utilized for factor rotation. There was no appreciable difference between the results using these methods as opposed to principal components extraction and oblimin rotation. The *MEANSUB* command was used within SPSS® to replace missing values with the variable mean for that item. Items which did not load at 0.60 or above were generally eliminated at this stage. Dillon & Goldstein (1984: 69), however, point out the researcher needs to consider an item's importance to the research objective as well as its "loading" during factor interpretation. Accordingly, some items which had a weak factor loading were designated for modification during this initial phase of analysis if their content was considered important to the research. To streamline the factor interpretation process, loadings below 0.40 were not reported.

Next, the external consistency of each construct was appraised by submitting the items remaining for the entire construct (e.g., Physical Supply) to exploratory factor analysis to uncover significant cross-loadings. Again maximum likelihood extraction with a varimax rotation and *MEANSUB* was utilized. Loadings below 0.40 were not reported. As the sample size of 50 observations was just large enough to justify factor analysis (Hair, Anderson, Tatham, & Black; 1995: 373), the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated for each construct using SPSS®. This insured it was appropriate to employ factor analysis (Kaiser 1970). Kaiser (1974) characterizes KMO measures in the 0.90's as outstanding, in the 0.80's as very good, in the 0.70's as average, in the 0.60's as tolerable, in the 0.50's as miserable, and below 0.50 as unacceptable.

Per Dillon & Goldstein's (1984: 69) recommendation, care was also taken at this stage not to be too hasty in eliminating items. While some items with significant cross-loadings were dropped during this stage of analysis, a number of items were designated for modification. For example, the item "We offer competitive prices relative to quality" loaded across two factors and was eventually simplified to "We offer competitive prices" for the large-scale survey.

The reliability (internal consistency) of the remaining items comprising each dimension was examined using Cronbach's alpha. Finally, predictive validity was assessed by correlating 1) composite measures of PHYSICAL SUPPLY, PHYSICAL DISTRIBUTION, and SPANNING PROCESSES with a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS, 2) a composite measure of MANUFACTURING FLEXIBILITY with a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS, and 3) a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS with a composite measure of (FIRM) PERFORMANCE.

3.3 PILOT STUDY RESULTS

The ensuing sections give the results of applying the methodology described in Section 3.2 to the fifty usable responses received via the pilot study mailing. Sections 3.3.1 through 3.3.6 present the outcomes related to each of the constructs of interest: Physical Supply, Physical Distribution, (Logistics) Spanning Processes, Capacity To Satisfy Customers, and Level Of Performance. In each section, the initial pilot study items regarding the construct are listed in the first table. The dimension-level corrected-item total correlations, factor loadings, and Cronbach's alpha before and after purification are given in the second. In the third table, the construct-level factor loadings are presented with the factors displayed in descending order, left-to-right, according to the amount of variance explained by each. Cronbach's alpha for the final retained items pertaining to each dimension are also given in the third table. See Appendix B for the eventual changes made to the items designated for modification and for the items that were added for the large-scale survey. Section 3.3.7 gives Cronbach's alpha for each construct and the correlations among composite measures of the constructs.

3.3.1 The Physical Supply (PHS) Construct

Initially, the Physical Supply (PHS) construct was represented by four dimensions and 24 items: (inbound transportation [6 items], material warehousing [5 items], inventory control: inputs [7 items], and production support [6 items]). The potential survey items for PHS were adapted from questionnaires or other literature published by: Bowersox, et al., (1989), Byrne & Markham (1991), LaLonde & Cooper (1989), and Novack, et al. (1994). The original 24 items for PHS are shown in Table 3.1.

Table 3.2 displays the factor loadings and corrected-items total correlations (CITCs) generated for each item related to a particular dimension of PHS. It also gives the initial Cronbach's alpha (α) for each dimension as well as α

Table 3.1 Physical Supply: Initial Pilot Study Items.

IT1	Inbound transportation delivering shipments on time
IT2	Inbound transportation delivering shipments in the condition they were offered
IT3	Inbound transportation providing us with a timely reply to inquires
IT4	Inbound transport responding to special requests
IT5	The cost we're incurring for inbound transportation
IT6	The overall quality of inbound transportation
MW1	Receiving and storing inbound materials
MW2	Picking and assembling production orders accurately at the materials warehouse
MW3	Material warehousing responding to special requests
MW4	The cost we're incurring for material warehousing
MW5	The overall quality of material warehousing
ICI1	The accuracy of records concerning the quantities of materials in the warehouse
ICI2	The accuracy of records concerning the location of materials in the warehouse
ICI3	The length of time required to update inventory records at the materials warehouse
ICI4	The number of production delays due to materials not being available at the warehouse
ICI5	Inbound inventory control responding to special requests
ICI6	The cost we're incurring in carrying materials inventory
ICI7	The overall quality of inventory control regarding incoming materials
PS1	Meeting schedule regarding the transfer of materials to production
PS2	Moving materials to the correct production location
PS3	Delivering materials in a form conducive to smooth handling by manufacturing/assembly
PS4	Production support responding to special requests
PS5	The cost we're incurring moving materials to production
PS6	The overall quality of our production support

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, PS -- Production Support.

Table 3.2 Physical Supply (PHS) -- Step 1: Initial Statistics (Pilot Study).

Item	Factor Loading	CITC	Initial α	α:Retained Items
Inbound Transportation				
IT6*	.9073	.795	α = .8295	α = .8323
IT3*	.7760	.695		
IT1*	.7101	.636		
IT2***	.6045	.499		
IT4**	.5883	.562		
IT5***	<0.40	.437		
Material Warehousing				
MW5*	.7952	.684	α = .7809	α = .7851
MW3*	.6978	.672		
MW2*	.6230	.529		
MW4*	.5358	.514		
MW1***	<0.40	.403		
Inventory Control - Inbound				
ICI2*	.9940	.656	α = .8585	α = .8393
ICI1*	.8215	.711		
ICI3*	.6404	.646		
ICI7*	.9505	.615		
ICI5*	.6941	.637		
ICI6***	.6104	.478		
ICI4**	<0.40	.638		
Production Support				
PS3*	.9239	.837	α = .8943	α = .8943
PS2*	.8350	.761		
PS6*	.7513	.706		
PS5*	.7397	.656		
PS1*	.7144	.704		
PS4*	.6876	.659		

*** = Retained for Step 2   ** = Designated for Modification   *** = Dropped**

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, PS -- Production Support.

for those items retained in their original form for Step 2 of analysis.

Step 1. The ***Inbound Transportation (IT)*** dimension originally consisted of six items (IT1 to IT6) which were submitted as a group to SPSS®. The initial α for these six items was 0.8295. IT2 and IT5 were dropped because of their poor CITCs. While IT4 had a poor loading, it was considered important to the research and was designated for modification. α consequently improved to .8323. IT4 after modification became item IT7 on the large-scale survey (see Appendix B). One item (MW1) was dropped from the ***Material Warehousing (MW)*** dimension because of its poor CITC and loading.

Two factors emerged from the ***Inventory Control - Inbound (ICI)*** dimension. The first, consisting of ICI2, ICI1, and ICI3, related to the management of material inventory records. The second consisted of ICI4 through ICI7 and related to the management of material inventory in general. One item (ICI6) was dropped because of its poor CITC. ICI4, was designated for modification because of its poor loading and became ICI8 on the large-scale survey. All six items from the ***Production Support (PS)*** dimension were retained for Step 2.

Step 2. Table 3.3 displays the results of submitting the 18 items remaining for the entire construct after Step 1 to factor analysis to assess the external consistency of the PHS construct. The KMO measure of 0.79 indicates that factor analysis was appropriate.

Table 3.3 Physical Supply (PHS) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .79					
Item	***Factor 1***	***Factor 2***	***Factor 3***	***Factor 4***	***α: Retained Items***
ICI7*	.8782				α = .9101
PS1*	.7488				
PS3*	.7240	.4207			
PS2*	.6967				
PS6*	.6355	.5363			
ICI5**	.5965				
PS5***	.5107	.4293			
MW5*		.7109			N/A
PS4**	.4218	.6126			
MW3**		.5551			
MW2**		.5046			
MW4***		.4905			
ICI2*			.9641		α = .8850
ICI1*			.8019		
ICI3*			.6059		
IT6*				.8922	α = .8323
IT3*				.7521	
IT1*				.6867	
* = Retained for Large-Scale Survey ** = Designated for Modification *** = Dropped					

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, PS -- Production Support.

Four PS items -- PS1, PS3, PS2, PS6 -- were retained in their original form despite significant cross loadings in regards to PS3 and PS6, as they were considered important to the research. PS5 had a poor loading on Factor 1, a significant cross loading on Factor 2, and was dropped. PS4 was considered important to the research and was modified to PS7 (see Appendix B).

ICI7 and ICI5 loaded with the Production Support items, not the remaining Inventory Control - Inbound items. ICI7 was retained in its original form and ICI5 became ICI9 after modification. They were joined by ICI8 (formerly ICI4) as the general material inventory management items on the large-scale survey. ICI2, ICI1, and ICI3 were retained in their original form and ICI10 was added as a fourth material inventory record item on the large-scale survey.

IT6, IT3, and IT1 were retained in their original form and were joined by IT7 (formerly IT4) on the large-scale survey.

3.3.2 The Physical Distribution (PHD) Construct

Initially, the Physical Distribution (PHD) construct was represented by four dimensions and 23 items: (packaging [7 items], finished goods warehousing [5 items], inventory control: outputs [5 items], and outbound transportation [6 items]). The potential survey items for PHD were adapted from questionnaires or other literature published by: Bowersox, et al. (1989), LaLonde & Cooper (1989), Byrne & Markham (1991), Coyle, et al. (1992), Lambert & Stock (1993), Novack, et al., (1994), and Coyle, et al. (1994). The original 23 items for PHD are shown in Table 3.4. Table 3.5 and Table 3.6 display the outcomes of Step 1 and Step 2 of analysis.

Step 1. All of the items for the ***Packaging (PK)***, ***Finished Goods Warehousing (FGW)***, and ***Inventory Control - Outbound (ICO)*** dimensions were retained for Step 2. OT4 was dropped from the ***Outbound Transportation (OT)*** dimension because of its poor loading and relatively low CITC. OT1 was designated for modification because of its relatively low CITC and loading and became OT7 on the large-scale survey (see Appendix B).

Step 2. The KMO measure of 0.76 shown in Table 3.6 indicates that factor analysis was appropriate. The seven PK items, the five ICO items, and the four remaining OT items were retained in their original form. FGW4 loaded poorly and apart from the other FGW items and was dropped. FGW5 -- despite a fairly high cross loading on Factor 2, and FGW2 -- despite a poor loading on Factor 4, were considered important

Table 3.4 Physical Distribution (PHD): Initial Pilot Study Items.

PK1	Packaging that minimizes damage to our final product
PK2	Packaging which facilitates efficient handling and transport of our outputs
PK3	Labeling on our packaged products that is accurate and distinguishable
PK4	Meeting the packaging specifications of our customers
PK5	Packaging sustaining our production plan
PK6	Packaging responding to special requests
PK7	The overall quality of our packaging function
FGW1	Warehousing finished goods
FGW2	Finished goods warehousing picking and assembling customer orders accurately
FGW3	Finished goods whse. responding to special requests
FGW4	The cost we're incurring for finished goods warehousing
FGW5	The overall quality of finished goods warehousing
ICO1	The accuracy of records concerning the quantities of finished product on-hand
ICO2	The accuracy of records concerning the location of finished goods in the warehouse
ICO3	The length of time required to update finished goods inventory records
ICO4	Maximizing overall revenue through the control of finished goods
ICO5	The overall quality of finished goods inventory control
OT1	Outbound transport meeting schedule for deliveries
OT2	Outbound transportation delivering shipments in the condition they were presented for transport
OT3	Outbound transportation providing us with a timely response to inquires
OT4	Outbound transport responding to special requests
OT5	The cost we're incurring for outbound transportation
OT6	The overall quality of outbound transportation

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

Table 3.5 Physical Distribution (PHD) -- Step 1: Initial Statistics (Pilot Study).

Item	Factor Loading	CITC	Initial α	α: Retained Items
Packaging				
PK4*	.9148	.865	α = .9205	α = .9205
PK7*	.8643	.832		
PK5*	.7768	.721		
PK6*	.7729	.721		
PK2*	.7590	.755		
PK3*	.7468	.699		
PK1*	.7141	.699		
Finished Goods Warehousing				
FGW5*	.7775	.751	α = .8119	α = .8119
FGW2*	.7455	.758		
FGW3*	.6577	.781		
FGW1*	.6365	.787		
FGW4*	.5990	.796		
Inventory Control - Outbound				
ICO2*	.9578	.891	α = .9310	α = .9310
ICO1*	.8847	.847		
ICO3*	.8631	.802		
IC017*	.8313	.877		
ICO4*	.6598	.699		
Outbound Transportation				
OT6*	.9247	.853	α = .8823	α = .8876
OT3*	.8579	.781		
OT2*	.7451	.756		
OT5*	.7304	.627		
OT1**	.6211	.593		
OT4***	.5993	.577		
* = Retained for Step 2 ** = Designated for Modification *** = Dropped				

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

Table 3.6 Physical Distribution (PHD) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .76					
Item	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*α: Retained Items*
PK4*	.8901				α = .9205
PK5*	.7869				
PK7*	.7688				
PK2*	.7461				
PK6*	.7308				
PK1*	.7108				
PK3*	.6303				
ICO2*		.9449			α = .9310
ICO1*		.8862			
ICO3*		.8519			
ICO5*		.8058			
ICO4*		.6408			
FGW4***		.4926			
OT6*			.8896		α = .8876
OT3*			.8749		
OT5*			.7320		
OT2*			.6711		
FGW5*		.4212		.8444	N/A
FGW2*				<.40	
FGW1**	.5193			.4651	
FGW3**				.4000	
* = Retained for Large-Scale Survey ** = Designated for Modification *** = Dropped					

and were retained. The other two FGW items had significant cross loadings and were designated for modification; FGW1 became FGW7, and FGW3 became FGW6 on the large-scale survey.

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

3.3.3 The Spanning Processes (SP) Construct

Initially, the Spanning Processes (SP) construct was represented by four dimensions and 22 items: (purchasing [7 items], customer order processing [4 items], strategy development [5 items], and information dissemination [6 items]). The potential survey items for SP were adapted from questionnaires or other literature published by: Swamidass & Newell (1987), LaLonde, Cooper, & Noordewier (1988), Bowersox, et al. (1989), Byrne & Markham (1991), Cooper, et al. (1992), Lambert & Stock (1993), Holcomb (1994), Coyle, et al. (1994), and Ward et al. (1994). The original 22 items for SP are shown in Table 3.7. Table 3.8 and Table 3.9 display the outcomes of Step 1 and Step 2 of analysis.

Step 1. Three items from the ***Purchasing (PU)*** dimension had poor CITCs and loadings. PU4 was dropped while PU1 and PU5 were considered important to the research and were designated for modification becoming PU8 and PU9, respectively. The ***Customer Order Processing (COP)*** dimension was partitioned into two factors. COP1 loaded by itself, had a poor CITC, and was designated for modification becoming COP5 (see Appendix B). COP3, COP2, and COP4 were retained in their original form for Step 2. SD3 of the ***Strategy Development (SD)*** dimension had a poor CITC and loading and was designated for modification, eventually becoming SD8. ID1 and ID6 had poor CITCs and loadings and were dropped from the ***Information Dissemination (ID)*** dimension.

Step 2. The KMO measure of 0.74 shown in Table 3.9 indicates that factor analysis was appropriate. The four PU items were retained in their original form. ID3 loaded weakly on Factor 2 and was dropped. ID4, ID5, and ID2 were joined on the large-scale survey by two additional items -- ID7 and ID8 -- in an attempt to strengthen the Information Dissemination dimension.

Although four factors were expected to emerge from the Spanning Processes construct, the items from the COP and SD dimensions converged into a single factor. It was deemed to be inappropriate to exclude either Customer Order Processing or (logistics involvement in) Strategy Development as a feasible dimension at this stage of the research. Therefore, a number of the COP and SD items were designated for modification and one item (COP8) was added for the large-scale survey. Whereas COP3 was considered important and retained in its original form, COP4 (now COP7), COP2 (now COP6), SD1 (now SD6), SD5 (now SD10), SD2 (now SD7), and SD4 (now SD9) were revised in an attempt to improve the measurement of these dimensions. Section 4.2.3 of Chapter 4 reports the results utilizing the large-scale survey data.

Table 3.7 Spanning Processes (SP): Initial Pilot Study Items.

PU1	**Purchasing obtains materials/equipment/supplies that meet specification**
PU2	**We select and evaluate suppliers effectively**
PU3	**Our communications with suppliers is excellent**
PU4	**Purchasing cooperates well with other functional areas**
PU5	**Purchasing is able to fill special requests**
PU6	**Purchasing expends capital in a manner that maximizes our company's overall viability**
PU7	**The overall quality of our purchasing function is high**
COP1	**Inbound logistics, production, & distribution are managed as an integrated system**
COP2	**Inbound logistics plays an important role in the fulfillment of customer orders**
COP3	**Outbound logistics plays an important role in the fulfillment of customer orders**
COP4	**Our logistics function is an important coordinating mechanism**
SD1	**Logistics is recognized throughout our organization as being important to creating customer value**
SD2	**There is a high level of integration of logistics strategy with the strategic plans of other areas**
SD3	**The input of logistics personnel is important to the overall strategy process**
SD4	**Logisticians are involved in decisions related to strategies for company growth**
SD5	**Logistics' day to day operations are administered in a manner that supports corporate goals**
ID1	**Incorporating the latest information system technologies into logistics is important**
ID2	**The information used to manage logistics activity is readily available**
ID3	**Our logistics information systems compare favorably to the information management systems of other areas**
ID4	**Our logistics function provides meaningful information regarding the competitive environment**
ID5	**Our logistics function provides useful information on the requirements of individual markets/clients**
ID6	**Our production schedule is driven by current customer orders and/or by current customer sales**

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

Table 3.8 Spanning Processes (SP) -- Step 1: Initial Statistics (Pilot Study).

Item	Factor Loading	CITC	Initial α	α: Retained Items
Purchasing				
PU7*	.8059	.717	α = .8400	α = .8297
PU3*	.7942	.722		
PU2*	.6966	.644		
PU6*	.6884	.638		
PU4***	.5707	.486		
PU5**	.5327	.489		
PU1**	.5067	.477		
Customer Order Processing				
COP3*	.8282	.324	α = .5974	α = .6989
COP2*	.6090	.476		
COP4*	.5607	.577		
COP1**	.7474	.244		
Strategy Development				
SD1*	.8707	.742	α = .8587	α = .8670
SD2*	.8618	.745		
SD5*	.7771	.752		
SD4*	.6570	.648		
SD3**	.5018	.509		
Information Dissemination				
ID4*	.9755	.791	α = .8128	α = .8818
ID5*	.8561	.693		
ID2*	.7064	.719		
ID3*	.6784	.689		
ID1***	<0.40	.297		
ID6***	<0.40	.285		

*** = Retained for Step 2   ** = Designated for Modification   *** = Dropped**

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

Table 3.9 Spanning Processes (SP) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .74				
Item	*Factor 1*	*Factor 2*	*Factor 3*	*α: Retained Items*
PU7*	.8153			α = .8297
PU6*	.7352			
PU3*	.7003			
PU2*	.6550			
ID4*		.9515		α = .8735
ID5*		.7943		
ID2*		.6254		
ID3***		.5663		
COP3*			.4040	N/A
SD1**	.4944		.6831	
COP4**			.6250	
SD5**	.4082		.5916	
SD2**	.5298	.4156	.5307	
SD4**			.4006	
COP2**			<.40	
* = Retained for Large-Scale Survey ** = Designated for Modification *** = Dropped				

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

3.3.4 The Capacity To Satisfy Customers (CTSC) Construct

Initially, the Capacity To Satisfy Customers (CTSC) construct was represented by seven dimensions and 29 items: (price offered [4 items], quality of products [3 items], product line breadth [5 items], order fill rate [4 items], order cycle time [4 items], order/shipment information [5 items], and frequency of delivery [4 items]). The potential survey items for CTSC were adapted from questionnaires or other literature published by: Swamidass & Newell (1987), Bowersox, et al. (1989), Byrne & Markham (1991), Cooper, et al. (1992), Holcomb (1994), Innis & LaLonde (1994), and Koufteros (1995). The original 29 items for CTSC are shown in Table 3.10. Table 3.11 and Table 3.12 display the outcomes of Step 1 and Step 2 of analysis.

Step 1. The ***Price Offered (PR)*** dimension separated into two factors. The items (PR2 and PR3) constituting the second factor had poor CITCs and were dropped. QP3 had a poor CITC and loading and was dropped from the ***Quality of Products (QP)*** dimension. The ***Product Line Breadth (PLB)*** dimension separated into two factors and the items constituting the second (PLB5, PLB4, PLB3) were each designated for modification, becoming PLB7, PLB8, and PLB6 respectively (see Appendix B). One item each was dropped from ***Order Fill Rate (FR)***, ***Order Cycle Time (OCT)***, and ***Order/Shipment Information (OSI)*** dimensions due to weak CITCs and loadings. The four ***Frequency of Delivery (FD)*** dimension items were retained in their original form.

Table 3.10 Capacity To Satisfy Customers (CTSC): Initial Pilot Study Items.

PR1	We offer competitive prices relative to quality
PR2	We are able to command premium prices
PR3	We do <u>not</u> charge extra for emergency orders
PR4	We are able to guarantee our prices
QP1	We offer products that function according to customer needs
QP2	We are able to compete based on quality
QP3	There are few customer returns to my company because of poor quality
PLB1	We respond well to changing customer preferences regarding products
PLB2	We respond well to changing customer preferences regarding accompanying services
PLB3	We offer an effective product mix to our customers
PLB4	We offer a satisfactory variety of products
PLB5	We offer an acceptable range of product features
FR1	We <u>deliver</u> the assortment of products needed on time to our customers
FR2	Our frequency of customer backorders is low
FR3	Our customers are satisfied with our level of completeness for <u>routine</u> shipments
FR4	Our customers are satisfied with our level of completeness for <u>emergency</u> shipments
OCT1	We offer customers a reliable order processing time
OCT2	The time from our receipt of an order to possession of the shipment by that customer is acceptable to our clients
OCT3	We have few past due invoices due to late delivery
OCT4	Orders submitted to us are delivered on-time, <u>as defined by the customer</u>

continued ....

Table 3.10 Continued.

