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INSTITUTO TECNOLOGICO Y DE ESTUDIOS SUPERIORES DE MONTERREY

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EXTENDED ENTERPRISES' LOGISTICAL BEST PRACTICES AND IT'S IMPACT IN FIRM PERFORMANCE

DOCTORADO EN ADMINISTRACIÓN

TESIS PRESENTADA POR

DANIEL ZAVALA RIO

ASESOR

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To Diana, you have always been an inspiration to be everyday a better husband, a better father, a better son, a better man. Thank you for your infinite patience and support in this important achievement in my life. I love you with all my heart.

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ABSTRACT

Economy and manufacturing globalization, environmental awareness and stress over business and organizational structures, are factors that are generating considerable amounts of pressure that are having impact on enterprises policies and strategies in order to adapt and react accordingly to these pressures. These pressures are forcing firms' integration into the Extended Enterprise model, an inter-enterprise network with highly developed agility and flexibility characteristics, with a strong sense of integration and with a responsible environmental awareness. This research statistically (Factor Analysis, Multiple Linear Regression, and T-Tests) examines the relationship between logistical practices typical of the extended enterprise and company performance in Mexico. The results provide empirical evidence that selected customer relations practices and supplier relations practices are strongly associated with the perceived financial and operational success of the Mexican firms responding the survey.

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Chapter 1

Introduction

1.1 Overview of Relevant Issues of Logistical Practices and its Impact on Firm Performance

Some managers consider that their firms' performance could be better than nowadays or maybe they would like to make a benchmarking to the world class logistical models just to compare them with their firms' practices and determine if they are going to continue with their status quo, or they need a change. Now, if as a result of the benchmarking process, they determine that their companies are not following the best logistical practices, maybe they will not be able to adopt all of these practices at the same time because of time, money or technology constraints. It would be very practical to know which of these practices are significant to firm performance and which are not. Companies could spend a lot of time, money, among other resources, trying to implement a logistical practice that could result not significant to performance (costs, response time, and service, among others). On the other hand, it is important to know, if for any logistical practice, there is a significant difference in performance between focusing intensively on that logistical practice or not.

There is research related to logistics or logistics management, or related to Supply Chain Management, or related to the Extended Enterprise. There are some research works relating the first two terms, logistics (or logistics management) and Supply Chain Management, but

there is very scarce work relating these two terms to the Extended Enterprise. It is important to clarify: which are the differences and similarities between these three terms, how are these terms related? Which of these terms could be considered the state of the art? Which of these practices and models have a real impact on business performance and in consequence can help me enhance my firm's competitiveness? Which of these practices make a difference in firm performance when firms use them intensively compared to firms that do not use them intensively? The answering of all these questions, and the possibility relating logistics, Supply Chain Management and the Extended Enterprise model, motivated me to do this research work.

The clarification and answering to all these questions is important, considering that Mexican companies are facing a fierce competition with global companies, so, in order to be competitive, these companies must allocate resources adequately, investing in implementing or improving logistical practices which can enhance performance and competitiveness. According to Davila and Martinez (1999), international competition, specifically with Asian firms, and the opening of the economies, forced industrial sectors into internal and external competitiveness. Iglesias (1999) states that Latin America is involved in this international competition, and must take action considering that constant interaction with the international community is an objective reality.

The objectives of this research are: (1) to present the relation between the logistics concept, the Supply Chain Management concept, and the Extended Enterprise concept, to clarify it they are the same thing, if one depends of any other, how are they related in case they are; (2) to determine statistically which logistical practices are significant to firm performance;

and finally, (3) to determine if for any logistical practice there is a significant difference in performance between focusing intensively on that logistical practice or not.

1.2 Hypotheses of this Work

Based on the second and third objectives of this research, six hypotheses have been developed. The first two hypotheses have to do with Customer Relations logistical practices. The first one looks for the significant Customer Relations practices that impact firm's performance. The second one looks for practices which in case of being intensively used by a firm, that firm would have a superior performance over companies that do not use that practice intensively.

H1.a: A customer relations focus, characterized by a profound involvement of customers in operations, information systems, collaborative design, forecasting, planning and strategic planning with involvement of customers, agility, and order fulfillment, has a statistically significant impact on Mexican firm's performance.

H1.b: Mexican Firms that strongly develop a customer relations focus will exhibit enhanced performance compared to those which not.

The third and fourth hypotheses have to do with Supplier Relations logistical practices. The third hypothesis looks for the significant Supplier Relations practices that impact firm's performance. The fourth one looks for practices which in case of being intensively used by

a firm, that firm would have a superior performance over companies that do not use that practice intensively.

H2.a: A supplier involvement focus, characterized by a profound involvement of suppliers in operations, information systems, collaborative design, forecasting, planning and strategic planning with involvement of suppliers, agility, and order fulfillment, has a statistically significant impact on Mexican firm's performance.

H2.b: Mexican Firms that strongly develop a supplier involvement focus will exhibit enhanced performance compared to those which not.

The fifth and sixth hypotheses have to do with Environmental Awareness logistical practices. The fifth hypothesis looks for the significant Environmental Awareness practices that impact firm's performance. The fourth one looks for practices which in case of being intensively used by a firm, that firm would have a superior performance over companies that do not use that practice intensively.

H3.a: An environmental awareness focus, characterized by a strong environmental responsibility, having defined processes for the recovery and afterwards recycling, remanufacturing or final disposition of products, and the design of products with a longer life cycle, has a statistically significant impact on Mexican firm's performance.

H3.b: Mexican Firms that strongly develop an environmental awareness focus will exhibit enhanced performance compared to those which not.

A questionnaire was developed, and questions on logistical practices were grouped in three sections: Customer Relations practices, Supplier Relations practices, and Environmental Awareness practices. A fourth section of the questionnaire consisted of performance measurement variables. The objective of the survey was to look for significant relations between the firms' capabilities on logistical practices, and the performance measurement variables.

The procedure to test hypotheses H1.a, H2.a, and H3.a, was as follows; first of all, a Factor Analysis was performed in order to group the variables of each of the three parts of the questionnaire that have to do with logistical practices, for each of the thirteen performance measurement variables, Multiple Linear Regression was carried out using the factors as independent variables, in order to determine which factors (groups of variables) were significant to firm's performance.

The procedure to test hypotheses H1.b, H2.b, and H3.b, was as follows; T-tests were carried out using the factors, for analyzing significant differences in performance of firms with high logistics capabilities and firms with low logistics capabilities.

1.3 Organization of the Report

Chapter two shows the literature review on how the Logistics concept has evolved, first into the Supply Chain Management model, and afterwards into the Extended Enterprise model, which represent the state of the art of logistical practices. Chapter three shows the methodology literature review on related works, and the statistical methodology that was

utilized in this research work. Chapter four show the results of literature review on related works, and the statistical results of this work. Finally, chapter five exposes the general conclusions of this work.

Chapter 2

Evolution of the Extended Enterprise

Logistics and Supply Chain Management terms have been used indistinctly by some academicians and practitioners. On the other side, it has not been defined which are the differences and similarities between Supply Chain Management and the Extended Enterprise model. One of the objectives of this research is to show the relation between the logistics concept, the Supply Chain Management concept, and the Extended Enterprise concept, to clarify it they are the same thing, if one depends of any other, how they are related in case they are. This is presented in this chapter. It is also presented the way in which logistics has been evolving into the Extended Enterprise.

2.1 Definitions and Concepts on Logistics

Logistics has been positioned as one way for firms to differentiate their product or service offerings by enabling them to serve selected customers better than competitors do, or to serve those customers at lower a price for the same service Level (Stank and Lackey, 1996).

In 1986, the Council of Supply Chain Management Professionals (CSCMP, previously called Council of Logistics Management, CLM), the leading-edge professional organization in the logistics area, defined logistics as:

"The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information flow from point- of-origin to point-of-consumption for the purpose of conforming to customer requirements" (Cooper, Lambert, and Pagh, 1997, p.1)

In the 1990's, many of those academicians and practitioners writing, talking, and offering seminars on Supply Chain Management were using these words as a synonym for logistics. Supply Chain Management is a broader discipline than just logistics properly implemented. In fact, logistics is a sub-system of Supply Chain Management (Cooper et al., 1997).

In 1998, CSCMP announced a modified definition for logistics. That definition explicitly declares CSCMP's position that logistics management is only a part of Supply Chain Management, and that the two terms are not the same (Lambert, Cooper, and Pagh, 1998). This revised definition says that: *"Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements".*

In 2004, the CSCMP's definition for Logistics was:

"Logistics management is that part of the supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements" (http://clm1.org/ 2004, visited August 2004).

This 2004 CSCMP's definition is considering not only an efficient and effective forward flow, but is also considering a reverse flow of goods, service and information, this definition is considering the supply chain as a closed loop, not only an unidirectional chain or network.

Table 2.1 shows the critical issues covered by each of the definitions. In this table, it can be observed how the definition of the logistics concept evolved over time until, from a simple management of flow and storage of products and information, to the considering of not only a forward flow, but also the considering of a reverse flow.

Table 2.1

Logistics Definitions comparative table

	CSCMP, 1986	**CSCMP, 1998**	**CSCMP, 2004**
Management (Planning, Implementing, Controlling) of flow and storage	√	√	√
Efficiency, cost effectiveness in management	√	√	√
Conformity with customer requirements	√	√	√
Forward flow	√	√	√
Logistics as part of the Supply Chain Management		√	√
Reverse flow			√

Based on Boyson, Corsi, and Dresner (1999), and CSCMP (2004), it can be stated that logistics consists of a set of activities which are included in table 2.2.

Table 2.2

Logistics set of activities

	Boyson et al. 1999	CSCMP 2004
Traffic and transportation management	√	√
Warehousing and storage	√	√
Industrial packaging	√	√
Materials handling	√	√
Inventory management and control	√	√
Order fulfillment	√	√
Demand forecasting	√	√
Production planning and scheduling	√	√
Purchasing	√	√
Customer service levels	√	√
Plant and Warehousing site location	√	
Returned goods handling	√	
Parts and service support	√	
Salvage and scrap disposal	√	
Logistics network design		√
Third Party Logistics service providers		√

Any organization with high performance standards recognizes that these activities are the core logistics and views them not as isolated technical functions but as a strategically important set of activities. This set of activities can yield a competitive advantage (Boyson et al., 1999) for any organization.

2.2 Definitions and Concepts on Supply Chain Management

This section presents the literature review concerning the Supply Chain Management model, definitions and concepts, the supply chain management evolution, and how this evolution is taking the Supply Chain Management model into the Extended Enterprise model.

2.2.1 Definitions and concepts

The concept of Supply Chain Management first appeared in the literature in the mid 1980's. The first writers stated that Supply Chain Management covers the flow of goods from supplier through manufacturing and distribution chains to the end user. This scope was afterwards expanded up to the source of supply and down to the point of consumption, which is the span of logistics defined by CSCMP. *"In 1994, the members of The International Center for Competitive Excellence defined Supply Chain Management as "the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers"* (Cooper et al., 1997, p.2). This previous definition is beginning to consider business processes, not just logistical activities.

The short term objective of the Supply Chain Management is to increase the value of products and services to all internal and external customers in the supply chain, improving customer service and quality, while reducing inventory carrying costs and also reducing cycle time, its long-term strategic goals are to increase customer satisfaction, market share,

and profits for all members of the supply chain network (Wisner, 2003). Successful Supply Chain Management involves the coordination of activities within the firm and between members of the supply chain (Croxton, Garcia-Dastugue, Lambert, and Roger, 2001).

Mentzer, et al. (2001, p.18), highlight a strategic focus when they define Supply Chain Management as a "*systemic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole*".

Bowersox, Closs, and Cooper (2002) state that Supply Chain Management consists of "*firms collaborating to influence over the firms' strategic positioning and to improve operating efficiency*". This definition emphasizes that the Supply Chain Management model spans *all* functional areas within the organization and links *all* trading partners across organizational boundaries to reconfigure business processes in a systematic way that seeks to optimize end-customer value by perfectly meeting customer needs and expectations with minimal waste.

Croxton et al. (2001), and Lambert et al. (1998) report the following definition of Supply Chain Management given in 1998 by The Global Supply Chain Forum: " *Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders*".

Davis (2004) accordingly stated that Supply Chain Management is about process management, more than isolated logistics activities. The Global Supply Chain Forum identified eight key processes that make up the core of Supply Chain Management (Croxton et al., 2001):

1. Customer Relationship Management.
2. Customer Service Management.
3. Demand Management.
4. Order Fulfillment.
5. Manufacturing Flow Management.
6. Supplier Relationship Management.
7. Product Development and Commercialization.
8. Returns Management.

A definition of each process can be seen in Appendix A.

Simchi-Levi, Kaminski, and Simchi-Levi (2003, p.1) define Supply Chain Management as a *"set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and the right time, in order to minimize system wide costs while satisfying service level requirements"*. This definition highlights business integration, complete chain integration.

Davis (2004) states that many authors and organizations have described Supply Chain Management as an integration of processes incorporating acquisition of all physical and informational inputs, the further transformation of these inputs into customers solutions, and fulfillment of customer orders

In 2004, the CSCMP's definition for Supply Chain Management was the following:
"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies" (http://clm1.org/ 2004, visited August 2004).
This definition includes concepts such as coordination and collaboration with customers and suppliers. These are important issues for the Extended Enterprise concept.

Table 2.3 shows the critical issues covered by each of the Supply Chain Management definitions. In this table, it can be observed how the definition of the Supply Chain Management concept varies from source to source. Simchi-Levi's may seem to be the more complete definition. Even though some definitions may seem limited, they are intrinsically involving the most basic Supply Chain Management's objectives regarding product, service and information flows and storages.

2.2.2 Supply Chain Management evolution into Extended Enterprise

According to Browne et al. (1995) and Beamon (1999), there are pressures in the economic and industrial environments, which emerge from a set of factors, some of which are:

Table 2.3

Supply Chain Management Definitions comparative table

	Internat. Center for Competitive Excellence 1994	The Global Supply Chain Forum 1998	Mentzer, et al. 200	Simchi-Levi et al. 2003	CSCMP 2004
Integration of Business Processes (functions)	√	√	√	√	√
Provides products, services and information	√	√		√	√
Value Addition to customers and/or stakeholders	√	√			
Performance Improvement			√	√	
System-Wide Cost Minimization				√	

(1) Manufacturing is taking place in a global economy.

- Formation of strategic alliances.
- Customized product or service.
- Time to market is increasingly critical.
- Customer driven manufacturing. Make to order manufacturing.

- Markets globalization.

(2) Manufacturing systems are required to develop environmentally benign products and processes.

- More awareness of environmental impact of products and processes.
- Compulsory designs in terms of energy utilization, the use of recyclable materials, the safe disposal and also the reuse of products at the end of their life cycle.

(3) Business and organizational structures are under increasing stress.

- Increased reliance and dependence on subcontractors and suppliers.
- Supplier networks.
- Information technology to support this cross-enterprise working.
- Organizational structures are being flattened.

All the above pressures result in new forms of supply chains, which are based on a close work with networks of suppliers on the one hand and customers on the other hand to develop customized products in very short lead times. Inter-enterprise networking represents the future shape of manufacturing systems (Browne et al., 1995; Browne and Zhang, 1999; Tracey and Tan, 2001). Global deregulation in many industries is opening markets to the entry of new competitors (McAdam, 2001). Increasing global competition, the demands of customers for higher product quality, greater product selection, and better customer service, the desire of firms to shrink their supply bases while striving to contain costs, and the rising costs of natural resources today have led many organizations to adopt cooperative, mutually beneficial partnership strategies with suppliers, distributors, retailers,

and other firms within their supply chains to maintain or improve profitability and overall firm performance (Wisner, 2003).

Changing work practices, technological developments, globalization, increased involvement in alliances and partnerships, and the emergence of new public policy issues cause firms to become more "extended" and to realize that their success (and therefore their value) increasingly depends more on relationships than on the accumulation of conventional assets (Post, Preston, Sachs, and Sybille, 2002).

In the following sections, it is shown how some trends and practices from the business environment, have been determinant in the Supply Chain Management evolution, some of this trends and practices are:

a) Strategic alliances between members of the supply chain (Al-Mudimigh, Zairi, and M. Ahmed, 2004; Boardman and Clegg, 2001; Browne, Sackett, and Wortmann, 1995; Ellram, Zsidisin, Siferd, and Stanly, 2002; Hillebrand and Biemans, 2003; Kannan and Tan, 2002; McCormack and Kasper, 2002; O'Neill and Sackett, 1994; Poirier and Quinn, 2003; Tan, 2002; Wisner, 2003)
b) Working as an enterprise network (Cooper et al., 1997; Lambert et al., 1998; Poirier and Quinn, 2003; Stank, Crum, and Arango, 1999; Wisner, 2003).
c) Increasing the level of cross-enterprise collaboration (Al-Mudimigh et al., 2004; Bowersox, Closs, and Stank, 2003; Croxton et al., 2001; Ellram et al., 2002; Frohlich and Westbrook, 2001; McGuffog and Wadsley, 1999; Poirier and Quinn,

2003; Stank et al., 1999; Tan, Kannan, and Handfield, 1998; Tracey and Tan, 2001; Wisner, 2003).

d) Incentive Alignment (Simatupang, Wright, and Sridharan, 2002; Simatupang and Sridharan, 2002; Narayanan and Raman, 2004)

e) Becoming environmentally responsible (Browne et al., 1995; Beamon, 1999; De Burgos and Cespedes, 2001; Croxton et al., 2001; Ellram et al., 2002; and Sroufe, 2003).

These trends and practices have caused an evolution in the Supply Chain Management, which has permitted the supply chain become more efficient, more agile, more global, more integrated, with better response to customers requests.

2.2.2.1 Strategic alliances

Over the past decade there has been a growing consensus concerning the strategic importance of integrating suppliers, manufacturers, and customers (Frohlich and Westbrook, 2001).

Firms are developing strategic alliances with suppliers, and are also considering suppliers as partners instead of adversaries (Tan et al., 1998). Manufacturers are increasingly taking advantage of suppliers' technologies and expertise in product design and development, a concept commonly known as early supplier involvement. Firms utilize their suppliers' processes, technologies, and capabilities to improve competitive advantage. Buying firms are developing cooperative, mutually beneficial relationships with suppliers and viewing

suppliers as virtual extensions of their firm. In doing so, they significantly increase their reliance on suppliers (Tan, Kannan, Handfield, and Ghosh, 1999).

When Toyota's upper manager started considering how to get certain components for ther cars and trucks, the decision between buying and manufacturing seemed totally irrelevant. To Toyota, the real issue was to determine how the manufacturer and the suppliers could work jointly and fluidly to reduce costs and improve quality, through any formal or legal relation between them (Womack, Jones, Roos, and Carpenter, 1992).

Effectively selecting and evaluating suppliers and managing their involvement in the supply chain are thought to be capabilities that enable manufacturers to achieve higher performance. Therefore, it is possible that an effective selection and evaluation of suppliers, promoting their involvement in critical logistical supplier chain activities will result in an improved firm performance via enhanced customer satisfaction (Tracey and Tan, 2001). Involving suppliers in product design decisions and continuous improvement efforts enables the firms to share knowledge and increase learning so that better solutions can be found to complex, inter-company problems that impact performance (Tracey and Vonderembse, 2000). Leading companies are jumping ahead of their slower rivals and are establishing positions of dominance, based largely on their ability to work collaboratively with carefully selected trading partners (Poirier and Quinn, 2003).

There is consistent evidence that the widest degree of integration with both suppliers and customers had the strongest association with performance improvement. The most successful manufacturers seem to be those that have carefully linked their internal processes to external suppliers and customers in unique supply chains. For the new

millennium, upstream and downstream integration with suppliers and customers has emerged as an important element of manufacturing strategy. The opportunity to use process integration across functional boundaries is now considered a key to competitive success (Frohlich and Westbrook, 2001). The greatest inventory turnover benefits go to the company best able to strongly link up with suppliers and customers (Schonberger, 2003). Suppliers of a lean manufacturer know that if the work hard and in a trustful relation, the manufacturer will guarantee a reasonable return on investments. That's why, sharing with other members of the chain means that the chain benefits will improve and all the members of the chain will benefit (Womack et al., 1992).

By exploiting suppliers' capabilities, improvements in product quality, quicker integration of technological breakthroughs, and shorter new product development lead times are the expected outcomes. Suppliers can also be involved in product design at an earlier stage and in doing so, generate more cost-effective design choices, develop alternative conceptual solutions, select the best components and technologies, and assist in design assessment (Kannan and Tan, 2002; Wisner, 2003).

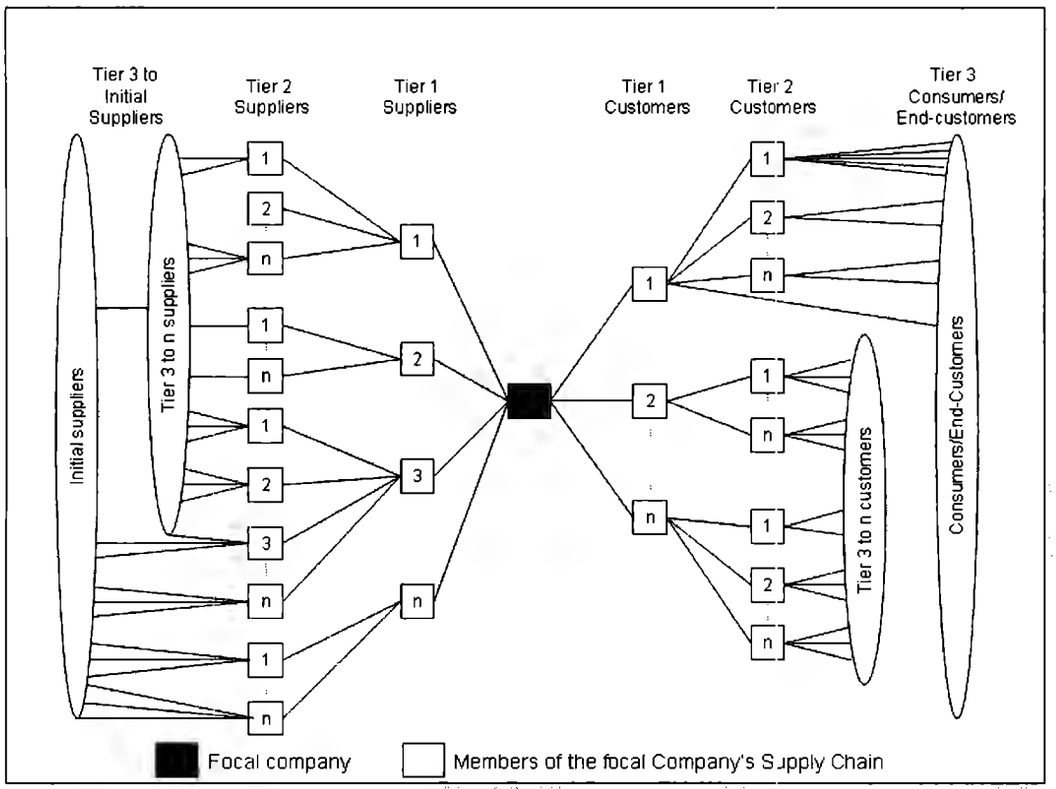
2.2.2.2 The network concept in Supply Chain Management

Browne et al. (1995) considered that the hierarchical paradigm of organizations with a focus on vertical command chains, will be probably replaced by a networking paradigm with the focus on horizontal (cross-enterprise) communication.

Executives are becoming aware of the emerging paradigm of inter-network competition, and that the successful integration and management of key business processes across members of the supply chain will determine the ultimate success of the single enterprise. The supply chain is not just a chain of businesses with one-to-one, business-to-business relationships, but a network of multiple businesses and relationships. The supply chain has to be considered really as a supply network. Hence, the objective of Supply Chain Management can be understood as to maximize competitiveness and profitability for the company as well as the whole supply chain network including the end-customer (Lambert et al., 1998). Figure 1 shows Lambert's (1998) conceptualization of the supply chain network.

FIGURE 1

SUPPLY CHAIN NETWORK STRUCTURE



The Supply Chain conceptualization considers the integration and management of key business processes across the network of organization. It's not only a partner's channel, nor a linear supply chain, but a network of organizations (Cooper et al., 1997; Croxton et al., 2001). The supply chain must be managed as a system (McAdam, 2001).

Individual companies are working together to form inter-enterprise networks, in order to survive and achieve business successes (Browne and Zhang, 1999). In the late 1990s, a big proportion of manufacturing and service businesses were moving to "network" models of organization, and many companies were establishing corporate logistics/supply-chain management centers to provide information, resources, and guidance to keep networks functioning on an optimal basis (Boyson et al., 1999). Building and sustaining supply networks are processes of aligning the interests of each network participant (Kinder, 2003).

Business management has entered the era of inter-network competition, and the final success of a single business will depend on the management's ability to integrate the company's intricate network of business relationships (Lambert et al., 1998). Corporations are recognizing that in the global business it is not a case of companies competing, but supply chains networks (McAdam, 2001; Cooper et al., 1997; Kinder, 2003; Tracey, 2000).

2.2.2.3 Cross-Enterprise collaboration

Intensive competition in the market place has forced companies to respond more quickly to customer needs through faster production development and shorter delivery time. To be effective in matching demand with supply, manufacturers and retailers need to collaborate

in the supply Chain (Simatupang and Sridharan, 2002). Since the mid 1980's it has been observed that many successful organizations are co-operating with partners in their supply chains (McAdam, 2001). In fact, the challenge to manufacturing in the future is to facilitate cross-enterprise networking in the supply chain (Browne et al., 1995). A closer coordination of activities both within and across the boundaries of firms throughout the supply chains is viewed as one important way to enhance performance (Stank and Lackey, 1996). If supply chain participants do not behave as "partners" and have a shared view of underlying consumer or base demand behavior and of each other's constraints, they are condemned to suffer the consequences in poorer service and/or greater total cost (McGuffog and Wadsley, 1999).

Coordination among independent firms, such as raw-material suppliers, manufacturers, distributors, third-party logistics providers and retailers, is the key to attaining the flexibility necessary to enable them to progressively improve logistics processes in response to rapidly changing market conditions. The main concern of supply chain management is how to coordinate the independent players to work together as a whole to pursue the common goal of chain profitability in changing market conditions. (Simatupang et al., 2002)

Wal-Mart is an example of a company which has benefited from enterprise collaboration. Wal-Mart transmits up-to-date sales and inventory information via satellite to its suppliers' systems to reduce order cycle time and enable stocking decisions to be based on observed early sales rather than on educated guesses. Wal-Mart focuses on the creation of customer services and non-price benefits and collaborates with its important suppliers in forecasting and replenishment. Both parties receive mutual benefits. Wal-Mart gains competitive retail

price and a reduction in lost sales and stocking costs, while the suppliers are able to replenish goods as they are sold, minimize stock-outs, and improve brand loyalty. (Simatupang and Sridharan, 2002)

Cross-enterprise collaboration emerges when two or more firms voluntarily agree to integrate human, financial, or technical resources in an effort to create a new, more efficient, effective, or relevant business model. The essence of cross-enterprise supply chain collaboration is to share information, jointly develop strategic plans, and synchronize operations. True cross-enterprise collaboration requires a company to modify work processes to incorporate and fuse the capabilities and competencies of other independent businesses (Bowersox et al., 2003).

Bowersox et al. (2003) also consider that the cross-enterprise collaboration is an organizational model that seeks the benefits of vertical integration without the inconvenience of financial ownership. This challenging perspective (the cross-enterprise collaboration) emerged in the late 20th century. In the cross-enterprise collaboration model, participating firms voluntarily create joint policies and integrate operational processes to eliminate duplication and nonproductive redundancy while seeking maximum productivity. In fact, they create what's often referred to as an Extended Enterprise.

A collaborative supply chain simply means that two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation (Simatupang and Sridharan, 2002). Stank et al. (1999) believed that a strong cross-enterprise coordination in the supply chain would be related to absolute performance

improvements in the following areas: inventory levels, transportation costs, warehousing costs, ordering costs, stock-outs, order cycle time, order cycle variance, on time deliveries, unacceptable deliveries, on time deliveries, product availability, customer satisfaction, transaction processes, order cycle time, flexibility, and the assessment of customer needs. Bowersox (1990) reports that logistics alliances offer opportunities to dramatically improve customer service and at the same time lower distribution and storage operating costs.

Close cooperation helps supply chain members to effectively match demand and supply to increase overall supply chain profitability (Simatupang and Sridharan, 2002). Supply Chain Management can extend a firm's capabilities by coordinating operations to include source, make, and delivery processes in collaboration with channel partners and suppliers. Coordination of sourcing, production, and logistical activities combined with cross-enterprise cooperation, in a supply chain perspective, shifts channel arrangements from loosely linked groups of businesses to coordinated enterprises, focused on efficiency improvement and increased competitiveness. The new organization is capable of rapidly responding to market demands by eliminating redundant activities and reducing response time through seamless flows of information, supply materials, and finished goods. Higher levels of coordination are expected to result in an improved logistics cost and customer service performance. Many firms have discovered that improved coordination and information flows can be achieved by strengthening their relationships with product and service suppliers and customers rather than relying on short-term, single-transaction arrangements. Benefits generally result from the synergy gained through shared expertise and resources, exchange of information, mutual planning and support, and joint problem solving fostered by win/win, mutually committed trading partners (Stank et al., 1999). The

firms collaborating with each other agree in principle and practice to the voluntary commitment and integration of resources in pursuit of jointly defined goals. (Bowersox et al., 2003).

Optimal supply chain performance requires the manufacturer to share her initial forecast truthfully, but there may be an incentive to inflate forecasts to induce the supplier to build more capacity. The supplier is aware of this bias, and so may not trust the manufacturer's forecast, harming supply chain performance. There are contracts that allow the supply chain to share demand forecasts credibly under either compliance regime. It is always in the interest of a manufacturer with a high demand forecast to share her forecast with the supplier (Cachon and Lariviere, 2001).

Although collaboration is based on a mutual objective, it is a self-interested process in which firms will participate only if it contributes to their own survival. Information sharing and incentive alignment facilitate the collaboration process. (Simatupang and Sridharan, 2002)

2.2.2.4 Incentives alignment

A supply chain develops strong relations only if every company on it has reasons to pull in the same direction. Every firm behaves in ways that maximize its own interests, but companies assume, wrongly, that when they do so, they also maximize the supply chains interests. Companies often don't act in ways that maximize the network's profits, consequently, the supply chains perform poorly. They also find it tedious and time-

consuming to define roles, responsibilities, and accountability for a group of businesses they don't manage directly. Besides, coordinating actions across firms is tough because organizations have different cultures and companies can't count on shared beliefs or loyalty to motivate their partners. To induce supply chain partners to behave in ways that are best for everybody, companies have to create or modify monetary incentives. (Narayanan and Raman, 2004)

Incentives define how companies in a supply chain are to be rewarded or penalized for the decisions they make. Existing incentives influence individual member behavior and its interaction with other partners. Conflict of interest is likely to occur when the existing incentives lead to actions that maximize personal gain but often reduce the total profitability (Clemons and Row, 1993). Traditional incentive schemes are often based on local costs and short-term concessions that attempt to fill the gap in inventory between chain members. Incentives such as local inventory cost, transportation cost and lot-size-based quantity discounts, often do not support the value creation process of improving customer services, because those incentives are tied to the action of reducing the internal costs of one stage of the supply chain. This local optimization often sacrifices the total profit. Local perspective and opportunistic behavior of maximizing individual profit often occurs at the expense of other members and works against the overall supply chain profitability. This behavior causes that products or services may not flow properly to end customers, which results in a mismatch between supply and demand. One way to resolve such a conflict of interests is to offer incentive schemes linked to the global performance that reflects both value creation for the customers and profitability (Simatupang and Sridharan, 2002). Incentive alignment induces partner behavior which is consistent with

customer focus and total profit. Examples from the practical world suggest that incentive alignment can motivate chain members to satisfy customer needs and increase their total profit. (Simatupang, Wright, and Sridharan, 2002).

Narayanan and Raman (2004) stated that a supply chain works well if its companies' incentives are aligned. That is, if risk, costs, and rewards of doing business are distributed fairly across the network. If incentives aren't in line, the companies' actions won't optimize the chain's performance. Indeed, misaligned incentives are often the cause of excess inventory, stock-outs, incorrect forecasts, inadequate sales efforts, and even poor customer service. Their research showed that if the companies work together to efficiently deliver goods and services to consumers, they will all win. If they don't, they will all lose to another supply chain. The challenge is to get all the firms in your supply network to play the game so that everybody wins. The only way you can do that is by aligning incentives.

2.2.2.5 Environmental awareness

Although the sustainability of economic development is a shared responsibility of, business, governments and consumers, the corporate role in slowing down the planet's environmental degradation is particularly relevant (De Burgos, 2001). Due to changing environmental requirements affecting manufacturing operations, increasing attention is given to developing environmental management strategies for the supply chain. There has been increasing public attention placed on the overall condition of the natural environment. Worldwide, there is an overall awareness of the worsening state of the environment, as well as a desire to reverse that trend (Beamon, 1999).

The ultimate objective of extending the boundaries of the traditional supply chain is to allow consideration of the total immediate and eventual environmental effects of all products and processes. The fully integrated, extended supply chain contains all of the elements of the traditional supply chain , but extends the chain to construct a semi-closed loop that includes product and packaging recycling, re-use, and/or remanufacturing operations. It is now imperative to analyze the entire lifecycle effects of all products and processes. Therefore, the traditional structure of the supply chain must be extended to include mechanisms for product recovery. This extension presents an additional level of complexity to supply chain design and analysis; more specifically, the addition of the product recovery mechanism gives rise to numerous issues affecting strategic and operational supply chain decisions (Beamon, 1999).

Browne et al. (1995) make emphasis in the increasing importance of environmentally benign production. Issues such as design for recycling, refurbishment, environmental costing, and legal matters can only be studied if the scope of study is enlarged to the chain of value adding activities, including ultimately end-of-life disassembly and refurbishment. O Neill and Sackett (1994) indicate that the manufacturer may take a product back when its capability to evolve has reached a limit, then some of its components may be recycled, or the product may be repackaged and used again. Today's visionary manufacturing companies are developing a total life cycle approach to their products (Browne et al., 1995). Recycling practices are an attempt to provide greater value to customers with fewer materials (Sroufe, 2003).

Browne et al. (1995) indicate that in the context of the Extended Enterprise and the need for enterprise networking, they consider that nowadays the organizations are facing a reduced product life cycle (and the consequences in terms of flexibility in the manufacturing capability), and the necessity of taking a total product life cycle view (due to the heightened awareness of environmental problems).

Various aspects regarding the environment, such as legislation, stakeholder pressure, economic opportunities and ethical motives have led to firms applying environmentally sustainable strategies. Managers must accept that the firm's overall strategy and environmental questions inevitably go hand in hand. They must, therefore, find a way of satisfying objectives of economic competitiveness and of environmental protection at the same time (De Burgos, 2001).

De Burgos (2001) also states that firms can obtain several benefits associated with the reduction of the organization's impact on the environment, which can help towards obtaining a competitive advantage. Among the benefits developed from environmental performance improvement are: cost reduction; quality improvement; early adoption of new regulations; benefits in management and personnel; external benefits derived, such as: improved company image; access to new markets; engaged competitiveness; improved customer loyalty; as well as improved stakeholder communication and feedback.

Croxton et al. (2001) consider that the effective management of returns is a critical part of Supply Chain Management. While many firms neglect the return process because management does not believe it is important, this process can assist the firm in achieving a

sustainable competitive advantage. Effective management of the return process enables the firm to identify productivity improvement opportunities and breakthrough projects.

It is early in design practices that decisions are made that impact operations practices and set into place the actions that ultimately create waste streams encountered in the transformation system. One way of controlling and reducing environmental waste is to integrate systems and practices to achieve better environmental performance. Design activities, in general, present opportunities for firms to find solutions to environmental issues. Through the use of an environmental design approach, products and processes are designed such that emissions and wastes are either minimized or completely removed. The assumption is that better environmental management will lead to better performance (Sroufe, 2003).

There must be a move towards sustainability, achieved through vast reductions in resource use and waste generation, and a move away from one-time use and product disposal. The first step in such a move is to extend the structure of the one-way supply chain to a closed loop, including supply chain operations designed for end-of-life product and packaging recovery, collection, and reuse (in the forms of recycling and/or remanufacturing) (Beamon, 1999).

2.2.3 How Supply Chain Management is moving to the Extended Enterprise

During the 1990s researchers and practitioners began to view the supply chain as a whole, and promoted customer focus, supplier partnerships, cooperation and information sharing

and business process management. As virtual organizations develop, business leaders need to take a holistic approach and consider the whole supply chain as one business (McAdam, 2001). Supply Chain Management, with its tendency to interact with many internal and external stakeholders, has become the driving force in an effort to create the Extended Enterprise (Boyson et al., 1999).

For a modern supply chain to function well, its participants should not only be exchanging orders or invoices, but also they should be willing to share future plans and past performance data. Depending on the nature of the supply chain, mutual benefits can be gained by jointly managing deliveries, inventory levels, service, etc. by communicating forward plans for distribution, production, and supply; jointly agreeing in the required response (Mc Guffog and Wadsley, 1999). During the 1990s, many manufacturers and service providers collaborated with their strategic suppliers to upgrade traditional supply and materials management functions and integrate them as part of corporate strategy. Supply Chain Management is the chain linking each element of the manufacturing and supply process from raw materials to the end users, and treating all firms within the supply chain as a unified virtual business entity. The Supply Chain Management scope was further expanded to include recycling. Leading organizations are adopting a strategic approach to managing the supply chain, such as forming strategic alliances with suppliers and distributors instead of vertical integrating, in order to exploit the competitive advantage associated with integrated processes (Tan, 2002).

Supply Chain Management's scope includes supply management from the supply of basic raw materials, to final product, and includes the possibility of recycling or re-use, trying

with this to create a kind of virtual organization, or Extended Enterprise, with the goal of efficiently and effectively managing the processes and operations of the separate organizations. Research results suggest that manufacturers are integrating their supplier's knowledge into new product and process design. Supply Chain Management also involves downstream integration of customers (Tan et al., 1998).

When successful, Supply Chain Management creates a virtual organization composed of several independent entities, often linked by sophisticated enterprise resource planning systems providing global visibility of real-time information from any part of a company or its supply chain partners. The visibility enables more effective forecasting, production, and inventory decisions .To accomplish this, Supply Chain Management must integrate a number of key business functions, including purchasing, demand management, distribution planning, transportation, quality management, production planning, and materials management throughout the supply chain (Wisner, 2003).

Table 2.4 shows a comparison between the key business functions proposed by the Global Supply chain Forum and the key business functions proposed by Wisner, it can be observed that the Global Supply Chain Forum has a more comprehensive focus, which is closer to the extended enterprise's focus.

Supply Chain Management is a major issue in many industries as organizations begin to appreciate the criticality of creating an integrated relationship with their suppliers and customers, as well as all other stakeholders (Al-Mujdimigh et al., in press).

Table 2.4

Key business functions according to GSCF and Wisner

	GSCF	Wisner
Customer Relationship Management	√	
Customer Service Management	√	
Demand Management	√	√
Order Fulfillment	√	√
Manufacturing Flow Management	√	√
Supplier Relationship Management	√	√
Product Development and Commercialization	√	
Returns	√	
Quality Management		√

McCormack and Kasper (2002) provide solid evidence of the benefit to the Supply Chain Management by extending the supply chain to include suppliers and customers. Croxton et al. (2001) state that the companies that would be successful in the future would be those that are able to take a new approach to business, working closely with partners to design and manage processes that extend across traditional corporate boundaries. Rolstadas (1998) agrees with the previous concepts when he argues that the modern enterprise will regard its customers and suppliers as part of its own company by establishing strategic alliances. He also states that some have started to talk about the virtual or Extended Enterprise. Tan et al.

(1999) consider that a key element of successful supply base management involves downstream integration of customers as well as the management of upstream suppliers. Each entity in the supply chain is a supplier as well as a customer. Tan et al. (1998) state that when all strategic suppliers in the chain integrate and act as a single entity performance is enhanced throughout the chain.

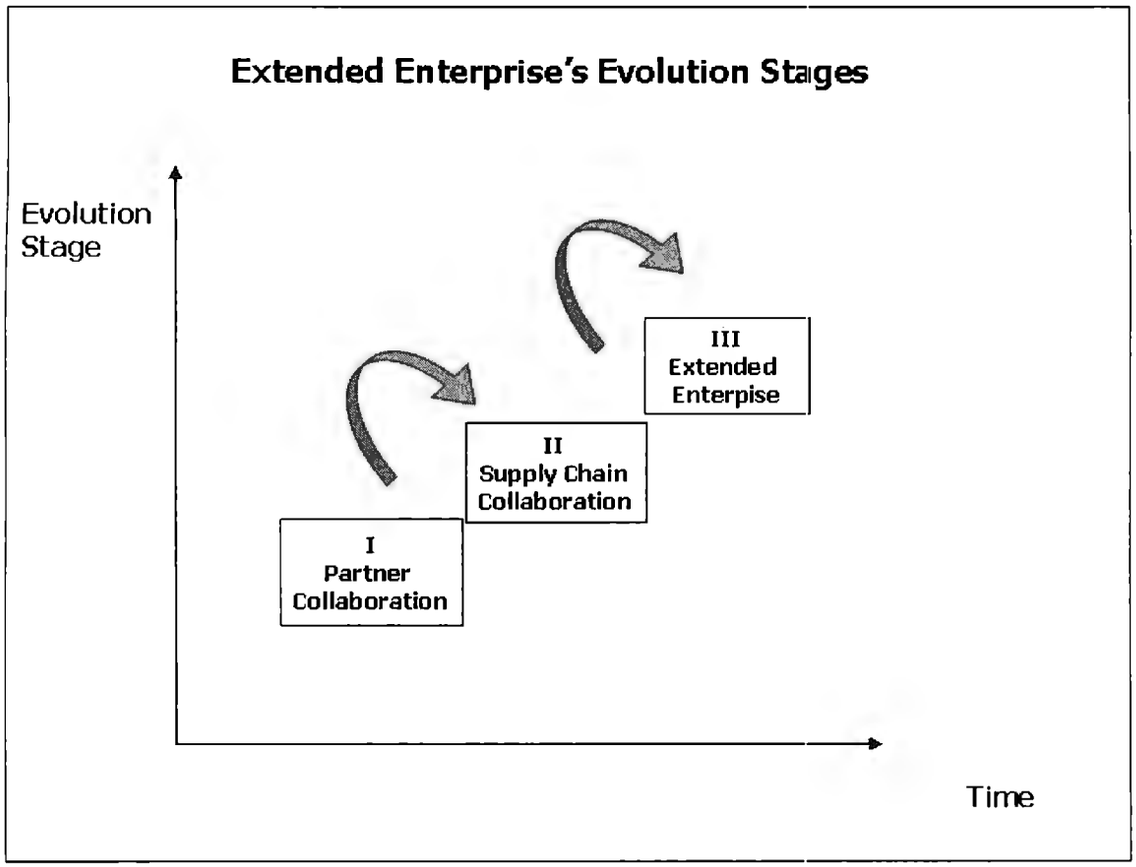
Changing work practices, technological developments, globalization, increased involvement in alliances and partnerships, and the emergence of new public policy issues all cause firms to realize that their success (and therefore their value) increasingly depends more on relationships than on the accumulation of conventional assets (Post et. al., 2002).

Based on Croxton et al. (2001) and Poirier and Quinn (2003), Figure 2 shows 3 levels of evolution for the Supply Chain in terms of collaboration and integration.

At Level I, the company begins some inter-enterprise activities, involving important suppliers and customers in strategic and operative sessions; it also begins to work on collaborative product and process designs and to match supply more closely with demand. Also collaboratively works to discover savings through mutually beneficial initiatives that reduce cycle time, achieve faster time to market, and utilize assets more effectively. This level includes integrating customers and suppliers into the product development process in order to reduce time to market. As product life cycles shorten, the right products must be developed and successfully launched in ever-shorter timeframes in order to remain competitive.