OSI1	We deliver orders as promised with no communication other than the initial contact
OSI2	We supply clients with accurate information regarding inventory availability
OSI3	We supply accurate projected shipping dates
OSI4	We supply accurate projected delivery dates
OSI5	We respond promptly to a customer inquiry regarding order/shipment information
FD1	Our customers are pleased with the frequency of our delivery
FD2	We can alter our delivery schedule per each customer's requirements
FD3	We work with each customer to develop a delivery schedule that is acceptable to us both
FD4	We meet customer expectations by being flexible in our frequency of delivery

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Table 3.11 Capacity To Satisfy Customers (CTSC) -- Step 1: Initial Statistics (Pilot Study).

Price Offered				
Item	*Factor Loading*	*CITC*	*Initial α*	*α: Retained Items*
PR1*	.6477	.508	α = .5138	α = .5483
PR4*	.5407	.423		
PR2***	.9949	.162		
PR3***	.5462	.207		
Quality Of Products				
QP2*	.9225	.622	α = .6819	α = .7918
QP1*	.7235	.553		
QP3***	<0.40	.443		
Product Line Breadth				
PLB2*	.9710	.696	α = .8094	α = .8889
PLB1*	.7505	.672		
PLB5**	.8821	.638		
PLB4**	.6710	.524		
PLB3**	.5997	.550		
Order Fill Rate				
FR3*	.8936	.793	α = .8404	α = .8635
FR2*	.8333	.713		
FR1*	.7586	.726		
FR4***	.5401	.502		
Order Cycle Time				
OCT2*	.9326	.864	α = .8898	α = .9301
OCT4*	.9309	.868		
OCT1*	.8489	.772		
OCT3***	.5732	.554		
* = Retained for Step 2 ** = Designated for Modification *** = Dropped				

continued ....

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Table 3.11 Continued.

Item	Factor Loading	CITC	Initial α	α:Retained Items
Order/Shipment Information				
OSI3*	.9948	.878	α = .8807	α = .9203
OSI4*	.9897	.887		
OSI5*	.8620	.805		
OSI2*	.5779	.654		
OSI1***	<0.40	.406		
Frequency Of Delivery				
FD3*	.8574	.803	α = .8831	α =.8831
FD4*	.8404	.788		
FD1*	.7577	.697		
FD2*	.7540	.697		
* = Retained for Step 2 ** = Designated for Modification *** = Dropped				

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Table 3.12 Capacity To Satisfy Customers (CTSC) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .88					
Item	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*α: Retained Items*
OCT4*	.8495				α = .9563
OCT2*	.7988				
FR3*	.7502				
FR2*	.7466				
FD1*	.7329	.4752			
OCT1*	.7134	.4232			
FR1**	.5605		.4201		
OSI3*		.8420			α = .9922
OSI4*		.8206			
OSI5**	.4070	.5830	.4391		
OSI2**		.4600			
QP2*			.8583		α = .7918
QP1*			.6697		
PR1**			.6272		
PR4**			.5852		
FD2*				.7028	α = .8158
PLB2*				.5521	
PLB1*	.4341			.4021	
FD3**		.5413		.6738	
FD4**				.5934	
* = Retained for Large-Scale Survey ** = Designated for Modification *** = Dropped					

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Step 2. The KMO measure of 0.88 shown in Table 3.12 indicates that factor analysis was appropriate. Four factors emerged where seven had been expected. The OCT and FR items along with FD1 loaded on the first factor. OCT4, OCT2, FR3, and FR2 were retained in their original form. FD1 and OCT1 were retained as well despite significant cross loadings due to their importance to the research. FR1 loaded weakly on Factor 1, had a significant cross loading, and was designated for modification, eventually becoming FR5 on the large-scale survey. The OSI items loaded on Factor 2. OSI5 and OSI2 had a poor loading and/or significant cross loadings and eventually became OSI7 and OSI6, respectively, on the large-scale survey.

QP2 and QP1 loaded on Factor 3. They were joined by QP4, QP5, and QP6 on the large-scale survey as items were added to strengthen the QP dimension. PR1 and PR4 loaded with the QP items and were modified to PR5 and PR9 respectively. PR6, PR7, and PR8 were also added to the large-scale survey to strengthen the PR dimension (see Appendix B).

The two PLB items remaining from Step 1 and FD2, FD3, and FD4 loaded on Factor 4. PLB1 and PLB2 were considered important to the research and were retained, joining the three modified PLB items from Step 1 on the large-scale survey. FD2 was retained in its original form, while FD3 and FD4 were modified to FD5 and FD6.

The Capacity To Satisfy Customers construct was subjected to a number of item modifications and several items were added due to the pilot study analysis described here. Section 4.2.4 of Chapter 4 reports the results of making these alterations.

3.3.5 The Manufacturing Flexibility (MF) Construct

Initially, the Manufacturing Flexibility (MF) construct was represented by three dimensions and 14 items: (advanced process technology [6 items], manufacturing managers participation in corporate strategy [2 items], and participative management [6 items]. The potential survey items for MF were adapted from questionnaires or other literature published by: Swamidass & Newell (1987), Koufteros (1995), and Ward, et al. (1994). The original 14 items for MF are shown in Table 3.13.

Table 3.13 Manufacturing Flex.: Initial Pilot Study Items.

APT1	We have robotics in our manufacturing facility(s)
APT2	We use computer-aided design (CAD) technology
APT3	We use computer-aided manufacturing (CAM) technology
APT4	We use computerized numerical control machines (CNC)
APT5	We have incorporated real-time process control into our production systems
APT6	We utilize production technology that is among the most flexible in our industry
MMP1	The input of manufacturing plant managers is an integral part of the strategy formation process
MMP2	Manufacturing plant managers are involved in decisions related to strategies for company growth
PM1	Production employees work in teams
PM2	Production workers perform a broad range of tasks
PM3	Production workers share responsibility for planning
PM4	Production workers share responsibility for quality
PM5	Production supervisors receive labor relations training
PM6	Production employees have access to a progressive training program

Legend: APT – Advanced Process Technology, MMP – Manufacturing Managers Participation in Corporate Strategy, and PM – Participative Management.

Step 1. Table 3.14 displays the outcome of Step 1 of analysis. The ***Advanced Process Technology (APT)*** dimension separated in two factors. The first contained two items (APT6 and APT5) which were general questions regarding the state of the firm's process technology. The second contained items (APT3, APT2, APT4, APT1) related to specific technology applications. Previous research (Koufteros 1995) had shown that specific items regarding process technology were not always reliable. This was also found to be the case here as α improved from 0.7993 to 0.8329 when the items comprising the second factor were dropped.

The two items for the ***Manufacturing Managers Participation in Corporate Strategy (MMP)*** dimension were retained. PM2 and PM1 were dropped from the ***Participative Management (PM)*** dimension due to their poor loadings and relatively low CITCs.

Step 2. Table 3.15 displays the outcome of Step 2 of analysis. The KMO measure of 0.81 indicates that factor analysis was appropriate. PM6, PM5, APT6, APT5, and PM3 loaded on Factor 1, giving rise to the possibility of a joint Advanced Process Technology/ Participative Management factor. These items were retained in their original form despite a significant cross loading regarding APT6, and a relatively poor loading on Factor 1 regarding PM3. PM4 cross-loaded on Factors 1 & 2 and was designated for modification, eventually becoming PM7. APT7 and APT8 were added for the large-scale survey to strengthen the APT dimension. MMP1 and MMP2 were retained in their original form and MMP3 was added for the large-scale survey to strengthen the MMP dimension. Section 4.2.5 of Chapter 4 reports the results of making these alterations.

Table 3.14 Manufacturing Flexibility (MF) -- Step 1: Initial Statistics (Pilot Study).

Item	Factor Loading	CITC	Initial α	α:Retained Items
Advanced Process Technology				
APT6*	.9989	.429	α = .7993	α = .8329
APT5*	.6891	.619		
APT3***	.7618	.660		
APT2***	.7413	.479		
APT4***	.6754	.547		
APT1***	<0.40	.606		
Manufacturing Managers Participation In Corporate Strategy				
MMP1*	.9707	.896	α = .9448	α = .9448
MMP2*	.9234	.896		
Participative Management				
PM5*	.8291	.750	α = .8654	α = .8633
PM3*	.7737	.759		
PM6*	.7412	.718		
PM4*	.7012	.642		
PM2***	.5540	.539		
PM1***	.5139	.586		

* = Retained for Step 2   ** = Designated for Modification   *** = Dropped

Legend: APT -- Advanced Process Technology, MMP -- Manufacturing Managers Participation in Corporate Strategy, and PM -- Participative Management.

Table 3.15 Manufacturing Flexibility (MF) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .81

Item	*Factor 1*	*Factor 2*	*α: Retained Items*
PM6*	.9094		α = .8771
PM5*	.6670		
APT6*	.6569	.4517	
APT5*	.6406		
PM3*	.5826		
MMP1*		.9609	α = .9448
MMP2*		.8452	
PM4**	.4259	.5040	

*** = Retained for Large-Scale Survey**
**** = Designated for Modification *** = Dropped**

Legend: APT -- Advanced Process Technology, MMP -- Manufacturing Managers Participation in Corporate Strategy, and PM -- Participative Management.

3.3.6 The Level of Performance (LOP) Construct

Initially, the Level of Performance (LOP) construct was represented by two dimensions and 8 items: customer satisfaction [3 items] and financial performance [5 items]. The potential survey items for LOP were adapted from questionnaires or other literature published by: Swamidass & Newell (1987), LaLonde, et al. (1988), Bowersox, et al. (1989), Byrne & Markham (1991), Heskett, Jones, Loveman, Sasser, & Schlesinger (1994), Koufteros (1995), and Ward, et al. (1994). The original 8 items for LOP are shown in Table 3.16.

Step 1. Table 3.17 displays the outcome of Step 1 of analysis. The three ***Customer Satisfaction (CS)*** items and the five ***Financial Performance (FP)*** items were retained for Step 2.

Step 2. Table 3.18 displays the outcome of Step 2 of analysis. The KMO measure of 0.83 indicates that factor analysis was appropriate. All eight items were retained in their original form due to their importance to the research although CS2 and CS3 had poor loadings on Factor 2. CS4 was added for the large-scale survey in an attempt to strengthen the Customer Satisfaction dimension.

Table 3.16 Level Of Performance (LOP): Initial Pilot Study Items.

CS1	**Customers perceiving they receive their money's worth when they purchase our products**
CS2	**Customer retention rate**
CS3	**Generating new business as the result of referrals**
FP1	**Sales growth position**
FP2	**Market share gain**
FP3	**Return on investment**
FP4	**New product success rate**
FP5	**Overall competitive position**

Table 3.17 Level Of Performance (LOP) -- Step 1: Initial Statistics (Pilot Study).

Customer Satisfaction				
Item	*Factor Loading*	*CITC*	*Initial α*	*α:Retained Items*
CS1*	.8450	.695	α = .8052	α = .8052
CS2*	.7180	.626		
CS3*	.7132	.639		
Level Of Performance				
FP2*	.9138	.842	α = .9053	α = .9053
FP5*	.8436	.882		
FP1*	.8405	.767		
FP3*	.7475	.744		
FP4*	.6644	.691		
* = Retained for Step 2 ** = Designated for Modification *** = Dropped				

Legend: CS -- Customer Satisfaction and FP -- Financial Performance.

Table 3.18 Level Of Performance (LOP) -- Step 2: Final Statistics (Pilot Study).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .83			
Item	***Factor 1***	***Factor 2***	***α: Retained Items***
FP2*	.9120		α = .9053
FP1*	.8203		
FP5*	.8011		
FP3*	.6764		
FP4*	.6054		
CS1*		.9938	α = .8052
CS2*		.5774	
CS3*		.5530	

*** = Retained for Large-Scale Survey**
**** = Designated for Modification *** = Dropped**

Legend: CS -- Customer Satisfaction and FP -- Financial Performance.

3.3.7 Composite Measure Correlations

Correlation analysis was utilized to assess the predictive validity of the initial instrument after purification and exploratory factor analysis. The use of correlation is appropriate when the objective of research is to understand the pattern of relationships between constructs, but is not attempting to explain the total variance of a construct (Hair, et al., 1995). In this research, the main objective was to determine whether logistics processes (i.e., physical supply, physical distribution, and logistics-related spanning processes) affect a firm's capacity to satisfy customers and, ultimately, firm performance. Therefore, it was important to confirm that the appropriate associations between the theorized independent and dependent variables existed as part of the pilot study.

Correlation does not in itself imply two variables are *causally* related. However, correlation can be considered as necessary to causation as the two variables must be *statistically* related as a prerequisite to being causally related (Emory & Cooper, 1991). That is, the researcher must establish that the changes in one construct - the independent variable - are associated with predictable changes in the second construct - the dependent variable (Hair, et al., 1995). In this way he or she may either validate or discard the possibility of a causal relationship.

A composite measure for each construct was derived by summing the scores of the remaining original items. For example, the composite measure for the Physical Supply (PHS) construct was calculated by summing the scores for twelve items (PS1, PS2, PS3, PS6, MW5, ICI1, ICI2, ICI3, ICI7, IT1, IT3, IT6). Each of these composite measures were then submitted to SPSS® to determine the Pearson product-moment correlation coefficients (*r*) for each relationship of interest. Table 3.19 displays the results. The correlation coefficients are acceptable and significant at α = .01. This means that each hypothesized relation between constructs is statistically related which validates the possibility of causal relationships.

Table 3.19 Correlations Between Composite Measures To Assess Predictive Validity.

Independent Variable	Dependent Variable	*r*
Physical Supply (PHS)	(CTSC)	.53
Physical Distribution (PHD)	(CTSC)	.48
Spanning Processes (SP)	(CTSC)	.78
Manufacturing Flexibility (MF)	(CTSC)	.80
Capacity To Satisfy Customers (CTSC)	Level Of Performance (LOP)	.68
Note: Significant at α = .01.		

The overall reliability of each construct was examined by submitting the original items remaining for each to SPSS® to determine a construct-level α. For example, the same twelve items (i.e., PS1, PS2, PS3, PS6, MW5, ICI1, ICI2, ICI3, ICI7, IT1, IT3, IT6) were submitted as a group to SPSS® to determine an overall α for the Physical Supply (PHS) construct. Table

3.20 gives the results of this analysis.

Table 3.20 Each Construct's Alpha After Purification and Factor Analysis (Pilot Study).

Construct	Number of Retained Original Items	α
Physical Supply (PHS)	12	.88
Physical Distribution (PHD)	16	.91
Spanning Processes (SP)	8	.80
Capacity To Satisfy Customers (CTSC)	13	.95
Manufacturing Flexibility (MF)	7	.90
Level Of Performance (LOP)	8	.89

As result of this first phase of instrument development, 113 items were placed on the large-scale survey. 63 were in their original form, 31 were modifications of original items, and 19 were additional items not included in the pilot study. Chapter 4 reports the results of Instrument Development Phase II, analysis utilizing the responses from a large-scale survey concerning these 113 items.

CHAPTER 4: INSTRUMENT DEVELOPMENT PHASE TWO - LARGE-SCALE DATA ANALYSIS

For this research to assist manufacturing managers in making sound decisions concerning logistics, the respondents involved in the large-scale survey needed to be in positions which enabled them to perceive the effectiveness of their firm's logistics activities, the degree of flexibility existing in their manufacturing operations, and the level of organizational performance that was being attained in terms of financial performance and overall customer satisfaction. They also needed to understand their firm's state of technology development and human resource management, and the attention logistics and manufacturing receives at the strategic level. It was also important to have a diverse group of respondents to insure the results were generalizable across industry classification, firm size, type of manufacturing operation, and so forth.

As described in Chapter 3, a mailing list was obtained that originally contained 3,833 potential respondents. Five hundred of these were systematically extracted for use in the pilot study. The remaining 3,333 were mailed a cover letter on a University of Toledo letterhead, the questionnaire resulting after Phase One of the instrument development (see Appendix B for the actual survey and Appendix C for the items categorized by construct/dimension), and a letter signed by R. Jerry Baker, Executive Vice President of the National Association of Purchasing Management encouraging response to the survey. A summary of the results was offered as an incentive to those who responded. A follow up letter and questionnaire was sent to those who do not return the initial questionnaire after a five week waiting period.

Fourteen packets were returned as undeliverable. Of the responses received, fifty-eight were appraised as being unsuitable for the large-scale analysis. Most of the rejected questionnaires were due to a lack of manufacturing at the respondent's location, or to an insufficiently completed survey. A total of 474 responses were appraised as suitable for the large-scale analysis giving an effective response rate of 14.5% [474 ÷ (3333 - 14 - 58)].

Appendix E contains detailed information regarding the 474 respondents whose information was utilized in the large-scale analysis. The majority described themselves as a President/General Manager or as a Plant/Facility Manager, that is, they were in positions which enabled them to respond to the questions knowledgeably. In addition, a representative variety of firm sizes, industry classifications, and types of manufacturing operations are present, which enhances the generalizability of the results.

4.1 ITEM REFINEMENT METHODOLOGY

The 474 acceptable responses from the large-scale survey were used to further refine the instrument using the same criteria as in Phase 1: purification, reliability, brevity, and internal, external, and predictive validity. In Step 1, the instrument was purified (Churchill 1979) by examining the corrected-item total correlations of the items in respect to a particular dimension (e.g., inbound transportation) of a specific construct (e.g., Physical Supply). The item inter-correlation matrices provided by SPSS® were utilized as in Phase 1 to drop items if they did not strongly contribute to Cronbach's alpha for the dimension under consideration (Flynn, et al., 1995).

The external validity of each construct was appraised in Step 2 by submitting the items remaining after purification for the entire construct (e.g., Physical Supply) to exploratory factor analysis. Maximum likelihood extraction with a varimax rotation and the *MEANSUB* command were utilized. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated for each construct to insure factor analysis was appropriate. Loadings below 0.40 were not reported to simplify analysis.

An item was generally retained during this stage of analysis if it loaded at 0.60 or above with no cross-loading greater than 0.40. A small number of items were retained which loaded slightly below 0.60 -- with no cross-loading above 0.40

-- due to their importance to the research.

The reliability (internal consistency) of the remaining items comprising each dimension was examined using Cronbach's alpha. Predictive validity was assessed by correlating 1) composite measures of PHYSICAL SUPPLY, PHYSICAL DISTRIBUTION, and SPANNING PROCESSES with a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS, 2) a composite measure of MANUFACTURING FLEXIBILITY with a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS, and 3) a composite measure of THE FIRM'S CAPACITY TO SATISFY CUSTOMERS with a composite measure of (FIRM) PERFORMANCE.

4.2 LARGE-SCALE SURVEY RESULTS

The ensuing sections give the results of applying the methodology described in Section 4.1 to the 474 usable responses received via the large-scale mailing. Sections 4.2.1 through 4.2.6 present the outcomes related to each of the constructs of interest: Physical Supply, Physical Distribution, (Logistics) Spanning Processes, Capacity To Satisfy Customers, and Level Of Performance. In each section, the items placed on the large-scale survey are listed in the first table. The dimension-level corrected-item total correlations and Cronbach's alpha before and after purification are given in the second table. In the third, the construct-level factor loadings are presented. The factor's rank in regards to the amount of variance explained is given immediately below its label. Cronbach's alpha for the final retained items are also given in the third table. See Appendix D for the items which were placed on the suggested final instrument. Section 4.2.7 gives Cronbach's alpha for each construct and the correlations among composite measures of the constructs.

4.2.1 The Physical Supply (PHS) Construct

Table 4.1 displays the 20 Physical Supply (PHS) items placed on the large-scale survey. Table 4.2 displays the corrected-items total correlations (CITCs) generated for each item related to a particular dimension of PHS. It also gives the initial Cronbach's alpha (α) for each dimension as well as α for those items retained for Step 2 of analysis.

Step 1. The ***Inbound Transportation (IT)*** and ***Material Warehousing (MW)*** dimensions retained all of their items at this stage. Two items (ICI8 and ICI9) were dropped from the ***Inventory Control - Inbound (ICI)*** dimension as they did not strongly contribute to α. Section 3.3.1 mentions the possibility of a separate general material inventory management factor. ICI8 and ICI9 were two of the three general material inventory management items on the large-scale survey. The third, ICI7, will be dropped during Step 2. PS7 was dropped from the ***Production Support (PS)*** dimension as it did not strongly contribute to α.

Table 4.1 Physical Supply (PHS): Items On Large-Scale Survey.

IT1	Inbound transportation delivering shipments on time
IT3	Inbound transportation providing us with a timely reply to inquires
IT6	The overall quality of inbound transportation
IT7	Inbound transport reacting quickly to special requests
MW5	The overall quality of material warehousing
MW6	Storing materials intact at the warehouse
MW7	The materials warehouse picking components accurately
MW8	Material warehousing responding promptly to special requests
ICI1	The accuracy of records concerning the quantities of materials in the warehouse
ICI2	The accuracy of records concerning the location of materials in the warehouse
ICI3	The length of time required to update inventory records at the materials warehouse
ICI7	The overall quality of inventory control regarding incoming materials
ICI8	Limiting the number of production delays due to materials being out-of-stock at the warehouse
ICI9	Inbound inventory control responding promptly to special requests
ICI10	The overall accuracy of inventory records for materials
PS1	Meeting schedule regarding the transfer of materials to production
PS2	Moving materials to the correct production location
PS3	Delivering materials in a form conducive to smooth handling by manufacturing/assembly
PS6	The overall quality of our production support
PS7	Production support responding expediently to special requests

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, and PS -- Production Support.

Table 4.2 Physical Supply (PHS) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	CITC	Initial α	α:Retained Items
Inbound Transportation			
IT1*	.587	α = .7871	α = .7871
IT3*	.555		
IT6*	.700		
IT7*	.556		
Material Warehousing			
MW5*	.694	α = .7961	α = .7961
MW6*	.578		
MW7*	.621		
MW8*	.546		
Inventory Control - Inbound			
ICI1*	.770	α = .8780	α = .8880
ICI2*	.706		
ICI3*	.639		
ICI7*	.715		
ICI10*	.800		
ICI8**	.511		
ICI9**	.506		
Production Support			
PS1*	.689	α = .8238	α = .8259
PS2*	.605		
PS3*	.626		
PS6*	.691		
PS7**	.493		
* = Retained for Step 2 ** = Dropped			

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, and PS -- Production Support.

Step 2. Table 4.3 displays the results of submitting the 17 items remaining after Step 1 as a group to factor analysis to assess the external validity of the PHS construct. The KMO measure of 0.94 indicates that factor analysis was appropriate. Two factors/dimensions (eight items) were retained and placed on the suggested final instrument. The **Inbound Transportation** factor ranked second in the amount of variance explained, while the **Inbound Inventory Control** factor explained the largest amount of variance.