FIGURE 2

FROM SUPPLY CHAIN MANAGEMENT TO EXTENDED ENTERPRISE



At Level II, the organization moves forward with its positions in one or more networks. The company begins working very seriously with a small base of upstream and downstream partners. Now, the focus shifts into establishing a position of dominance in an industry for a particular network with the aid of all the network partners. The company works with key vendors to enhance value for both parties. A serious sharing of information with key customers is launched with the objective of developing joint strategies and business goals that increase revenues and profits for both parties.

At Level III, the most advanced stage of supply chain evolution is reached; this is when a Supply Chain works under the principles of an Extended Enterprise. This level is characterized by communication connectivity across the total supply chain network. Collaborative design and manufacturing, and collaborative planning, forecasting, and replenishment appear in this level. Full network collaboration and the use of technology to gain positions of market dominance are utilized. This level is also characterized by Environmental Awareness, in terms of reverse logistics, recycling, refurbishment, remanufacturing, and environmental design.

2.3 Definitions and Concepts on Extended Enterprise

In this section will be presented the literature review concerning the Extended Enterprise model, its related definitions as well as the organization, agility and flexibility concepts. The network concept applied to the Extended Enterprise model, and finally, some examples of companies that are actually using this new model.

2.3.1 Definitions

The Extended Enterprise model cannot be realized overnight. It evolves over time. Elements of it can already be seen in some industrial sectors. Indeed programs such as JIT, World Class Manufacturing, and Lean Production; processes such as Business Process Redesign, and Benchmarking, and technologies such as computer networking and EDI (Electronic Data Interchange) have allowed manufacturing enterprises to move in the

direction of inter-enterprise networking (Browne et al., 1995). Large corporations are evolving into complex Extended Enterprises (Post et al., 2002).

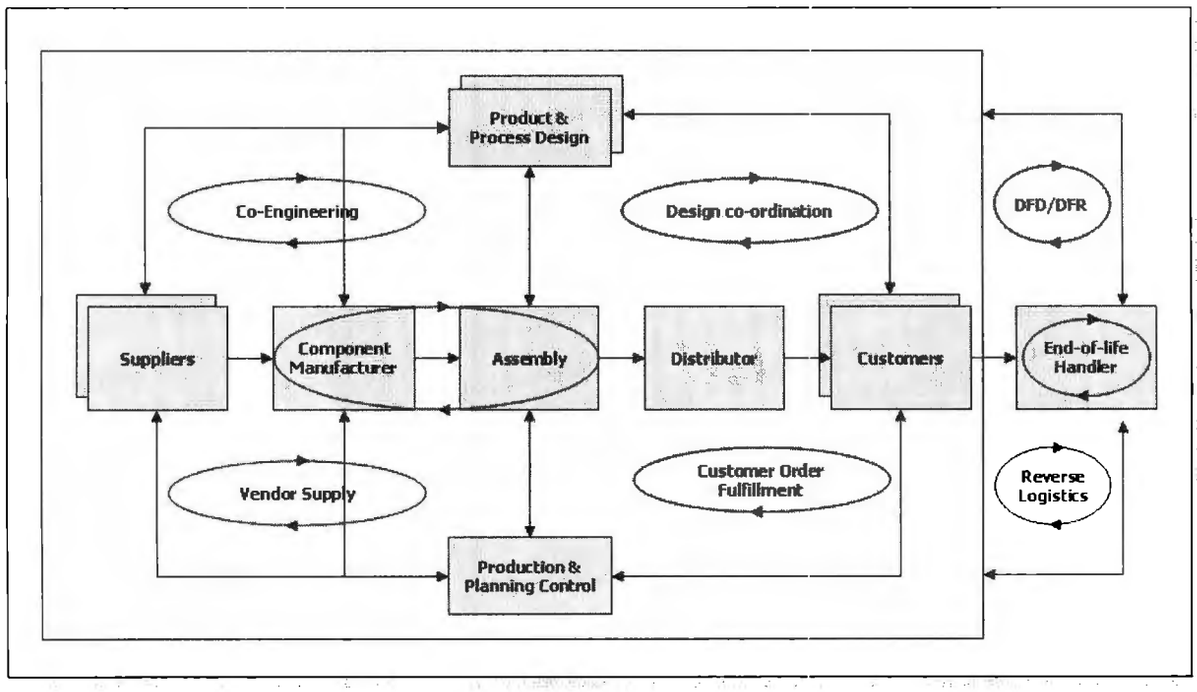
Companies which manage logistics on a functional basis are some 30 years behind current best practices. Those who manage logistics well across the enterprise but who refuse to manage Extended Enterprise relationships with the same intensity and effectiveness as they do internally are at least 10 years behind current best practice. Even those companies that have a high performance with unified management approaches and systems across the entire chain cannot afford to rest, because economic and technological forces continue to accelerate the speed of change (Boyson et al., 1999). Manufacturing enterprises are facing critical challenges to reconstruct themselves in order to survive in an ever more volatile competitive market environment. Their success largely depends on their ability to quickly practice and adopt state-of-the-art manufacturing strategies and technologies. There is a shift from "self-centered" closed-enterprises to global open-enterprises. One of the terms used to describe this new approach is that of the "Extended Enterprise" (Browne and Zhang, 1999). This model is inevitable in sectors where the importance of the customer service is increasing (O Neill and Sackett, 1994).

The Extended Enterprise can be regarded as a kind of enterprise which is represented by all those organizations or parts of organizations, customers, suppliers and sub-contractors, engaged collaboratively in the design, development, manufacture and delivery of a product to the end user. The Extended Enterprise can be seen in the context of enterprise partnerships, designed to facilitate co-operation and integration across the supply chain.

The concept of the Extended Enterprise focuses on long-term enterprise relationships with suppliers and consumers across the supply chain (Browne and Zhang, 1999).

FIGURE 3

GRAPHICAL CONCEPTUALIZATION OF THE EXTENDED ENTERPRISE



The Extended Enterprise extends beyond traditional organizational boundaries. It includes the relationships that an enterprise has with its customers, suppliers, business partners, and even former competitors. The Extended Enterprise is responsible for the whole product life cycle, from material procurement to component production and manufacturing, to final assembly, further to distribution and customer service, and in an increasing number of cases, to the disposition and, where possible, recycling of end-of-life products (Browne and

Zhang, 1999). Figure 3 shows Browne and Zhang's (1999) graphical conceptualization of Extended Enterprise.

The left side (the big box) of Figure 3 represents the conventionally called "forward manufacturing process" and associated "forward value chain", while the right side (the small box) represents an augmented business model to incorporate end-of-life product disposition and possible component recycling (Browne and Zhang, 1999).

The forward manufacturing process includes five "conventional" processes: co-engineering, design co-ordination, vendor supply or supply chain management, customer order fulfillment, and manufacturing/assembly. Four of those cross traditional enterprise boundaries (Browne and Zhang, 1999).

a) Co-engineering refers to the involvement of key specialist suppliers in the product/process design process (Browne and Zhang, 1999). Suppliers may participate earlier in the product design process to achieve more cost-effective design choices, develop alternative conceptual solutions, select the best components and technologies, and help in design assessment (Tan et al., 1999). There has been an increase in the sharing of information between suppliers and customers (Al-Mujdimigh et al., in press). A critical responsibility is the developing and maintaining of long term strategic alliances with key suppliers. Research suggests that managing well supplier involvement can lead to a better supplier performance, improved manufacturing, and product and process advancements that, in turn, enhance customer satisfaction and firm performance. There is also a relative benefit

to be gained through the involvement of suppliers on product development and continuous improvement teams. Such involvement has a significant positive total effect on customer satisfaction and on firm performance (Tracey and Tan, 2001).

b) Design co-ordination is concerned with the design of product and the manufacturing process to meet customer need and, therefore, involves close interaction with customers and/or their representatives (Browne and Zhang, 1999). Knowledge about customers, including their receptivity to various communication modes and other forms of influence, not only guides marketing efforts, but also creates opportunities for collaboration in the search for mutually beneficial product-service improvements (Post et al., 2002).

c) The vendor supply process is concerned with the management of the flow of materials from suppliers in order to meet customer orders efficiently and cost-effectively (Browne and Zhang, 1999). The global situation with the Extended Enterprise extends the customer satisfaction approach beyond the customer. It actually includes suppliers, vendors, financial institutions, and even owners. Having the best possible suppliers is nowadays regarded as an asset. There is therefore an open competition in the marketplace not only for customers, but also for suppliers and owners (Rolstadas, 1998).

d) The customer order fulfillment process is concerned with the delivery of that order. Frequently it involves specialist distribution and transport enterprises and, indeed, logistics service providers (Browne and Zhang, 1999).

The three business processes that are emerging under the Extended Enterprise paradigm are, design for recycling/disassembly, product recovery and reverse logistics, and finally end-of-life product disposition (Browne and Zhang, 1999). It has been previously mentioned that according to Browne et al. (1995), public opinion is more and more aware of the environmental impact of manufacturing processes as well as the final and intermediate products of the manufacturing processes. Local and global agreements has increasingly forced and constrained product and process design in terms of energy utilization, the use of recyclable materials, the safe disposal and also the reuse of products at the end of their life cycle.

2.3.2 Organizational structure in the Extended Enterprise

A very important issue to achieve a successful performance of the Extended Enterprise model is an adequate organizational structure. The Extended Enterprise demands a new organizational concept. The power of the conventional hierarchy is seriously weakened by the flat, geographically distributed and transient structure of the Extended Enterprise. Decision making is widely distributed (O Neill and Sackett, 1994). Hierarchical authority systems that are widely spread in vertically integrated industrial firms are slow in identifying rapidly changing customer requirements and in reacting quickly with creative product offerings (Brown et al., 1995).

Effective management of the Extended Enterprise requires both a new conception of the firm (a network, rather than a hierarchy) and new approaches to the practical issues and

problems that arise in such a setting (Post et al., 2002). The authority structure has to move from a single firm's command-and-control organization to a framework of mutually prescribed, rule-based operating agreements among the firms that form the network (Bowersox et al., 2003).

2.3.3 Agility and flexibility in the Extended Enterprise

At the beginning of the 21st century, companies must emphasize on a greater organizational and process agility and flexibility. According to Backhouse and Burns (1999), agility is the ability of a company to adapt to unpredicted changes in the external environment. This is in contrast to flexibility, which is taken to mean the ability of companies to respond to a variety of customer requirements which exist within defined constraints. There are rapidly emerging requirement for agility both within individual business units and across sophisticated manufacturing value chains. The way in which companies are expected to respond to rapid and unpredictable change in the external environment have resulted in new paradigms for manufacturing which are formed by a combination of leanness, agility, and the Extended Enterprise model.

Browne et al. (1995) indicate that in the context of the Extended Enterprise and the need for inter-enterprise networking, nowadays, organizations are facing a reduced product life cycle (and the consequences in terms of flexibility in the manufacturing capability), and an increase in the time-base competition (and the associated need to reduce the time to market for new products). Cooper et al. (1997) state that there is a need to include external organizations in the product development process in order to reduce the time-to-market on

new product introductions. Stank and Lackey (1996) state that the ability to respond to change has been found to positively impact firms' performance.

Stank and Lackey (1996) analyzed the performance of Mexican maquiladora firms on key logistic capabilities and concluded that increased agility enables maquiladora firms to determine and quickly respond to an extremely volatile operating environment. Mexican maquiladoras that have adopted flexible processes in manufacturing, scheduling, and distribution, and manage personnel to achieve flexibility significantly outperformed other firms in both customer service and cost performance. They also concluded that agility allows firms to rapidly respond to changes in supply and/or demand, changing production and distribution schedules easily to meet customer orders and overcome supply shortages or operational crises without excess expenditure of resources.

Agility is a must in a modern business environment. The ability to innovate, and to be responsive, flexible, and cost effective is the only way to standout among various competitors (Al-Mujdimigh et al., in press).

2.3.4 The network concept in the Extended Enterprise

The challenge for the future is to consider the Extended Enterprise and facilitate inter-enterprise networking across the supply chain (Browne and Zhang, 1999). For companies to survive and prosper, they will need to operate their supply chains as Extended Enterprises with relationships which embrace business processes, from materials extraction to consumption (Lambert et al., 1998).

The Extended Enterprise networks the activities of a number of entities to produce and market products and services. The coordination of the relationships between these entities and the communication among them are the critical issues for an Extended Enterprise (Browne and Zhang, 1999). The linkages between the Extended Enterprise and the companies that constitute it must be considered as the principal means of sustaining and improving its wealth-creating capacity. The contemporary large corporation has become an "Extended Enterprise" engaged in diverse functions at multiple locations and linked with numerous other entities and individuals in the course of its operations (Post et al., 2002).

The term "Extended Enterprise" refers to breaking down a company's outer wall and extending its strategy, structure, and processes to its core partners. The goal is to get everyone in the Extended Enterprise onto a common platform of logistics transactions and information systems for a greater inter-organizational integration. This integration can result in a significantly faster response time to volatile changes in marketplace events and patterns of demand. By creating and managing a highly organized network of complementary companies across the supply chain, an Extended Enterprise can rapidly build strategic effectiveness and wealth (Boyson et al., 1999).

Both management literature and managerial practice increasingly emphasize that firms can no longer act like corporate islands in turbulent and very competitive waters. Most companies have realized that they may gain significant advantages through strategic alliances with other organizations (Hillebrand and Biemans, 2003). The capacity of a firm

to generate sustainable wealth over time, and hence its long-term value, is determined by its relationships with critical stakeholders (Post et al., 2002).

2.3.5 Some examples of Extended Enterprises

Some of the most important companies in the world have been moving to de Extended Enterprise model in order to maintain their leadership in their respective industries, this model is a must in order to be productive, flexible, customer driven and to achieve a sustainable development.

According to Hillebrand and Biemans (2003) the term "Extended Enterprise" appears to have originated at Chrysler Corporation, where it was used to shape information exchange and cost reduction practices within the supply chain. Jack Welch, CEO of General Electric, wrote a now famous memo about the need for a boundary-less organization. The concept was subsequently generalized as a distinctive approach to manufacturing-logistics management.

Chrysler estimated the effort for the Cherokee Jeep to involve 100,000 firms and 5 million people. Their former CEO, Thomas Stallkamp, referred to this "system" as the Chrysler Extended Enterprise". As much as 80% of the life-cycle system's design and manufacturing costs are fixed by decisions made within the first 20 per cent of the product's life-cycle; hence, huge investments have been made in concurrent engineering methods, and in their application, to the product development process. Lucas Aerospace has also been implementing concurrent engineering principles where suppliers and customers are

integrated and actively involved in the product introduction process (Boardman and Clegg, 2001)

IBM represents another example of a company that has enjoyed some success in strategic integration. Operating in a very complex supply chain, the company has been able to focus the efforts of each partner and enhance the performance of the Extended Enterprise. While specific supply chain activities may be outsourced (e.g., card assembly and manufacturing and transportation), IBM still monitors and coordinates component manufacturing and movement through its planning systems. Unlike a traditional contract manufacturing relationship in which a manufacturer provides the contractor with a periodic set of requirements, supply chain operations such as manufacturing, assembly, kitting, and testing take place in a series of stages both inside and outside of IBM. This requires that planning be integrated across all members of the Extended Enterprise (Bowersox et al., 2003).

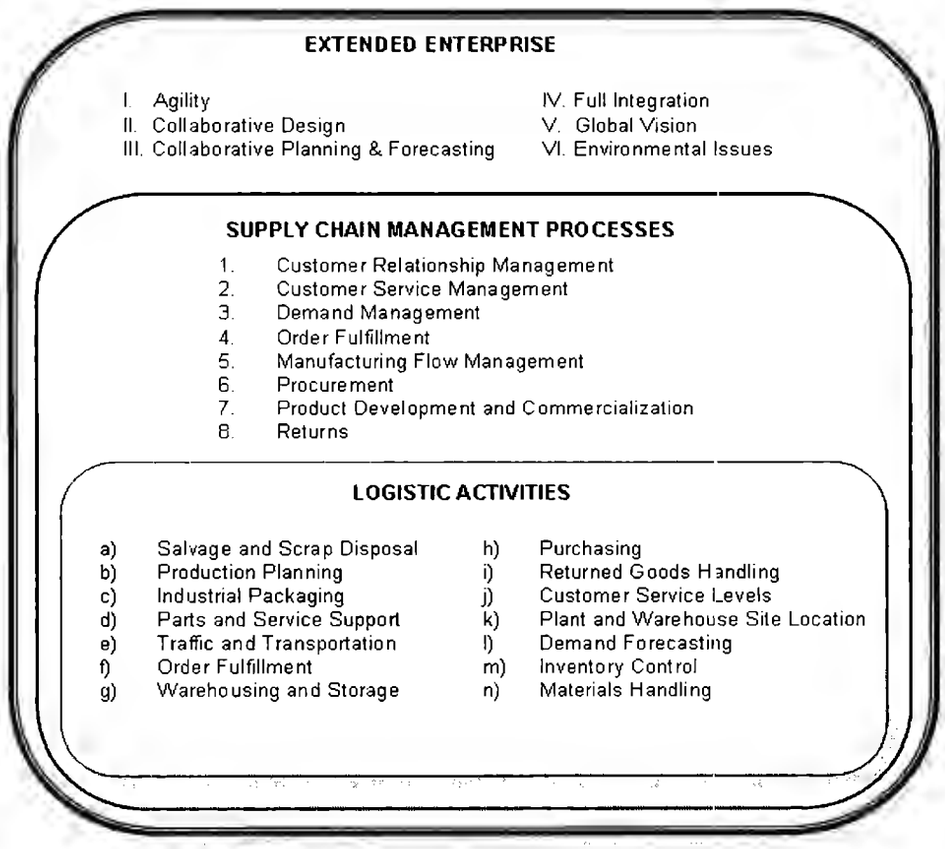
2.4 Summary

Boyson et al. (1999) relate the Logistics, Supply Chain Management and Extended Enterprise concepts to the fact that high performance organizations see logistics as the glue that holds together customers, suppliers, transportation carriers, and all other firms in their Extended Enterprises. Indeed, logistics can be viewed as a core managerial function for firms attempting to manage Extended Enterprises or to integrate the operations of supply-chain members. Figure 4 shows graphically the relation between these three concepts.

The Supply Chain Management model consists of set of key business processes, these processes are used to plan and manage the logistical activities, it also includes coordination and collaboration with the other members of the enterprise network, looking for cost minimizing of the entire chain.

FIGURE 4

LOGISTICS, SUPPLY CHAIN MANAGEMENT, EXTENDED ENTERPRISE



On the other hand, the Extended Enterprise will gradually be adopted by more firms and inter-enterprise networks in the near future. Extended Enterprise looks

for a full connectivity and collaboration between the members of the supply chain. The Extended Enterprise looks for an integration of key clients and suppliers in strategic collaborative decision processes (product, process, and logistic design) in order to achieve and maximize the flexibility and agility of the network, besides, it considers strongly environmental issues in terms of re-use, recycle, and re-manufacturing of products. Environmental awareness and regulations will be compulsory in the near future, governments all around the world are looking for environmental regulations to reach a sustainable development, the degree of involvement, joint and collaborative decision processes, and integration of network members will be the only choice.

Chapter 3

Literature Review

3.1 Objectives and Scope

This chapter presents a summary of the studied approaches related to the second and third objectives of this research. The studied approaches have to do with the analysis of the utilization of Supply Chain Management and Extended Enterprise's logistical best practices, focusing specifically on customer relationships, supplier relationships, and environmental issues practices, as well as the impact that these practices have on the perceived financial and operational success of firms.

These relational (clients and suppliers) areas were specifically selected because the extended enterprise model is based in a very profound relation and involvement with clients and suppliers in areas such as: product and process design; joint forecasting and strategic planning; an intense information exchange thorough all the enterprise network; joint programs and operations; agile, quick, and joint response to sudden changes in the market conditions and necessities; among others. On the other hand, environmental issues are a very important part of the Extended Enterprise model, including areas such as: environmental concern; reverse logistics; re-use; re-manufacturing; recycling; and environmental design (Browne and Zhang, 1999; Rolstadas, 1998; Tan et al., 1999; Al-Mujdimigh et al., in press; Backhouse and Burns, 1999; Stank and Lackey, 1996).

There is available literature on research related to supplier relations management, or to customer relations management, and its impact in firm performance (D'Avanzo, Von Lewinski, and Van Wassenhove, 2003; Ellram et al., 2002; Frohlich and Westbrook, 2001; Kannan and Tan, 2002; Stank et al., 1999; Stank and Lackey, 1996; Tan, 2002; Tan et al., 1998, Tan et al., 1999, Tracey and Tan, 2001; Tracey and Vonderembse, 2000; Wisner, 2003). These research works measure if the opinion of customers and suppliers is taken into account when taking operational or planning decisions; if there exists an adequate degree of information exchange; if there is a complaint management system; and if there is an adequate level of partnering, among others. However, the reported research does not analyze the impact in firm's performance of a more intense collaboration among the members of the enterprise network; this intense collaboration can be measured in terms of: joint strategic planning; joint forecasting; joint product and process design. These logistics and supply chain management research works don't consider environmental issues and its possible repercussion in firm performance.

3.2 Methodological Review

This section presents examples of the methodology utilized in previous logistical research, as well as the results of those works related to logistical capabilities and firm performance. These research works relate supplier relations and customer relations to firm performance.

Stank and Lackey (1997) investigated the performance of Mexican maquiladora firms on key logistics capabilities. A questionnaire covering manager's perception of their firm's level of expertise in various logistics capabilities as well as questions aimed at determining

performance information was developed based upon interviews and previous literature. Scales were purified by running factor analyses. Respondents were asked to indicate their agreement with statements concerning aspects of their companies' logistical capabilities and performance Overall scores for 13 logistics capabilities were created by averaging the responses across the individual items comprising each capability scale. The overall capability scores were used to group data on logistics performance variables. Groupings were achieved by splitting out respondents with overall capability scores of 3 or less into one group (indicating high levels of capability) and respondents with overall capability scores of greater than 3 into a second group (indicating low levels of capability). T-test of significant differences in means of performance variables between the two groups based upon levels of logistics capability were conducted to test each hypothesis. Their research provided an indication of the importance of competence in key logistics capabilities to the overall logistical performance of Mexican maquiladora firms. Capabilities related to competence in integration and agility were found to be of particular importance to logistical performance. The results showed real and definite benefits associated with developing logistics processes that enhance supply chain integration to individual firms. Maquiladora firms that had achieved integration among functional areas such as purchasing, production scheduling, distribution, and sales, and that had developed processes that enable them to readily share information with suppliers and customers, demonstrated improved performance. Performance improvements were noticeable in customer service performance such as order cycle time reductions and increases in on-time delivery of shipments, as well as indicators of cost performance. It was shown that increased agility enabled maquiladora firms to determine and quickly respond to an extremely volatile operating environment. Agility allowed firms to rapidly respond to changes in supply and/or demand, changing

production and distribution schedules easily to meet customer orders and overcome supply shortages or operational crises without an excessive expenditure of resources. Their research showed that customer-focused Mexican maquiladoras demonstrated superior overall logistical performance when they developed capabilities and processes that (1) ensured a seamless flow of information among internal and external supply chain members: and (2) developed local operations and personnel that could quickly respond to changes in supply and demand.

Tan et al. (1998) examined the relationship between supply chain management practices, supplier performance and firm performance. Information was collected on how companies manage three important components of Supply Chain Management: purchasing, quality management and customer relations. In addition, the survey sought information on company performance. The survey population consisted of members of the American Society for Quality Control, in the USA. Bonferroni Multiple Range Tests were run to look for significant differences between means of how extensively were used the Supply Chain Management practices. Multiple Linear Regression was used to test the relationship between the supplier evaluation variables and supplier performance, and finally, bivariate correlation analysis was used to identify relationships between Supply Chain Practices and Firm Performance. Their research found among other things that manufacturers were integrating their suppliers' knowledge into new product and process design. Results of this research suggested that purchasing practices that took advantage of supplier capabilities correlated positively and significantly with most firm performance measures. Using supplier knowledge and skills, and sharing confidential information, correlated positively with return on assets, growth in market share, sales, and return on assets. Only the use of

suppliers' knowledge and skills yielded a significant positive correlation with production cost. Results showed that the performance measures had a significant positive correlation with each of the customer relation practices. These are all practices that emphasize a long-term supply chain perspective in relationships with customers, reinforcing the suggestion that maintaining communication and close contact with customers is critical for future success.

Bowersox, Closs, and Stank (1999) conducted an empirical research (supply chain 2000) which identified critical areas of integration needed to boost supply chain effectiveness. Their research provided insights into the relationship between best logistical practices and superior financial achievement. In their research, the supply chain management framework was divided into six competencies (Customer Integration, Internal Integration, Material/Service Supplier Integration, Technology and Planning, Measurement Integration, and Relationship Integration) and these six competencies were divided into twenty-five capabilities. Based on these capabilities, a questionnaire was designed and sent to a survey population selected exclusively from the CSCMP (former CLM) membership. All survey respondents were USA firms. Three statistical methods were used to determine the relationship between capability achievement and perceived performance: correlation analysis, means testing, and multiple linear regression analysis. The coefficients of correlation indicated little doubt that overall supply chain competency is related to individual measures of firm performance. In the means test analysis, firms were divided into two groups. The first group consisted of the firms that scored in the top 15 percent as measured by the Supply Chain 2000 index, the second group consisted of the remaining firms. The mean score for each performance metric was calculated for both groups. It was

expected that the mean performance of the top 15 percent of firms as identified by the Supply Chain 2000 index would exceed the mean of the remaining 85 percent of firms, and such was the case. The regression analysis indicated that customer and internal integration had the most impact on overall supply chain performance. Additionally, it indicated that customer integration emerged as the dominant competency in terms of influencing firm perceived performance, and that internal integration was the second most dominant competency. Based on respondents' performance perceptions, this work offers substantial proof that having high achievement provides reasonable assurance that a firm will out-perform lower achievers. Firms demonstrating high levels of supply chain competency report high-perceived performance levels on a number of different outcome measures. The statistical analysis strongly supports the belief that customer integration has the single greatest influence on firm performance. The analysis supports the belief that effective supply chain management begins with a sound understanding of intermediate and end-customer requirements.

Saavedra (1999) conducted a research work which consisted in determining, which were the best operational practices on materials and components supply, in the supply chain of the large size manufacturing firms in Mexico. These best operational practices were afterwards related to the firms' global competitive position. To collect information on 105 proposed practices, a questionnaire was developed and responded by 32 of the 100 most important (according to "America Economía") firms in Mexico. The 32 firms were ranked based on the number of practices that were utilized at least at an 80% level. This ranking was compared to the one proposed by "America Economia". Only 3 of the 32 firms had a different position in the list when both rankings were compared. In the logistical area, the

most accepted and utilized practices were determined to be: joint product improvement, performance measurement, continuous process improvement, notification of evaluation criteria for suppliers, and planning information sharing.

Stank et al.(1999) investigated the relationship between inter-firm supply chain coordination (characterized by effective communication, information exchange, partnering, performance monitoring) and firm performance. They developed a survey instrument based on variables used in previous studies to measure the relevant relationship constructs and performance attributes. A sample of food industry firms from the USA was generated from: The Council of Supply Chain Management professionals; The American Society of Transportation and Logistics; and Quick' Annual Directory and Buyer's Guide for Frozen Foods. Scales were purified by running factor analyses. Cronbach's alphas were utilized to determine the overall reliability of the scales. Main effects of inter-firm relationship dimensions on logistics performance were estimated using regression analyses. Their research found that inter-firm supply chain coordination is a significant explanatory factor for seven performance outcomes: decreased inventory levels, decreased order cycle time, decreased order cycle variance, product availability, customer satisfaction, flexibility in meeting customer requirements, and assessment of customer needs. Partnering resulted to be a significant variable for customer satisfaction.

Tan et al. (1999) presented details of a survey carried out to determine whether particular quality management, supply base management, and customer relations practices could impact firm performance. To obtain data to determine this, a survey instrument was designed (based on the previous constructs) and sent to a survey population selected from a

list of the American Society of Quality Control in the USA. Cronbach's alphas were utilized to determine the overall reliability of the scales. They utilized regression models to identify several factors that directly and positively impacted corporate performance. For each of the item scales, factor analysis was used to reduce the total number of items to a smaller number of underlying factors. Principal components analysis was used to extract factors (eigen values > 1). Varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of factor analysis. Stepwise multiple linear regressions were used to develop models relating the measures of performance to the independent variables. The Durbin-Watson was used to verify that residuals were independent and normal probability plots were used to verify that residuals were normally distributed. Their research found, among other things, that: (1) manufacturers are integrating their suppliers knowledge and capability into new product and process design; (2) enhancing customers' ability to seek assistance has a great impact on overall performance; (3) and, evaluating suppliers and involving them in the decision making process are both positively related to Return On Assets.

Barajas (2001) studied the situation of Supply Chain Management in medium and large size firms in some countries of Latin-America (Mexico, Colombia, Peru, Honduras and Ecuador). He identified the integration factors that stimulate supply chain's effectiveness in these firms. The results of Latin-American firms were compared to the results of Bowersox's "Supply Chain 2000" study (Bowersox et al., 1999). Bowersox's study surveyed companies from the United States, and served as a basis for Barajas study. Barajas considered that the identification of key factors with the lowest performance was a good

starting point for Supply Chain Management's improvement. Barajas found, among other issues, that Latin-American medium size firms give low importance to suppliers' integration and that large size firms give a high importance to planning and technology issues; another important issue for medium and large size firms is the reduction on the complexity of logistical operations; additionally, Barajas found that supplier and customer integration were also important factors for medium and large size firms in Latin-America. He also found that Supply Chain Management is very similar when comparing Latin-American firms to United States firms.

Tracey and Tan (2001) examined empirically the relationships among supplier selection criteria (quality, delivery reliability, product performance and unit price), supplier involvement on design teams and in continuous improvement programs, four dimensions of customer satisfaction (competitive pricing, product quality, product variety, and delivery service), and overall firm performance. They developed a questionnaire based on previously developed scales, and mailed it to subscribers of the publication *Industry Week*, from across the USA. Cronbach's alphas were utilized to determine the overall reliability of the scales. Analysis of Variance (ANOVA) and Tukey pairwise comparisons were utilized on every item of the survey to control for firm size, type of manufacturing, operation, and industry classification. Correlation was used as a predictor for causation. Their research concluded that it is plausible that supplier's involvement in critical supplier chain activities will result in improved firm performance via enhanced customer satisfaction. Involving suppliers on product design teams and in continuous improvement programs would have a significant positive effect on customer satisfaction and on firm performance.

Kannan and Tan (2002) conducted a research work which consisted on an empirical study of the importance of relationships between supplier selection and assessment criteria and a buying firm's business performance. A survey instrument was developed (from previous literature, discussions with practitioners, and company manuals) to collect data for this study. The instrument was sent to managers in the United States who were members of the Institute for Supply Management (ISM) of APICS-The Educational Society for Resource Management. Respondents were asked to evaluate their firm's performance in comparison to that of major competitors in their respective industries. Reliability (Cronbach's alpha) and factor analyses were conducted. For each of the item scales, factor analysis was used to reduce the total number of items to a smaller number of underlying factors. Principal components analysis was used to extract factors (eigen values > 1). Varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of factor analysis. Their research found that: (1) considering information sharing and strategic commitment from supplier to buyer as supplier selection criteria, correlates positively with all performance measures included in the research, (2) considering suppliers' honesty and integrity as supplier selection criteria, correlates positively with seventy five percent of all performance measures included in the research, and (3) the study reinforced the need to view suppliers as extensions of the buying firm itself and not as independent entities to be dealt with at the distance.

Ellram et al. (2002) conducted a research work to analyze the relation between the application of Purchasing and Supply Management (PMS) best practices and organizational success. Organizational success was defined as total return to shareholders, based on this

parameter; respondent firms were classified in average, above average and below average. PMS best practices were identified from a review of managerial and scholarly literature, existing research and input from industry practitioners. A survey questionnaire was developed after an extensive review of the Purchasing and Supply Management literature. The questionnaire was mailed to purchasing professionals associated with the Institute for Supply Management (ISM) (formerly the National Association of Purchasing Management), in the USA. Factor analyses were conducted and Cronbach's alphas were utilized for evaluating the reliability of the scales. Analysis of Variance (ANOVA) was conducted for all factors to statistically test if differences existed in mean responses by firms classification. Their research established: (1) above average and below average firms both perceive a higher level of utilization of supplier alliance activities than do the average firms studied, (2) below average firms exceed average firms in the perceived use of a linkage between the application of Purchasing and Supply Management best practices and organizational success.

Tan (2002) identified 25 commonly cited supply chain management practices from the literature. These practices were related to supply and materials management issues, operations, information technology and sharing, and customer service by means of bivariate correlation and multiple linear regression analysis. A survey instrument in the form of a questionnaire was designed based on previous literature. The survey population consisted of member of the Institute for Supply Management (ISM) membership list, and also from the American Production and Inventory Control Society (APICS). The reliability of the scales was evaluated using Cronbach's alpha. For each of the item scales, factor analysis was used to reduce the total number of items to a smaller number of underlying

factors. Principal components analysis was used to extract factors (eigen values > 1). Varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of factor analysis. For each of the performance measures, multiple linear regression was carried out using the factors as independent variables. The Durbin-Watson was used to verify that residuals were independent and normal probability plots were used to verify that residuals were normally distributed. Some of the most relevant findings of Tan's research were: (1) supply chain integration, information sharing, and JIT capability practices, had a positive impact on overall competitive position, and (2) creating a greater level of trust among supply chain members is an effective tool for improving overall customer service.

3.3 Summary

Table 3.1 presents a summary of the statistical methodologies utilized in the previously presented research works. From this table it can be observed that the most frequently utilized statistical methodologies are: Cronbach's alpha, Factor Analysis, and Multiple Linear Regression, the three of them are utilized in my research work. Correlation analysis is also widely utilized. T-tests, Bonferroni Multiple Rang Tests, Linear Regression, Statistical Benchmarking, Anova, and Tukey Wise comparisons, are found to be used less frequently.

Table 3.1

Statistical Methodologies Utilized in Research Works

	Cro	T-t	Bon	Tuk	Anv	Sta	Cor	FA	Slr	Mlr
Stank and Lackey (1997)		√						√		
Tan et al. (1998)			√				√			√
Bowersox, Closs and Stank (1999)		√					√			√
Saavedra (1999)									√	
Stank et al. (1999)	√									√
Tan et al. (1999)	√							√		√
Barajas (2001)						√				
Tracey and Tan (2001)	√			√	√		√			
Kannan and Tan (2002)	√			√			√	√		
Ellram et al. (2002)	√		√		√			√		
Tan (2002)	√							√		√

With regard to the conclusions found in the studied research works, they can be summarized as follows:

a) A higher competence (intensity) in logistical practices enhances firms' performance (Stank and Lackey, 1997; Bowersox, Closs, and Stank, 1999)

b) A higher supplier/customer integration enhances firms' performance (Stank and Lackey, 1997; Bowersox, Closs, and Stank, 1999; Stank et al., 1999; Tan et al., 1999; Barajas, 2001; Tracey and Tan, 2001; Tan, 2002)

c) Capabilities related to Agility were found to be important to firms' performance (Stank and Lackey, 1997)

d) Firms that shared information with suppliers and customer demonstrated improved performance (Stank and Lackey, 1997; Tan, 2002)

e) Manufacturers are integrating their suppliers' knowledge into new product and process design (Tan et al., 1998; Tan et al., 1999)

f) Taking advantage of suppliers' capabilities correlates positively and significantly with most firm performance measures (Tan et al., 1998)

g) Customer Relations had a positive significant with performance measures (Tan et al., 1998)

h) High achievers of logistical practices will outperform lower achievers of those practices (Bowersox, Closs, and Stank, 1999; Saavedra, 1999)

i) Considering strategic commitment from suppliers as selection criteria correlates positively with firms' performance (Kannan and Tan, 2002)

j) Considering honesty and integrity (trust) in suppliers relations correlates positively with firms' performance (Kannan and Tan, 2002; Tan 2002)

The most frequently found result has to do with suppliers, customers, and in general, an inter-firm integration, as a performance booster. Integration is a very important concept in the Extended Enterprise construct.

Chapter 4

Followed Research Methodology and Analysis of Survey

4.1 Followed Research Methodology

In this research, a survey in the form of a questionnaire was applied to medium size and large size organizations in Mexico. Multivariate analysis was performed with respondent's information to provide empirical evidence that Extended Enterprise's customer relations, supplier relations, and environmental awareness, have a statistically significant impact on perceived firm's performance, and also that firms which strongly develop customer relations, supplier relations, and environmental awareness, exhibit enhanced performance compared to those which do not.

The survey and subsequent analysis of this research work was made on medium size and large size companies, this due to the intrinsic problematic of the small companies in Mexico and Latin America. Braidot and Soto (1999) indicate that small companies in Latin America are fragile and exposed to disappearing due to their lack of capacity to respond to actual changing situation in the economic environment. Some of the problems of small companies are: Short term vision; lack of attention to quality issues; inadequate production technology; not enough productivity levels; inadequate organization; inadequate financing instruments available, among others. These problematic issues cause that small and micro companies in Mexico do not have the logistics best practices as strategic issues. To classify

companies by size, in medium and large, the INEGI 1999 economic census classification was used (see Appendix B). The demographic data of the 124 firms that were considered for the statistical analysis is shown in Appendix B.

4.1.1 Questionnaire

In this research work, an instrument consisting of four scales was developed, based on the literature review: one scale for measuring Customer Relations levels, another one for measuring Supplier Relations levels, another one for measuring Environmental Awareness level, and another one for measuring Firm Performance.

The Customer Relations scale consists of 17 items that have to do with customers' intense involvement in: Manufacture and production plans; product and process design; planning and forecasting; logistics; agility and flexibility; and order fulfillment. There are at least two items on each of these sub-areas.

The Supplier Relations scale consists of 15 items that have to do with suppliers' intense involvement in: Manufacture and production plans; product and process design; planning and forecasting; logistics; agility and flexibility; and order fulfillment. There are at least two items on almost all of these sub-areas, only in two of them there is only one item.

The Environmental Awareness scale consists of 8 items that have to do with: companies' environmental awareness and responsibility; reverse logistics; environmental manufacturing practices such as re-manufacture, re-cycling, and re-use.

In these first three scales, respondents were asked to indicate their agreement with statements concerning aspects of their companies logistical capabilities related to Customer Relations, Supplier Relations and Environmental Awareness (based on 5-point Likert scales where 1 = Totally Disagree and 5 = Totally Agree).

The Performance Measurement scale consists of 13 items that have to do with: Customer service, Cost Management, Quality, Productivity, and Asset Management. The complete survey can be seen in Appendix C.

To get information on performance, respondents were asked to indicate, using a similar five point Likert scale, their perception on their company's performance relative to that of major industry competitors in terms of thirteen performance measurement indicators. Some other questions including demographics information were also presented in the questionnaire.

Questions on Customers Relations, Supplier Relations, Environmental Awareness, and Firm Performance, were developed based on the literature review related to Supply Chain Management and Extended Management. Questions on Performance Measurement were obtained from Bowersox et al. (1999).

With regard to firm performance measurement's operationalization, economists disagree about the use of accounting data to measure firm performance because it ignores opportunity costs and the time value of money (Chen and Lee, 1995). They have argued that business performance should be measured by financial data (e.g., internal rate of

return). Financial data provides a measurement of a firm's performance via the market's valuation of the firm's securities. However, since future cash flows of the business entity cannot be observed, measures of business performance are typically based on accounting data (e.g., return on investment [ROI]). Tobin and Brainard (1968) challenged ROI's validity as a performance measure. A firm's financial leverage can affect its ROI to such a degree that it renders comparisons between firms meaningless. ROI also ignores opportunity costs and the time value of investments. An alternate measure of performance, Tobin's q ratio, evaluates the ratio of the market value of a firm to the replacement cost of its assets (Tobin 1969). However, the prospect of obtaining accurate measures of each firm's market value and the replacement cost of its assets to calculate Tobin's "q" was considered impractical for this research.

Besides, no consensus exists as to a universal performance definition. Similarly, no agreement regarding what factors constitute the best measure of performance has been reached. While performance has often been evaluated by analyzing information reporting performance outcomes, such indicators may not be appropriate and/or relevant when the object of analysis is the performance of specific business activities or processes such as logistics (Stank et al., 1999).

Given the lack of consensus regarding a valid cross-industry measure of corporate performance, performance in this research was operationalized by management's perceptions of a firm's performance in comparison to that of major competitors (Tan et al., 1998). Although objective measures of firm performance are preferable to perceived

measures, they are difficult to obtain and empirical research has demonstrated that perceived measures are legitimate representatives of objective data (Tracey and Tan, 2001).

In this research work, a total of 186 enterprises (medium size and large size) from the industry, commerce and service sectors were contacted by students of the Universidad Virtual of ITESM. One hundred and eighty five questionnaires were received, and subsequently, each of the firms were contacted by telephone and email in order to validate the application of the survey, and to validate the firm's size. Fifty one questionnaires were eliminated from the analysis because they did not comply with INEGI's size specification, and ten were eliminated from the analysis because it was concluded that they were not correctly applied in the firms. The remaining 124 surveys were utilized for a Multivariate Analysis using the SPSS statistical software.

4.1.2 Power of the test

Often, instead of considering the β of a hypothesis test, we speak of the power of a hypothesis test. Whereas β is the probability of accepting Ho when Ho is false, the power of a test is merely the probability of correctly rejecting Ho when Ho is false. That is, power = 1- β (Berger and Maurer, 2001). The power of the test is used to calculate the number of surveys necessary to obtain certain level of power, given a certain significance level (α), or to calculate the power of the test given a certain number of surveys and given a certain significance level. Chapter 5 includes the results of the Power of the Test calculation for this work.

4.1.3 Validity and reliability

To facilitate content validity, the questionnaire was developed after a thorough literature review. A relation was made between each of the questions of the scales, and the papers related to logistics, supply chain management, extended enterprise, and firm performance.

The reliability of the scales for Customer Relations, Supplier Relations, Environmental Awareness and Performance Measurement Indicators was evaluated using Cronbach's alpha (Cronbach, 1951). For each scale, a value of alpha was obtained; alpha's value greater than 0.6 were expected, suggesting that the scales were reliable (Nunnally, 1988). Sixty three percent of the articles containing multi-item scales in leading logistics journals from 1961 to 2000, used Cronbach's alphas for testing reliability of the scales (Keller, Savistskie, Stank, Lynch, and Ellinger, 2002).

4.1.4 Factor analysis

For each of the three first scales, exploratory factor analysis was used to identify the not directly observable factors based on the variables. The goal was to identify a smaller set of factors to represent the relationships among the variables parsimoniously (i.e., to explain the observed correlation with fewer factors). 72% of the articles containing multi-item scales, in the leading logistics journals from 1961 to 2000 used Factor Analysis (Keller et al., 2002). In this research, principal components analysis with eigenvalues greater than one was used to extract factors, and varimax rotation was used to facilitate interpretation of the factor matrix (de la Garza, 1995; Johnson, 1998). The Bartlett Test of Sphericity (to test the

null hypothesis that the correlation matrix is an identity matrix) and the Kaiser-Meyer-Olkin measure of sampling adequacy (small value of KMO indicates factor analysis is inappropriate) was used to validate the use of factor analysis. This was done for all firms, then for medium size firms, and finally for large size firms.

4.1.5 Regression analysis

For each of the thirteen performance measures, multiple linear regressions were carried out using the factors as independent variables (each factor was represented with the average of the variables that loaded higher in that factor). The Durbin-Watson statistic and normal probability plots were used to verify that residuals were independent and normally distributed. All independent variables (factors) were entered simultaneously in the regression analyses. A backwards analysis was used in the SPSS to get to a model with only significant variables. This was done for all firms, then for medium size firms, and finally for large size firms.

4.1.6 T-test for analyzing significant differences in performance means of firms with high logistic capabilities and firms with low logistic capabilities

The items of the questionnaire that loaded higher on each factor were averaged in order to get a variable for each factor. These variables were used to group companies depending on how intensively they used the logistical capabilities. For each of this variables (factors), groupings were achieved by splitting out respondents with overall scores of 4 or more into one group (indicating high levels of capability) and respondents with overall scores of

lower than 4 into a second group (indicating low levels of capability). T-test of significant differences in means of performance variables between the two groups based upon levels of logistics capability were conducted to test each hypothesis. This was done for all firms, then for medium size firms, and finally for large size firms.