The items comprising the Inbound Inventory Control factor (ICI1, ICI10, ICI2, ICI3) all related to the quality of material inventory records. MW5 also loaded clearly on this factor but was not retained for the final instrument due to its lack of compatibility with these four ICI items. ICI7 was dropped due to a significant cross loading, eliminating the possibility of a separate general material inventory management factor. Material Warehousing and Production Support did not emerge as viable dimensions of the PHS construct during this phase of analysis. With the exception of MW5, The MW and PS items had poor loadings in conjunction with significant cross loading regarding the Inbound Inventory Control and Inbound Transportation factors.

Table 4.3 Physical Supply (PHS) -- Step 2: Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .94

Item	*Inbound Transportation Factor (2nd)*	*Inbound Inventory Control Factor (1st)*	*α: Retained Items*
IT6*	.6840		$\alpha = .7871$
IT1*	.6362		
IT7*	.6222		
IT3*	.5920		
ICI1*		.8877	$\alpha = .8792$
ICI10*		.8774	
ICI2*		.7356	
ICI3*		.6100	
MW5**		.7901	
ICI7**	.4033	.6350	
MW7**		.5751	
MW6**		.5611	
PS2**	.4181	.5594	
PS1**	.4971	.5141	
PS3**	.4404	.5138	
PS6**	.5445	.4963	
MW8**	.4491	.4882	

* = Retained ** = Dropped

Legend: IT -- Inbound Transportation, MW -- Material Warehousing, ICI -- Inventory Control - Inbound, and PS -- Production Support.

A possible explanation regarding Material Warehousing is that the respondents perceive the warehousing (storage) of materials as a component of Inbound Inventory Control. In other words, manufacturing managers distinguish excellent material inventory records as the most important variable concerning a viable Physical Supply function, and they view materials warehousing as part of, or a means to that end.

In Chapter 2, Production Support was defined as the conveyance of materials to production. While Ernst & Whinney (1987) classify production support as a logistics process, it may not have emerged as a distinct dimension of Physical Supply because it is perceived as a manufacturing, not a logistics process by the manufacturing managers surveyed.

4.2.2 The Physical Distribution (PHD) Construct

Table 4.4 displays the 21 Physical Distribution (PHD) items placed on the large-scale survey. <u>Step 1.</u> Table 4.5 displays the results of Step 1 of analysis. All of the items for the ***Packaging (PK)*** and ***Finished Goods Warehousing (FGW)*** dimensions were retained for Step 2. ICO4 was dropped from the ***Inventory Control - Outbound (ICO)*** dimension, and OT2 and OT5 were dropped from the ***Outbound Transportation (OT)*** dimension.

<u>Step 2.</u> Table 4.6 displays the results of submitting the 18 items remaining after Step 1 as a group to factor analysis to assess the external validity of the PHD construct. The KMO measure of 0.94 indicates that factor analysis was appropriate. Three factors/dimensions (fourteen items) were retained and placed on the suggested final instrument.

A **Packaging** factor ranked second in variance explained and is comprised of four items (PK7, PK6, PK4, PK2) on the final suggested instrument. Three items were dropped due to their poor loading on the Packaging factor and two of the three also had significant cross loadings as well. A **Outbound Transportation factor** is comprised of the three items retained from Step 1 and was third in the amount of variance explained.

Table 4.4 Physical Distribution (PHD): Items On Large-Scale Survey.

PK1	Packaging that minimizes damage to our final product
PK2	Packaging which facilitates efficient handling and transport of our outputs
PK3	Labeling on our packaged products that is accurate and distinguishable
PK4	Meeting the packaging specifications of our customers
PK5	Packaging sustaining our production plan
PK6	Packaging responding to special requests
PK7	The overall quality of our packaging function
FGW2	Finished goods warehousing picking and assembling customer orders accurately
FGW5	The overall quality of finished goods warehousing
FGW6	Finished goods warehousing responding promptly to customer requests
FGW7	Warehousing finished goods undamaged
ICO1	The accuracy of records concerning the quantities of finished product on-hand
ICO2	The accuracy of records concerning the location of finished goods in the warehouse
ICO3	The length of time required to update finished goods inventory records
ICO4	Maximizing overall revenue through the control of finished goods
ICO5	The overall quality of finished goods inventory control
OT2	Outbound transportation delivering shipments in the condition they were presented for transport
OT3	Outbound transportation providing us with a timely response to inquires
OT5	The cost we're incurring for outbound transportation
OT6	The overall quality of outbound transportation
OT7	Outbound transport meeting delivery schedules

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

Table 4.5 Physical Distribution (PHD) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	*CITC*	*Initial α*	*α: Retained Items*
Packaging			
PK1*	.684	α = .8948	α = .8948
PK2*	.713		
PK3*	.642		
PK4*	.725		
PK5*	.712		
PK6*	.625		
PK7*	.793		
Finished Goods Warehousing			
FGW2*	.702	α = .8505	α = .8505
FGW5*	.745		
FGW6*	.660		
FGW7*	.656		
Inventory Control - Outbound			
ICO1*	.786	α = .8753	α = .8834
ICO2*	.765		
ICO3*	.704		
ICO17*	.732		
ICO4**	.545		
Outbound Transportation			
OT3*	.691	α = .8458	α = .8474
OT6*	.791		
OT7*	.662		
OT2**	.618		
OT5**	.532		
* = Retained for Step 2 ** = Dropped			

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

Table 4.6 Physical Distribution (PHD) -- Step 2: Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .95				
Item	*Packaging Factor (2nd)*	*Finished Goods Management Factor (1st)*	*Outbound Transportation Factor (3rd)*	*α: Retained Items*
PK7*	.7831			α = .8442
PK6*	.6511			
PK4*	.6153			
PK2*	.6107			
PK1**	.5650			
PK5**	.5432	.4212		
PK3**	.4859	.4701		
ICO1*		.7939		α = .9216
FGW5*		.7406		
ICO5*		.7386		
ICO2*		.7359		
FGW2*		.7004		
ICO3*		.6847		
FGW6*		.6166		
FGW7**		.5668		
OT3*			.7816	α = .8474
OT6*			.6957	
OT7*			.6797	
* = Retained ** = Dropped				

Legend: PK -- Packaging, FGW -- Finished Goods Warehousing, ICO -- Inventory Control - Outbound, OT -- Outbound Transportation.

In Section 3.3.2 described the need for modifications to some of the Finished Goods Warehousing (FGW) items. In Step 2 of the large-scale analysis, the FGW items and the Inventory Control - Outbound (ICO) items loaded together and were fused into a single factor labeled **Finished Goods Management**. It explained the largest amount of variance. Unlike the inbound side (see 4.2.1), manufacturing managers apparently do not differentiate between warehousing and inventory control regarding the management of finished goods to insure customer satisfaction.

4.2.3 The Spanning Processes (SP) Construct

Table 4.7 displays the 21 Spanning Processes (SP) items placed on the large-scale survey. Step 1. Table 4.8 displays the results of Step 1 of analysis. PU6 and PU8 were dropped from the ***Purchasing (PU)*** dimension as they did not contribute strongly to α. Section 3.3.3 described the poor results attained regarding the ***Customer Order Processing (COP)*** dimension during the pilot study analysis. It was deemed to be inappropriate to exclude it as a feasible dimension of the SP construct at that stage of the research. It was deleted as a workable dimension of SP at this large-scale stage of analysis due to its low individual CITCs and unsatisfactory overall α of 0.6908.

A possible basis for this poor showing of Customer Order Processing as a dimension of logistics *Spanning Processes* is that the managers of manufacturing firms do not recognize their logistics management as the proprietor of the overall order processing operation. This was a condition set forth in the literature (e.g., Lambert & Stock, 1993) in support of designating customer order processing as a dimension of logistics spanning processes.

Section 3.3.3 also described the poor results attained regarding the ***Strategy Development (SD)*** dimension during the pilot study analysis. In this case the modifications made for the large-scale survey proved to be more effective. Only one item (SD6) was dropped from this dimension, and α for the

Table 4.7 Spanning Processes (SP): Items On Large-Scale Survey.

PU2	We select and evaluate suppliers effectively
PU3	Our communications with suppliers is excellent
PU6	Purchasing expends capital in a manner that maximizes our company's overall viability
PU7	The overall quality of our purchasing function is high
PU8	Purchasing obtains materials that meet specification
PU9	Purchasing is able to fill special requests promptly
COP3	Outbound logistics plays an important role in the fulfillment of customer orders
COP5	We manage inbound logistics, production support, & distribution as an integrated system
COP6	Inbound logistics plays an important role in the ultimate filling of customer orders
COP7	Our logistics function is an important coordinating mechanism in the filling of customer orders
COP8	Our logistics function enables us to process customer orders effectively
SD6	Our logistics function contributes at the highest levels to creating customer value
SD7	Logistics strategy is highly integrated with the strategic plans of other areas
SD8	Logistics personnel have input to strategy development for our organization
SD9	Logisticians are involved in strategic decisions that affect company growth
SD10	Logistics operations are administered in a manner that supports our strategic plan
ID2	The information used to manage logistics activity is readily available
ID4	Our logistics function provides meaningful information regarding the competitive environment
ID5	Our logistics function provides useful information on the requirements of individual markets/clients
ID7	We incorporate the latest information system technologies into logistics
ID8	We invest in information systems which help us manage our logistics function

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

Table 4.8 Spanning Processes (SP) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	*CITC*	*Initial α*	*α: Retained Items*
Purchasing			
PU2*	.649	α = .8472	α = .8212
PU3*	.639		
PU7*	.722		
PU9*	.650		
PU6**	.577		
PU8**	.561		
Customer Order Processing			
COP3**	.379	α = .6908	
COP5**	.378		
COP6**	.477		
COP7**	.571		
COP8**	.457		
Strategy Development			
SD7*	.588	α = .8178	α = .8011
SD8*	.606		
SD9*	.685		
SD10*	.634		
SD6**	.540		
Information Dissemination			
ID2*	.579	α = .8170	α = .8170
ID4*	.600		
ID5*	.647		
ID7*	.632		
ID8*	.586		
* = Retained for Step 2 ** = Dropped			

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

items retained for Step 2 was 0.8011. All five items were retained regarding the ***Information Dissemination (ID)*** dimension.

Step 2. Table 4.9 displays the results of submitting the 13 items remaining after Step 1 as a group to factor analysis to assess the external validity of the SP construct. The KMO measure of 0.90 indicates that factor analysis was appropriate. Two factors/dimensions (eleven items) were retained and placed on the suggested final instrument. A **Purchasing** factor ranked second in the amount of variance explained.

Items from the Strategy Development and Information Dissemination dimensions loaded together and were fused into a single factor -- labeled **Strategy/Information Management** -- during this phase of analysis. ID8 and ID7 were retained for the final instrument despite loadings slightly under 0.60 due to their importance to the research. ID5 and ID2 were not retained due to fairly significant (0.3718 and 0.3316, respectively) cross loading on the Purchasing factor. These cross loading are not shown in Table 4.9.

Although separate Strategy Development and Information Management factors were expected, the literature provides support for this re-conceptualization of a single Strategy/Information Management factor. Persson (1991) and Manheim (1992) cited in Chapter 2 suggest that modern information systems enable logisticians to contribute to strategy, but only if resources are allocated for these systems, and if the logisticians are accorded the opportunity to contribute. In other words, the logisticians ability to augment higher level strategy in a meaningful way is contingent on the existence of modern information technology and the opportunity for them to disseminate useful information.

Table 4.9 Spanning Processes (SP) -- Step 2: Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .90			
Item	*Purchasing Factor (2nd)*	*Strategy/ Information Management Factor (1st)*	*α: Retained Items*
PU7*	.7598		α = .8212
PU3*	.6737		
PU2*	.6737		
PU9*	.6603		
SD9*		.6764	α = .8481
SD10*		.6394	
SD8*		.6245	
SD7*		.6178	
ID4*		.6077	
ID8*		.5980	
ID7*		.5921	
ID5**		.5919	
ID2**		.5817	
* = Retained ** = Dropped			

Legend: PU -- Purchasing, COP -- Customer Order Processing, SD -- Strategy Development, ID -- Information Dissemination.

4.2.4 The Capacity To Satisfy Customers (CTSC) Construct

Table 4.10 displays the 31 Capacity To Satisfy Customers (CTSC) items placed on the large-scale survey. Step 1. Table 4.11 displays the results of Step 1 of the analysis. Two items were dropped from the ***Price Offered (PR)*** dimension, one each was dropped from the ***Quality of Products (QP)***, ***Product Line Breadth (PLB)*** and ***Order Fill Rate (FR)*** dimensions. Two items each were dropped from the ***Order Cycle Time (OCT)*** and ***Order/Shipment Information (OSI)*** dimensions. The four ***Frequency of Delivery (FD)*** dimension items were retained for Step 2.

Step 2. Table 4.12 displays the results of submitting the 22 items remaining after Step 1 as a group to factor analysis to assess the external validity of the CTSC construct. The KMO measure of 0.91 indicates that factor analysis was appropriate. Four factors/dimensions (nineteen items) were retained and placed on the suggested final instrument.

Section 3.3.4 described the item modifications and additions made for the large-scale analysis regarding the Capacity To Satisfy Customers construct. For the most part, these alterations were successful. **Price Offered**, **Quality of Products**, and **Product Line Breadth** emerged as distinct factors ranking fourth, second, and third, respectively, in variance explained.

During the pilot study analysis OCT, FR, and FD items loaded on a single factor. In Step 2 of the large-scale

Table 4.10 Capacity To Satisfy Customers (CTSC): Items On Large-Scale Survey.

PR5	We offer competitive prices
PR9	We guarantee our prices
PR6	We are able to compete based on our prices
PR7	We are able to offer prices as low or lower than our competitors
PR8	We are able to sell our products at prices that are above average
QP5	We offer products that function according to customer needs
QP6	We are able to compete based on quality
QP8	We offer products that are highly reliable
QP9	We offer products that are very durable
QP10	We offer high quality products to our customers
PLB8	We respond well to changing customer preferences regarding products
PLB9	We respond well to changing customer preferences regarding accompanying services
PLB13	We alter our product offerings to meet client needs
PLB14	We respond well to customer demand for "new" features
PLB15	We offer the products and services our customers want
FR14	Our frequency of customer backorders is low
FR15	Our customers are satisfied with our level of completeness for <u>routine</u> shipments
FR18	We deliver the assortment of products ordered
FR17	We deliver the desired quantities of products
OCT17	We offer customers a reliable order processing time
OCT18	The time from our receipt of an order to possession of the shipment by that customer is acceptable to our clients
OCT20	Orders submitted to us are delivered on-time, <u>as defined by the customer</u>
OCT21	We provide on-time delivery of customer orders

continued ....

Table 4.10 (Continued).

OSI23	We supply accurate projected shipping dates
OSI24	We supply accurate projected delivery dates
OSI26	We supply clients with accurate information regarding product availability
OSI27	We respond with accurate information to a customer inquiry concerning an order
FD26	Our customers are pleased with the frequency of our delivery
FD27	We can alter our delivery schedule per each customer's requirements
FD29	We are flexible in developing delivery schedules
FD30	We work with each customer to develop a delivery schedule that is acceptable

analysis, items from the Order Fill Rate, Order Cycle Time, Order/Shipment Information, and Frequency of Delivery dimensions loaded together and were fused into a single dimension. It was labeled **Delivery Capability** and explained the largest amount of variance.

There is support in the literature for re-conceptualizing these four dimensions as a single factor. Goldhar, et al., (1991), Hall (1992), Lado, et al., (1992), and Porter (1992) state that customer satisfaction today depends on providing unique, high quality, products at a reasonable expense. These attributes of customer satisfaction are represented in the **Price Offered**, **Quality of Products**, and **Product Line Breadth** factors. These authors also contend that customer satisfaction is contingent on a efficient, flexible delivery system. The manufacturing managers surveyed may perceive high order fill rates, short order cycle times, accurate order and shipment

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Table 4.11 Capacity To Satisfy Customers (CTSC) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	CITC	Initial α	α:Retained Items
Price Offered			
PR5*	.532	α = .5654	α = .7899
PR6*	.585		
PR7*	.458		
PR9**	.273		
PR8**	-.080		
Quality Of Products			
QP2*	.641	α = .8631	α = .8588
QP4*	.761		
QP5*	.695		
QP6*	.772		
QP1**	.578		
Product Line Breadth			
PLB1*	.730	α = .8468	α = .8425
PLB2*	.665		
PLB6*	.660		
PLB7*	.676		
PLB8**	.561		
Order Fill Rate			
FR2*	.577	α = .7506	α = .7456
FR3*	.666		
FR6*	.575		
FR5**	.430		
* = Retained for Step 2 ** = Dropped			

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Order Cycle Time			
Item	*CITC*	*Initial α*	*α:Retained Items*
OCT4*	.825	α = .8902	α = .9192
OCT5*	.832		
OCT2**	.753		
OCT1**	.637		
Order/Shipment Information			
OSI3*	.801	α = .8663	α = .9057
OSI4*	.784		
OSI6**	.655		
OSI7**	.631		
Frequency Of Delivery			
FD1*	.587	α = .7916	α =.7916
FD2*	.584		
FD4*	.614		
FD5*	.631		
* = Retained for Step 2 ** = Dropped			

information, and an acceptable frequency of delivery as facets of a single customer satisfaction attribute: excellent delivery capability.

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

Table 4.12 Capacity To Satisfy Customers (CTSC) -- Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .93					
Item	*Price Offered Factor (4th)*	*Quality Of Products Factor (2nd)*	*Product Line Breadth Factor (3rd)*	*Delivery Capability Factor (1st)*	*α: Retained Items*
PR6*	.8288				
PR5*	.7054				α = .7899
PR7*	.6436				
QP6*		.8215			
QP4*		.7934			α = .8588
QP5*		.7141			
QP2*		.6233			
PLB1*			.7760		
PLB2*			.6708		α = .8425
PLB7*			.6651		
PLB6*			.6543		
OSI4*				.8559	
OCT5*				.8549	
OSI3*				.8299	
OCT4*				.8194	α = .9292
FD1*				.7272	
FR3*				.6789	
FR2*				.6654	
FD5*				.6536	
FD4**				.5291	
FR6**				.5197	
FD2**				.5036	
* = Retained ** = Dropped					

Legend: PR -- Price Offered, QP -- Quality of Products, PLB -- Product Line Breadth, FR -- Order Fill Rate, OCT -- Order Cycle Time, OSI -- Order/Shipment Information, FD -- Frequency of Delivery.

4.2.5 The Manufacturing Flexibility (MF) Construct

Table 4.13 Manufacturing Flexibility: Items On Large-Scale Survey.

APT5	We have incorporated real-time process control into our production systems
APT6	We utilize production technology that is among the most flexible in our industry
APT7	We apply computer-enhanced technology to improve the flexibility of manufacturing
APT8	We reorganize our facilities as necessary to increase our manufacturing flexibility
MMP1	The input of manufacturing plant managers is an integral part of the strategy formation process
MMP2	Manufacturing plant managers are involved in decisions related to strategies for company growth
MMP3	Manufacturing plant managers have a good understanding as to how company/divisional strategy is formed
PM3	Production workers share responsibility for planning
PM5	Production supervisors receive labor relations training
PM6	Production employees have access to a progressive training program
PM7	Production workers participate in quality assurance

Table 4.13 displays the 11 Manufacturing Flexibility (MF) items placed on the large-scale survey. Step 1. Table 4.14 displays the results of Step 1 of analysis. One item was dropped from the ***Advanced Process Technology (APT)*** dimension. The three items for the ***Manufacturing Managers Participation in Corporate Strategy (MMP)*** dimension were retained.

Participative Management (PM) did not emerge as a workable dimension of MF at this stage of analysis due to its

Legend: APT -- Advanced Process Technology, MMP -- Manufacturing Managers Participation in Corporate Strategy, and PM -- Participative Management.

Table 4.14 Manufacturing Flexibility (MF) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	CITC	Initial α	α:Retained Items
Advanced Process Technology			
APT5*	.599	α = .7759	α = .7727
APT6*	.666		
APT7*	.596		
APT8**	.481		
Manufacturing Managers Participation In Corporate Strategy			
MMP1*	.585	α = .7538	α = .7538
MMP2*	.625		
MMP3*	.545		
Participative Management			
PM3**	.459	α = .7058	
PM5**	.427		
PM6**	.605		
PM7**	.502		
* = Retained for Step 2 ** = Dropped			

low individual CITCs and unsatisfactory overall α of 0.7058. Section 3.3.5 describes the loading of items from APT and PM on a single factor and the modification and adding of items in an attempt to strengthen each dimension. There is a reasonable basis for the poor showing of Participative Management as a dimension of MF in the large-scale analysis. Weick (1990), Zuboff (1988), and others maintain utilizing advanced process technology to its full potential entails allowing the operators full involvement in managing the system. It is

Legend: APT -- Advanced Process Technology, MMP -- Manufacturing Managers Participation in Corporate Strategy, and PM -- Participative Management.

possible the managers of manufacturing firms view a participative management style as a component of, or a means to, incorporating advanced process technology into the production process, and not a distinct factor itself. The findings here support the research of Swamidass & Newell (1987) and Ward, et al., (1994) which state that proactiveness in regards to technology alone is not enough to insure flexibility. They contend another critical ingredient is the participation of manufacturing managers in corporate and/or business unit strategy.

Step 2. Table 4.15 displays the results of submitting the 6 items remaining after Step 1 as a group to factor analysis to assess the external validity of the MF construct. The KMO measure of 0.77 indicates that factor analysis was appropriate. Two factors/dimensions (six items) were retained and placed on the suggested final instrument. The **Technology** factor explained the largest amount of variance, while the **Participation In Strategy** factor ranked second. MMP3 was retained despite a loading of below 0.60 due to its importance to the research.

Table 4.15 Manufacturing Flexibility (MF) -- Step 2: Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .77			
Item	*Technology Factor (1st)*	*Participation In Strategy Factor (2nd)*	*α: Retained Items*
APT6*	.7611		α = .7727
APT5*	.6761		
APT7*	.6497		
MMP2*		.7847	α = .7538
MMP1*		.6822	
MMP3*		.5888	
* = Retained ** = Dropped			

Legend: APT -- Advanced Process Technology, MMP -- Manufacturing Managers Participation in Corporate Strategy, and PM -- Participative Management.

4.2.6 The Level of Performance (LOP) Construct

Table 4.16 Level Of Performance: Items On Large-Scale Survey.

CS1	Customers perceiving they receive their money's worth when they purchase our products
CS2	Customer retention rate
CS3	Generating new business through customer referrals
CS4	Customers feeling we offer products with high value
FP1	Sales growth position
FP2	Market share gain
FP3	Return on investment
FP4	New product success rate
FP5	Overall competitive position

Table 4.16 displays the 11 Manufacturing Flexibility (MF) items placed on the large-scale survey. Step 1. Table 4.17 displays the results of Step 1 of analysis. The four ***Customer Satisfaction (CS)*** items and three of the five ***Financial Performance (FP)*** items were retained for Step 2.

Step 2. Table 4.18 displays the results of submitting the 7 items remaining after Step 1 as a group to factor analysis to assess the external validity of the LOP construct. The KMO measure of 0.88 indicates that factor analysis was appropriate. One factor/dimension (six items) was retained and placed on the suggested final instrument.

In the model development section of Chapter 2, the LOP construct was expected to embody two dimensions. This was the case in the pilot study analysis (see Section 3.3.6) as a

Legend: CS – Customer Satisfaction and FP – Financial Performance.

financial performance factor and a customer satisfaction factor emerged. In this phase of the large-scale analysis, a single factor emerged and was labeled the **Performance** factor. A possible explanation is that the manufacturing managers responding do not differentiate between providing excellent customer service and the attainment of financial goals in their perception of their firms' level of performance. CS4 -- which was added after the pilot study analysis -- was not retained for the final suggested instrument due its poor loading.

Table 4.17 Level Of Performance (LOP) -- Step 1: Initial Statistics and α After Purification (Large-Scale Survey).

Item	CITC	Initial α	α:Retained Items
Customer Satisfaction			
CS1*	.664	α = .8013	α = .8013
CS2*	.658		
CS3*	.553		
CS4*	.612		
Financial Performance			
FP1*	.719	α = .8626	α = .8605
FP2*	.786		
FP5*	.754		
FP3**	.641		
FP4**	.529		
* = Retained for Step 2 ** = Dropped			

Legend: CS -- Customer Satisfaction and FP -- Financial Performance.

Table 4.18 Level Of Performance (LOP) -- Step 2: Final Factors, Loadings, and α (Large-Scale Survey).

KAISER-MEYER-OLKIN Measure of Sampling Adequacy = .88		
Item	*Performance Factor*	*α: Retained Items*
FP2*	.8443	α = .8918
CS2*	.7892	
FP1*	.7815	
FP5*	.7795	
CS3*	.6718	
CS1*	.6351	
CS4**	.5691	
* = Retained ** = Dropped		

Legend: CS -- Customer Satisfaction and FP -- Financial Performance.

4.2.7 Composite Measure Correlation

Appendix D contains the dimensions/factors and final items suggested for each construct. Cronbach's Alpha (α) was derived by submitting the items remaining for each construct to SPSS®. For example, eight items (ICI1, ICI2, ICI3, ICI10, IT1, IT3, IT6, IT7) were submitted as a group to SPSS® to determine an overall α for the Physical Supply (PHS) construct. Table 4.19 gives the results of this analysis.

Table 4.19 Each Construct's Final Alpha After Purification and Factor Analysis (Large-Scale Survey).

Construct	Dimensions/ Factors	Retained Items	α
Physical Supply (PHS)	2	8	.84
Physical Distribution (PHD)	3	14	.93
Spanning Processes (SP)	2	11	.87
Capacity To Satisfy Customers (CTSC)	4	19	.91
Manufacturing Flexibility (MF)	2	6	.77
Level Of Performance (LOP)	1	6	.89

The remaining items for each construct were then summed to derive a composite measure. For example, the composite measure for the Physical Supply (PHS) construct was calculated by summing the scores for the same eight items (i.e., ICI1, ICI2, ICI3, ICI10, IT1, IT3, IT6, IT7). Each of these composite measures were then submitted to SPSS® to determine the Pearson product-moment correlation coefficients (r) for each relationship of interest. Table 4.20 displays the results.

The correlation coefficients are acceptable and significant at $\alpha = .01$. This indicates that the constructs of interest are statistically related which validates the possibility of causal relationships. As result of the second phase of instrument development, 64 items are suggested for the final instrument (see Appendix D).

Table 4.20 Correlations Between The Final Composite Measures To Assess Predictive Validity (Large-Scale Survey).

Independent Variable	Dependent Variable	*r*
Physical Supply (PHS)	(CTSC)	.33
Physical Distribution (PHD)	(CTSC)	.46
Spanning Processes (SP)	(CTSC)	.52
Manufacturing Flexibility (MF)	(CTSC)	.51
Capacity To Satisfy Customers (CTSC)	Level Of Performance (LOP)	.48
Note: Significant at $\alpha = .01$.		

The two phases of instrument development described in Chapters 3 and 4 have resulted in measures for the constructs delineated in Chapter 2 which are valid and reliable. Also, the use of a pilot test avoided to some extent the limitations found in developing an instrument and testing hypothesized relationships with the same data. Chapter 5 will report on the testing of the model and hypotheses presented in Chapter 2.

CHAPTER 5: CAUSAL MODEL/ HYPOTHESIS TESTING

5.1 FINAL RELIABILITY AND VALIDITY VERIFICATION

Table 5.1 contains a summary of measurement analysis (Flynn, Schroeder, & Sakakibara, 1994) regarding the reliability and construct validity of the items/measures resulting from the instrument development described in

Table 5.1 Summary of Measurement Analysis.

Construct	Dimension/Factor	Items	α	KMO	Eigenvalue
Physical Supply (PHS)	Inbound Transportation (IT)	4	.79	.76	1.98
	Inbound Inventory Control (ICI)	4	.88	.81	2.60
Physical Distribution (PHD)	Packaging (PK)	4	.84	.78	2.27
	Finished Goods Management (FGM)	7	.92	.93	4.31
	Outbound Transportation (OT)	3	.85	.73	1.94
Spanning Processes (SP)	Purchasing (PU)	4	.82	.79	2.17
	Strategy/Information Management (S/IM)	7	.85	.84	3.05
Capacity To Satisfy Customers (CTSC)	Price Offered (PR)	3	.79	.70	1.75
	Quality of Products (QP)	4	.86	.81	2.48
	Product Line Breadth (PLB)	4	.84	.80	2.27
	Delivery Capability (DC)	8	.93	.91	4.95
Manufacturing Flexibility (MF)	Technology (APT)	3	.77	.70	1.56
	Participation in Strategy (MMP)	3	.75	.68	1.52
Level Of Performance (LOP)	Performance	6	.89	.88	3.39

Chapters 3 and 4. The final alpha value (α), Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and eigenvalue for each of the scales is displayed. In each case the KMO indicates that factor analysis is appropriate (Kaiser 1970). The concluding within-scale factor analysis shows that the eigenvalue for each of the scales exceeds the minimum acceptable eigenvalue of 1.00 (Ghiselli, Campbell, & Zedeck, 1981).

Tables 5.2 and 5.3 display the results of submitting composite measures of the independent and dependent variables to SPSSX® to determine the Pearson product-moment correlations. This analysis was performed to conduct a concluding discriminant validity check for the items retained on the final instrument. The absence of strong correlations other than those anticipated, e.g., between inbound and

Table 5.2 Correlations Between The Composite Measures Of The Final Independent Variables To Assess Discriminant Validity.

Dimension (μ, σ)	IT	ICI	PK	FGM	OT	PU	S/IM	APT
IT (3.28, 0.55)								
ICI (3.34, 0.86)	.39							
PK (3.46, 0.63)	.38	.41						
FGM (3.59, 0.74)	.43	.73	.65					
OT (3.47, 0.64)	.55	.40	.59	.55				
PU (3.62, 0.73)	.35	.22	.39	.28	.35			
S/IM (3.20, 0.69)	.28	.39	.35	.37	.30	.52		
APT (3.42, 0.87)	.20	.34	.33	.35	.28	.37	.56	
MMP (3.96, 0.65)	.19	.20	.25	.26	.27	.36	.39	.39

Legend: IT - Inbound Transportation, ICI - Inbound Inventory Control, PK - Packaging, FGM - Finished Goods Management, OT - Outbound Transportation, PU - Purchasing, S/IM - Strategy/Information Management, APT - Advanced Process Technology, MMP - Manufacturing Managers Participation In Corporate Strategy.

outbound transportation, indicate that the items accurately measure what they were intended to measure (Hair, et al., 1995).

The composite measures were calculated by summing the individual scores for each item of a dimension and then dividing by the number of items. For example, the responses to IT1, IT3, IT6, and IT7 were summed and then divided by four to determine the composite measure for Inbound Transportation, represented by IT. These mean scores (μ) and their standard deviations (σ) are given in parentheses in the left-hand columns of Tables 5.2 and 5.3.

Table 5.3 Correlations Between The Composite Measures Of The Final Dependent Variables To Assess Discriminant Validity.

Dimension (μ, σ)	PR	QP	PLB	DC
PR (3.67, 0.77)				
QP (4.40, 0.56)	.23			
PLB (4.05, 0.64)	.32	.47		
DC (3.81, 0.74)	.34	.33	.37	
LOP (3.68, 0.70)	.31	.39	.47	.33

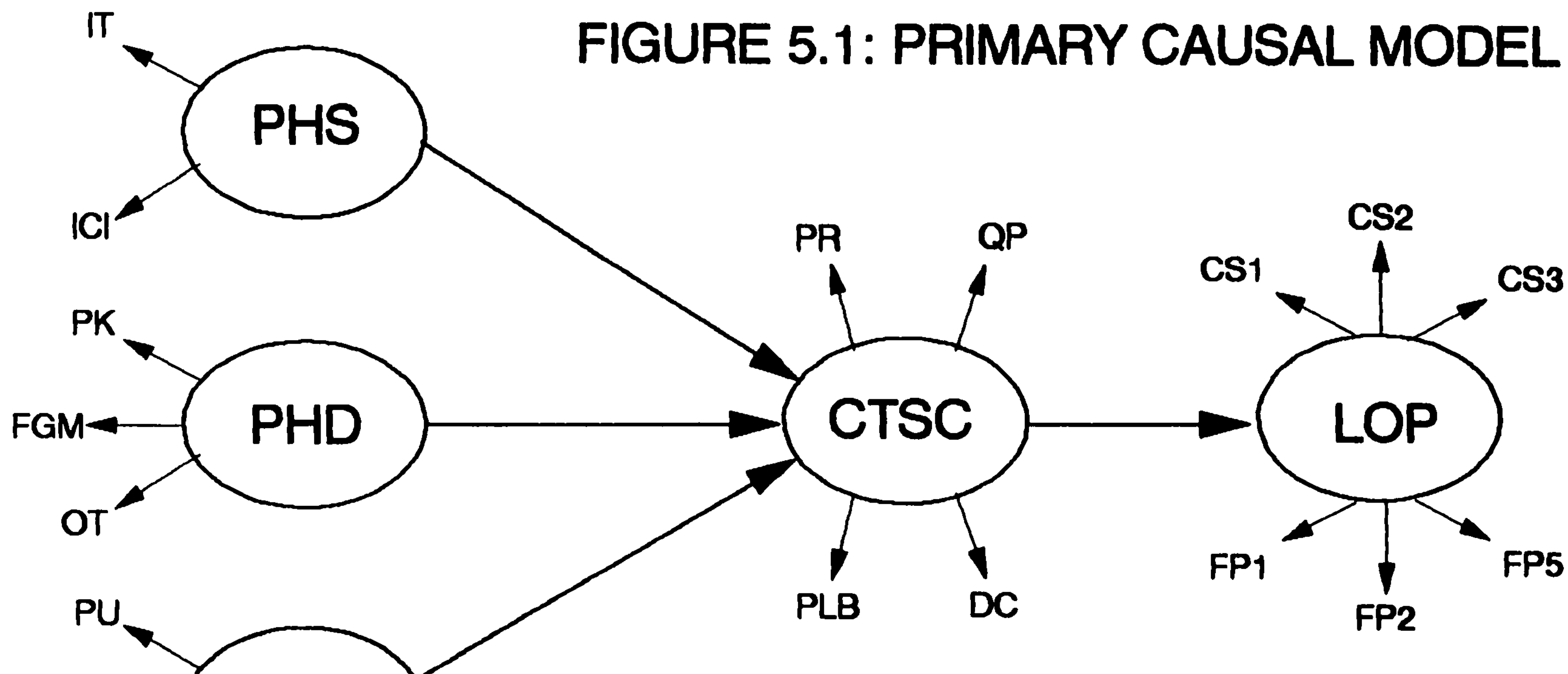
Legend: PR - Price Offered, QP - Quality of Products, PLB - Product Line Breadth, DC - Delivery Capability, LOP - Level of Performance

5.2 THE CAUSAL MODEL

Exogenous Latent Constructs

Figure 5.1 is an extension of the model shown in Figure 2.3. It displays the causal model which emerges after the various phases of factor analysis reported in Chapter 4.

FIGURE 5.1: PRIMARY CAUSAL MODEL



Legend:

PHS - Physical Supply
IT - Inbound Transportation
ICI - Inventory Control: Inbound

PHD - Physical Distribution
PK - Packaging
FGM - Finished Goods Management
OT - Outbound Transportation

SP - Spanning Processes
PU - Purchasing
S/IM - Strategy/Information Management

CTSC - Capacity To Satisfy Customers
PR - Price Offered
QP - Quality of Products
PLB - Product Line Breadth
DC - Delivery Capabilities

LOP - Level Of Performance
CS - Customer Satisfaction
FP - Financial Performance

It was theorized in Chapter 2 that the Physical Supply (PHS) construct would be found to be a function of four logistics processes that take place before or during production: inbound transportation, material warehousing, inventory control - inputs, and production support. Section 4.2.1 describes how material warehousing and production support did not emerge as dimensions (factors) of the PHS construct. Figure 5.1 accordingly shows inbound transportation (IT) and inventory control - inputs (ICI) as the two observable measures or indicators of the exogenous latent construct/variable, PHS. IT represents the composite average score (see the previous section) for the four Inbound Transportation items retained, while ICI represents the composite average score for the four Inventory Control - Inputs items retained.

Figure 5.1 displays the composite average scores for Packaging (PK), Finished Goods Management (FGM), and Outbound Transportation (OT), as the observable indicators of the exogenous latent construct/variable, PHD. The composite average scores for Purchasing (PU) and Strategy/ Information Management (S/IM) are displayed in Figure 5.1 as the observable indicators of the exogenous latent construct/ variable, SP.

Endogenous Latent Constructs

Figure 5.1 displays the composite scores for Price Offered (PR), Quality of Products (QP), Product Line Breadth

(PLB), and Delivery Capability (DC) as the observable indicators of the endogenous latent construct/variable, CTSC. In structural equation modeling it is preferable to have several indicators of a construct as opposed to a single indicator (Hair, et al., 1995). Therefore, as displayed in Figure 5.1, the average score for each of the six retained measures (i.e., CS1, CS2, CS3, FP1, FP2, FP5) are employed as observable indicators of the latent endogenous construct/variable, LOP.

Causal Relationships

In this section, the constructs specified in the previous two sections will be used as building blocks to define the causal relationships suggested by Figure 2.3 and in the hypothesis development sections of Chapter 2.

Hypothesis 1 is represented in Figure 2.3 by the number 1 and is stated in Chapter 2 as follows: *There is a positive relationship between the quality of a firm's Logistics Processes and its Capacity to Satisfy Customers.* In the causal model shown in Figure 5.1, Hypothesis 1 is represented by the three straight arrows which emanate from each of the three exogenous constructs PHS, PHD, and SP, and terminate at the endogenous construct CTSC. These straight arrows indicate a direct causal relationship from each of the logistics processes constructs to the CTSC construct.

Hypothesis 2 is represented in Figure 2.3 by the number 2 and is stated in Chapter 2 as follows: *The level of*

Manufacturing Flexibility will moderate the relationship between Logistics Processes and the Firm's Capacity to Satisfy Customers. Hypothesis 2 is not explicitly depicted in Figure 5.1 as it cannot be represented as a direct causal relationship. Rather, the moderating effect of manufacturing flexibility will be investigated by dividing the sample into two groups based on a composite measure of manufacturing flexibility. The causal model in Figure 5.1 will then be tested separately -- once with the group with relatively high manufacturing flexibility, and again with the group with a relatively low level. Any differences between the two groups regarding significant causal relationships will then be noted.

Hypothesis 3 was represented in Figure 2.3 by the symbols **3a** and **3b** and is presented in Chapter 2 as two hypotheses: *There is a positive relationship between the Firm's Capacity to Satisfy Customers and Overall Customer Satisfaction;* and, *There is a positive relationship between the Firm's Capacity to Satisfy Customers and its Financial Performance*. Given that factor analysis established the (Level Of) Performance construct consists of a single dimension, Hypotheses 3a and 3b will be combined to read as follows -- <u>Hypothesis 3:</u> *There is a positive relationship between the Firm's Capacity to Satisfy Customers and its Level Of Performance*. Hypothesis 3 is represented in Figure 5.1 by a straight arrow which emanates from the endogenous construct CTSC and terminates at the endogenous construct LOP.

5.3 RESULTS OF TESTING THE CAUSAL MODEL UTILIZING LISREL.

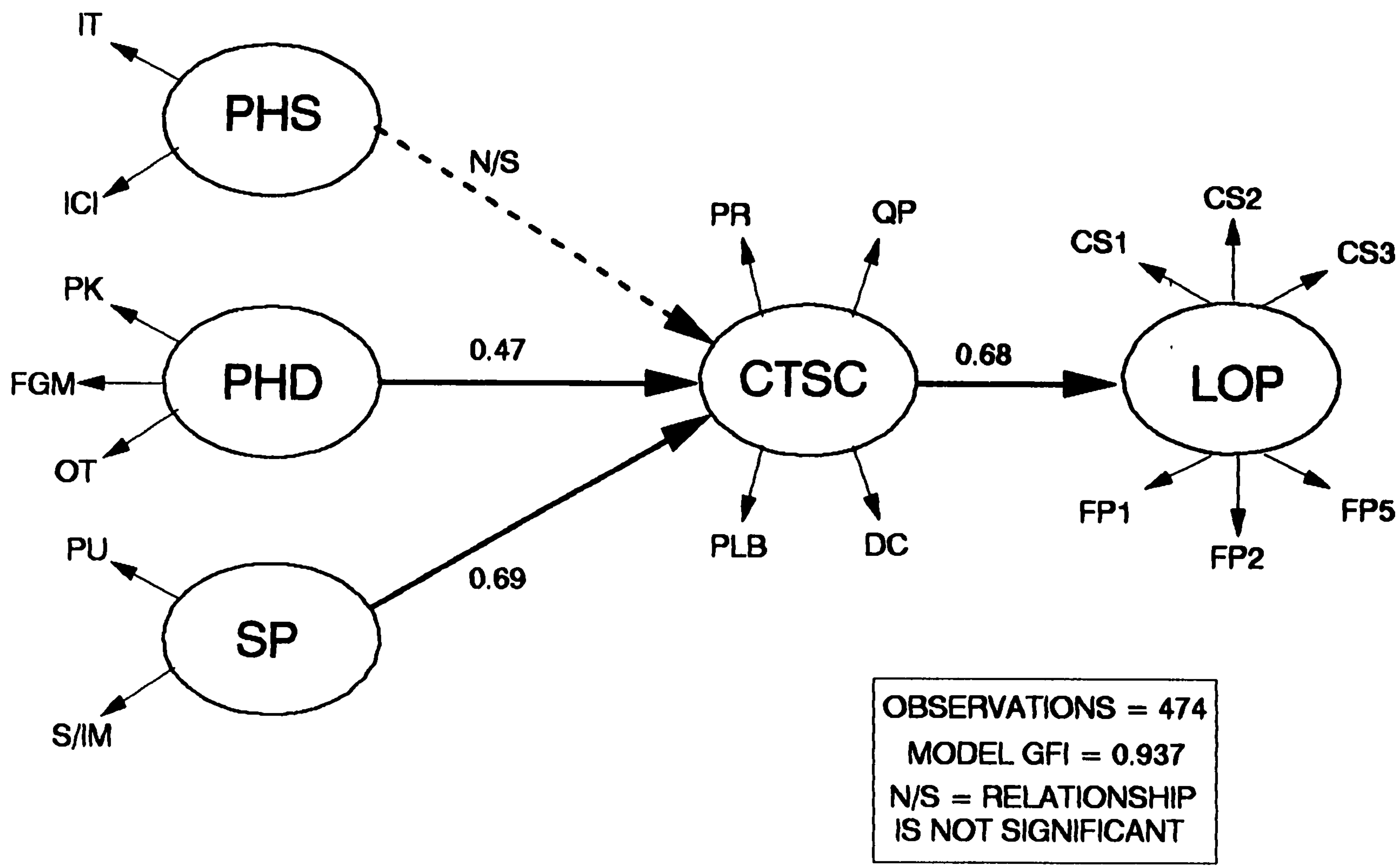
Linear structural relations (LISREL) provides a vigorous method for testing causal models with both observable and latent variables as it is capable of simultaneously evaluating both the measurement and causal components of complex models. LISREL consequently is becoming preferred to correlation, regression, or path analysis by researchers for testing causal models (Dillion & Goldstein, 1984).

The goodness-of-fit index (GFI) was used to evaluate the appropriateness of the models tested. It is relatively robust against departures from normality and appraises all of the model's parameters -- including measurement items, directional relationships, and error terms -- at the same time. GFI provides a measure ranging from zero to one. GFI will be close to one if a "good" model to data fit is detected (Dillion & Goldstein, 1984). The statistical distribution of the GFI measure is unknown, so there is no absolute standard with which to compare them (Jöreskog & Sörbom, 1989).

5.3.1 Testing Hypothesis 1 and Hypothesis 3.

Figure 5.2 displays the results of submitting the causal model depicted in Figure 5.1 to LISREL analysis to test Hypothesis 1 and Hypothesis 3. The entire group of 474 suitable responses (see Chapter 4) were utilized in this phase of analysis. Although not shown in Figure 5.2, the three exogenous variables (i.e., PHS, PHD, SP) were allowed to co-

FIGURE 5.2: RESULTS OF LISREL ANALYSIS TO TEST HYPOTHESIS 1 AND HYPOTHESIS 3.



vary. The GFI of 0.937 indicates of good model to data fit.

The *t*-values computed by LISREL to evaluate the statistical significance (at $\alpha = 0.05$) of the indicators are shown in Table 5.4. They are above the minimum acceptable value of 2.00. Table 5.4 also displays the LISREL coefficients which gives an indication of the relative strength of each of the indicators.