4.2 Multivariate Analysis

A Multivariate Analysis of all the 124 firms, medium size firms, and finally, of the large-size firms are discussed in the following sections. The Multivariate Analysis that was be performed for each group (all firms, medium size firms, and large-size firms) consists of three phases. The first phase is a Factor Analysis to look for underlying factors in the information; the second one consists of a Multiple Linear Regression on the factors obtained in the first section. This is done to look for any significant relation between the factors, and the performance variables, which were utilized as dependent variables. Finally, t-tests were utilized, looking for significant differences in performance between enterprises that use intensively logistical practices, and those which not, were performed.

4.2.1 Multivariate analysis for all the firms

In this section, multivariate analysis on medium size and large size enterprises is presented. First of all, Power of the Test were calculated, as well as the Cronbach's Alpha to test on the reliability of the scales. After that, variables were grouped based on a Factor Analysis, these Factors were subsequently utilized to perform Multiple Linear Regression analyses

where the Factors were considered as independent variables, and finally, the results of the t-test are exposed.

4.2.1.1 Power of the test and Cronbach's alpha for all the firms

With an alpha of 0.05, the Power of the test for all firms is 0.92. The reliability of the scales for Customer Relations, Supplier Relations, Environmental Issues, and Performance Measurement Indicators was evaluated using Cronbach's alpha. For each scale, a value > 0.75 was obtained (Table 4.1), suggesting that the scales were reliable (Nunnally, 1998)

Table 4.1

Reliability Analysis of scales-all firms

Scale Items	# of Questions	Cronbach's alpha
Customer Relations	17	0.879
Supplier Relations	15	0.895
Environmental Issues	8	0.823
Performance Measurement	13	0.867

4.2.1.2 Factor analysis of all the firms

For each of the first three item scales (independent variables), exploratory Factor Analysis was used to identify the not directly observable factors based on the variables. The goal was to identify a smaller set of factors to represent the relationship among the variables parsimoniously. In this research, principal components analysis with eigenvalues greater

than one was used to extract factors, and varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity (to test the null hypothesis that the correlation matrix is an identity matrix) and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of Factor Analysis.

The 17 Customer Relations practices were reduced to four underlying factors (Table 4.2). The FCR1 (Customer Involvement) factor alone, accounts for 35.22 percent of the variance in the data. The FCR2 (Plans, Programs, Information), FCR3 (Focus on customer), and FCR4 (Focus on customer 2) factors, jointly with the FCR1 factor, account for 56.62 percent of total variance in the data.

The 15 Supplier Relations practices were reduced to three underlying factors (Table 4.3). The FSR1 (Supplier Involvement) factor alone, accounts for 41.45 percent of the variance in the data. The FSR2 (Supplier involvement 2), and FSR3 (Information) factors, jointly with the FSR1 factor, account for 57.41 percent of total variance in the data.

The 8 Environmental concern practices were reduced to two underlying factors (Table 4.4). The FEI1 (Recovery, Recycling, Remanufacture) factor alone, accounts for 45.09 percent of the variance in the data. The FEI2 (Environmental concern), jointly with the FEI1 factor, account for 61.26 percent of total variance in the data.

Table 4.2

Factor Analysis-Customer Relations-All firms

Factor	% of Variance	Scale Items	Factor Loading
FCR1: Customer Involvement	35.22	**C7**.- forecasting and plans involving customers	0.556
		C8.- involving customers in design (product, process)	0.493
		C15.- information about events that could affect counterpart	0.628
		C16.- information to customers about fluctuation in production	0.708
		C17.- involving customers in planning of logistics strategy	0.758
FCR2: Plans, Programs, Information	08.04	**C3**.- integrated programs and activities with customers	0.555
		C4.- friendly product (in transit) information system to customers	0.691
		C5.- information exchange with customers for planning	0.733
		C6.- strategic plans with involvement of important customers	0.549
FCR3: Focus on Customer	06.92	**C1**.- logistics focused in success of important customers	0.653
		C2.- compliance with special requests of chosen customers	0.695
		C13.- internet and electronic data in order fulfillment process	0.599
		C14.- quick reaction to sudden changes in demand	0.577
FCR4: Focus on Customer 2	06.44	**C9**.- quick reaction (manufacturing) to changes in demand	0.545
		C10.- production planning considering customers needs and req	0.691
		C11.- new prod dvlpmnt, concurrent engineering with customers	0.624
		C12.- various areas involved in order fulfillment	0.641

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.841

Bartlett test of Sphericity = 686.404, Significance = 0.000

Table 4.3

Factor Analysis-Supplier Relations-All firms

Factor	% of Variance	Scale Items	Factor Loading
FSR1: Supplier Involvement	41.45	**S9**.- new prod dvlpmnt, concurrent engineering with suppliers	0.527
		S11.- involving suppliers in planning of logistics strategy	0.703
		S12.- information exchange with suppliers for planning	0.596
		S13.- internet and electronic data in supplier's delivery process	0.796
		S14.- programs w/suppliers to support special request by customer	0.778
		S15.- quick reaction to sudden changes in demand	0.625
FSR2: Supplier Involvement 2	08.64	**S1**.- prodtn plan considers advantages given by suppliers	0.636
		S2.- integrated programs and activities with suppliers	0.542
		S3.- involving suppliers in design (product, process)	0.574
		S4.- long term agreements with suppliers	0.780
		S5.- strategic plans with collaboration of important suppliers	0.739
		S6.- forecasting and plans involving suppliers	0.487
		S7.- synchronizing demand and material flow with prdtn plan	0.549
FSR3: Information	07.32	**S8**.- prodtn plan considers suppliers operational and delivery conditions	0.853
		S10.- information about events that could affect counterpart	0.715

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.870

Bartlett test of Sphericity = 734.476, Significance = 0.000

Table 4.4

Factor Analysis-Environmental Awareness-All firms

Factor	% of Variance	Scale Items	Factor Loading
FEI1: Recovery, Recycling, Remanufacture	45.09	**E4**.- recovered product total or partial re-use, when it applies	0.782
		E5.- customers and suppliers involved in joint design of recycling and final product disposition processes	0.611
		E7.- recovered product is recycled or reutilized	0.886
		E8.- recovered product is re-manufactured (total or partial)	0.874
FEI2: Environmental Concern	16.17	**E1**.- environmental conservation taken seriously	0.713
		E2.- product recovery at the end of life cycle	0.728
		E3.- product return due to damage, expiration, etc	0.779
		E6.- greatest possible lengthening of the product's life cycle	0.473

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.795

Bartlett test of Sphericity = 354.393, Significance = 0.000

4.2.1.3 Multiple regression analysis for all the firms

For each of the thirteen performance measure indicators, multiple linear regressions were carried out using the nine factors as independent variables. The Durbin Watson statistic and normal probability plots were used to verify that residuals were independent and normally distributed. All thirteen regression models were statistically significant at alpha of 0.05, Table 4.5 shows the regression models, with the R^2 and Durbin-Watson coefficient.

Hypotheses H1.a, H2.a, and H3.a, are supported by the findings that are presented in table 4.5 and 4.6, which shows the regression (and its associated significance) coefficients for the Performance Measurement variables and the eleven factors.

It can be seen in table 4.6 that the four customer relations factors were statistically significant to at least one performance variable, being the FCR2 ("Plans, Programs, Information") factor the one which affected positively most of the performance variables (7 out of 13 variables). Only the FCR3 ("Focus on Customer") factor affected adversely on the Inventory turns performance measurement. Two out of the three supplier relations factors were statistically significant to at least one performance variable, being the "Supplier Involvement" factor the one which affected positively more performance variables (4 out of 13 variables). The two environmental issues factors were statistically significant to at least one performance variable.

Strongly supporting hypothesis H1.a, it can be observed from table 4.6 that:

a) The FCR1 ("Customer Involvement") factor had a significant positive impact on Customer Satisfaction.
b) The FCR2 ("Plans, Programs, and Information") factor had a significant positive impact on Return on Assets, Delivery Speed, Responsiveness to Key Customers, Order Fill Capacity, Advanced shipment Notification, and Inventory Turns.
c) The FCR3 ("Focus on Customer") factor has a significant positive impact on Informal System Support, and a significant adverse impact on Inventory Turns.

d) The FCR4 ("Focus on Customer 2") factor had a significant positive impact on Product Flexibility.

Moderately supporting hypothesis H2.a, it can be observed from table 4.6 that:

a) The FSR1 ("Supplier Involvement") factor had a significant positive impact on Low Logistics Costs, Order Fill Capacity, Order Flexibility, and Delivery Time Flexibility.
b) The FSR2 ("Supplier Involvement 2") factor had a significant positive impact on Delivery Dependability, and Inventory Turns.
c) The FSR3 ("Information") factor did not have a significant impact on any of the performance measurement indicators.

Weakly supporting hypothesis H3.a, it can be observed from table 4.6 that:

a) The FEI1 ("Recovery, Recycling, and Remanufacturing") factor had a significant adverse impact on Advanced Shipment Notification.
b) The FEI2 ("Environmental Concern") factor had a significant positive impact on Inventory Turns.

It can be observed that the Environmental Awareness factors are the ones which have the lowest frequency of significant impact (positive or adverse) compared to the Customer and Supplier Relations Factors.

Table 4.5

Regression Models-All firms

REGRESSION MODELS (ALL FIRMS)	R^2	Durbin-Watson Test
PM1: Return on Assets = 2.916 + 0.234 FCR2	0.038	2.09
PM2: Prod Flexibility = 2.368 + 0.428 FCR4	0.107	2.02
PM3: Low Logistics Costs= 2.107 + 0.445 FSR1	0.099	1.77
PM4: Delivery Speed = 3.223 + 0.206 FCR2	0.027	2.017
PM5: Delivery Dependability = 2.021 + 0.509 FSR2	0.108	1.92
PM6: Responsiveness to Key Customers = 2.568 + 0.439 FCR2	0.147	2.19
PM7: Order Fill Capacity = 2.273 + 0.273 FCR2 + 0.205 FSR1	0.155	1.89
PM8: Order Flexibility = 2.851 + 0.302 FSR1	0.054	1.68
PM9: Delivery Time Flexibility = 2.758 + 0.362 FSR1	0.090	1.72
PM10: Advanced Shipment Notification = 2.830 + 0.385 FCR2 – 0.149 FEI1	0.113	1.92
PM11: Inventory Turns = 1.548 + 0.309 FCR2 – 0.452 FCR3 + 0.557 FSR2 + 0.183 FEI2	0.229	2.18
PM12: Customer Satisfaction = 1.539 + 0.316 FCR1 + 0.316 FCR3	0.153	1.96
PM13: Informal Systems Support = 0.274 + 0.234 FCR2 + 0.405 FCR3 + 0.254 FEI2	0.193	2.06

Table 4.6

Regression Matrix-All firms

	Factors (Independent variables)								
Dependent variables	**FCR1**	**FCR2**	**FCR3**	**FCR4**	**FSR1**	**FSR2**	**FSR3**	**FEI1**	**FEI2**
PM1		0.234 S:0.034							
PM2				0.428 S:0.000					
PM3					0.445 S:0.000				
PM4		0.206 S:0.069							
PM5						0.509 S:0.000			
PM6		0.439 S:0.000							
PM7		0.273 S:0.012			0.205 S:0.069				
PM8					0.302 S:0.010				
PM9					0.362 S:0.001				
PM10		0.385 S:0.000						-0.149 S:0.056	
PM11		0.309 S:0.023	-0.452 S:0.010			0.557 S:0.001			0.183 S:0.078
PM12	0.316 S:0.007		0.316 S:0.030						
PM13		0.234 S:0.093	0.405 S:0.031						0.254 S:0.033

4.2.1.4 Testing for significant differences in performance between all enterprises that use intensively logistical practices and those which not

This section presents the results of t-test, looking for significant differences in means of performance variables based on the intensive use or not of logistics practices. The factors estimated in section 4.1.2 were used in this test. Using the mean of the variables that loaded highly on each factor, two groups were defined, a group of enterprises that use logistical extended enterprise practices intensively, being these the enterprises with an average of 4 or more in each factor, and in the other group are the enterprises which do not do an intensive use of the logistical practices, being these the enterprises with an average of less than 4 in each factor. For each of these groups, an average in each of the performance measurements was calculated, to determine if there is a significant difference in those means. A summary of the hypothesis testing is presented in table 4.7. A table with the significant relations of the hypothesis testing is presented in table 4.8. The specific t-test performed for each factor is presented in Appendix D.

From Table 4.7, it can be observed that Hypothesis H1.b was strongly supported; Hypothesis H2.b was moderately supported; and Hypothesis H3.b was weakly supported.

Strongly supporting H1.b, from Table 4.8, with an alpha of 0.5, it can be observed that:

a) The FCR1 ("Customer Involvement") factor was significant to Delivery Dependability, Responsiveness to Key Customers, Inventory Turns, Customer Satisfaction, and Informal Systems Support.

b) The FCR2 ("Plans, Programs, Information") factor was significant to Low Logistics Costs, Delivery Dependability, Responsiveness to Key Customers, Order Fill Capacity, Advanced Shipment Notification, Inventory Turns, Customer Satisfaction, and Informal Systems Support.

c) The FCR3 ("Focus on Customer") factor was significant to Prod Flexibility, Low Logistics Costs, Responsiveness to Key Customers, Order Fill Capacity, Customer Satisfaction, and Informal Systems Support.

d) The FCR4 ("Focus on Customer 2") factor was significant to Prod Flexibility, Responsiveness to Key Customers, and Advanced Shipment Notification.

Table 4.7

Summary of Hypothesis Testing-All firms

	Number of performance variables (out of 13) significant at p<0.05/p<0.10		Hypothesis Test
CUSTOMER RELATIONS	p<0.05	p<0.10	
Customer Involvement	5	2	Strong Support
Plans, Programs, Information	8	2	Strong Support
Focus on Customer	6	1	Strong Support
Focus on Customer 2	3	1	Moderate Support
SUPPLIER RELATIONS			
Supplier Involvement	9	1	Strong Support
Supplier Involvement 2	10	1	Strong Support
Information	2	0	Weak Support
ENVIRONMENTAL AWARENESS			
Recovery, Recycling, Remanufacture	1	0	Weak Support
Environmental Concern	1	0	Weak Support

Moderately supporting H2.b, from Table 4.8, with an alpha of 0.5, it can be observed that:

a) The FSR1 ("Supplier Involvement") factor was significant to Delivery Dependability, Responsiveness to Key Customers, Order Fill Capacity, Order Flexibility, Delivery Time Flexibility, Advanced Shipment Notification, Inventory Turns, Customer Satisfaction, and Informal Systems Support.

Table 4.8

Summary of Significant Relations of Hypothesis Testing-All firms with an alpha of 0.5

	FCR1	FCR2	FCR3	FCR4	FSR1	FSR2	FSR3	FEI1	FEI2
PM1: ROA						√			
PM2: PF			√	√		√			
PM3: LLC		√	√						
PM4: DS									
PM5: DD	√	√			√	√			
PM6: RKC	√	√	√	√	√	√			
PM7: OFC		√	√		√	√			
PM8: OF					√	√			
PM9: DTF					√	√	√		
PM10: ASN		√		√	√				
PM11: IT	√	√			√	√	√		√
PM12: CS	√	√	√		√	√			
PM13: ISS	√	√	√		√	√		√	

b) The FSR2 ("Supplier Involvement 2") factor was significant to Return on Assets, Prod Flexibility, Delivery Dependability, Responsiveness to Key Customers, Order

Fill Capacity, Order Flexibility, Delivery Time Flexibility, Inventory Turns, Customer Satisfaction, and Informal Systems Support.

c) The FSR3 ("Information") factor was significant to Delivery Time Flexibility, and Inventory Turns.

Weakly supporting H3.b, from Table 4.8, with an alpha of 0.5, it can be observed that:

a) The FEI1 ("Recovery, Recycling, Remanufacture") factor was significant to Informal Systems Support.
b) The FEI2 ("Environmental Awareness") factor was significant to Inventory Turns.

4.2.2 Multivariate analysis medium size enterprises

In this section, multivariate analysis on medium size enterprises is presented. First of all, Power of the Test were calculated, as well as the Cronbach's Alpha to test on the reliability of the scales. After that, variables were grouped based on a Factor Analysis, these Factors were subsequently utilized to perform Multiple Linear Regression analyses where the Factors were considered as independent variables, and finally, the results of the t-test are exposed.

4.2.2.1 Power of the test and Cronbach's alpha for medium size enterprises

With an alpha of 0.05, the Power of the test for medium size firms is 0.67. The reliability of the scales for Customer Relations, Supplier Relations, Environmental Issues, and

Performance Measurement Indicators was evaluated using Cronbach's alpha. For each scale, a value > 0.75 was obtained (Table 4.9), suggesting that the scales were reliable (Nunnally, 1998)

Table 4.9

Reliability Analysis of scales-Medium Size firms

Scale Items	# of Questions	Cronbach's alpha
Customer Relations	17	0.857
Supplier Relations	15	0.883
Environmental Issues	8	0.827
Performance Measurement	13	0.780

4.2.2.2 Factor analysis medium size enterprises

For each of the first three item scales (independent variables), exploratory Factor Analysis was used to identify the not directly observable factors based on the variables. The goal was to identify a smaller set of factors to represent the relationship among the variables parsimoniously. In this research, principal components analysis with eigenvalues greater than one was used to extract factors, and varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity (to test the null hypothesis that the correlation matrix is an identity matrix) and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of Factor Analysis.

The 17 Consumer Relations practices were reduced to four underlying factors (Table 4.10). The FCR1 (Customer Involvement) factor alone, accounts for 32.44 percent of the variance in the data. The FCR2 (Information), FCR3 (Production involving customers), and FCR4 (Logistics, fulfillment, agility) factors, jointly with the FCR1 factor, account for 57.24 percent of total variance in the data.

The 15 Supplier Relations practices were reduced to four underlying factors (Table 4.11). The FSR1 (Planning and forecasting with suppliers) factor alone, accounts for 38.96 percent of the variance in the data. The FSR2 (Supplier, involvement, agility), the FSR3 (Production, logistics), and the FSR4 (Coordination with supplier) factors, jointly with the FSR1 factor, account for 64.80 percent of total variance in the data.

The 8 Environmental concern practices were reduced to three underlying factors (Table 4.12). The FEI1 (Conservation, recovery, joint design for recycling) factor alone, accounts for 45.28 percent of the variance in the data. The FEI2 (Recycling, remanufacturing), and FEI3 (Lengthening) jointly with the FEI1 factor, account for 71.88 percent of total variance in the data.

Table 4.10

Factor Analysis-Customer Relations-Medium Size firms

Factor	% of Variance	Scale Items	Factor Loading
FCR1: Customer Involvement	32.44	**C2**.- compliance with special requests of chosen customers	0.741
		C6.- strategic plans with involvement of important customers	0.584
		C7.- forecasting and plans involving customers	0.476
		C8.- involving customers in design (product, process)	0.650
		C12.- various areas involved in order fulfillment	0.573
FCR2: Information	09.98	**C3**.- integrated programs and activities with customers	0.641
		C4.- friendly product (in transit) information system to customers	0.619
		C5.- information exchange with customers for planning	0.557
		C15.- information about events that could affect counterpart	0.772
		C16.- information to customers about fluctuation in production	0.464
		C17.- involving customers in planning of logistics strategy	0.419
FCR3: Production involving Customers	07.80	**C9**.- quick reaction (manufacturing) to changes in demand	0.635
		C10.- production planning considering customers needs and req	0.765
		C11.- new prod dvlpmnt, concurrent engineering with customers	0.848
FCR4: Logistics, Fulfillment, Agility	07.02	**C1**.- logistics focused in success of important customers	0.593
		C13.- internet and electronic data in order fulfillment process	0.724
		C14.- quick reaction to sudden changes in demand	0.494

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.753

Bartlett test of Sphericity = 359.683, Significance = 0.000

Table 4.11

Factor Analysis-Supplier Relations-Medium Size firms

Factor	% of Variance	Scale Items	Factor Loading
FSR1: Planning and Forecasting with Suppliers	38.96	**S4**.- long term agreements with suppliers	0.697
		S5.- strategic plans with collaboration of important suppliers	0.596
		S6.- forecasting and plans involving suppliers	0.772
		S7.- synchronizing demand and material flow with prdtn plan	0.722
FSR2: Supplier Involvement, Agility	10.09	**S2**.- integrated programs and activities with suppliers	0.608
		S3.- involving suppliers in design (product, process)	0.864
		S12.- information exchange with suppliers for planning	0.630
		S15.- quick reaction to sudden changes in demand	0.504
FSR3: Production, Logistics	08.72	**S1**.- prodtn plan considers advantages given by suppliers	0.639
		S8.- prodtn plan considers suppliers operational and delivery conditions	0.665
		S9.- new prod dvlpmnt, concurrent engineering with suppliers	0.657
		S10.- information about events that could affect counterpart	0.657
		S11.- involving suppliers in planning of logistics strategy	0.515
FSR4: Coordination with Suppliers	07.03	**S13**.- internet and electronic data in supplier's delivery process	0.837
		S14.- programs w/suppliers to support special request by customer	0.671

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.806

Bartlett test of Sphericity = 365.563, Significance = 0.000

Table 4.12

Factor Analysis-Environmental Awareness-Medium Size firms

Factor	% of Variance	Scale Items	Factor Loading
FEI1: Conservation, Recovery, Joint Design for Recycling	45.28	**E1**.- environmental conservation taken seriously	0.670
		E2.- product recovery at the end of life cycle	0.798
		E3.- product return due to damage, expiration, etc	0.672
		E4.- recovered product total or partial re-use, when it applies	0.623
		E5.- customers and suppliers involved in joint design of recycling and final product disposition processes	0.645
FEI2: Recycling Remanufacturing	13.44	**E7**.- recovered product is recycled or reutilized	0.789
		E8.- recovered product is re-manufactured (total or partial)	0.887
FEI3: Lengthening	13.16	**E6**.- greatest possible lengthening of the product's life cycle	0.927

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.768

Bartlett test of Sphericity = 172.181, Significance = 0.000

4.2.2.3 Multiple regression analysis medium size enterprises

For each of the performance measure indicators, multiple linear regressions were carried out using the eleven factors as independent variables. The Durbin Watson statistic and normal probability plots were used to verify that residuals were independent and normally distributed. Twelve out of thirteen regression models were statistically significant at alpha

of 0.05, Table 4.13 shows the regression models, with the R^2 and Durbin-Watson coefficient.