Table 5.4 Summary Of LISREL Generated Data -- Indicators (Entire Sample: Figure 5.2).

Independent Variable Indicator	LISREL Co-efficient	*t*-value	Dependent Variable Indicator	LISREL Co-efficient	*t*-value
IT	0.591	-	PR	0.470	-
ICI	0.614	9.113	QP	0.584	7.995
PK	0.819	12.431	PLB	0.614	8.205
FGM	0.802	11.309	DC	0.611	8.267
OT	0.727	-	CS1	0.775	-
PU	0.714	-	CS2	0.757	14.391
S/I	0.729	11.669	CS3	0.718	13.140
			FP4	0.655	12.140
			FP5	0.847	14.400
			FP8	0.795	15.036

Table 5.5 displays a summary of the data generated by LISREL related to the testing of the relationships of interest between the constructs. Hypothesis 1 is supported because a positive relationship is demonstrated between the quality of a firm's logistics processes and its capacity to satisfy

Table 5.5 Summary Of LISREL Generated Data -- Hypothesis 1 And Hypothesis 3 (Entire Sample: Figure 5.2).

Relationship	*t*-value	Significant?	LISREL Coefficient	*r*
PHS → CTSC	-1.295	NO	-0.286	0.607
PHD → CTSC	2.937	YES	0.467	0.644
SP → CTSC	4.680	YES	0.693	0.766
CTSC → LOP	7.589	YES	0.680	0.698

customers. The results of testing this general model indicate that logistics creates value to customers through the advantageous administration of the physical distribution and spanning processes functions. It appears the relationship between logistics spanning processes (SP) and the firm's capacity to satisfy customers (CTSC) is stronger than the relationship between physical distribution (PHD) and the firm's capacity to satisfy customers (CTSC). Future research would include using the LISREL program to test the LISREL coefficients to determine if they are statistically different.

This exploratory analysis does not preclude the possibility that the physical supply function (or the inbound transportation or inventory control - inbound processes individually) positively impacts one or more of the customer service attributes. For example, inbound transportation may have a significant positive influence on the quality of the firm's products. Chapter 6 will discuss the possibilities for performing future research in this area.

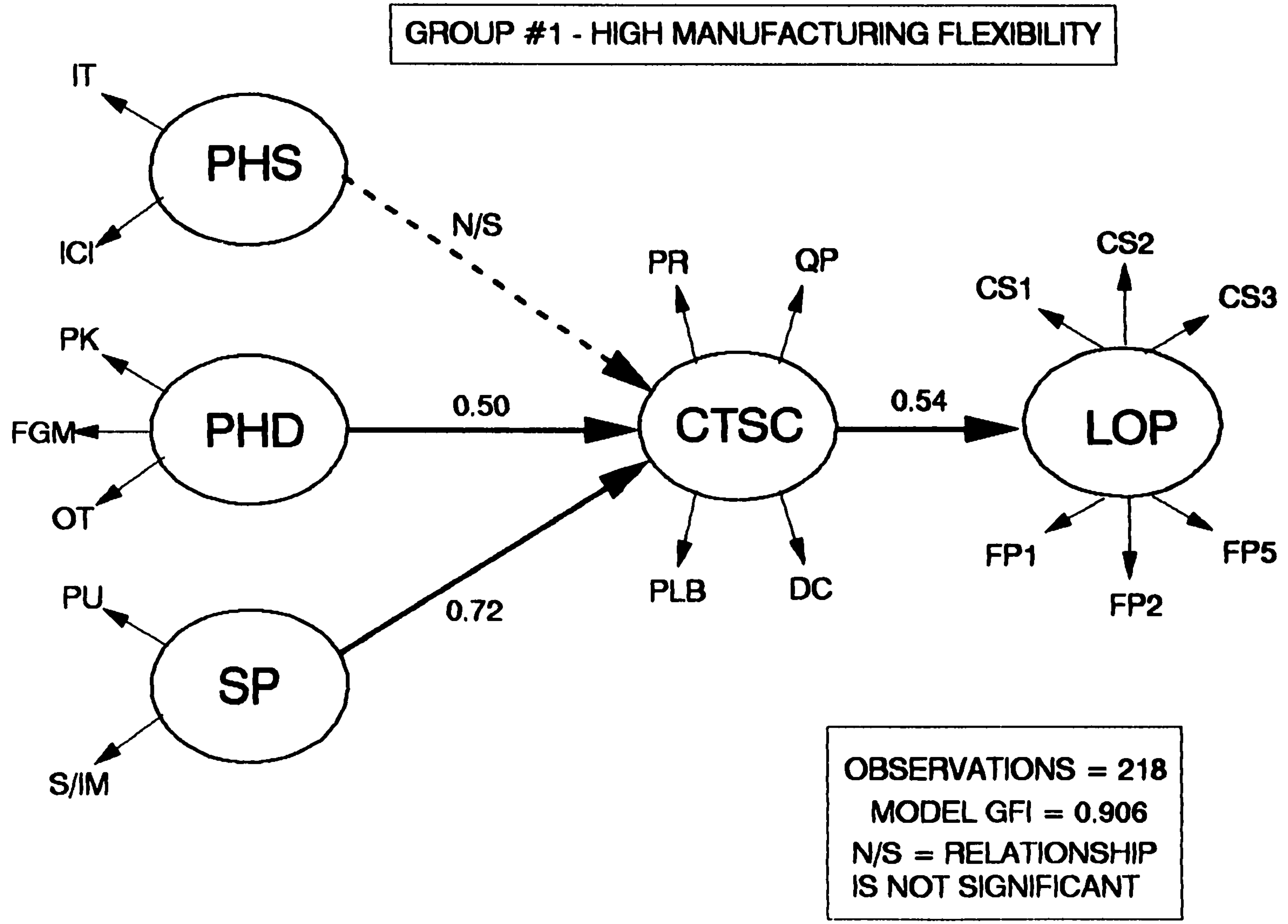
Hypothesis 3 is also supported as a positive relationship is demonstrated between the capacity to satisfy customers (CTSC) and the level of performance (LOP) constructs. Taken in conjunction with the acceptance of Hypothesis 1, it can be concluded that logistics processes -- at the least physical distribution and logistics spanning processes -- positively affect firm performance when executed in a manner conducive to satisfying the firm's customers.

5.3.2 Testing Hypothesis 2.

As noted in the section headed **Causal Relationships**, it was necessary to separate the sample into two groups to test Hypothesis 2. A composite score for manufacturing flexibility was calculated by summing the scores each respondent gave to the items found to be statistically significant indicators of manufacturing flexibility (see Section 4.2.5) and then dividing by six. Thirty-one respondents did not provide answers to all six of the items and were not included in this analysis. The average composite score for the remaining 443 respondents was 3.699. Two-hundred eighteen (218) respondents with a composite score greater than 3.699 were placed in Group 1 -- the High Manufacturing Flexibility group. Two-hundred twenty-five (225) had a composite score of less than 3.699 and were placed in Group 2 -- the Low Manufacturing Flexibility group.

The causal model depicted in Figure 5.1 was submitted to LISREL utilizing the information relative to Group 1. The results are displayed in Figure 5.3A. As shown in Table 5.6,

FIGURE 5.3A: LISREL ANALYSIS TO TEST HYPOTHESIS 2.



the *t*-values for the indicators were over 2.00.

Table 5.6 Summary Of LISREL Generated Data -- Indicators (High Manufacturing Flexibility: Figure 5.3A).

Independ. Variable Indicator	LISREL Co-efficient	*t*-value	Dependent Variable Indicator	LISREL Co-efficient	*t*-value
IT	0.604	-	PR	0.386	-
ICI	0.670	5.974	QP	0.622	4.600
PK	0.751	7.817	PLB	0.697	4.734
FGM	0.853	6.586	DC	0.494	4.598
OT	0.635	-	CS1	0.767	-
PU	0.647	-	CS2	0.757	9.852
S/I	0.639	6.075	CS3	0.664	8.868
			FP4	0.702	8.444
			FP5	0.831	9.126
			FP8	0.832	10.362

Table 5.7 displays the results of testing the pertinent relationships with LISREL. Positive relationships were demonstrated between PHD and CTSC, and between SP and CTSC, with the second relationship again appearing to be stronger.

Table 5.7 Summary Of LISREL Generated Data: Group 1 -- High Manufacturing Flexibility (Figure 5.3A).

Relationship	*t*-value	Significant?	LISREL Coefficient	*r*
PHS → CTSC	-1.400	NO	-0.432	0.439
PHD → CTSC	2.010	YES	0.501	0.548
SP → CTSC	3.016	YES	0.723	0.732
CTSC → LOP	3.789	YES	0.537	0.583

The relationship between CTSC and LOP was also found to be significant.

The causal model depicted in Figure 5.1 was then submitted to LISREL utilizing the information relative to Group 2. The results are displayed in Figure 5.3B.

As shown in Table 5.8, the t-values for the indicators were again over 2.00. Table 5.9 displays the results of testing the pertinent relationships with LISREL. In this instance, a single relationship was found to be significant -- the one between CTSC and LOP.

Table 5.8 Summary Of LISREL Generated Data -- Indicators (Low Manufacturing Flexibility: Figure 5.3B).

Independ. Variable Indicator	LISREL Co-efficient	*t*-value	Dependent Variable Indicator	LISREL Co-efficient	*t*-value
IT	0.494	-	PR	0.366	-
ICI	0.410	5.099	QP	0.673	3.779
PK	0.883	6.497	PLB	0.530	3.695
FGM	0.659	5.650	DC	0.551	4.017
OT	0.762	-	CS1	0.583	-
PU	0.689	-	CS2	0.825	8.458
S/I	0.676	6.555	CS3	0.585	7.139
			FP4	0.711	8.181
			FP5	0.775	8.506
			FP8	0.757	7.915

FIGURE 5.3B: LISREL ANALYSIS TO TEST HYPOTHESIS 2.

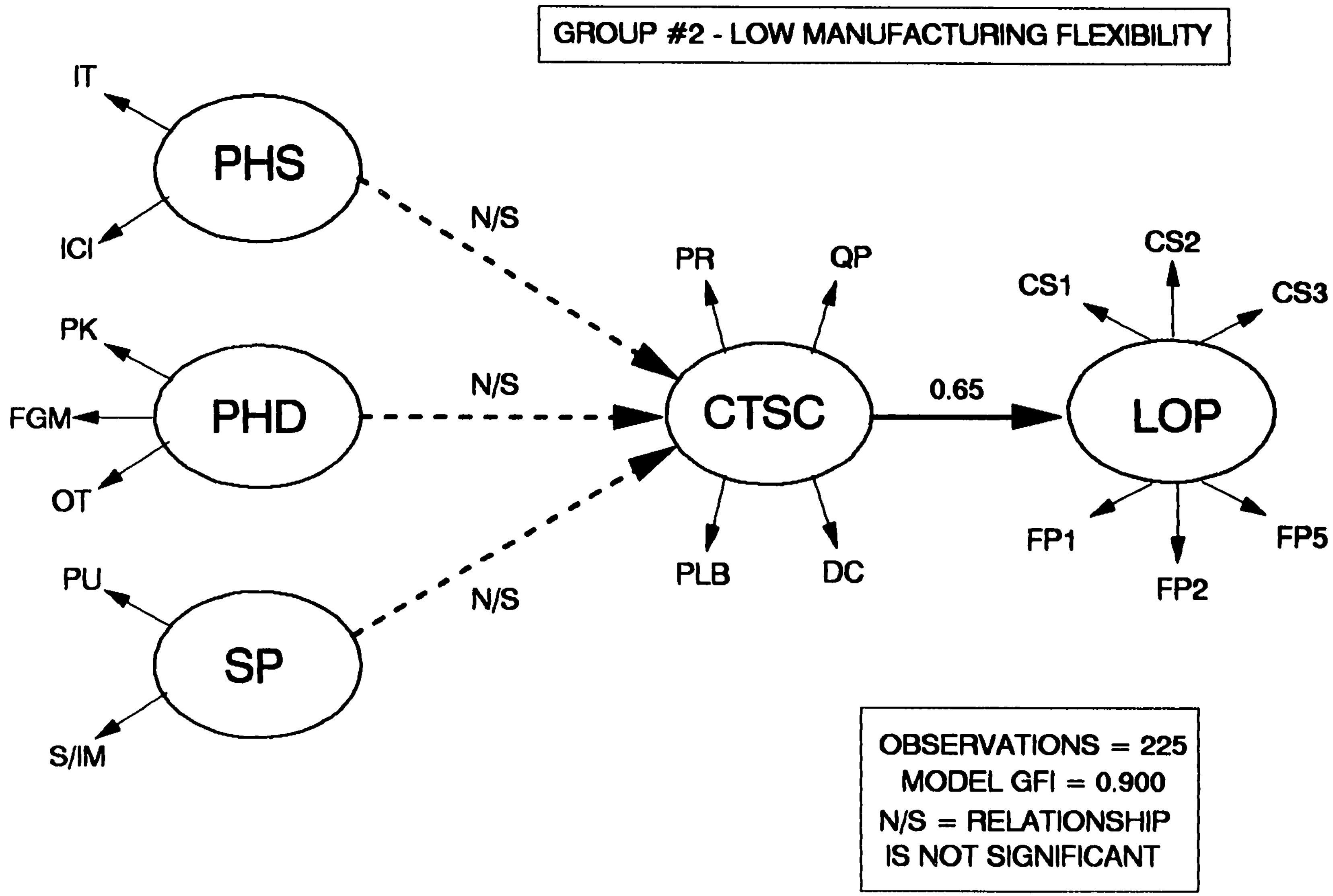


Table 5.9 Summary Of LISREL Generated Data: Group 2 -- Low Manufacturing Flexibility.

Relationship	t-value	Significant?	LISREL Coefficient	*r*
PHS → CTSC	0.195	NO	0.153	0.633
PHD → CTSC	0.654	NO	0.281	0.534
SP → CTSC	0.462	NO	0.251	0.536
CTSC → LOP	3.404	YES	0.648	0.638

This phase of analysis supports Hypothesis 2. The level of manufacturing flexibility present in the firm moderates the relationship between logistics processes and the firm's capacity to satisfy customers. LISREL analysis incorporating Group 1 data demonstrates that in firms with a relatively high level of manufacturing flexibility, physical distribution and logistics spanning processes have positive impacts on the capacity to satisfy customers. Performing the same analysis using Group 2 data found that in firms with a relatively low level of manufacturing flexibility, logistics processes do not positively impact the ability to satisfy customers. It seems appropriate to conclude that the ability of logistics to satisfy customers is influenced by manufacturing's ability to produce a variety of high-quality, competitively priced goods in a timely manner.

5.4 CONCLUSIONS.

Section 1.1 stated the central objective of this research as the expansion of our knowledge pertaining to the relationship between logistics/purchasing processes, a manufacturing organization's capacity to compete, and firm performance. Four questions were presented that required investigation if this research was to provide information which would be helpful to manufacturing managers as they administer their logistics function. This section will revisit those four questions in light of the analysis which has been conducted and will comment on the implications for management.

Question 1: ***Does logistics affect the firm's capacity to satisfy customers?*** This research confirms what has often been speculated -- the quality of a manufacturer's logistics processes undoubtedly moderates its ability to please clients. The caliber of the firm's logistics system influences the price it may offer, the quality of its products, the breadth of the product lines it presents, and its delivery capabilities.

Managers of manufacturing concerns need to grant adequate consideration and resource allocations to the logistics area if they are to realize an approach to business that will enhance their firms' ability to satisfy customers. Lowering cost, improving quality, achieving operational flexibility, and increasing service demands empowering logistics managers to contribute in a meaningful way to company competitiveness.

Question 2: ***What aspects of the logistics function most influence this relationship?*** The most influential area of logistics management is the more recently recognized category of logistics spanning processes. Excellent logistics information systems allow logisticians to gather, process, and disseminate data which is critical to adjusting appropriately to fluctuating environmental conditions. Furthermore, this research demonstrates the importance of logistics/purchasing managers being recognized as principal members of the firm's boundary-spanning and integration efforts. It substantiates that their participation in the design of strategy on a continuous basis is crucial to company success.

The level of customer satisfaction realized by the firm is also dependent on the quality of its purchasing function, in particular, how well it selects and communicates with suppliers and responds to special requests. Three-quarters of the manufacturers responding indicated that purchasing is formally part of their logistics function (see Appendix E). Regardless of its official position in the organizational structure, it is obvious that purchasing's high level of interaction with other members of the value chain positions it as key spanning process for a manufacturing concern.

The quality of the traditional physical distribution activities of packaging, finished goods warehousing, inventory control, and outbound transportation also has important repercussions regarding the manufacturer's capacity to satisfy customers. Pleasing clients in today's marketplace encompasses picking orders accurately, meeting their packaging specifications, fulfilling delivery schedules, responding promptly to customer requests, and in general performing well in regards to outbound logistics.

Although no positive relationship was found between physical supply and the capacity to satisfy customers, future research will need to examine the possibility that the physical supply function (or the inbound transportation or inventory control - inbound processes individually) positively impacts one or more of the customer service attributes either directly, or as an enabler of production flexibility.

A manufacturing manager with the goal of improving customer service should appraise the amount of attention and resources that are given to the firm's logistics information systems, the purchasing department, and the physical distribution function. He/she should also scrutinize the comprehensiveness of the organization's strategy-making process.

Question 3: *Does logistics affect organizational performance?* Manufacturing firms which do not maintain a high level of logistics competency will eventually find themselves at a competitive disadvantage. Positive relationships have been demonstrated between logistics/purchasing processes and the firm's capacity to satisfy customers. Also, a positive relationship has been demonstrated between the firm's capacity to satisfy customers and organizational performance.

The firm's success in the areas of cost control, operational flexibility, functional integration, and information dissemination all hinge on the quality of its logistics processes. It is apparent logistics should be regarded as a proprietary resource that aids the firm in obtaining competitive advantage. Manufacturers who do not insure their logistics processes are executed in a manner conducive to satisfying clients will in time experience a deterioration in its competitive position relative to those competitors who emphasize logistics proficiency.

Question 4: ***Does the level of manufacturing flexibility present in the firm affect logistics' ability to be a positive influence?*** The relationship between logistics processes and the organization's capacity to satisfy customers is influenced by manufacturing's capacity to produce a variety of quality products. In firms with high levels of manufacturing flexibility, logistics has a significant impact on customer satisfaction and thus on performance. On the other hand, no evidence of a positive relationship was found in firms with a low level of manufacturing flexibility. This suggests that an effective logistics function is prerequisite to receiving the full benefits associated an increase in manufacturing flexibility.

CHAPTER 6: AREAS OF FUTURE RESEARCH

The Instrument

A major contribution of this research has been the development of a concise instrument that supports future research in the areas of logistics processes, manufacturing flexibility, satisfying customers, and firm performance. Scales have been established that provide reliable and valid measurement of these constructs, including their component dimensions. This enables empirical research in areas which have received little pragmatic attention. Confirmatory factor analysis could be utilized in the future to substantiate the appropriateness of the instrument. Table 6.1 displays that the internal consistency of each scale holds up well over the various industry classifications. Similar analysis could test the generalizability of the instrument in regards to firm size, type of manufacturing operation, and title of the respondent.

Relationships Among Logistics Processes, The Capacity To Satisfy Customers, And Firm Performance.

The relationships depicted in Figure 5.2 have been validated by LISREL. Consequently, we now understand more thoroughly the relationship between logistics processes, the organization's capacity to satisfy customers, and firm

Table 6.1 Comparison of the Reliability of Each Scale Across Industries.

Construct	Dimension/ Factor	α Overall	α Fabricated Metal	α Electronics	α Machinery
	Responses:	474	184	111	61
Physical Supply	Inbound Transport	.79	.78	.77	.80
	Inbound Inventory Control	.88	.87	.88	.91
Physical Distribution	Packaging	.84	.84	.85	.81
	Finished Goods Management	.92	.92	.92	.93
	Outbound Transport	.85	.85	.85	.75
Spanning Processes	Purchasing	.82	.81	.85	.78
	Strategy/Info. Management	.85	.86	.85	.87
Capacity To Satisfy Customers	Price Offered	.79	.81	.81	.79
	Quality of Products	.86	.86	.86	.90
	Product Line Breadth	.84	.85	.83	.80
	Delivery Capability	.93	.93	.92	.95
Manufacturing Flexibility	Technology	.77	.77	.76	.77
	Participation in Strategy	.75	.78	.75	.82
Level Of Performance	Performance	.89	.89	.90	.88

performance. Associations which have previously been suggested by the literature (see Chapter 1) have been empirically tested and verified. It has been shown that on the organizational level, the logistics functions of physical distribution and logistics spanning processes directly create value for customers and affect firm performance.

While this is a significant contribution, more detailed information is needed to make these findings even more meaningful to the managers of manufacturing firms. To uncover additional knowledge regarding the impact of logistics on manufacturing companies, future research should examine the relationship between specific logistics processes, the capacity to satisfy customers, and firm performance.

For example, Figure 6.1 displays a causal model that could be tested with LISREL utilizing the entire data base to determine the influence of the individual dimensions of logistics spanning processes on the capacity to satisfy customers (CTSC) and on the level of performance (LOP). In this case, the scales which have been developed for purchasing (PU) and strategy/information management (S/IM) would be utilized in investigating the relationships between PU and S/IM, CTSC, and LOP directly. This analysis would provide more detailed information which may be used in the management of these particular dimensions of logistics spanning processes.

More in-depth knowledge could also be attained by examining the relationship between an individual dimension of logistics spanning processes, the four capacity to satisfy customers dimensions, and LOP. Figure 6.2 displays the subsequent causal model which could be submitted to LISREL analysis. The scales which have been developed for purchasing (PU), price offered (PR), quality of products (QP), product line breadth (PLB), delivery capability (DC), and LOP can now

FIGURE 6.1: AREAS OF FUTURE RESEARCH

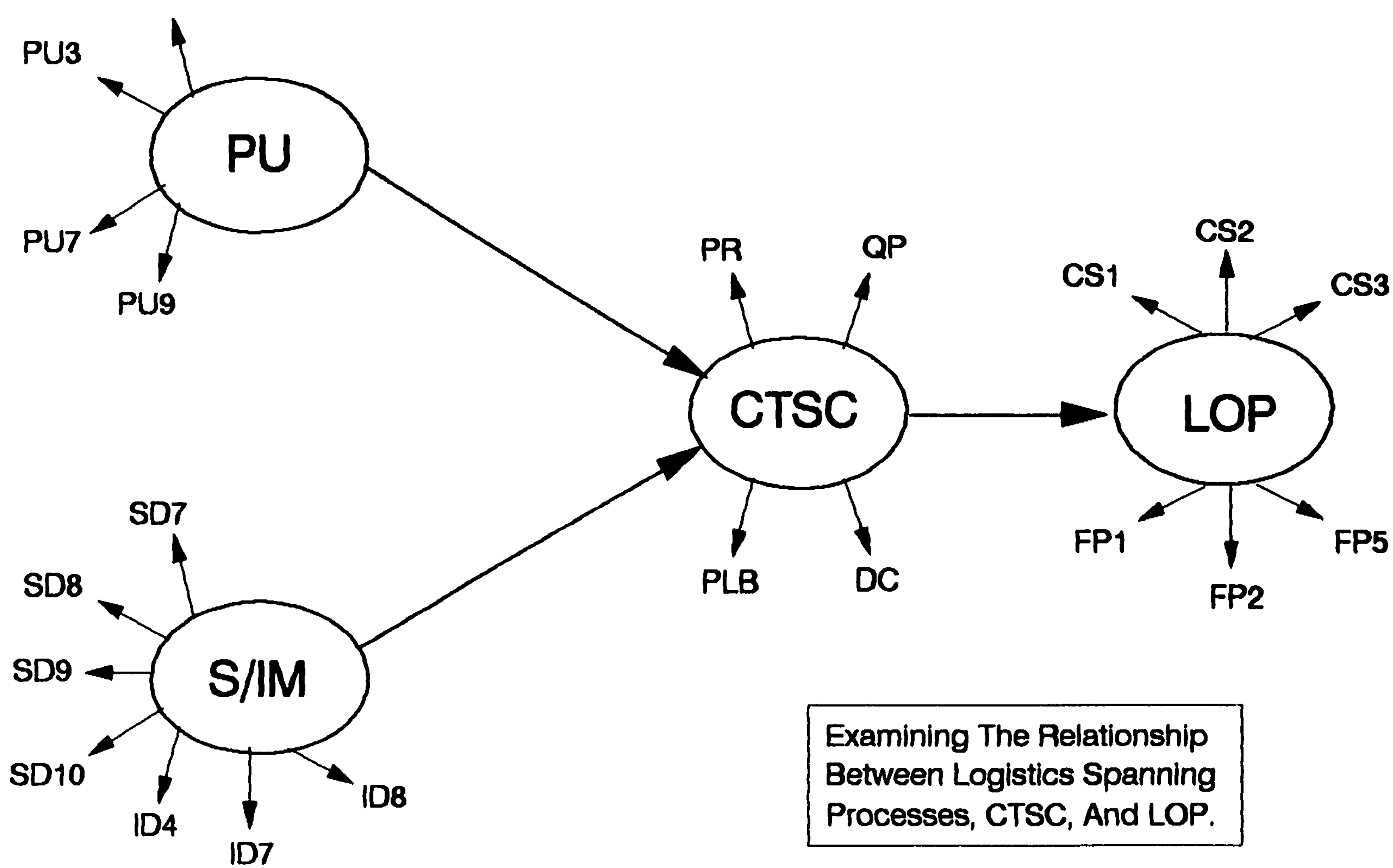
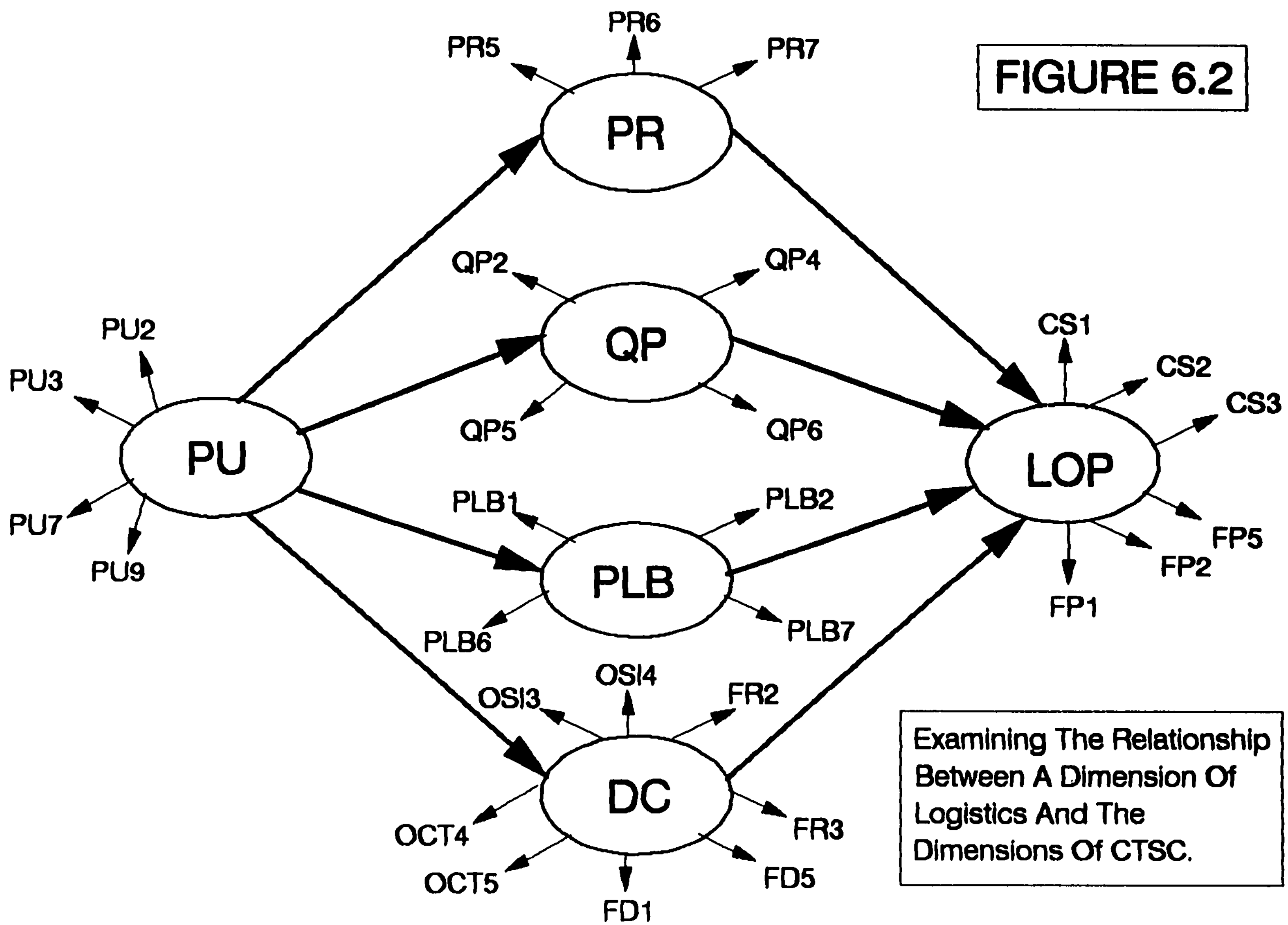


FIGURE 6.2



Examining The Relationship Between A Dimension Of Logistics And The Dimensions Of CTSC.

be employed to examine hypothesized relationships among these variables.

The detailed level of analysis described above allows for more informed decisions regarding logistics at both the strategic and operational level. It can be replicated for all three of the logistics processes constructs (i.e., physical supply, physical distribution, spanning processes) and their component dimensions. In this way it would enable manufacturing firms to allocate resources for logistics in ways specifically designed to improve certain customer satisfaction attributes with the ultimate goal of improving firm performance.

The Joint Effect Of Logistics And Manufacturing Flexibility.

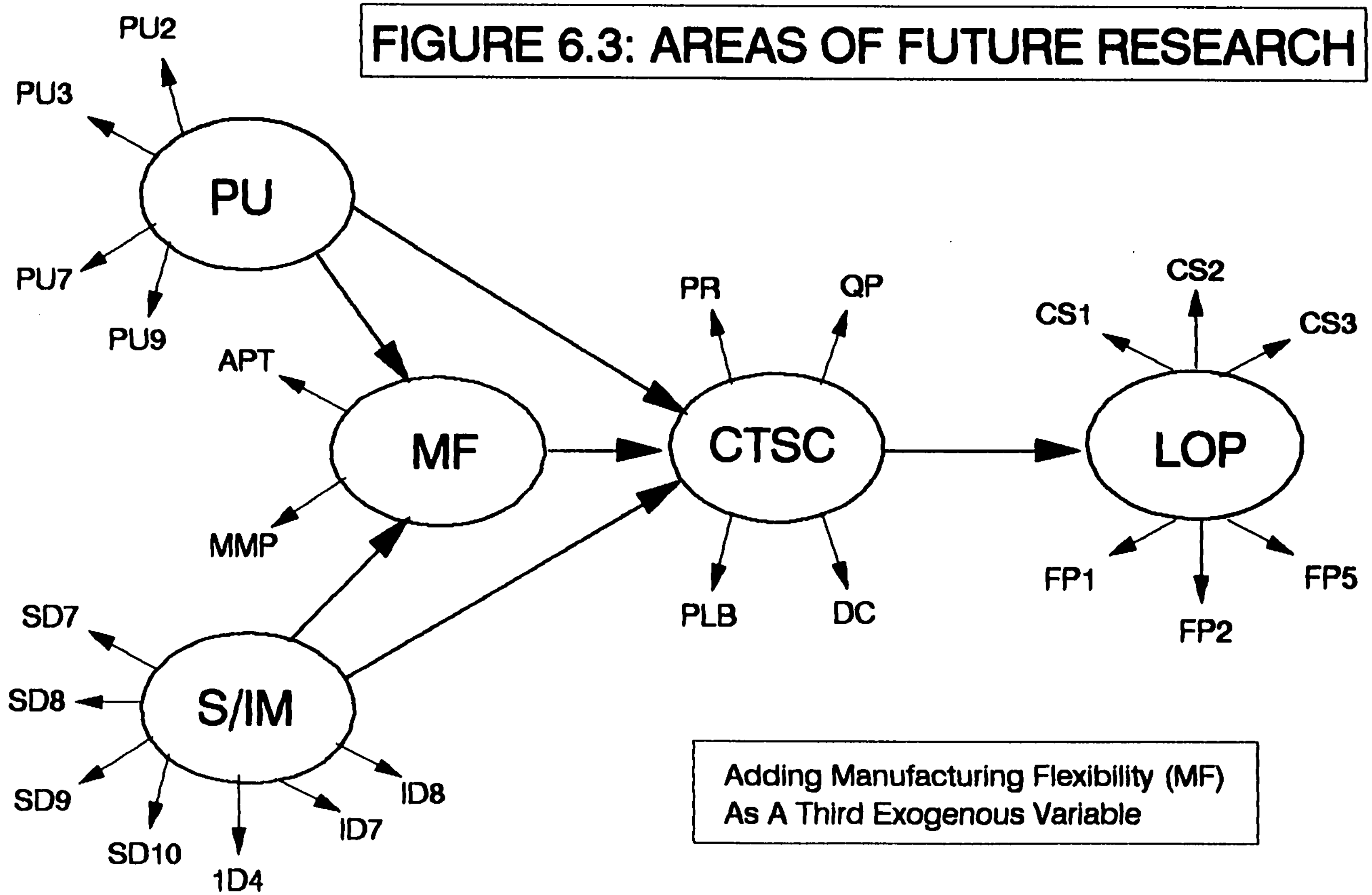
As result of testing Hypothesis 2, it was concluded that logistics ability to satisfy customers is impacted by the level of manufacturing flexibility in the firm. It was found that in firms with a relatively high level of manufacturing flexibility, positive relationships exist between physical distribution and logistics spanning processes, and the capacity to satisfy customers. No positive relationships were found between logistics processes and the capacity to satisfy customers in the group with low manufacturing flexibility.

More insight is needed in regards to this phenomena. It is obvious that the high (Group 1) and low (Group 2) groups in regards to manufacturing flexibility differ in their capacity to satisfy customers. The average composite score for the nineteen items retained as measures of the CTSC construct for Group 1 was 78.959 with a standard deviation of 8.440. The average composite score for Group 2 was 71.670 with a standard deviation of 9.372. The *F*-statistic (1.23) confirmed that the two groups have equal variance regarding their CTSC score at alpha equal to 0.05. The *z*-value of 8.173 indicates that the mean score for CTSC for Group 1 is significantly greater than the mean score for Group 2 (alpha equal to 0.01).

While this result is interesting, there remains some question as to what degree the greater CTSC score is due to the relatively high level of manufacturing flexibility, and to what degree the enhanced ability of logistics to satisfy customers is responsible. Important knowledge could be gained by adding manufacturing flexibility (MF) as a third endogenous variable at the level of analysis depicted in Figure 6.1.

Figure 6.3 displays such a model which could be tested with LISREL using the entire data base. In this instance, the direct effects of purchasing (PU) and strategy/information management (S/IM) on CTSC could be assessed as well as their indirect effects via MF. Furthermore, LISREL can utilize the coefficients to test for statistical differences in the strengths of the relationships of interest. In this manner the relative strengths of the relationships between MF and CTSC, and between PU and S/IM and CTSC could be investigated. The analysis could be replicated using the physical supply and physical distribution constructs as well.

FIGURE 6.3: AREAS OF FUTURE RESEARCH



Adding Manufacturing Flexibility (MF)
As A Third Exogenous Variable

Appendix A: Initial Pilot Study Items.

Physical Supply - Inbound Transportation, Material Warehousing, Inventory Control (Inbound), Production Support.

IT1	Inbound transportation delivering shipments on time
IT2	Inbound transportation delivering shipments in the condition they were offered
IT3	Inbound transportation providing us with a timely reply to inquires
IT4	Inbound transport responding to special requests
IT5	The cost we're incurring for inbound transportation
IT6	The overall quality of inbound transportation
MW1	Receiving and storing inbound materials
MW2	Picking and assembling production orders accurately at the materials warehouse
MW3	Material warehousing responding to special requests
MW4	The cost we're incurring for material warehousing
MW5	The overall quality of material warehousing
ICI1	The accuracy of records concerning the quantities of materials in the warehouse
ICI2	The accuracy of records concerning the location of materials in the warehouse
ICI3	The length of time required to update inventory records at the materials warehouse
ICI4	The number of production delays due to materials not being available at the warehouse
ICI5	Inbound inventory control responding to special requests
ICI6	The cost we're incurring in carrying materials inventory
ICI7	The overall quality of inventory control regarding incoming materials
PS1	Meeting schedule regarding the transfer of materials to production
PS2	Moving materials to the correct production location
PS3	Delivering materials in a form conducive to smooth handling by manufacturing/assembly
PS4	Production support responding to special requests
PS5	The cost we're incurring moving materials to production
PS6	The overall quality of our production support

Appendix A: Initial Pilot Study Items.

Physical Distribution (PHD) - Packaging, Finished Goods Warehousing, Inventory Control (Outbound), Outbound Transportation.

PK1	Packaging that minimizes damage to our final product
PK2	Packaging which facilitates efficient handling and transport of our outputs
PK3	Labeling on our packaged products that is accurate and distinguishable
PK4	Meeting the packaging specifications of our customers
PK5	Packaging sustaining our production plan
PK6	Packaging responding to special requests
PK7	The overall quality of our packaging function
FGW1	Warehousing finished goods
FGW2	Finished goods warehousing picking and assembling customer orders accurately
FGW3	Finished goods whse. responding to special requests
FGW4	The cost we're incurring for finished goods warehousing
FGW5	The overall quality of finished goods warehousing
ICO1	The accuracy of records concerning the quantities of finished product on-hand
ICO2	The accuracy of records concerning the location of finished goods in the warehouse
ICO3	The length of time required to update finished goods inventory records
ICO4	Maximizing overall revenue through the control of finished goods
ICO5	The overall quality of finished goods inventory control
OT1	Outbound transport meeting schedule for deliveries
OT2	Outbound transportation delivering shipments in the condition they were presented for transport
OT3	Outbound transportation providing us with a timely response to inquires
OT4	Outbound transport responding to special requests
OT5	The cost we're incurring for outbound transportation
OT6	The overall quality of outbound transportation

Appendix A: Initial Pilot Study Items.

Spanning Processes (SP) - Purchasing, Customer Order Processing, Strategy Development, Information Dissemination.

PU1	Purchasing obtains materials/equipment/supplies that meet specification
PU2	We select and evaluate suppliers effectively
PU3	Our communications with suppliers is excellent
PU4	Purchasing cooperates well with other functional areas
PU5	Purchasing is able to fill special requests
PU6	Purchasing expends capital in a manner that maximizes our company's overall viability
PU7	The overall quality of our purchasing function is high
COP1	Inbound logistics, production, & distribution are managed as an integrated system
COP2	Inbound logistics plays an important role in the fulfillment of customer orders
COP3	Outbound logistics plays an important role in the fulfillment of customer orders
COP4	Our logistics function is an important coordinating mechanism
SD1	Logistics is recognized throughout our organization as being important to creating customer value
SD2	There is a high level of integration of logistics strategy with the strategic plans of other areas
SD3	The input of logistics personnel is important to the overall strategy process
SD4	Logisticians are involved in decisions related to strategies for company growth
SD5	Logistics' day to day operations are administered in a manner that supports corporate goals
ID1	Incorporating the latest information system technologies into logistics is important
ID2	The information used to manage logistics activity is readily available
ID3	Our logistics information systems compare favorably to the information management systems of other areas
ID4	Our logistics function provides meaningful information regarding the competitive environment
ID5	Our logistics function provides useful information on the requirements of individual markets/clients
ID6	Our production schedule is driven by current customer orders and/or by current customer sales

Appendix A: Initial Pilot Study Items.

Capacity To Satisfy Customers (CTSC) - Price Offered, Quality of Products, Product Line Breadth, Order Fill Rate, Order Cycle Time, Order/Shipment Information, Frequency of Delivery.

PR1	We offer competitive prices relative to quality
PR2	We are able to command premium prices
PR3	We do not charge extra for emergency orders
PR4	We are able to guarantee our prices
QP1	We offer products that function according to customer needs
QP2	We are able to compete based on quality
QP3	There are few customer returns to my company because of poor quality
PLB1	We respond well to changing customer preferences regarding products
PLB2	We respond well to changing customer preferences regarding services
PLB3	We offer an effective product mix to our customers
PLB4	We offer a satisfactory variety of products
PLB5	We offer an acceptable range of product features
FR1	We deliver the assortment of products needed on time to our customers
FR2	Our frequency of customer backorders is low
FR3	Our customers are satisfied with our level of completeness for routine shipments
FR4	Our customers are satisfied with our level of completeness for emergency shipments
OCT1	We offer customers a reliable order processing time
OCT2	The time from our receipt of an order to possession of the shipment by that customer is acceptable to our clients
OCT3	We have few past due invoices due to late delivery
OCT4	Orders submitted to us are delivered on-time, as defined by the customer
OSI1	We deliver orders as promised with no communication other than the initial contact
OSI2	We supply clients with accurate information regarding inventory availability
OSI3	We supply accurate projected shipping dates
OSI4	We supply accurate projected delivery dates
OSI5	We respond promptly to a customer inquiry regarding order/shipment information
FD1	Our customers are pleased with the frequency of our delivery
FD2	We can alter our delivery schedule per each customer's requirements
FD3	We work with each customer to develop a delivery schedule that is acceptable to us both
FD4	We meet customer expectations by being flexible in our frequency of delivery

Appendix A: Initial Pilot Study Items.

Manufacturing Flexibility - Advanced Process Technology, Manufacturing Managers Participation in Corporate Strategy, Participative Management.

APT1	We have robotics in our manufacturing facility(s)
APT2	We use computer-aided design (CAD) technology
APT3	We use computer-aided manufacturing (CAM) technology
APT4	We use computerized numerical control machines (CNC)
APT5	We have incorporated real-time process control into our production systems
APT6	We utilize production technology that is among the most flexible in our industry
MMP1	The input of manufacturing plant managers is an integral part of the strategy formation process
MMP2	Manufacturing plant managers are involved in decisions related to strategies for company growth
PM1	Production employees work in teams
PM2	Production workers perform a broad range of tasks
PM3	Production workers share responsibility for planning
PM4	Production workers share responsibility for quality
PM5	Production supervisors receive labor relations training
PM6	Production employees have access to a progressive training program

Level Of Performance (LOP) - Customer Satisfaction, Financial Performance.

CS1	Customers perceiving they receive their money's worth when they purchase our products
CS2	Customer retention rate
CS3	Generating new business as the result of referrals
FP1	Sales growth position
FP2	Market share gain
FP3	Return on investment
FP4	New product success rate
FP5	Overall competitive position

Appendix B: Large-Scale Questionnaire

UNIVERSITY OF TOLEDO SURVEY: MANUFACTURING/ LOGISTICS EFFECTIVENESS

Please use the scale 1 = Unacceptable; 2 = Below Satisfactory; 3 = Satisfactory; 4 = Above Satisfactory; 5 = Superior; X = NA; to indicate the level of performance <u>your firm/division</u> is experiencing regarding the following areas.

Physical Supply

1. Inbound transportation delivering shipments on time
2. The accuracy of records concerning the location of materials in the warehouse ....
3. The delivery of materials to manufacturing/assembly in a form conducive to smooth handling ....
4. Inbound transportation providing us with a timely reply to inquires ....
5. The length of time required to update inventory records at the materials warehouse ....
6. Material warehousing responding promptly to special requests ....
7. Meeting schedule regarding the transfer of materials to production ....
8. Limiting the number of production delays due to materials being out-of-stock at the warehouse ......
9. The overall quality of inbound transportation ......
10. Production support responding expediently to special requests ....
11. The materials warehouse picking components accurately
12. Inbound inventory control responding promptly to special requests ....
13. Inbound transport reacting quickly to special requests
14. The overall quality of our production support ......
15. Storing materials undamaged at the warehouse ....
16. The accuracy of records concerning the quantities of materials in the warehouse.......................
17. The overall quality of material warehousing ....
18. The overall accuracy of inventory records for materials
19. Moving materials to the correct production location
20. The overall quality of inventory control regarding incoming materials ....

Appendix B: Large-Scale Questionnaire

Please indicate the level of performance your firm/division is experiencing regarding the following areas.