Hypotheses H1.a, H2.a, and H3.a, are supported by the findings that are presented in tables 4.13 and 4.14, which shows the regression (and its associated significance) coefficients for the Performance Measurement variables and the eleven factors.

It can be seen in table 4.14 that the four customer relations factors were statistically significant to at least one performance variable, being the FCR2 ("Information") factor the one which affected positively most of the performance variables (3 out of 13 variables). The FCR2 factor affected adversely the Return on assets performance measurement, and the FCR4 ("Logistics, Fulfillment, Agility") factor affected adversely the Inventory turns performance measurement. The four supplier relations factors were statistically significant to at least one performance variable, being the FSR3 ("Production, Logistics") factor the one which affected positively more performance variables (4 out of 13 variables). The FSR2 ("Supplier, Involvement, Agility") factor affected adversely four performance measurement variables. The three environmental issues factors were statistically significant to at least one performance variable.

Moderately supporting hypothesis H1.a, it can be observed from table 4.14 that:

a) The FCR1 ("Customer Involvement") factor had a significant positive impact on Low Logistics Costs.

b) The FCR2 ("Information") factor had a significant positive impact on Delivery Dependability, Responsiveness to Key Customers, and Informal Systems Support; and a significant adverse impact on Return on Assets.

c) The FCR3 ("Production Involving Customers") factor had a significant positive impact on Production Flexibility.

d) The FCR4 ("Logistics, Fulfillment, Agility") factor had a significant positive impact on Informal Systems Support; and a significant adverse impact on Inventory Turns.

Moderately supporting hypothesis H2.a, it can be observed from table 4.14 that:

a) The FSR1 ("Planning and Forecasting with Suppliers") factor had a significant positive impact on Delivery Dependability and Inventory Turns.

b) The FSR2 ("Supplier Involvement, Agility") factor had a significant adverse impact on Delivery Dependability, Order Flexibility, Advanced Shipment Notification, and Informal Systems Support.

c) The FSR3 ("Production, Logistics") factor had a significant positive impact on Return on Assets, Order Flexibility, Advanced Shipment Notification, and Customer Satisfaction.

d) The FSR4 ("Coordination with Supplier") factor had a significant positive impact on Order Flexibility, Delivery Time Flexibility, and Informal systems Support.

Weakly supporting hypothesis H3.a, it can be observed from table 4.14 that:

a) The FEI1 ("Conservation, Recovery, Joint Design for Recycling") factor had a significant adverse impact on Delivery Time Flexibility.

b) The FEI2 ("Recycling, Manufacturing") factor had a significant positive impact on Return on Assets and Customer Satisfaction.

c) The FEI3 ("Lengthening") factor had a significant impact on Order Fill Capacity.

It can be observed that the Environmental Awareness factors are the ones which have the lowest frequency of significant impact (positive or adverse) compared to the Customer and Supplier Relations Factors.

Table 4.13

Regression Models-Medium Size firms

REGRESSION MODELS (MEDIUM SIZE ENTERPRISES)	R^2	Durbin-Watson Test
PM1: Return on Assets = 2.423 – 0.337 FCR2 + 0.400 FSR3 + 0.307 FEI2	0.153	2.40
PM2: Prod Flexibility = 2.440 + 0.401 FCR3	0.108	2.38
PM3: Low Logistics Costs= 2.418 + 0.317 FCR1	0.054	1.73
PM4: Delivery Speed = NO STATISTICALLY SIGNIFICANT MODEL	0.000	
PM5: Delivery Dependability = 1.235 + 0.577 FCR2 + 0.673 FSR1 – 0.541 FSR2	0.297	2.33
PM6: Responsiveness to Key Customers = 2.631 + 0.424 FCR2	0.111	2.24
PM7: Order Fill Capacity = 3.482 + 0.139 FEI3	0.044	1.45
PM8: Order Flexibility = 2.081 – 0.403 FSR2 + 0.535 FSR3 + 0.356 FSR4	0.219	1.88
PM9: Delivery Time Flexibility = 3.611 + 0.336 FSR4 – 0.203 FEI1	0.132	1.58
PM10: Advanced Shipment Notification = 2.992 – 0.334 FSR2 + 0.528 FSR3	0.092	1.91
PM11: Inventory Turns = 2.454 – 0.446 FCR4 + 0.443 FSR1	0.211	2.22
PM12: Customer Satisfaction = 1.542 + 0.435 SR3 + 0.253 FEI2	0.198	1.83
PM13: Informal Systems Support = 0.322 + 0.504 FCR2 + 0.465 FCR4 – 0.482 FSR2 + 0.320 FSR4	0.246	2.20

Table 4.14

Regression Matrix-Medium Size firms

	Factors (Independent variables)										
Dependent variables	**FCR1**	**FCR2**	**FCR3**	**FCR4**	**FSR1**	**FSR2**	**FSR3**	**FSR4**	**FEI1**	**FEI2**	**FEI3**
PM1		-0.337 S:0.092					0.400 S:0.051			0.307 S:0.004	
PM2			0.401 S:0.008								
PM3	0.317 S:0.066										
PM4											
PM5		0.577 S:0.009			0.673 S:0.001	-0.541 S:0.009					
PM6		0.424 S:0.008									
PM7											0.139 S:0.100
PM8						-0.403 S:0.038	0.535 S:0.019	0.356 S:0.011			
PM9								0.336 S:0.006	-0.203 S:0.096		
PM10						-0.334 S:0.075	0.528 S:0.017				
PM11				-0.446 S:0.028	0.443 S:0.030						
PM12							0.435 S:0.004			0.253 S:0.007	
PM13		0.504 S:0.070		0.465 S:0.056		-0.482 S:0.039		0.320 S:0.076			

4.2.2.4 Testing for significant differences in performance between medium size enterprises that use intensively logistical practices and those which not

This section presents the results of t-test, looking for significant differences in means of performance variables, based on the intensive use or not of logistics practices in Medium Size enterprises. A summary of the hypothesis testing is presented in table 4.15. A table with the significant relations of the hypothesis testing is presented in table 4.16. The specific t-test performed for each factor is presented in Appendix E.

Table 4.15

Summary of Hypothesis Testing-Medium Size firms

	Number of performance variables (out of 13) significant at p<0.05/p<0.10		Hypothesis Test
CUSTOMER RELATIONS	p<0.05	p<0.10	
Customer Involvement	1	1	Weak Support
Information	5	1	Moderate Support
Production Involving Customers	1	0	Weak Support
Logistics, Fulfillment, Agility	1	0	Weak Support
SUPPLIER RELATIONS			
Planning and Forecasting with Suppliers	3	2	Moderate Support
Supplier Involvement, Agility	1	1	Weak Support
Production, Logistics	5	2	Strong Support
Coordination with Suppliers	4	0	Moderate Support
ENVIRONMENTAL AWARENESS			
Conservation, Recovery, Joint Design			
For Recycling	1	0	Weak Support
Recycling, Remanufacturing	1	1	Weak Support
Lengthening	0	2	Weak Support

From table 4.15, it can be observed that Hypothesis H1.b was weakly supported; Hypothesis H2.b was moderately supported; and Hypothesis H3.b was weakly supported.

Weakly supporting H1.b, from Table 4.16, with an alpha of 0.5, it can be observed that:

a) The FCR1 ("Customer Involvement") factor was significant to Customer Satisfaction.
b) The FCR2 ("Information") factor was significant to Delivery Dependability, Responsiveness to Key Customers, Order Fill Capacity, Customer Satisfaction, and Informal Systems Support.
c) The FCR3 ("Production Involving Customers") factor was significant to Product Flexibility.
d) The FCR4 ("Logistics, Fulfillment, Agility") factor was significant to Customer Satisfaction.

Moderately supporting H2.b, from Table 4.16, with an alpha of 0.5, it can be observed that:

a) The FSR1 ("Planning and Forecasting with Suppliers") factor was significant to Low Logistics Costs, Inventory Turns, and Customer Satisfaction.
b) The FSR2 ("Supplier Involvement, Agility") factor was significant to Responsiveness to Key Customers.
c) The FSR3 ("Production, Logistics") factor was significant to Prod Flexibility, Order Fill Capacity, Order Flexibility, Inventory Turns, and Customer Satisfaction.
d) The FSR4 ("Coordination with Suppliers") factor was significant to Delivery

Dependability, Order Flexibility, Delivery Time Flexibility, and Customer Satisfaction.

Table 4.16

Summary of Significant Relations of Hypothesis Testing-Medium Size firms with an alpha of 0.5

	FCR1	FCR2	FCR3	FCR4	FSR1	FSR2	FSR3	FSR4	FEA1	FEI2	FEI3
PM1: ROA										√	
PM2: PF			√				√				
PM3: LLC					√						
PM4: DS											
PM5: DD		√						√			
PM6: RKC		√				√					
PM7: OFC		√					√				
PM8: OF							√	√			
PM9: DTF								√			
PM10: ASN											
PM11: IT					√		√				
PM12: CS	√	√		√	√		√	√	√		
PM13: ISS		√									

Weakly supporting H3.b, from Table 4.16, with an alpha of 0.5, it can be observed that:

a) The FEI1 ("Conservation, Recovery, Joint Design for Recycling") factor was significant to Customer Satisfaction.

b) The FEI2 ("Recycling, Remanufacturing") factor was significant to Return on Assets.

c) The FEI3 ("Lengthening") factor was not significant to any Performance Measurement Indicator.

4.2.3 Multivariate analysis for large size enterprises

In this section, multivariate analysis on large size enterprises is presented. First of all, Power of the Test was calculated, as well as the Cronbach's Alpha to test on the reliability of the scales. After that, variables were grouped based on a Factor Analysis, these Factors were subsequently utilized to perform Multiple Linear Regression analyses where the Factors were considered as independent variables, and finally, the results of the t-test were exposed.

4.2.3.1 Power of the test and Cronbach's alpha for large size enterprises

With an alpha of 0.05, the Power of the test for Large Size firms is 0.66. The reliability of the scales for Customer Relations, Supplier Relations, Environmental Issues, and Performance Measurement Indicators was evaluated using Cronbach's alpha. For each scale, a value > 0.75 was obtained (Table 4.17), suggesting that the scales were reliable (Nunnally, 1998)

Table 4.17

Reliability Analysis of scales-Large Size firms

Scale Items	# of Questions	Cronbach's alpha
Customer Relations	17	0.893
Supplier Relations	15	0.903
Environmental Issues	8	0.826
Performance Measurement	13	0.913

4.2.3.2 Factor analysis large size enterprises

For each of the first three item scales (independent variables), exploratory Factor Analysis was used to identify the not directly observable factors based on the variables. The goal was to identify a smaller set of factors to represent the relationship among the variables parsimoniously. In this research, principal components analysis with eigenvalues greater than one was used to extract factors, and varimax rotation was used to facilitate interpretation of the factor matrix. The Bartlett Test of Sphericity (to test the null hypothesis that the correlation matrix is an identity matrix) and the Kaiser-Meyer-Olkin measure of sampling adequacy were used to validate the use of Factor Analysis.

The 17 Customer Relations practices were reduced to five underlying factors (Table 4.18). The FCR1 (Planning and information) factor alone, accounts for 37.57 percent of the variance in the data. The FCR2 (Information, customer involvement), FCR3 (Focus on customer, agility), FCR4 (Forecasting, design), and FCR5 (Focus on customer 2) factors, jointly with the FCR1 factor, account for 69.24 percent of total variance in the data.

Table 4.18

Factor Analysis-Customer Relations-Large Size firms

Factor	% of Variance	Scale Items	Factor Loading
FCR1: Planning and Information	37.57	**C6**.- strategic plans with important customers	0.670
		C11.- new prod dvlpmnt, concurrent engineering with customers	0.718
		C15.- information about events that could affect counterpart	0.357
		C16.- information to customers about fluctuation in production	0.759
		C17.- involving customers in planning of logistics strategy	0.847
FCR2: Information, Customer Involvement	09.03	**C3**.- integrated programs and activities with customers	0.532
		C4.- friendly product (in transit) information system to customers	0.670
		C5.- information exchange with customers for planning	0.674
		C10.- production planning considering customers needs and requirements	0.774
		C13.- internet and electronic data in order fulfillment process	0.534
FCR3: Focus on Customer, Agility	08.66	**C1**.- logistics focused in success of important customers	0.738
		C2.- compliance with special requests of chosen customers	0.848
		C14.- quick reaction to sudden changes in demand	0.525
FCR4: Forecasting, Design	07.08	**C7**.- forecasting and plans involving customers	0.857
		C8.- involving customers in design (product, process)	0.613
FCR5: Agility	06.90	**C9**.- quick reaction (manufacturing) to changes in demand	0.756
		C12.- various areas involved in order fulfillment	0.719

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.784

Bartlett test of Sphericity = 444.586, Significance = 0.000

The 15 Supplier Relations practices were reduced to four underlying factors (Table 4.19). The FSR1 (Information exchange, agility) factor alone, accounts for 44.42 percent of the variance in the data. The FSR2 (Integration for planning), the FSR3 (Production and

supplier involvement), and FSR4 (Supplier consideration) factors, jointly with the FSR1 factor, account for 69.46 percent of total variance in the data.

Table 4.19

Factor Analysis-Supplier Relations-Large Size firms

Factor	% of Variance	Scale Items	Factor Loading
FSR1: Information Exchange, Agility	44.52	**S11**.- involving suppliers in planning of logistics strategy	0.755
		S12.- information exchange with suppliers for planning	0.863
		S13.- internet and electronic data in supplier's delivery process	0.877
		S14.- programs w/suppliers to support special request by customer	0.634
		S15.- quick reaction to sudden changes in demand	0.674
FSR2: Integration for Planning	09.76	**S2**.- integrated programs and activities with suppliers	0.496
		S5.- strategic plans with collaboration of important suppliers	0.590
		S6.- forecasting and plans involving suppliers	0.879
		S9.- new prod dvlpmnt, concurrent engineering with suppliers	0.703
FSR3: Production and Supplier Involvement	08.17	**S1**.- prodtn plan considers advantages given by suppliers	0.662
		S3.- involving suppliers in design (product, process)	0.702
		S4.- long term agreements with suppliers	0.851
		S7.- synchronizing demand and material flow with prdtn plan	0.486
FSR4: Supplier Consideration	07.01	**S8**.- prodtn plan considers suppliers operational and delivery conditions	0.867
		S10.- information about events that could affect counterpart	0.768

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.822

Bartlett test of Sphericity = 476.885, Significance = 0.000

The 8 Environmental concern practices were reduced to two underlying factors (Table 4.20). The FEI1 (Recovery, Recycling, Remanufacture) factor alone, accounts for 46.33 percent of the variance in the data. The FEI2 (Environmental conservation, life cycle lengthening), jointly with the FEI1 factor, account for 65.12 percent of total variance in the data.

Table 4.20

Factor Analysis-Environmental Awareness-Large Size firms

Factor	% of Variance	Scale Items	Factor Loading
FEI1: Recovery, Recycling, Remanufacturing	46.33	**E4**.- recovered product total or partial re-use, when it applies	0.868
		E5.- customers and suppliers involved in joint design of recycling and final product disposition processes	0.747
		E7.- recovered product is recycled or reutilized	0.894
		E8.- recovered product is re-manufactured (total or partial)	0.864
FEI2: Environmental Conservation, Life Cycle Lengthening	18.79	**E1**.- environmental conservation taken seriously	0.699
		E2.- product recovery at the end of life cycle	0.720
		E3.- product return due to damage, expiration, etc	0.809
		E6.- greatest possible lengthening of the product's life cycle	0.639

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.759

Bartlett test of Sphericity = 212.435, Significance = 0.000

4.2.3.3 Multiple regression analysis large size enterprises

For each of the performance measure indicators, multiple linear regression was carried out using the eleven factors as independent variables. The Durbin Watson statistic and normal probability plots were used to verify that residuals were independent and normally distributed. All thirteen regression models were statistically significant at alpha of 0.05, Table 4.21 shows the regression models, with the R^2 and Durbin-Watson coefficient.

H1.a, H2.a, and H3.a, are supported by the findings that are presented in tables 4.21 and 4.22, which shows the regression (and its associated significance) coefficients for the Performance Measurement variables and the eleven factors.

It can be seen in table 4.22 that the five Customer Relations factors were statistically significant to at least one performance variable. The FCR1 ("Planning and Information") factor, the FCR2 ("Information, Customer Involvement") factor, the FCR3 ("Focus on Customer, Agility") factor, and the FCR5 ("Agility") factor, affected positively some performance variables. The FCR4 ("Forecasting, Design") factor affected adversely two performance variables. Two out of the four supplier relations factors were statistically significant to at least one performance variable, being the FSR1 ("Information Exchange, Agility") factor the one which affected positively more performance variables (5 out of 13 variables). The two environmental issues factors were statistically significant to at least one performance variable. The FEI2 ("Environmental Conservation, Life Cycle Lengthening") factor affected positively two of the performance variables, while the FEI1 ("Recovery, Recycling, Remanufacturing") factor affected adversely one performance variable.

Moderately supporting hypothesis H1.a, it can be observed from table 4.22 that:

a) The FCR1 ("Planning and Information") factor had a significant positive impact on Product Flexibility, Responsiveness to Key Customers, and Informal systems Support.
b) The FCR2 ("Information, Customer Involvement") factor, had a significant positive impact on Return on Assets, Order Fill Capacity, and Inventory Turns.
c) The FCR3 ("Focus on Customer, Agility") factor had a significant positive impact on Order Flexibility, and Customer Satisfaction; and a significant adverse impact on Inventory Turns.
d) The FCR4 ("Forecasting, Design") factor had a significant adverse impact on Low Logistics Costs, and Delivery Speed.
e) The FCR5 ("Agility") factor had a significant positive impact on Low Logistics Costs, Delivery Speed, and Advanced Shipment Notification.

Weakly supporting hypothesis H2.a, it can be observed from table 4.22 that:

a) The FSR1 ("Information Exchange, Agility") factor had a significant positive impact on Low Logistics Costs, Delivery Speed, Delivery Dependability, Delivery Time Flexibility and Advanced Shipment Notification.
b) The FSR2 ("Integration for Planning") factor had a significant positive impact on Inventory Turns.

c) The FSR3 ("Production and Supplier Involvement") factor, and the FSR4 ("Supplier Consideration") factor, did not have a significant impact on any Performance Measurement Indicator.

Table 4.21

Regression Models-Large Size firms

REGRESSION MODELS (LARGE SIZE ENTERPRISES)	R^2	Durbin-Watson Test
PM 1: Return on Assets = 3.162 + 0.369 FCR2 – 0.230 FEI1	0.144	1.91
PM2: Prod Flexibility = 2.819 + 0.350 FCR1	0.103	1.52
PM3: Low Logistics Costs= 1.639 – 0.322 FCR4 + 0.434 FCR5 + 0.428 FSR1	0.177	1.88
PM4: Delivery Speed = 2.260 – 0.336 FCR4 + 0.426 FCR5 0.323 FSR1	0.165	2.22
PM5: Delivery Dependability = 2.558 + 0.381 FSR1	0.091	1.51
PM6: Responsiveness to Key Customers = 2.217 + 0.536 FCR1	0.214	2.04
PM7: Order Fill Capacity = 2.304 + 0.467 FCR2	0.162	2.37
PM8: Order Flexibility = 2.357 + 0.360 FCR3	0.049	1.40
PM9: Delivery Time Flexibility = 2.368 + 0.428 FSR1	0.131	1.90
PM10: Advanced Shipment Notification = 0.744 + 0.474 FCR5 + 0.301 FSR1	0.246	1.76
PM11: Inventory Turns = 1.256 + 0.357 FCR2 – 0.502 FCR3 + 0.566 FSR2 + 0.273 FEI2	0.281	1.95
PM12: Customer Satisfaction = 1.114 + 0.688 FCR3	0.162	1.89
PM13: Informal Systems Support = 1.575 + 0.411 FCR1 + 0.243 FEI2	0.246	2.20

Weakly supporting hypothesis H3.a, it can be observed from table 4.22 that:

a) The FEI1 ("Recovery, Recycling, Remanufacturing") factor had a significant adverse impact on Return on Assets.

b) The FEI2 ("Environmental Conservation, Life Cycle Lengthening") factor had a significant positive impact on Inventory Turns and Informal Systems Support.

Table 4.22

Regression Matrix-Large Size firms

	Factors (Independent variables)										
Dependent variables	**FCR1**	**FCR2**	**FCR3**	**FCR4**	**FCR5**	**FSR1**	**FSR2**	**FSR3**	**FSR4**	**FEI1**	**FEI2**
PM1		0.369 S:0.017								-0.230 S:0.022	
PM2	0.350 S:0.012										
PM3				-0.322 S:0.066	0.434 S:0.057	0.428 S:0.036					
PM4				-0.366 S:0.036	0.426 S:0.041	0.323 S:0.080					
PM5						0.381 S:0.018					
PM6	0.536 S:0.000										
PM7		0.467 S:0.001									
PM8			0.360 S:0.085								
PM9						0.428 S:0.004					
PM10					0.474 S:0.011	0.301 S:0.063					
PM11		0.357 S:0.042	-0.502 S:0.054				0.566 S:0.009				0.273 S:0.080
PM12			0.688 S:0.001								
PM13	0.411 S:0.008										0.243 S:0.083

4.2.3.4 Testing for significant differences in performance between large size enterprises that use intensively logistical practices and those which not

This section presents the results of t-test, looking for significant differences in means of performance variables, based on the intensive use or not of logistics practices in Large Size enterprises. A summary of the hypothesis testing is presented in table 4.23. A table with the significant relations of the hypothesis testing is presented in table 4.24. The specific t-test performed for each factor is presented in Appendix F.