Physical Distribution

1. Packaging that minimizes damage to our final product
2. The overall quality of finished goods inventory control
3. Finished goods warehousing responding promptly to customer requests ....
4. Outbound transportation delivering shipments in the condition they were presented for transport ....
5. Warehousing finished goods without loss or damage ..
6. Packaging which facilitates efficient handling and transport of our outputs ....
7. The length of time required to update finished goods inventory records ....
8. Finished goods warehousing picking orders accurately
9. Labeling on our packaged products that is accurate and distinguishable ....
10. The accuracy of records concerning the quantities of finished product on-hand ....
11. Outbound transport meeting delivery schedules
12. Meeting the packaging specifications of our customers
13. The accuracy of records concerning the location of finished goods in the warehouse ....
14. Packaging sustaining our production plan ....
15. Outbound transportation providing us with a timely response to inquires ....
16. The overall quality of finished goods warehousing ..
17. Maximizing overall revenue through the control of finished goods ....
18. The cost we're incurring for outbound transportation
19. Packaging responding to special requests ....
20. The overall quality of our packaging function ......
21. The overall quality of outbound transportation .....

Appendix B: Large-Scale Questionnaire

Please indicate the extent to which you agree or disagree with the following statements regarding your firm/division.

Spanning Processes

1. Purchasing obtains materials that meet specification
2. We manage inbound logistics, production support, & distribution as an integrated system ....
3. Our logistics function contributes at the highest levels to creating customer value ....
4. We incorporate the latest information system technologies into logistics ....
5. We select and evaluate suppliers effectively ......
6. Inbound logistics plays an important role in the ultimate filling of customer orders ....
7. Logistics strategy is highly integrated with the strategic plans of other areas ....
8. The information used to manage logistics activity is readily available ....
9. Our communications with suppliers is excellent .....
10. Outbound logistics plays an important role in the filling of customer orders ....
11. Logistics personnel have input to organizational level strategy development ....
12. We invest in information systems which help us manage our logistics function ....
13. Purchasing is able to fill special requests promptly
14. Our logistics function is an important coordinating mechanism in the filling of customer orders ....
15. Logisticians are involved in strategic decisions that affect company growth ....
16. Purchasing expends capital in a manner that maximizes our company's overall viability ....
17. Our logistics function enables us to process customer orders effectively ....
18. Logistics operations are administered in a manner that supports our strategic plan ....
19. Our logistics function provides meaningful information regarding the competitive environment ..
20. The overall quality of our purchasing function is high

Appendix B: Large-Scale Questionnaire

21. Our logistics function provides useful information on the requirements of individual markets/clients ..

Your Firm/Division's Capacity to Satisfy Customers

1. We offer competitive prices ....
2. We offer products that function according to customer needs ....
3. We respond well to changing customer preferences regarding products ....
4. We deliver the assortment of products ordered ......
5. We supply clients with accurate information regarding product availability ....
6. Our customers are pleased with the frequency of our delivery ....
7. We guarantee our prices ....
8. We are able to compete based on quality ....
9. We respond well to changing customer preferences regarding accompanying services ....
10. We alter our product offerings to meet client needs
11. We are able to compete based on our prices ....
12. We supply accurate projected shipping dates ....
13. We can alter our delivery schedule per each customer's requirements ....
14. We offer products that are highly reliable ....
15. We respond well to customer demand for "new" features
16. Our frequency of customer backorders is low ....
17. Our customers are satisfied with our level of completeness for routine shipments ....
18. We are able to offer prices as low or lower than our competitors ....
19. We supply accurate projected delivery dates ....
20. We work with each customer to develop a delivery schedule that is acceptable ....
21. We offer products that are very durable ....
22. We offer the products and services our customers want
23. We deliver the desired quantities of products ......

Appendix B: Large-Scale Questionnaire

24. We offer customers a reliable order processing time

25. The time from our receipt of an order to possession of the shipment by that customer is acceptable to our clients ....

26. We respond with accurate information to a customer inquiry concerning an order ....

27. We are flexible in developing delivery schedules ...

28. We are able to sell our products at prices that are above average ....

29. We offer high quality products to our customers ....

30. Orders submitted to us are delivered on-time, as defined by the customer ....

31. We provide on-time delivery of customer orders .....

Your Level of Manufacturing Flexibility

1. We apply computer-enhanced technology to improve the flexibility of manufacturing ....
2. The input of manufacturing plant managers is an integral part of the strategy formation process ....
3. Production workers share responsibility for planning
4. We have incorporated real-time process control into our production systems ....
5. Manufacturing plant managers are involved in strategic decisions that affect company/divisional growth ....
6. Production workers participate in quality assurance
7. We utilize production technology that is among the most flexible in our industry ....
8. Manufacturing plant managers have a good understanding as to how company/divisional strategy is formed ....
9. Production supervisors receive labor relations training
10. We reorganize our facilities as necessary to increase manufacturing flexibility ....
11. Production employees have access to a progressive training program ....

Appendix B: Large-Scale Questionnaire

Please indicate the level of performance <u>your firm/division</u> has attained in the following areas over the <u>last three years</u>.

1. Customers perceiving they receive their money's worth when they purchase our products ....
2. Sales growth position ....
3. Customer retention rate ....
4. Market share gain ....
5. Generating new business through customer referrals
6. Return on investment ....
7. Customers feeling we offer products with high value
8. New product success rate ....
9. Overall competitive position ....

To help me classify and organize the responses, I would appreciate your answers to the following questions.

1. What is your title? ______________________________

2. How many employees does your company/division have?
☐ Less than 100 ☐ 100 to 500 ☐ 501 to 1,000 ☐ More than 1,000

3. Please select the type of manufacturing operation that <u>best</u> describes your company/division.
☐ Continuous flow process ☐ Flexible manufacturing ☐ Assembly line ☐ Job Shop
☐ High volume, discrete part production ☐ Manufacturing cells ☐ Batch processing ☐ Projects (one-of-a-kind production)

4. What percentage of your products are: Make to Stock? __________% Make to Order? __________%

5. Please select the type of manufacturing industry that <u>best</u> describes your firm/division.
☐ Furniture & Fixtures ☐ Fabricated Metal ☐ Machinery ☐ Electronic & Electrical Equipment
☐ Other ______________________________

6. Is Purchasing formally considered part of the logistics function in your firm? ☐ Yes ☐ No

7. What percentage of your sales are: Industrial ________% Commercial ________%

8. How would you describe the main industry in which you compete?
☐ Little competition ☐ Moderately competitive ☐ Quite competitive ☐ Very competitive

9. If you would like to receive a copy of the survey results, please provide the following information, or write to me separately.

Name ______________________________

Company ______________________________

Street ______________________________

City ____________________ State __________ Zip __________

THANK YOU FOR YOUR ASSISTANCE IN THIS STUDY. YOUR COOPERATION HAS BEEN ESSENTIAL TO THE PROJECT'S SUCCESS.

Appendix C: Items On Large-Scale Survey.

Physical Supply - Inbound Transportation, Material Warehousing, Inventory Control (Inbound), Production Support.

IT1	Inbound transportation delivering shipments on time
IT3	Inbound transportation providing us with a timely reply to inquires
IT6	The overall quality of inbound transportation
IT7	Inbound transport reacting quickly to special requests
MW5	The overall quality of material warehousing
MW6	Storing materials intact at the warehouse
MW7	The materials warehouse picking components accurately
MW8	Material warehousing responding promptly to special requests
ICI1	The accuracy of records concerning the quantities of materials in the warehouse
ICI2	The accuracy of records concerning the location of materials in the warehouse
ICI3	The length of time required to update inventory records at the materials warehouse
ICI7	The overall quality of inventory control regarding incoming materials
ICI8	Limiting the number of production delays due to materials being out-of-stock at the warehouse
ICI9	Inbound inventory control responding promptly to special requests
ICI10	The overall accuracy of inventory records for materials
PS1	Meeting schedule regarding the transfer of materials to production
PS2	Moving materials to the correct production location
PS3	Delivering materials in a form conducive to smooth handling by manufacturing/assembly
PS6	The overall quality of our production support
PS7	Production support responding expediently to special requests

Appendix C: Items On Large-Scale Survey.

Physical Distribution (PHD) - Packaging, Finished Goods Warehousing, Inventory Control (Outbound), Outbound Transportation.

PK1	Packaging that minimizes damage to our final product
PK2	Packaging which facilitates efficient handling and transport of our outputs
PK3	Labeling on our packaged products that is accurate and distinguishable
PK4	Meeting the packaging specifications of our customers
PK5	Packaging sustaining our production plan
PK6	Packaging responding to special requests
PK7	The overall quality of our packaging function
FGW2	Finished goods warehousing picking and assembling customer orders accurately
FGW5	The overall quality of finished goods warehousing
FGW6	Finished goods warehousing responding promptly to customer requests
FGW7	Warehousing finished goods undamaged
ICO1	The accuracy of records concerning the quantities of finished product on-hand
ICO2	The accuracy of records concerning the location of finished goods in the warehouse
ICO3	The length of time required to update finished goods inventory records
ICO4	Maximizing overall revenue through the control of finished goods
ICO5	The overall quality of finished goods inventory control
OT2	Outbound transportation delivering shipments in the condition they were presented for transport
OT3	Outbound transportation providing us with a timely response to inquires
OT5	The cost we're incurring for outbound transportation
OT6	The overall quality of outbound transportation
OT7	Outbound transport meeting delivery schedules

Appendix C: Items On Large-Scale Survey.

Spanning Processes (SP) - Purchasing, Customer Order Processing, Strategy Development, Information Dissemination.

PU2	We select and evaluate suppliers effectively
PU3	Our communications with suppliers is excellent
PU6	Purchasing expends capital in a manner that maximizes our company's overall viability
PU7	The overall quality of our purchasing function is high
PU8	Purchasing obtains materials that meet specification
PU9	Purchasing is able to fill special requests promptly
COP3	Outbound logistics plays an important role in the fulfillment of customer orders
COP5	We manage inbound logistics, production support, & distribution as an integrated system
COP6	Inbound logistics plays an important role in the ultimate filling of customer orders
COP7	Our logistics function is an important coordinating mechanism in the filling of customer orders
COP8	Our logistics function enables us to process customer orders effectively
SD6	Our logistics function contributes at the highest levels to creating customer value
SD7	Logistics strategy is highly integrated with the strategic plans of other areas
SD8	Logistics personnel have input to strategy development for our organization
SD9	Logisticians are involved in strategic decisions that affect company growth
SD10	Logistics operations are administered in a manner that supports our strategic plan
ID2	The information used to manage logistics activity is readily available
ID4	Our logistics function provides meaningful information regarding the competitive environment
ID5	Our logistics function provides useful information on the requirements of individual markets/clients
ID7	We incorporate the latest information system technologies into logistics
ID8	We invest in information systems which help us manage our logistics function

Appendix C: Items On Large-Scale Survey.

Capacity To Satisfy Customers (CTSC) - Price Offered, Quality of Products, Product Line Breadth, Order Fill Rate, Order Cycle Time, Order/Shipment Information, Frequency of Delivery.

PR5	We offer competitive prices
PR9	We guarantee our prices
PR6	We are able to compete based on our prices
PR7	We are able to offer prices as low or lower than our competitors
PR8	We are able to sell our products at prices that are above average
QP1	We offer products that function according to customer needs
QP2	We are able to compete based on quality
QP4	We offer products that are highly reliable
QP5	We offer products that are very durable
QP6	We offer high quality products to our customers
PLB1	We respond well to changing customer preferences regarding products
PLB2	We respond well to changing customer preferences regarding accompanying services
PLB6	We alter our product offerings to meet client needs
PLB7	We respond well to customer demand for "new" features
PLB8	We offer the products and services our customers want
FR2	Our frequency of customer backorders is low
FR3	Our customers are satisfied with our level of completeness for <u>routine</u> shipments
FR5	We deliver the assortment of products ordered
FR6	We deliver the desired quantities of products
OCT1	We offer customers a reliable order processing time
OCT2	The time from our receipt of an order to possession of the shipment by that customer is acceptable to our clients
OCT4	Orders submitted to us are delivered on-time, <u>as defined by the customer</u>
OCT5	We provide on-time delivery of customer orders

continued ....

Appendix C: Items On Large-Scale Survey.

Capacity To Satisfy Customers (CTSC) - (Continued).

OSI3	We supply accurate projected shipping dates
OSI4	We supply accurate projected delivery dates
OSI6	We supply clients with accurate information regarding product availability
OSI7	We respond with accurate information to a customer inquiry concerning an order
FD1	Our customers are pleased with the frequency of our delivery
FD2	We can alter our delivery schedule per each customer's requirements
FD5	We are flexible in developing delivery schedules
FD6	We work with each customer to develop a delivery schedule that is acceptable

Manufacturing Flexibility - Advanced Process Technology, Manufacturing Managers Participation in Corporate Strategy, Participative Management.

APT5	We have incorporated real-time process control into our production systems
APT6	We utilize production technology that is among the most flexible in our industry
APT7	We apply computer-enhanced technology to improve the flexibility of manufacturing
APT8	We reorganize our facilities as necessary to increase our manufacturing flexibility
MMP1	The input of manufacturing plant managers is an integral part of the strategy formation process
MMP2	Manufacturing plant managers are involved in decisions related to strategies for company growth
MMP3	Manufacturing plant managers have a good understanding as to how company/divisional strategy is formed
PM3	Production workers share responsibility for planning
PM5	Production supervisors receive labor relations training
PM6	Production employees have access to a progressive training program
PM7	Production workers participate in quality assurance

Appendix C: Items On Large-Scale Survey.

Level Of Performance (LOP) - Customer Satisfaction, Financial Performance.

CS1	Customers perceiving they receive their money's worth when they purchase our products
CS2	Customer retention rate
CS3	Generating new business through customer referrals
CS4	Customers feeling we offer products with high value
FP1	Sales growth position
FP2	Market share gain
FP3	Return on investment
FP4	New product success rate
FP5	Overall competitive position

Appendix D: Items Placed On Suggested Final Instrument.

CONSTRUCT: PHYSICAL SUPPLY

Inbound Transportation Dimension/Factor

Inbound transportation delivering shipments on time

Inbound transportation providing us with a timely reply to inquires

The overall quality of inbound transportation

Inbound transport reacting quickly to special requests

Inbound Inventory Control Dimension/Factor

The accuracy of records concerning the quantities of materials in the warehouse

The accuracy of records concerning the location of materials in the warehouse

The length of time required to update inventory records at the materials warehouse

The overall accuracy of inventory records for materials

Appendix D: Items Placed On Suggested Final Instrument.

CONSTRUCT: PHYSICAL DISTRIBUTION

Packaging Dimension/Factor

Packaging which facilitates efficient handling and transport of our outputs

Meeting the packaging specifications of our customers

Packaging responding to special requests

The overall quality of our packaging function

Finished Goods Management Dimension/Factor

Finished goods warehousing picking orders accurately

Finished goods warehousing responding promptly to customer requests

The accuracy of records concerning the quantities of finished product on-hand

The accuracy of records concerning the location of finished goods in the warehouse

The length of time required to update finished goods inventory records

The overall quality of finished goods inventory control

The overall quality of finished goods warehousing

Outbound Transportation Dimension/Factor

Outbound transport meeting delivery schedules

Outbound transportation providing us with a timely response to inquires

The overall quality of outbound transportation

Appendix D: Items Placed On Suggested Final Instrument.

CONSTRUCT: SPANNING PROCESSES

Purchasing Dimension/Factor

We select and evaluate suppliers effectively

Our communications with suppliers is excellent

Purchasing is able to fill special requests promptly

The overall quality of our purchasing function is high

Strategy/Information Management Dimension/Factor

Our logistics function provides meaningful information regarding the competitive environment

Logistics strategy is highly integrated with the strategic plans of other areas

Logisticians are involved in strategic decisions that affect company growth

Logistics operations are administered in a manner that supports our strategic plan

We incorporate the latest information system technologies into logistics

We invest in information systems which help us manage our logistics function

Logistics personnel have input to strategy development for our organization

Appendix D: Items Placed On Suggested Final Instrument.

CONSTRUCT: CAPACITY TO SATISFY CUSTOMERS

Price Of Products Dimension/Factor

We offer competitive prices

We are able to compete based on our prices

We are able to offer prices as low or lower than our competitors

Quality of Products Dimension/Factor

We are able to compete based on quality

We offer products that are highly reliable

We offer products that are very durable

We offer high quality products to our customers

Product Line Breadth Dimension/Factor

We respond well to changing customer preferences regarding products

We respond well to changing customer preferences regarding accompanying services

We alter our product offerings to meet client needs

We respond well to customer demand for "new" features

Product Delivery Dimension/Factor

Our frequency of customer backorders is low

Our customers are satisfied with our level of completeness for routine shipments

Orders submitted to us are delivered on-time, as defined by the customer

We provide on-time delivery of customer orders

We supply accurate projected shipping dates

We supply accurate projected delivery dates

continued ....

Appendix D: Items Placed On Suggested Final Instrument.

Our customers are pleased with the frequency of our delivery

We work with each customer to develop a delivery schedule that is acceptable

---

CONSTRUCT: MANUFACTURING FLEXIBILITY

Technology Dimension/Factor

We apply computer-enhanced technology to improve the flexibility of manufacturing

We have incorporated real-time process control into our production systems

We utilize production technology that is among the most flexible in our industry

Participation in Corporate Strategy Dimension/Factor

The input of manufacturing plant managers is an integral part of the strategy formation process

Manufacturing plant managers are involved in strategic decisions that affect company/divisional growth

Manufacturing plant managers have a good understanding as to how company/divisional strategy is formed

---

CONSTRUCT: LEVEL OF PERFORMANCE

Performance Dimension/Factor

Customers perceiving they receive their money's worth when they purchase our products

Customer retention rate

Generating new business through customer referrals

Sales growth position

Market share gain

Overall competitive position

Appendix E: Information On Large-Scale Survey Respondents.

Responding Executives Titles		
Title	Frequency	Valid %
Plant/Facility Manager	145	31
President/General Manager	118	25
Director of Materials	38	8
Director of Purchasing	38	8
Director of Operations	32	7
Director of Manufacturing	28	6
Director of Logistics	18	4
Director of Marketing	8	2
Other	40	9
Missing	9	-
NOTE: Other Areas Include - Customer Service, Quality Control, Product Group, Engineering, and Controller.		

Employees At Respondent's Location		
Number of Employees	Frequency	Valid %
Less Than 100	119	25
100 To 500	223	49
501 To 1000	54	12
More Than 1000	66	14
Missing	2	-

Is Purchasing Formally Part Of Logistics?		
Response	Frequency	Valid %
Yes	349	75
No	114	25
Missing	10	-

Appendix E: Information On Large-Scale Survey Respondents.

Type Of Manufacturing Operation		
Response	Frequency	Valid %
Job Shop	98	21
Manufacturing Cells	88	19
Assembly Line	59	13
High Volume, Discrete	56	12
Continuous Flow	54	12
Batch Processing	51	11
Flexible Manufacturing System	48	10
Custom Projects	10	2
Missing	10	-

Industry Classification		
Response	Frequency	Valid %
Fabricated Metal	184	39
Electronics	111	24
Machinery	61	13
Furniture & Fixtures	32	7
Other	80	17
Missing	6	-

NOTE: Other Industry Types Include - Automotive (9), Specialized Packaging (9), Plastics (9), Building Supplies (8), Plumbing Fixtures (5), and Wood Products (5).

Appendix E: Information On Large-Scale Survey Respondents.

Level Of Competition In Main Industry		
Response	**Frequency**	**Valid %**
Very Competitive	266	56
Quite Competitive	156	33
Moderately Competitive	45	10
Little Competition	6	1
Missing	1	-

Other Data		
	Frequency	**Valid %**
Firm Sales 100% Industrial	170	39
Firm Sales 100% Commercial	71	16
Average Percent Of Sales: Industrial	60%	
Average Percent Of Sales: Commercial	40%	
Firm Products 100% "Made-To-Order"	119	26
Firm Products 100% "Made-To-Stock"	13	3
Average Percent Of Production Sales: "Made-To-Order"	68%	
Average Percent Of Production Sales: "Made-To-Stock"	32%	

REFERENCES

Ackerman, K.A., "Business Logistics Comes of Age", Annual Conference Proceedings: Council of Logistics Management, Vol. 2, 1992, pp. 403-410.

Anderson, J.C., Rungtusanatham, M., Schroeder, R.G., Devaraj, S., "A Path Analytic Model of a Theory of Quality Management Underlying the Deming Management Method: Preliminary Empirical Findings", Decision Sciences, Vol. 26, No. 5, 1995.

Bardi, E.J., Raghunathan, T.S., Bagchi, P.K., "Logistics Information Systems: The Strategic Role of Top Management", Journal of Business Logistics, Vol. 15 No. 1, 1994, pp. 71-86.

Bardi, E.J., Tracey, M., "Transportation Outsourcing: a Survey of U.S. Practices", International Journal of Physical Distribution & Logistics Management, Vol. 21 No. 3, 1991, pp. 15-21.

Berry, L.L., Zeithaml, V.A., Parasuraman A., "Five Imperatives for Improving Service Quality", Sloan Management Review, Summer, 1990, pp. 29-38.

Bockerstette, J.A., Shell, R.L., Time Based Manufacturing, McGraw-Hill, New York, 1993.

Bourgeois, L.J., "Strategic Goals, Perceived Uncertainty, and Economic Performance in Volatile Environments", Academy of Management Journal, Vol. 28, No. 3, 1985, pp. 548-573.

Bowersox, D.J., "Framing Global Logistics Requirements", Annual Conference Proceedings: Council of Logistics Management, Vol. 2, 1992, pp. 267-277.

Bowersox, D.J., Carter, P.L., Monczka, R.M., "Materials Logistics Management", International Journal of Physical Distribution & Materials Management, Vol. 15, No.5, pp. 27-35.

Bowersox, D.J., Closs, D.J., Helferich, O.K., Logistical Management, Third Edition, Macmillan, New York, 1986.

Bowersox, D.J., Daugherty, P.J., "Achieving and Maintaining Logistics Leadership: Logistics Organizations of the Future", Annual Conference Proceedings: Council of Logistics Management, Vol. 1, 1989, pp. 59-72.

Bowersox, D.J., Daugherty, P.J., Dröge, C.L., Rogers, D.S., Wardlow, D.L., Michigan State University, Leading Edge Logistics Competitive Positioning for the 1990's, Council of Logistics Management, Oak Brook, Illinois, 1989.

Bowersox, D.J., Daugherty, P.J., Dröge, C.L., Germain, R.N., Rogers, D.S., Logistical Excellence, Digital Press, Burlington, MA, 1992.

Boynton, A.C., "Achieving Dynamic Stability through Information Technology", California Management Review, Vol. 35, No. 2, 1993, pp. 58-77.

Braithwaite, A., Christopher, M., "Managing the Global Pipeline", International Journal of Logistics Management, Vol. 2, No. 2, 1991, pp. 55-62.

Bresticker, R.B., American Manufacturing and Logistics in the Year 2001, Brigadoon Bay Books, Hoffman Estates, Illinois, 1992.

Burt, D.N., Soukup, W.R., "Purchasing's Role in New Product Development", Harvard Business Review, Vol. 63, No. 5, September-October, 1985, pp. 90-97.

Byrne, P.M., Markham, W.J., Improving Quality and Productivity in the Logistics Process, Council of Logistics Management, Oak Brook, Illinois, 1991.

Campbell, D.T., Fiske, D.W., "Convergent and Discriminant Validation by Multitrait-Multimethod Matrix", Psychological Bulletin, Vol. 56 No. 1, 1959, pp. 81-105.

Capacino, W.C., Britt, F.F., "Perspectives on Global Logistics", International Journal of Logistics Management, Vol. 2, No. 1, 1991, pp. 35-41.

Carlsson, B., "Management of Flexible Manufacturing: An International Comparison", Omega, Vol. 20, No. 1, 1992, pp. 11-22.

Churchill, G.A., "A Paradigm for Developing Better Measures of Marketing Constructs", Journal of Marketing Research, Vol. 16, 1979, pp. 64-73.

Cohen, M.A., Lee, H.L., "Out of Touch with Customer Needs? Spare Parts and After Sales Service", Sloan Management Review, Winter, 1990, pp. 55-66.

Cohen, W.M., Levinthal, D.A., "Absorptive Capacity: A New Perspective on Learning and Innovation", Administrative Science Quarterly, Vol. 35, 1990, pp. 128-152.

Cooper, M.C., Ellram, L.M., "Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy", International Journal of Logistics Management, Vol. 4, No. 2, 1993, pp. 13-24.

Cooper, M.C., Innis, D.E., Dickson, P.R., Strategic Planning For Logistics, Council of Logistics Management, Oak Brook, IL, 1992.

Council of Logistics Management, What It's All About, 1994.

Coyle, J.J., "Preparing Logistics Systems for the 21st Century", Annual Conference Proceedings: Council of Logistics Management, Vol. 2, 1990, pp. 1-10.

Coyle, J.J., Bardi, E.J., Langley, C.J., The Management of Business Logistics, Fifth Edition, West Publishing, St. Paul, MN, 1992.

Coyle, J.J., Bardi, E.J., Novack, R.A., Transportation, Fourth Edition, West Publishing, St. Paul, MN, 1994.

Davenport, T.H., Process Innovation: Reengineering Work Through Information Technology, Harvard Business School Press, Boston, 1993.

Davis, T., "Effective Supply Chain Management", Sloan Management Review, Summer, 1993, pp. 35-46.

Davis, D. Gibson, B., "Responsiveness: Redefining Logistics Management For the 1990s and Beyond", Proceedings of the Twenty Second Annual Transportation and Logistics Educators Conference, The Ohio State University, Columbus, 1993, pp. 1-19.

Day, G.S., "The Capabilities of Market-Driven Organizations", Journal of Marketing, Vol. 58, October 1994, pp. 37-52.

Delaney, R.V., "Trends in Logistics and U.S. World Competitiveness", Transportation Quarterly, Vol. 45, No. 1, January 1991, pp. 19-41.

Dillion, W.R., and Goldstein, M., Multivariate Analysis: Methods and Applications, John Wiley & Sons, New York, 1984.

Doll, W.J., Vonderembse, M.A., "The Evolution of Manufacturing Systems: Towards the Post-Industrial Enterprise", Omega, Vol. 19, No. 5, 1990, pp. 401-411.

Ellram, L.M., "A Taxonomy of Total Cost of Ownership Models", Journal of Business Logistics, Vol. 15, No. 1, 1994, pp. 171-191.

Ellram, L.M., Krause, D.R., "Supplier Partnerships in Manufacturing Versus Non-Manufacturing Firms", International Journal of Logistics Management, Vol. 5, No. 1, 1994, pp. 43-53.

Emory, C.W., Cooper, D.R., Business Research Methods,Fourth Edition, Irwin, Boston, 1991.

Ernst & Whinney, Corporate Profitability & Logistics, Council of Logistics Management, Oak Brook, Illinois, 1987.

Ettlie, J.E., Penner-Hahn, J.D., "Flexibility Ratios and Manufacturing Strategy", Management Science, Vol. 40, No. 11, 1994, pp. 1444-1454.

Farrell, J.W., "Organization Study: New Clout for Logistics", Traffic Management, Vol. 24, September, 1985, pp. 37-43.

Fawcett, S.E., Birou, L.M., "Exploring the Logistics Interface between Global and JIT Sourcing", International Journal of Physical Distribution & Logistics Management, Vol. 22, No. 1, 1992, pp. 3-14.

Fawcett, S.E., Closs, D.J., "Coordinated Global Manufacturing, the Logistics/Manufacturing Interaction, and Firm Performance", Journal of Business Logistics, Vol. 14, No. 1, 1993, pp. 1-25.

Foster, T.A., "The $55 Billion Logistics Challenge", Distribution, Vol. 91, July 1991. p. 4.

Fuller, J.B., O'Conor, J., Rawlinson, R., "Tailored Logistics: The Next Advantage", Harvard Business Review, Vol. 71, No. 3, May-June, 1993, pp. 87-98.

Flynn, B.B., Schroeder, R.G., Sakakibara, S., "A Framework for Quality Management Research and an Associated Measurement Instrument", Journal of Operations Management, Vol. 11, 1994, pp. 339-366.

Garvin, D.A., Managing Quality, The Free Press, New York, 1988.

Gatewood, R.D., Feild, H.S., Employee Selection, Dryden Press, Fort Worth, Texas, 1994.

Gerwin, D., "Manufacturing Flexibility: A Strategic Perspective", Management Science, Vol. 39, No. 4, April, 1993, pp. 395-410.

Ghiselli, E.E., Campbell, J.P., Zedeck, S., Measurement Theory for the Behavaorial Sciences, W.H. Freeman, San Francisco, 1981.

Glick, W.H., Miller, C.C., Huber, G.P., "The Impact of Upper-Echelon Diversity on Organizational Performance", in Organizational Change and Redesign, edited by George P Huber and William H. Glick, Oxford University Press, New York, 1993, pp. 176-212.

Goldhar, J.D., Jelinek, M., "Plan for Economies of Scope", Harvard Business Review, Vol. 61, No. 6, November-December, 1983, pp. 141-148.

Goldhar, J.D., Jelinek, M. Schlie, T.W., "Competitive Advantage in Manufacturing Through Information Technology", International Journal of Technology Management, Special Publication on the Role of Technology in Corporate Policy, 1991, pp. 162-180.

Goldhar, J.D., Lei, D., "The Shape of Twenty-first Century Global Manufacturing", The Journal of Business Strategy, Vol. 12 No.2, 1991, pp. 37-41.

Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., Multivariate Data Analysis, Fourth Edition, Prentice Hall, Englewood Cliffs, New Jersey, 1995.

Hall, R., "The Strategic Analysis of Intangible Resources", Strategic Management Journal, Vol. 13, 1992, pp. 135-144.

Hammer, M., "Reengineering Work: Don't Automate, Obliterate", Harvard Business Review, Vol. 68, July-August, 1990, pp. 104-112.

Hammer, M., Champy, J., Reengineering the Corporation, Harper Business, New York, New York, 1993.

Hansen, G.S., Wernerfelt, B., "Determinants of Firm Performance: The Relative Importance of Economic and Organizational Factors", Strategic Management Journal, Vol. 10, 1989, pp. 399-411.

Harrison, M., Advanced Manufacturing Technology Management, Pitman Publishing, London, 1990, pp. 10-25.

Hayes, R.H., Pisano, G.P., "Beyond World-Class: The New Manufacturing Strategy", Harvard Business Review, Vol. 72, No. 1, January-February, 1994, pp. 77-86.

Hays, L., "IBM's Finance Chief, Ax in Hand, Scours Empire for Costs to Cut", The Wall Street Journal, Vol. LXXV, No. 73, January 26, 1994, pp. A1, A4.

Heskett, J.L., "Logistics- Essential to Strategy", Harvard Business Review, Vol. 55, No. 6, November-December, 1977, pp. 85-96.

Heskett, J.L., Jones, T.O., Loveman, G.W., Sasser, W.E., Schlesinger, L.A., "Putting the Service-Profit Chain to Work", Harvard Business Review, Vol. 72, No. 2, March-April, 1994, pp. 164-174.

Holcomb, M.C., "Customer Service Measurement: A Methodology for Increasing Customer Value through Utilization of the Taguchi Strategy", Journal of Business Logistics, Vol. 15, No. 1, 1994a, pp. 29-52.

Holcomb, M.C., "Logistics: The New Frame of Reference", Annual Conference Proceedings: Council of Logistics Management, 1994b, pp. 401-407.

Huber, G.P., "The Nature and Design of Post-Industrial Organizations", Management Science, Vol. 30, No. 8, August 1984, pp. 928-951.

Innis, D.E., LaLonde, B.J., "Customer Service: The Key to Customer Satisfaction, Customer Loyalty, and Market Share", Journal of Business Logistics, Vol. 15, No. 1, 1994, pp. 1-28.

Introna, L.D., "The Impact of Information Technology on Logistics", International Journal of Physical Distribution & Logistics Management, Vol. 21 No. 5, 1991, pp. 32-37.

Itami, H., Mobilizing Invisible Assets, Harvard University Press, Cambridge, MA, 1987.

Jaikumar, R., "Postindustrial Manufacturing", Harvard Business Review, Vol. 63, No. 6, Nov/Dec 1986, pp. 69-76.

Jemison, D.B., "The Importance of Boundary Spanning Roles and Strategic Decision-Making", Journal of Management Studies, Vol. 21, 1984, pp. 131-152.

Jöreskog, K.G. and Sörbom, D., LISREL® 7, User's Reference Guide, Scientific Software, Inc., 1989.

Johnson, J.C., Wood, D.F., Contemporary Logistics, Fifth Edition, Macmillan, New York, 1993.

Kaiser, H.F., "A Second-Generation Little Jiffy", Psychometrika, Vol. 35, 1970, pp. 401-415.

Kaiser, H.F., "Little Jiffy, Mark IV", Educational and Psychology Measurement, Vol. 34, 1974, pp. 111-117.

Kallock, R.W., Robinson, D.G., "Reengineering Business Logistics" Annual Conference Proceedings: Council of Logistics Management, Vol. 1, 1990, pp. 171-185.

Kenderdine, J.M., Larson, P.D., "Quality and Logistics: A Framework for Strategic Integration", International Journal of Physical Distribution & Materials Management, Vol. 18, No.6, 1988, pp. 5-10.

Koufteros, X.A., Time-Based Competition: Developing A Nomological Network of Constructs and Instrument Development, Dissertation, The University of Toledo, 1995.

Kumar A., Sharman, G., "We Love Your Product, but Where is It?", The McKinsey Quarterly, No. 1, 1992, pp.24-44.

Lado, A.A., Boyd, N.G., Wright, P., "A Competency-Based Model of Sustainable Competitive Advantage: Toward a Conceptual Integration", Journal of Management, Vol. 18, No. 1, 1992, pp. 77-91.

LaLonde, B.J., Cooper, M.C., The Ohio State University, Partnerships in Providing Customer Service: A Third-Party Perspective, Council of Logistics Management, Oak Brook, Illinois, 1989.

LaLonde, B.J., Cooper, M.C., Noordewier, T.G., The Ohio State University, Customer Service: A Management Perspective, Council of Logistics Management, Oak Brook, Illinois, 1988.

LaLonde, B.J., Masters, J.M., "Logistics: Perspectives for the 1990s", International Journal of Logistics Management, Vol. 1, No. 1, 1990, pp. 1-6.

LaLonde, B.J., Powers, R.F., "Disintegration and Re-Integration: Logistics of the Twenty-First Century", International Journal of Logistics Management, Vol. 4, No. 2, 1993, pp. 1-12.

Lambert, D.M., Stock, J.R., Strategic Logistics Management, Third Edition, Irwin, Homewood, IL, 1993.

Langley, C.J., Holcomb, M.C., "Creating Logistics Customer Value", Journal of Business Logistics, Vol. 13, No.2, 1992, pp. 1-27.

Larson, P.D., "An Empirical Study of Inter-Organizational Functional Integration and Total Costs", Journal of Business Logistics, Vol. 15, No.1, 1994, pp. 153-169.

Lawrence, P.R, Lorsch, J.W., Organization and Environment, Homewood, IL, Irwin, 1969.

Lenz, R.T., "Strategic Capability: A Concept and Framework for Analysis", Academy of Management Review, Vol. 5, No. 2, 1980, pp. 225-234.

Lewin, A.Y., Stephens, C.U., "Designing Postindustrial Organizations: Combining Theory and Practice", in Organizational Change and Redesign, edited by George P Huber and William H. Glick, Oxford University Press, New York, 1993, pp. 393-409.

Link, A., Tassey, G., Strategies for Technology-Based Competition: Meeting the Global Challenge, Lexington Books, Lexington, Mass., 1987.

Manheim, M.L., "Global Information Technology - Issues and Strategic Opportunities", International Information Systems, January, 1992, pp. 38-67.

McGinnis, M.A., Kohn, J.W., "Logistics Strategy, Organizational Environment, and Time Competitiveness", Journal of Business Logistics, Vol. 14, No. 2, 1993, pp. 1-23.

McGrath, M.E., Hoole, R.W., "Manufacturing's New Economies of Scale", Harvard Business Review, Vol. 70, No. 3, May-June, 1992, pp. 94-102.

Mesher, A., Rybeck, T., "A Manufacturer's Guide to Customer-Oriented Management Systems", Annual Conference Proceedings: Council of Logistics Management, 1994, pp. 183-192.

Miller, D., Friesen, P.H., "Strategy-Making and Environment: The Third Link", Strategic Management Journal, Vol. 4, 1983, pp. 221-235.

Mintzberg, H., Mintzberg on Management - Inside Our Strange World of Organizations, The Free Press, New York, 1989, pp. 98-220.

Muller, E.J., "How Top Management Really Views Logistics", Distribution, Vol. 87, December 1988, pp. 22-30.

Naumann, E., Creating Customer Value: The Path to Sustainable Competitive Advantage, Thompson Executive Press, Cincinnati, OH, p.11.

Nemetz, P.A., Fry, L.W., "Flexible Manufacturing Organizations: Implications for Strategy Formulation and Organization Design", Academy of Management Review, Vol. 13, No. 4, 1988, pp. 627-638.

Novack, R.A., Grenoble, W.L., Goodbread, N.J., "Teaching Quality in Logistics", Proceedings of the Twenty Second Annual Transportation and Logistics Educators Conference, The Ohio State University, Columbus, 1992, pp. 48-85.

Novack, R.A., Rinehart, L.M., Langley, C.J., "An Internal Assessment of Logistics Value", Journal of Business Logistics, Vol. 15, No. 1, 1994, pp. 113-152.

Novack, R.A., Rinehart, L.M., Wells, M.V., "Rethinking Concept Foundations in Logistics Management", Journal of Business Logistics, Vol. 13, No. 2, 1992, pp. 233-267.

Nunnally, J.C., Psychometric Theory, McGraw-Hill, New York, 1967.

Nunnally, J.C., Psychometric Theory, McGraw-Hill, New York, 1978.

Nutt, P.C., "The Identification of Solution Ideas During Organizational Decision Making", Management Science, Vol. 39, No. 9, 1993, 1071-1085.

Parasuraman, A., Berry, L.L., Zeithaml, V.A., "Understanding Customer Expectations of Service, Sloan Management Review, Spring, 1991, pp. 39-48.

Parthasarthy, R., Sethi, S.P., " The Impact of Flexible Automation on Business Strategy and Organizational Structure" Academy of Management Review, Vol. 17, No. 1, 1992, pp. 86-111.

Perry, J.H., "Emerging Economic and Technological Futures: Implications for Design and Management of Logistics Systems in the 1990s", Journal of Business Logistics, Vol. 12, No. 2, 1991, pp. 1-16.

Persson, G., "Achieving Competitiveness Through Logistics", The International Journal of Logistics Management, Vol. 2, No. 1, 1991, pp. 1-11.

Petersen, D., A Better Idea., Houghton Mifflin, Boston, 1991.
Ploos van Amstel, M.J., Farmer, D., "Controlling the Logistics Pipeline", International Journal of Logistics Management, Vol. 1, No. 1, 1990, pp. 19-27.

Ploos van Amstel, M.J., Verategen, M.F.G.M., "Development of a Total Logistics Concept: A Method for Improving Logistics Performance", International Journal of Logistics Management, Vol. 2, No. 2, 1991, pp. 63-73.

Ploos van Amstel, W., Starreveld, D.W., "Does Your Company Need a Logistical Executive?", International Journal of Logistics Management, Vol. 4, No. 1, 1993, pp. 49-58.

Pooley, J., Dunn, S.C., "A Longitudinal Study of Purchasing Positions: 1960-1989", Journal of Business Logistics, Vol. 15, No. 1, 1994, pp. 193-214.

Porter, M.E., Competitive Advantage, The Free Press, New York, 1985.

Porter, M.E., "Capital Disadvantage: America's Failing Capital Investment System", Harvard Business Review, Vol. 70, No. 5, September-October, 1992, pp. 65-82.

Porter, M.E., Millar, V.E., "How Information Gives You Competitive Advantage", Harvard Business Review, Vol. 63, Number 4, July-August 1985, pp. 149-160.

Ramamurthy, K., King, W.R., "Computer Integrated Manufacturing: An Exploratory Study of Key Organizational Barriers", Omega, Vol. 20, No. 4, 1992, pp. 475-491.

Reck, R.F., Long, B.G., "Purchasing: A Competitive Weapon", Journal of Purchasing and Materials Management, Fall, 1988, pp. 2-8.

Rogers, D.S., Dawe, R.L., Guerra, P., "Information Technology: Logistics Innovations for the 1990's", Annual Conference Proceedings: Council of Logistics Management, Vol. 2, 1992, pp. 245-261.

Russell, R.D., Russell, C.J., "An Examination of the Effects of Organizational Norms, Organizational Structure, and Environmental Uncertainty on Entrepreneurial Strategy", Journal of Management, Vol. 18, No. 4, 1992, pp. 639-656.

Schary, P.B., "A Concept of Customer Service", Logistics and Transportation Review, Vol. 28, No.4, 1992, pp. 341-351.

Schary, P.B., Coakley, J., "Logistics Organization and the Information System", International Journal of Logistics Management, Vol. 2, No. 2, 1991, pp. 22-29.

Shapiro, B.P., Rangan, V.K. Sviokla, J.J., "Staple Yourself to an Order", Harvard Business Review, Vol. 70, Number 4, July-August 1992, pp. 113-122.

Sheffi, Y., "Third Party Logistics: Present and Future Prospects", Journal of Business Logistics, Vol. 11, No. 2, 1990, pp. 27-39.

Skinner, W., "The Taming of Lions: How Manufacturing Leadership Evolved, 1780-1984", in The Uneasy Alliance: Managing the Productivity-Technology Dilemma, edited by Kim B. Clark, Robert Hayes, and Christopher Lorenz, Harvard Business School Press, Boston, 1985, pp. 257-270.

Skinner, W., "What Matters to Manufacturing", Harvard Business Review, Vol. 66, January-February, 1988, pp. 10-16.

Stark, G., "Time - The Next Source of Competitive Advantage", Harvard Business Review, Vol. 67, July-August, 1989, pp. 41-51.

Stock, J.R., Lambert, D.M., "Becoming a 'World Class' Company with Logistics Service Quality", The International Journal of Logistics Management, Vol. 3, No. 1, 1992, pp. 73-81.

Susman, G.I., "Work Groups: Autonomy, Technology, and Choice", in Technology and Organizations, edited by Paul S. Goodman, Lee S. Sproull, and Associates, Jossey- Bass, San Francisco, 1990, pp. 87-108.

Susman, G.I., Chase, R.B., "A Sociotechnical Analysis of the Integrated Factory", The Journal of Applied Behavioral Science, Vol. 22, No. 3, 1986, pp. 257-270.

Swamidass, P.M., Newell, W.T., "Manufacturing Strategy, Environmental Uncertainty and Performance: A Path Analytic Model", Management Science, Vol. 33, No. 4, April 1987, pp. 509-524.

"Quality: The Ante to Play the Game", Traffic Management, Vol. 29, July, 1990, pp. 42-49.

Tyndall, G.R., Zivan, S.M., "Corporate Profitability and Logistics: An Update on Logistics Excellence", Annual Conference Proceedings: Council of Logistics Management, Vol. 1, 1989, pp. 283-306.

Venketraman, N., Ramanujam, V., "On the Correspondence Between 'Primary' and 'Secondary' Measures of Business Economic Performance: An Attempt at Methodological Triangulation", Faculty Working Paper #1127, Bureau of Economic and Business Research, University of Illinois, Urbana-Champaign, 1985.

Vonderembse, M.A., Tracey, M., Tan, C.L., Bardi, E.J., "Current Purchasing Practices and JIT: Some of the Effects on Inbound Logistics", International Journal of Physical Distribution & Logistics Management, Vol. 25, No. 3, 1995, pp. 33-48.

Ward, P.T., Leong, G.K., Boyer, K.K., "Manufacturing Proactiveness and Performance", Decision Sciences, Vol. 25, No. 3, pp. 337-358.

Weick, K.E., "Technology as Equivoque: Sensemaking in New Technologies", in Technology and Organizations, edited by Paul S. Goodman, Lee S. Sproull, and Associates, Jossey- Bass, San Francisco, 1990, pp. 1-44.

Weiss, D.J., "Factor Analysis in Counseling Research", Journal of Counseling Psychology, Vol. 17, 1970, pp. 477-485.

Wernerfelt, B., "A Resource-based View of the Firm", Strategic Management Journal, Vol. 5, 1984, pp. 171-180.

Wheelwright, S.C., Clark, K.B., Revolutionary Product Development, The Free Press, New York, 1992.

Wheelwright, S.C., Hayes, R.H., "Competing Through Manufacturing", Harvard Business Review, Vol. 63, No. 1, January-February, 1985, pp. 99-109.

Wheelwright, S.C., Sasser, W.E., "The New Product Development Map", Harvard Business Review, Vol. 67, No. 3, May-June, 1989, pp. 112-125.

Zuboff, S., In the Age of the Smart Machine: The Future of Work and Power, Basic Books, New York, 1988.