Table 4.23

Summary of Hypothesis Testing-Large Size firms

	Number of performance variables (out of 13) significant at p<0.05/p<0.10		Hypothesis Test
CUSTOMER RELATIONS	p<0.05	p<0.10	
Planning and Information	2	0	Weak Support
Information, Customer Involvement	7	2	Strong Support
Focus on Customer, Agility	2	3	Moderate Support
Forecasting, Design	0	1	Weak Support
Agility	1	0	Weak Support
SUPPLIER RELATIONS			
Information Exchange, Agility	1	3	Moderate Support
Integration for Planning	1	0	Weak Support
Production and Supplier Involvement	1	0	Weak Support
Supplier Consideration	0	0	No Support
ENVIRONMENTAL AWARENESS			
Recovery, Recycling, Remanufacturing	0	0	No Support
Environmental Conservation, Life Cycle Lengthening	0	0	No Support

From table 4.23, it can be observed that Hypothesis H1.b was moderately supported; Hypothesis H2.b was weakly supported; and Hypothesis H3.b was not supported.

Moderately supporting H1.b, from Table 4.24, with an alpha of 0.5, it can be observed that:

a) The FCR1 ("Planning and Information") factor was significant to Product Flexibility and Responsiveness to Key Customers.
b) The FCR2 ("Information, Customer Involvement") factor was significant to Prod Flexibility, Low Logistics Costs, Responsiveness to Key Customers, Order Fill Capacity, Delivery Time Flexibility, Advanced Shipment Notification, and Customer Satisfaction.
c) The FCR3 ("Focus on Customer, Agility") factor was significant to Product Flexibility, and Low Logistics Costs.
d) The FCR4 ("Forecasting, Design") factor was not significant to any Performance Measurement Indicator.
e) The FCR5 ("Agility") factor was significant to Advanced Shipment Notification.

Weakly supporting H2.b, from Table 4.24, with an alpha of 0.5, it can be observed that:

a) The FSR1 ("Information Exchange, Agility") factor was significant to Inventory Turns.
b) The FSR2 ("Integration for Planning") factor was also significant to Inventory Turns.

c) The FSR3 ("Production and Supplier Involvement") factor was significant to Responsiveness to Key Customers.

d) The FSR4 ("Supplier Consideration") factor was not significant to any Performance Measurement Indicator.

Table 4.24

Summary of Significant Relations of Hypothesis Testing-Large Size firms with an alpha of 0.5

	FCR1	FCR2	FCR3	FCR4	FCR5	FSR1	FSR2	FSR3	FSR4	FEA1	FEI2
PM1: ROA											
PM2: PF	√	√	√								
PM3: LLC		√	√								
PM4: DS											
PM5: DD											
PM6: RKC	√	√						√			
PM7: OFC		√									
PM8: OF											
PM9: DTF		√									
PM10: ASN		√			√						
PM11: IT						√	√				
PM12: CS		√									
PM13: ISS											

Not supporting at all H3.b, from Table 4.24, with an alpha of 0.5, it can be observed that the FEI1 ("Recovery, Recycling, Remanufacturing") factor and the FEI2 ("Environmental Conservation, Life Cycle Lengthening") factor, were not significant to any Performance Measurement Indicator.

4.3 Summary

This section presents the most important factors for All Firms, Medium Firms, and Large Size Firms. In the case of Multiple Linear Regression, importance is measured based on how many performance measurement indicators affected a certain factor, and in the case of T-test, importance is measured based on how many performance measurement indicators (out of 13) presented a significant difference in mean due to an intensive use or not of certain logistics practices (factors), as stated in sections 4.2.1.4, 4.2.2.4, and 4.2.3.4.

Table 4.25

Most Important Factors for All firms

FACTOR	Scale Items	M L R	T-Test
FCR1: Customer Involvement	**C7, C8, C15, C16, C17**		√
FCR2: Plans, Programs, Information	**C3, C4, C5, C6**	√	√
FCR3: Focus on Customer	**C1, C2, C13, C14**	√	√
FSR1: Supplier Involvement	**S9, S11, S12, S13, S14, S15**	√	√
FSR2: Supplier Involvement 2	**S1, S2, S3, S4, S5, S6, S7**	√	√
FEI2: Environmental Concern	**E1, E2, E3, E6**	√	

Table 4.25 shows the six most important factors for All Firms, with their associated scale items. The FCR1 (Customer Involvement) factor was important in the T-Test, but not in the Multiple Linear Regression. The FEI2 (Environmental Concern) factor was important in the Multiple Linear Regression, but not in the T-Tests. The other four factors were important in both statistical techniques.

Table 4.26

Most Important Factors for Medium Size firms

FACTOR	Scale Items	M L R	T-Test
FCR2: Information	**C3, C4, C5, C15, C16, C17**	√	√
FSR1: Planning and Forecasting with Suppliers	**S4, S5, S6, S7**		√
FSR2: Supplier Involvement, Agility	**S2, S3, S12, S15**	√	
FSR3: Production, Logistics	**S1, S8, S9, S10, S11**	√	√
FSR4: Coordination with Suppliers	**S13, S14**	√	√

Table 4.26 shows the five most important factors for Medium Firms, with their associated scale items. The FSR1 (Planning and Forecasting with Suppiers) factor was important in the T-Test, but not in the Multiple Linear Regression. The FSR2 (Supplier Involvement,

Agility) factor was important in the Multiple Linear Regression, but not in the T-Tests. The other three factors were important in both statistical techniques.

Table 4.27

Most Important Factors for Large Size firms

FACTOR	Scale Items	M L R	T-Test
FCR1: Planning and Information	**C6, C11, C15, C16, C17**	√	√
FCR2: Information, Customer Involvement	**C3, C4, C5, C10, C13**	√	√
FCR3: Focus on Customer, Agility	**C1, C2, C14**	√	√
FCR5: Agility	**C9, C12**	√	√
FSR1: Information Exchange, Agility	**S11, S12, S13, S14, S15**	√	√
FSR2: Integration for Planning	**S2, S5, S6, S9**		√
FSR3: Production and Supplier Involvement	**S1, S3, S4, S7**		√

Table 4.27 shows the seven most important factors for Large Size Firms, with their associated scale items. The FSR2 (Integration for Planning) factor, and the FSR3 (Production and Supplier Involvement) factor, were important in the T-Test, but not in the Multiple Linear Regression. The other five factors were important in both statistical techniques.

Chapter 5

Summary and Conclusions

5.1 Overview of Findings in Extended Enterprise

Economy and manufacturing globalization, environmental awareness and stress over business and organizational structures, are factors that are generating considerable amounts of pressure that are having impact on enterprises policies and strategies in order to adapt and react accordingly to these pressures. These pressures are forcing firms' integration into inter-enterprise networks with highly developed agility and flexibility characteristics, with a strong sense of integration and with a responsible environmental awareness.

In this new millennium, upstream and downstream integration with suppliers and customers is emerging as a very important element of business strategy. In the future, the Supply Chain model will be displaced by the concept of a supply network model, an inter-enterprise network, and it will eventually evolve to the Extended Enterprise model.

Eventually, the hierarchical paradigm of organizations with a focus on vertical command chains will be replaced by a networking paradigm with the focus on horizontal inter-enterprise communication. Individual companies are working together to form inter-enterprise networks in order to survive and achieve business successes, this should make them more competitive in a business world full of economic, environmental and managerial

pressures. Corporations are recognizing that in the global business it is not a case of companies competing, but supply chains networks.

Inter-enterprise networking represents the future shape of manufacturing systems. Companies must look for synergies within their inter-enterprise networks. There must be a closer coordination of activities both within and across the boundaries of firms through the supply networks in order to enhance performance. The final objective must be a total and aggressive involvement of both suppliers and customers in the network, functioning as a single enterprise, with strong cohesion, using systems which allow shared decision taking processes, looking always for higher benefits for the enterprise network, and for the individual companies as well. This coordination and collaboration is supposed to bring higher benefits for the inter-enterprise network, and the members of the network, than an individual enterprise management. The expected outcomes are: costs reductions, efficiency and competitiveness enhancement, agility, and flexibility among others. It's a fact that strategic alliances with both suppliers and customers have to be developed. Firms must utilize their suppliers' processes, technologies, and capabilities to improve competitive advantage. Suppliers and customers must be seen as virtual extensions of the firms, they must be considered as partners instead of adversaries.

With respect to environmental awareness, there has been increasing public attention placed on the overall condition of the natural environment. Worldwide, there is an overall awareness of the worsening state of the environment, as well as a desire to reverse that trend. Although the sustainability of economic development is a shared responsibility of, business, governments and consumers, the corporate role in slowing down the planet's

environmental degradation is particularly relevant. Aligned to the need of generating a more sustainable development, one of the principal objectives of extending the traditional supply chain is to allow consideration of the total immediate and eventual environmental effects of all products and processes. The fully integrated, extended supply chain contains all of the elements of the traditional supply chain, but extends the chain to construct a semi-closed loop that includes product and packaging recycling, re-use, and/or remanufacturing operations Therefore, the traditional structure of the supply chain must be extended to include mechanisms for product recovery, this supply chain extension tends to move the supply chain model to the Extended Enterprise model.

Today's visionary manufacturing companies are developing a total life cycle approach to their products. Managers must accept that environmental issues must be contained and considered in the firm's overall strategy. They must find a way of satisfying objectives of economic competitiveness and of environmental protection at the same time.

Supply Chain Management, with its tendency to create an inter-enterprise network, with its search for competitiveness, agility, and flexibility, and its environmental awareness, has become the driving force in an effort to create the Extended Enterprise. It could be considered that for companies to survive and prosper, they will need to operate their supply chains as Extended Enterprises with relationships which embrace business processes, from materials extraction to consumption, including environmental processes. As in the case of advanced supply chains, the Extended Enterprise can be seen in the context of enterprise partnerships, designed to facilitate co-operation and integration across the supply chain. The concept of the Extended Enterprise focuses on long-term enterprise relationships with

suppliers and consumers across the supply chain, and not any kind of relationship, but a very profound relation, based on a win-win approach, with shared decision taking mechanisms in order to increase the network competitiveness and also its agility and flexibility. Agility allows firms to rapidly respond to changes in supply and demand, changing production and distribution schedules easily to meet customer orders. By creating and managing a highly organized network of complementary companies across the supply network, an Extended Enterprise can rapidly build strategic effectiveness and wealth.

The Extended Enterprise extends beyond traditional organizational boundaries. It includes the relationships that an enterprise has with its customers, suppliers, business partners, and even former competitors. The Extended Enterprise is responsible for the whole product life cycle, from material procurement to component production and manufacturing, to final assembly, further to distribution and customer service, and in an increasing number of cases, to the disposition and, where possible, recycling of end-of-life products

Some of the most important companies in the world have been moving to de Extended Enterprise model in order to maintain their leadership in their respective industries, this model is a must in order to be productive, flexible, customer driven and to achieve a sustainable development.

5.2 Overview of Findings in the Empirical Research

While analyzing all firms, Multiple Regression strongly supported that a Customer Relation Focus had a statistically significant impact on firm's performance; moderately supported

that a Supplier Relation Focus had a statistically significant impact on firm's performance; and weakly supported that an environmental awareness focus had a statistically significant impact on firm's performance. Additionally, T-tests strongly supported that firms that strongly develop a customer relations focus will exhibit enhanced performance compared to those which not; moderately supported that firms that strongly develop a supplier relations focus will exhibit enhanced performance compared to those which not; and weakly supported that firms that strongly develop an environmental awareness focus will exhibit enhanced performance compared to those which not.

While analyzing medium size firms, Multiple Regression moderately supported that a Customer Relation Focus had a statistically significant impact on firm's performance; moderately supported that a Supplier Relation Focus had a statistically significant impact on firm's performance; and weakly supported that an environmental awareness focus had a statistically significant impact on firm's performance. Additionally, T-tests weakly supported that firms that strongly develop a customer relations focus will exhibit enhanced performance compared to those which not; moderately supported that firms that strongly develop a supplier relations focus will exhibit enhanced performance compared to those which not; and weakly supported that firms that strongly develop an environmental awareness focus will exhibit enhanced performance compared to those which not.

While analyzing large size firms, Multiple Regression moderately supported that a Customer Relation Focus had a statistically significant impact on firm's performance; weakly supported that a Supplier Relation Focus had a statistically significant impact on firm's performance; and weakly supported that an environmental awareness focus had a

statistically significant impact on firm's performance. Additionally, T-tests moderately supported that firms that strongly develop a customer relations focus will exhibit enhanced performance compared to those which not; weakly supported that firms that strongly develop a supplier relations focus will exhibit enhanced performance compared to those which not; and did not support that firms that strongly develop an environmental awareness focus will exhibit enhanced performance compared to those which not.

Table 5.1

Summary of Hypothesis Testing

	Test	Customer Relations	Supplier Relations	Environmental Awareness
All Firms	**Multiple Reg**	**Strong**	**Moderate**	**Weak**
	T-Test	**Strong**	**Moderate**	**Weak**
Medium Firms	**Multiple Reg**	**Moderate**	**Moderate**	**Weak**
	T-Test	**Weak**	**Moderate**	**Weak**
Large Size Firms	**Multiple Reg**	**Moderate**	**Weak**	**Weak**
	T-Test	**Moderate**	**Weak**	**No**

Table 5.1 shows a summary of hypothesis testing. Customer Relations have a strong to moderate impact on firm performance, Supplier Relations have a moderate impact on firm performance, and Environmental Awareness has a weak impact on firm performance.

5.3 Recommendations for management

Based on the results of this study, we make recommendations with regard to each of the three areas of logistical important practices. This recommendations are based on the activities that were present in any of the most important factors in at least two enterprise groups (all, medium of large size). A summary of the practices and the firms in which they were important are shown in tables 5.2 and 5.3.

With regard to Customer Relations, the recommendations are:

1. Integrate programs and activities with customers
2. Make sure that you have a friendly product (in transit) information system to customers
3. Exchange information with customers for planning
4. Involve important customers in strategic planning
5. Inform counterparts about events that could affect them
6. Inform customers about fluctuation in production
7. Involve customers in planning of logistics strategy

With regard to Supplier Relations, the recommendations are:

1. Consider advantages given by suppliers in production planning
2. Integrate programs and activities with suppliers
3. involve suppliers in design of products and processes
4. Establish long term agreements with suppliers
5. Make strategic plans with collaboration of important suppliers

6. Involve suppliers when elaborating forecasts and plans
7. Synchronize demand and material flow with your production plan
8. Involve suppliers in new product development and concurrent engineering
9. Involve suppliers in planning of logistics strategy
10. Exchange information with suppliers for planning
11. Use internet and electronic data in your suppliers' delivery process
12. Elaborate programs with suppliers to support special requests by customers
13. Elaborate contingency plans to react quickly to sudden changes in demand

Table 5.2

Most Important Practices in Customer Relations

Customer Relations		All Firms	Médium Firms	Large Firms
C3	Integrated programs and activities with customers	√	√	√
C4	Friendly product (in transit) information system to customers	√	√	√
C5	Information exchange with customers for planning	√	√	√
C6	Strategic plans with involvement of important customers	√		√
C15	Information about events that could affect counterparts	√	√	√
C16	Information to customers about fluctuation in production	√	√	√
C17	Involving customers in planning of logistics strategy	√	√	√

5.4 Limitations

There were restrictions and limitations in this research. The surveys included a limited number of respondents, not enough to draw conclusions by industry, only by size. The

survey was also restricted to medium size and large size enterprises, it is known that small enterprises do not have an adequate managerial and organizational structure, but it could be interesting to try to measure the degree of logistical chaos that is present in small enterprises. Another limitation is that there is only one respondent from each company, there is only one source of information from each company, and the respondent is asked for his appreciation on logistical practices and performance measurement variable, so that there can be a certain degree of bias on the responses.

Table 5.3

Most Important Practices in Supplier Relations

Supplier Relations		All Firms	Médium Firms	Large Firms
S1	Production planning considers advantages given by suppliers	√	√	√
S2	Integrated programs and activities with suppliers	√		√
S3	Involving suppliers in design of products and processes	√		√
S4	Long term agreements with suppliers	√	√	√
S5	Strategic plans with collaboration of important suppliers	√	√	√
S6	Forecasting and plans involving suppliers	√	√	√
S7	Synchronizing demand and material flow with production plan	√	√	√
S9	New product development, concurrent engineering with suppliers	√	√	√
S11	Involving suppliers in planning of logistics strategy	√	√	√
S12	Information exchange with suppliers for planning	√		√
S13	Internet and electronic data in suppliers' delivery process	√	√	√
S14	Programs with suppliers to support special requests by customers	√	√	√
S15	Quick reaction to sudden changes in demand	√		√

5.5 Suggestions for Future Research

Replication of these results would be useful across different types of industry to provide information on the behavior and the degree of application of the different logistical capabilities, as well as its impact on firm performance in different industry sectors. Replication of these results would also be useful across different countries to provide information on the behavior and degree of application of the different logistical capabilities on firm performance in different economic environments.

It would be interesting to extend this study to small enterprises and try to determine: which are the logistical practices that have a significant impact on performance. If medium size and large size enterprises have to assign resources in an intelligent way, this is a more important issue when resources are as scarce as in small enterprises.

Another important question is to study the reasons why certain logistical capabilities have a lower impact or no impact on firm performance. Are they the same capabilities that have a low impact the same among different industry sector? If enterprises know these reasons they could find the way to overcome a certain difficulty and try to enhance the impact on performance of a certain logistical capability.

A larger sample could allow in the future the comparison among national and multinational firms, and also the comparison among norther vs. southern or central firms in Mexico.

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Appendix A

Definition of the eight key business processes (identified by the Global Supply Chain Forum), that make up the core of Supply Chain Management.

9. Customer Relationship Management. This process provides the structure for how the relationship with the customer is developed and maintained. Management identifies key customers and customer groups to be targeted as part of the firm's business mission. Customer teams tailor Product and Service Agreements (PSA) to meet the needs of key accounts and segments of other customers. Teams work with key accounts to improve processes, and eliminate demand variability and non-value-added activities.
10. Customer Service Management. This process is the firm's face to the customer. It provides the single source of customer information, such as product availability, shipping dates and order status. Real-time information is provided to the customer through interfaces with the firm's functions, such as manufacturing and logistics.
11. Demand Management. This process needs to balance customer's requirement with the firm's supply capabilities. This includes forecasting demand and synchronizing it with production, procurement, and distribution. The process is also concerned with developing and executing contingency plans when operations are interrupted.
12. Order Fulfillment. A key to effective supply chain management is to meet customer requirements in terms of order fulfillment. Effective order fulfillment requires integration of the firms manufacturing logistics and marketing plans. The firm

should develop partnerships with key members of the supply chain to meet customer requirements and reduce total delivered cost to customers.

13. Manufacturing Flow Management. This process deals with making the products and establishing the manufacturing flexibility needed to serve the target markets. The process includes all activities necessary for managing the product flow through the manufacturing facilities and for obtaining, implementing and managing flexibility.
14. Supplier Relationship Management. This process defines how a company interacts with its suppliers. Just as a company needs to develop relationships with its customers, it needs to foster relationships with its suppliers.
15. Product Development and Commercialization. This process is critical to the continuing success of the firm. Developing new products quickly and getting them to the marketplace in an efficient manner is a major component of corporate success. Time to market is a critical objective of this process. As product life cycles shorten, the right products must be developed and successfully launched in ever-shorter timeframes in order to remain competitive.
16. Returns Management. This process is a critical part of supply chain management. While many firms neglect the return process because management does not believe it is important, this process can assist the firm in achieving a sustainable competitive advantage.

Appendix B

INEGI's 1999 economic census enterprise stratification.

Table 1. Enterprise stratification, Economic Census, INEGI 1999

Size	Industry	Commerce	Service
Micro	0-30	0-5	0-20
Small	31-100	6-20	21-50
Medium	101-500	21-100	51-100
Large	501-	101-	101-

Respondents' Demographic Data

Organization Size	**Frequency**
Medium Size	63
Large Size	61
Rank of Respondent	**Percent**
President/Owner	8.87%
Manager	58.87%
Supervision/other	32.26%
Industry	**Percent**
Manufacturing	41.13
Comerse	23.39
Service	35.48

Appendix C

Field research on the use of the best logistics practices in Supply Chain and their impact in performance measurement indicators

August 2004

To whom it may concern:

The Monterrey Institute of Technology (ITESM) has the Mission of developing individuals committed with the development of their community, and that are competitive internationally in their area of expertise. This Mission includes performing relevant research and consulting for the sustainable development of our society.

The present study is a part of ITESM's efforts in helping Mexican companies to strengthen and increase their productivity, identifying the best logistic practices and their impact in performance measurement indicators.

We will greatly appreciate if you can share with us your experience, by answering the following questionnaire, on the use in your firm's supply chain.

The information that you will provide us will be handled with extreme confidentiality, and will not be made available to any other organization. A copy of the general results obtained in this study will be sent to you.

We want to thank you in advance for your collaboration in this study, and please let us know if you have any questions about any of the items in the questionnaire.

Sincerely,

Dr. Fernando Mata Carrasco
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DEMOGRAPHICAL INFORMATION

COMPANY NAME:_____

INDUSTRY GROUP:_____

ADDRESS:_____

_____

COMPANY SIZE: ☐ **MEDIUM** ☐ **LARGE**

COMPANY: ☐ **INDUSTRY** ☐ **COMMERCE** ☐ **SERVICE**

RESPONDENT'S INFORMATION

NAME:_____

POSITION:_____

E-MAIL:_____

PHONE NUMBER:_____

FAX NUMBER:_____

Evaluation Criteria

① Totally disagree	② Disagree	③ Not agree or disagree	④ Agree	⑤ Totally agree

Part I: Customer Relations		1	2	3	4	5
1	The logistic operations of my company are focused in contributing to the success of our most important customers.	①	②	③	④	⑤
2	My company has established programs to authorize and to comply with special requests of chosen customers.	①	②	③	④	⑤
3	My company successfully integrates operations with customers developing integrated programs and activities.	①	②	③	④	⑤
4	Product availability, shipment dates, order status and general information of the product that is going to be acquired by our customers are available in a friendly information system.	①	②	③	④	⑤
5	There exists an information exchange with our customers. This information exchange is used in the design of the firm's planning processes.	①	②	③	④	⑤
6	My company develops strategic plans in collaboration with important customers.	①	②	③	④	⑤
7	My company elaborates forecasts and plans with the involvement of its customers.	①	②	③	④	⑤
8	My company seeks to involve its customers in the design of new products, new processes, and distribution channels.	①	②	③	④	⑤
9	The manufacturing department reacts quickly to changes in market demand.	①	②	③	④	⑤
10	Production planning in my company takes into consideration the requests and needs of the customers.	①	②	③	④	⑤
11	New product development is based on the concurrent engineering principles, involving important customers.	①	②	③	④	⑤
12	The manufacturing, logistics, and selling areas are involved in the order fulfillment process.	①	②	③	④	⑤
13	The use of internet and electronic data and information exchange are practices utilized in fulfill the order.	①	②	③	④	⑤
14	The company is able to react in order to comply with special orders, due to sudden changes in demand, caused by internal or external factors.	①	②	③	④	⑤
15	My company and its customers keep each other informed about events or changes that could affect their counterparts.	①	②	③	④	⑤
16	My company informs its customers about fluctuations in production levels that could affect product availability.	①	②	③	④	⑤
17	My company involves its customers in the planning of the logistics strategy.	①	②	③	④	⑤

Evaluation Criteria

① Totally disagree	② Disagree	③ Not agree or disagree	④ Agree	⑤ Totally agree

Part II: Supplier Relations		1	2	3	4	5
1	The production plan considers advantages given by suppliers.	①	②	③	④	⑤
2	My company successfully integrates operations with suppliers developing integrated programs and activities.	①	②	③	④	⑤
3	My company seeks to involve its suppliers in the design of new products, new processes, and distribution channels.	①	②	③	④	⑤
4	My company is ready to commit to long term agreements with its suppliers.	①	②	③	④	⑤
5	My company develops strategic plans in collaboration with important suppliers.	①	②	③	④	⑤
6	My company elaborates forecasts and plans with the involvement of its suppliers.	①	②	③	④	⑤
7	My company has the ability of synchronizing customer's demand and supplier's material flow with the firm's production planning.	①	②	③	④	⑤
8	Production planning takes into account suppliers operational and delivery conditions.	①	②	③	④	⑤
9	New product development is based on the concurrent engineering principles, involving important suppliers.	①	②	③	④	⑤
10	My company and its suppliers keep each other informed about events or changes that could affect their counterparts.	①	②	③	④	⑤
11	My company involves its suppliers in the planning of the logistics strategy.	①	②	③	④	⑤
12	There exists an information exchange with our suppliers. This information exchange is used in the design of the firm's planning processes.	①	②	③	④	⑤
13	The use of internet and electronic data and information exchange is a practice utilized in our suppliers' delivery processes.	①	②	③	④	⑤
14	My company has established programs so that the supplier gives us support in the compliance of special requests of selected customers.	①	②	③	④	⑤
15	My company has established programs so it is able to react in order to comply with special orders, due to sudden changes in demand, caused by internal or external factors.	①	②	③	④	⑤

Evaluation Criteria

① Totally disagree	② Disagree	③ Not agree or disagree	④ Agree	⑤ Totally agree

Part III: Environmental Awareness		1	2	3	4	5
1	My company takes environmental conservation seriously.	①	②	③	④	⑤
2	My company is committed with product recovery once it has ended its life cycle.	①	②	③	④	⑤
3	If necessary, the product is returned to my company before the ending of its life cycle, due to damage in transit, expired, discontinued or out of season products.	①	②	③	④	⑤
4	When it applies, recovered product is utilized for its entire re-use or the re-use of some of its components, without implying a remanufacturing.	①	②	③	④	⑤
5	Customers and suppliers were involved in a joint design of the recycling, reverse logistics, and final product disposition processes.	①	②	③	④	⑤
6	In the development of new products, a fundamental objective is the greatest possible lengthening of the product's life cycle.	①	②	③	④	⑤
7	The recovered product is used to recycle or to recover some base materials that can be reutilized into the production process.	①	②	③	④	⑤
8	The recovered product is used to re-manufacture the entire product or some of its parts, applying quality standards as rigorous as the ones applied in the production of the first time manufactured products.	①	②	③	④	⑤

PERFORMANCE MEASUREMENT INDICATORS

In this section, please specify, in accordance with your perception, the current performance of your company in comparison to its principal competitors, under the following criteria: 1 = "Worse than competitors", 3 = "comparable with competitors", 5 = "better than competitors"

Part IV: Performance Measurement Indicators		1	2	3	4	5
A	Return on Assets. The ratio of income before interest expense divided by average total assets.	①	②	③	④	⑤
B	Product Flexibility (Customization). The ability to handle difficult, nonstandard orders to meet special customer specifications and to manufacture products characterized by numerous features, options, size and/or colors.	①	②	③	④	⑤
C	Low Logistics Costs. The ability to achieve the lowest total cost of logistics through efficient operations, technology and/or scale economies.	①	②	③	④	⑤
D	Delivery Speed. The ability to reduce the time between order receipt and customer delivery to as close to zero as possible.	①	②	③	④	⑤
E	Delivery Dependability. The ability to meet quoted or anticipated delivery dates and quantities on a consistent basis.	①	②	③	④	⑤
F	Responsiveness to Key Customers. The ability to respond to the needs and wants of key customers.	①	②	③	④	⑤
G	Order Fill Capacity. The ability to provide desired quantities on a consistent basis.	①	②	③	④	⑤
H	Order Flexibility. The ability to modify order size, volume or composition during logistics operation.	①	②	③	④	⑤
I	Delivery Time Flexibility. The ability to accommodate delivery times for specific customers.	①	②	③	④	⑤
J	Advanced Shipment Notification. The ability to notify customers in advance of delivery when products will arrive.	①	②	③	④	⑤
K	Inventory Turns. The ratio of cost of goods sold divided by the average investment in inventory during a time period.	①	②	③	④	⑤
L	Customer Satisfaction. The global judgment regarding the extent to which perceived logistics performance matches customer expectations.	①	②	③	④	⑤
M	Informal Systems Support. The ability of information systems to provide operational managers with sufficient and timely information to manage logistical activities.	①	②	③	④	⑤

Appendix D

T-test of significant differences in mean of performance-all firms

Customer Relations

	FCR1			FCR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.8689	3.7759	.604	3.9412	3.6667	.128
PE02	4.2813	3.9667	.061	4.2603	3.9412	.062
PE03	3.9219	3.6833	.223	3.9726	3.5686	.041
PE04	4.1875	3.8833	.093	4.1644	3.8627	.101
PE05	4.2813	3.8333	.015	4.3014	3.7255	.002
PE06	4.5625	4.0167	.001	4.5479	3.9412	.000
PE07	4.2031	4.0333	.269	4.3425	3.8039	.000
PE08	4.1406	3.8833	.151	4.1507	3.8235	.072
PE09	4.2813	4.0167	.113	4.2466	4.0196	.182
PE10	4.0000	3.7167	.106	4.1370	3.4706	.000
PE11	4.0635	3.4915	.002	3.9412	3.6667	.007
PE12	4.4375	3.7000	.000	4.2603	3.9412	.002
PE13	4.1875	3.4833	.001	3.9726	3.5686	.001

T-test of significant differences in mean of performance-all firms

Customer Relations

	FCR3			FCR4		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.9167	3.6000	.105	3.8312	3.8095	.908
PE02	4.2472	3.8286	.024	4.3049	3.7857	.003
PE03	3.9438	3.4571	.024	3.9146	3.5952	.122
PE04	4.0337	4.0571	.908	4.0732	3.9762	.614
PE05	4.1461	3.8571	.162	4.1341	3.9286	.297
PE06	4.4045	4.0286	.040	4.4390	4.0238	.017
PE07	4.2247	3.8571	.030	4.1707	4.0238	.365
PE08	4.1124	3.7714	.086	4.0732	3.9048	.375
PE09	4.2472	3.9143	.072	4.1098	4.2381	.469
PE10	3.8989	3.7714	.514	3.9878	3.6190	.046
PE11	3.8736	3.5714	.144	3.8875	3.5952	.137
PE12	4.2472	3.6571	.002	4.1829	3.8810	.100
PE13	4.0000	3.4571	.018	3.9878	3.5714	.057

T-test of significant differences in mean of performance-all firms

Suppier Relations

	FSR1			FSR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.9655	3.6885	.120	3.9851	3.6154	.039
PE02	4.2623	4.0000	.119	4.3000	3.9074	.020
PE03	3.9836	3.6349	.074	3.9286	3.6481	.155
PE04	4.1803	3.9048	.128	4.1714	3.8704	.099
PE05	4.2951	3.8413	.014	4.3143	3.7407	.002
PE06	4.5574	4.0476	.002	4.5429	3.9815	.001
PE07	4.4098	3.8413	.000	4.2857	3.9074	.014
PE08	4.2787	3.7619	.003	4.1857	3.7963	.030
PE09	4.4098	3.9048	.002	4.3000	3.9630	.045
PE10	4.0492	3.6825	.036	3.9857	3.7037	.110
PE11	4.1667	3.4194	.000	4.0725	3.4151	.000
PE12	4.2787	3.8889	.024	4.2714	3.8333	.012
PE13	4.1803	3.5238	.001	4.0571	3.5741	.020

T-test of significant differences in mean of performance-all firms

Supplier Relations

FSR3

	High levels	Low levels	p-value
PE01	3.7805	3.9189	.474
PE02	4.1494	4.0811	.712
PE03	3.8046	3.8108	.977
PE04	4.0575	4.0000	.773
PE05	4.1609	3.8378	.112
PE06	4.3793	4.1081	.133
PE07	4.1724	4.0000	.304
PE08	4.0460	3.9459	.611
PE09	4.2759	3.8649	.024
PE10	3.9195	3.7297	.323
PE11	3.9176	3.4865	.033
PE12	4.1724	3.8649	.106
PE13	3.9425	3.6216	.158

T-test of significant differences in mean of performance-all firms

Environmental Awareness

	FEI1			FEI2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	4.0000	3.7590	.220	3.8983	3.7500	.407
PE02	4.1111	4.1264	.935	4.1803	4.0794	.551
PE03	3.6667	3.8736	.340	3.8033	3.8095	.975
PE04	4.0556	4.0230	.871	4.0656	4.0159	.785
PE05	4.1111	4.0345	.710	4.1311	4.0000	.482
PE06	4.3611	4.2644	.598	4.3607	4.2381	.460
PE07	4.1667	4.1149	.760	4.1967	4.0476	.332
PE08	4.0000	4.0115	.954	4.0492	3.9841	.718
PE09	4.0278	4.1954	.365	4.1803	4.1270	.751
PE10	3.8611	3.8736	.949	3.9344	3.7937	.423
PE11	3.9167	3.7412	.395	3.9667	3.6129	.058
PE12	4.1667	4.0345	.493	4.1967	3.9683	.190
PE13	4.1667	3.7241	.053	3.9672	3.7302	.255

Appendix E

T-test of significant differences in mean of performance-Medium Size firms

Customer Relations

	FCR1			FCR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.6875	3.6897	.993	3.8077	3.6000	.407
PE02	4.1212	3.9333	.461	4.1111	3.9722	.589
PE03	3.8485	3.4000	.081	3.7037	3.5833	.647
PE04	4.0303	3.9667	.803	4.2222	3.8333	.128
PE05	4.1515	3.8667	.288	4.4444	3.6944	.004
PE06	4.3636	4.0667	.205	4.5556	3.9722	.012
PE07	4.0909	3.9000	.338	4.2222	3.8333	.050
PE08	4.0303	3.8000	.368	4.1481	3.7500	.120
PE09	4.3030	4.0667	.309	4.4444	4.0000	.055
PE10	3.8182	3.6333	.439	3.8148	3.6667	.539
PE11	3.7500	3.5000	.327	3.8519	3.4571	.123
PE12	4.2727	3.7667	.024	4.3704	3.7778	.008
PE13	3.6364	3.3333	.322	4.0370	3.0833	.001

T-test of significant differences in mean of performance-Medium Size firms

Customer Relations

	FCR3			FCR4		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.7143	3.6538	.810	3.7436	3.5909	.555
PE02	4.2973	3.6538	.011	4.0488	4.0000	.855
PE03	3.7297	3.5000	.383	3.7073	3.5000	.447
PE04	4.0000	4.0000	1.000	4.0244	3.9545	.794
PE05	4.0270	4.0000	.921	4.0976	3.8636	.406
PE06	4.3514	4.0385	.188	4.2439	4.1818	.802
PE07	4.0811	3.8846	.331	4.0732	3.8636	.315
PE08	3.9730	3.8462	.626	3.9756	3.8182	.558
PE09	4.0811	4.3462	.260	4.2683	4.0455	.360
PE10	3.6757	3.8077	.586	3.6829	3.8182	.589
PE11	3.6111	3.6538	.869	3.6500	3.5909	.825
PE12	4.0541	4.0000	.816	4.2195	3.6818	.022
PE13	3.5405	3.4231	.706	3.6585	3.1818	.135

T-test of significant differences in mean of performance-Medium Size firms

Supplier Relations

	FSR1			FSR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.7353	3.6296	.672	3.7241	3.6563	.785
PE02	4.1143	3.9286	.468	4.2667	3.8182	.075
PE03	3.6286	3.6429	.957	3.7000	3.5758	.633
PE04	3.9429	4.0714	.616	4.0000	4.0000	1.000
PE05	4.2857	3.6786	.022	4.0333	4.0000	.902
PE06	4.2857	4.1429	.546	4.5000	3.9697	.022
PE07	4.0571	3.9286	.522	4.0667	3.9394	.524
PE08	4.1143	3.6786	.087	4.0000	3.8485	.554
PE09	4.3714	3.9643	.079	4.2333	4.1515	.726
PE10	3.8857	3.5357	.142	3.6333	3.8182	.439
PE11	3.9118	3.2857	.013	3.8276	3.4545	.142
PE12	4.2286	3.7857	.051	4.1667	3.9091	.259
PE13	3.6286	3.3214	.318	3.6333	3.3636	.379

T-test of significant differences in mean of performance-Medium Size firms

Supplier Relations

	FSR3			FSR4		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.7857	3.6061	.470	3.6857	3.6923	.979
PE02	4.3571	3.7714	.020	4.166726	3.8519	.219
PE03	3.8929	3.4286	.073	3.722236	3.5185	.438
PE04	4.0714	3.9429	.616	4.0278	3.9630	.801
PE05	4.2857	3.8000	.069	4.2500	3.7037	.041
PE06	4.4286	4.0571	.113	4.3333	4.0741	.274
PE07	4.2143	3.8286	.051	4.0556	3.9259	.520
PE08	4.2857	3.6286	.009	4.1944	3.5556	.011
PE09	4.3929	4.0286	.116	4.3889	3.9259	.046
PE10	3.8214	3.6571	.494	3.8611	3.5556	.203
PE11	3.9286	3.3824	.030	3.8000	3.4074	.125
PE12	4.3571	3.7714	.009	4.2778	3.7037	.011
PE13	3.5357	3.4571	.799	3.6667	3.2593	.186

T-test of significant differences in mean of performance-Medium Size firms

Environmental Awareness

	FEI1			FEI2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.9524	3.5500	.120	4.1538	3.3529	.001
PE02	4.0476	4.0238	.930	4.1538	3.9167	.361
PE03	3.6190	3.6429	.931	3.5769	3.6944	.660
PE04	4.1905	3.9048	.289	4.1538	3.8611	.259
PE05	4.2381	3.9048	.240	4.1154	3.9167	.469
PE06	4.2381	4.2143	.924	4.2692	4.1667	.670
PE07	4.0952	3.9524	.499	3.9615	4.0556	.643
PE08	4.0476	3.8571	.483	4.1923	3.6944	.053
PE09	4.0476	4.2619	.384	4.1538	4.1944	.865
PE10	3.8571	3.6667	.451	3.6538	3.8056	.535
PE11	3.7143	3.5854	.633	3.7692	3.5429	.387
PE12	4.3810	3.8571	.028	4.2308	3.8611	.110
PE13	3.7143	3.3810	.304	3.7692	3.3056	.138

T-test of significant differences in mean of performance-Medium Size firms

Environmental Awareness

FEI3

	High levels	Low levels	p-value
PE01	3.8205	3.4545	.154
PE02	4.1220	3.8636	.332
PE03	3.7073	3.5000	.447
PE04	4.0488	3.9091	.601
PE05	4.0732	3.9091	.560
PE06	4.2683	4.1364	.593
PE07	4.1220	3.7727	.092
PE08	4.0244	3.7273	.267
PE09	4.3415	3.9091	.073
PE10	3.7561	3.6818	.767
PE11	3.6000	3.6818	.760
PE12	4.1463	3.8182	.168
PE13	3.5122	3.4545	.858

Appendix F

T-test of significant differences in mean of performance-Large Size firms

Customer Relations

	FCR1			FCR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.9744	3.9474	.922	4.0952	3.6250	.100
PE02	4.4286	3.7895	.006	4.3778	3.8125	.023
PE03	4.0952	3.7368	.256	4.1778	3.4375	.023
PE04	4.1190	4.0000	.677	4.2000	3.7500	.131
PE05	4.2143	3.8947	.260	4.1778	3.9375	.422
PE06	4.5952	3.8947	.005	4.6000	3.7500	.001
PE07	4.3095	4.1053	.420	4.4667	3.6250	.001
PE08	4.1667	4.0000	.545	4.2222	3.8125	.155
PE09	4.1905	3.9474	.359	4.3111	3.5625	.006
PE10	4.0000	4.0000	1.000	4.2000	3.4375	.008
PE11	4.0732	3.6842	.184	4.0909	3.5625	.084
PE12	4.2619	3.8421	.146	4.3556	3.5000	.004
PE13	4.3333	3.9474	.158	4.2667	4.0625	.481

T-test of significant differences in mean of performance-Large Size firms

Customer Relations

	FCR3			FCR4		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.9583	4.0000	.903	4.1143	3.7391	.152
PE02	4.3529	3.6000	.011	4.3158	4.0870	.320
PE03	4.1176	3.3000	.036	3.9211	4.0870	.584
PE04	4.1176	3.9000	.542	3.9737	4.2609	.291
PE05	4.2157	3.6000	.080	4.1316	4.0870	.870
PE06	4.4706	3.9000	.071	4.5263	4.1304	.102
PE07	4.2941	4.0000	.353	4.2895	4.1739	.633
PE08	4.1569	3.9000	.455	4.1053	4.1304	.924
PE09	4.1765	3.8000	.255	4.1316	4.0870	.861
PE10	4.0588	3.7000	.303	4.1053	3.8261	.294
PE11	4.0000	3.7000	.413	3.9730	3.9130	.832
PE12	4.2353	3.6000	.077	4.1842	4.0435	.613
PE13	4.2745	3.9000	.275	4.2632	4.1304	.614

T-test of significant differences in mean of performance-Large Size firms

Customer Relations

FCR5

	High levels	Low levels	p-value
PE01	4.0000	3.8571	.636
PE02	4.2766	4.0714	.440
PE03	4.0426	3.7857	.461
PE04	4.1064	4.0000	.735
PE05	4.1915	3.8571	.285
PE06	4.4255	4.2143	.453
PE07	4.2340	4.2857	.853
PE08	4.1277	4.0714	.853
PE09	4.1064	4.1429	.901
PE10	4.2128	3.2857	.002
PE11	4.0000	3.7857	.508
PE12	4.2128	3.8571	.265
PE13	4.2766	4.0000	.361

T-test of significant differences in mean of performance-Large Size firms

Supplier Relations

	FSR1			FSR2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	4.0541	3.8095	.362	4.0513	3.7895	.340
PE02	4.3000	4.0952	.384	4.2683	4.1500	.620
PE03	4.1000	3.7619	.272	4.0488	3.8500	.524
PE04	4.1750	3.9048	.330	4.1220	4.0000	.665
PE05	4.2750	3.8095	.090	4.1463	4.0500	.732
PE06	4.5000	4.1429	.149	4.4146	4.3000	.650
PE07	4.4000	3.9524	.066	4.2927	4.1500	.568
PE08	4.1500	4.0476	.703	4.1951	3.9500	.366
PE09	4.2750	3.8095	.069	4.1463	4.0500	.713
PE10	4.1250	3.7619	.180	4.0244	3.9500	.788
PE11	4.1538	3.5714	.039	4.1951	3.4211	.007
PE12	4.2250	3.9524	.335	4.1220	4.1500	.922
PE13	4.3250	4.0000	.224	4.2683	4.1000	.536

T-test of significant differences in mean of performance-Large Size firms

Supplier Relations

	FSR3			FSR4		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	4.0513	3.7895	.340	3.9024	4.1176	.448
PE02	4.2683	4.1500	.620	4.1818	4.3529	.493
PE03	3.9756	4.0000	.938	3.9545	4.0588	.750
PE04	4.1220	4.0000	.665	4.0455	4.1765	.657
PE05	4.2195	3.9000	.253	4.0682	4.2353	.570
PE06	4.5366	4.0500	.051	4.4091	4.2941	.664
PE07	4.2439	4.2500	.981	4.2727	4.1765	.713
PE08	4.0976	4.1500	.847	4.0227	4.3529	.244
PE09	4.1220	4.1000	.933	4.1364	4.0588	.778
PE10	4.1220	3.7500	.175	3.9545	4.1176	.572
PE11	4.0976	3.6316	.110	4.0000	3.8235	.561
PE12	4.1951	4.0000	.496	4.1364	4.1176	.950
PE13	4.2195	4.2000	.943	4.1818	4.2941	.693

T-test of significant differences in mean of performance-Large Size firms

Environmental Awareness

	FEI1			FEI2		
	High levels	Low levels	p-value	High levels	Low levels	p-value
PE01	3.7000	4.1053	.133	3.8529	4.1250	.298
PE02	4.1429	4.2750	.575	4.3143	4.1154	.378
PE03	3.6667	4.1500	.114	3.9143	4.0769	.583
PE04	3.9048	4.1750	.330	4.0000	4.1923	.472
PE05	3.9524	4.2000	.371	4.0571	4.1923	.612
PE06	4.3810	4.3750	.981	4.4286	4.3077	.614
PE07	4.3333	4.2000	.589	4.2571	4.2308	.912
PE08	3.9048	4.2250	.231	4.0857	4.1538	.792
PE09	4.0000	4.1750	.499	4.1429	4.0769	.791
PE10	3.9048	4.0500	.594	4.0000	4.0000	1.000
PE11	4.0000	3.9231	.789	4.1143	3.7200	.153
PE12	3.9048	4.2500	.221	4.1429	4.1154	.920
PE13	4.2857	4.1750	.680	4.1714	4.2692	.705