

CHAPTER I

Introduction

Apparel markets are moving toward more fashionable items (Pashigian, 1988; Standard & Poor's, 1998) as economic trends are prosperous and consumers' demand diversifies. This change requires more product variety, generating demand uncertainty that is closely related to fashionability and seasonality of the apparel product. Uncertain demand leads to many managerial problems for the apparel company, such as production planning, forecasting, inventory management, production system, and timely distribution. To reduce the risk level due to demand uncertainty, the supply chain in the apparel industry, from raw materials to final customers, should undergo innovative and revolutionary changes that have successfully occurred in other industries.

Under the traditional supply chain approach, apparel companies at each node in the supply chain build inventories in the form of raw materials, Work-In-Process (WIP), and finished goods. Apparel manufacturers react very slowly to new demand trends because they build similar levels of inventory for volatile and non-volatile items and the manufacturing system does not keep pace with the movement of fastest selling items (Sabath, 1998). Supply chain management (SCM) aims to maximize the concurrent information flow throughout the chain and collaboration between partners through a true integration of the chain. With SCM, inventories can be reduced and responsiveness to the market increased while reducing operation cost, improving asset productivity, and compressing order cycle time for the whole supply chain (Palevich, 1997).

Many experts engaged in the apparel industry agree that successful SCM enables the apparel industry to reach Quick Response (QR) (Rabon, 1998). QR is a philosophy and a partnership strategy in which suppliers, manufacturers and distributors work together to respond more quickly to consumer needs by sharing information. Recently, many studies have proven that QR is beneficial to the apparel industry with basic goods (Askelson, 1995), and some studies also found QR used by fashion-oriented companies (Kincade & Cassill, 1993; Ko & Kincade, 1998). Deep markdowns and frequent

clearance sales advertisements are still experienced by retailers at the end of selling seasons, which seems rather contradictory to the expected outcome of QR adoption. The reasons for the market inefficiencies may not be failure of QR but changing markets and lack of QR implementation. With quickly changing market conditions, retailers face more problems in their inventory management, and they put more pressure on manufacturers (Abernathy, Dunlop, Hammond, & Weil, 1995). To be better responsive to market demand trends, retailers want to place small quantity orders more frequently for fashionable items. These items have volatile demand and are hard to forecast.

Recent emphasis on SCM and retailers' demands for improved inventory flow can be a burden to apparel manufacturers. The majority of apparel manufacturers are small companies that are unable to invest much capital in the systems technology that is now being demanded by the major retailers (Finnie, 1992; Jones, 1999; Standard & Poors, 1998). They have not adopted QR technologies to assist with SCM (Kincade & Cassill, 1993; Ko & Kincade, 1998). For manufacturers to satisfy their customers while using current facilities and capabilities, they will need to continue with the high level of inventory in some form. Manufacturers' strategy to build high levels of inventory reduces efficiency of SCM throughout the pipeline. For example, customers (i.e., retailers) are imposed with high costs that are tied with the inventory (i.e., storage, depreciation, material handling), which eventually result in end-use customers' (i.e., consumers) burden to buy a product at a higher price than necessary. Deep markdowns and clearance sales on overrun inventories might be associated with inefficiency in inventory management of the apparel industry, which results from the inflated regular prices of apparel products imposed on retailers. When manufacturers do not produce based on the actual demand closer to the selling season with the retailers' sales data and they do not respond to retailers' demand in a flexible and agile manner, misalignment between apparel retailers' demand and manufacturers' capability to supply will be found. This misalignment can also be described as an unbalanced level of SCM initiatives between chain participants.

Inventory management to manufacturer deals with all activities and plans to acquire raw materials to transform into a finished product delivered to a customer. Efficient inventory management is a result of successful SCM. Inventory can be defined as the stock of any item or resource used in an organization, and it can be raw materials, components, work-in-process (WIP), and finished goods (Schroeder, 1993, chap.16). For most companies, inventory investment composes over 20% of a company's assets (Lambert, Stock, & Ellram, 1998, chapter 5). A set of policies and controls that monitors and determines the level of inventory, replenishment time, and reorder decisions, is required for the inventory management. Mathematical models for inventory control have been developed to obtain operating rules, which use a cost minimization approach. The outputs of these models are reorder quantity and reorder time. Most models used in other manufacturing industries have not been appropriately used in the apparel industry because the inherent assumptions for the models do not reflect well the volatile and uncertain world of fashion products (Bhat, 1985). Available research on the apparel industry's inventory management is limited. Whether the apparel industry has benefited from existing inventory theories from other industries is questionable because demand forecasting tends to be dependent on the experts' intuition or own experience historically accumulated.

Problem Statement

Inventory performance is directly connected to the success of SCM. The level of inventory is reduced and inventory turns increase when supply chain is efficiently managed. Research to explain the inefficient inventory management seen in the apparel industry needs to start by examining apparel manufacturers' SCM initiatives. In addition, an adopter's characteristics is known to influence the performance of an organizational innovation (Subramanian & Nilakanta, 1996). For apparel manufacturers to be efficient participants in SCM, they need to adopt the innovativeness of SCM in systems, policies, devices, programs, products, or services. With the amount of inefficiencies continuing in the apparel pipeline, evidence implies that apparel manufacturing has not made changes in accordance with the principles of SCM. Therefore, apparel manufacturers'

characteristics need to be studied as an important factor to influence the SCM performance of a company.

A number of decisions are made as companies implement inventory management. Issue include decisions related to controlling inventory costs, determining order quantity and reorder point, and selecting techniques in forecasting or handling the inventory. Representative inventory costs include holding costs, setup costs, ordering costs, and shortage costs (Lambert, Stock, Ellram, 1998, Chapter 5). Within inventory management, these decisions affect inventory performance. This research will focus on inventory performance as measured by level of inventory within the type in relation with raw material purchasing, production, and shipment. Inventory levels within the type are closely connected to the volume and timing decisions of a company, which will be measured in this study. Measures on volume include (a) how much of finished goods are sold (i.e., shipped to customers), (b) how much of finished goods are produced, and (c) how much of raw materials are purchased consequently. Measures on timing include (a) how long it takes to ship products to retail customers, (b) how long it takes to initiate and complete the production, and (c) how long it takes to receive raw materials.

Purpose of the Study

This research will focus on the relationship between SCM initiatives (innovation), apparel manufacturers (adopter), and inventory management (performance). The purpose of this research is to examine apparel manufacturers' inventory performance in terms of the level within the type of inventory, which is one of the major indicators of SCM. The objectives of this research are (a) to identify the level of SCM activities of apparel manufacturers, (b) to examine the differences of apparel manufacturers' characteristics (i.e., product characteristic, production system, fabric suppliers, retail customers) according to the level of SCM activities, and (c) to illustrate how the SCM activities and apparel manufacturers' characteristics relate to the inventory management performance.

This study contributes to the apparel industry by providing empirical evidence to understand the apparel industry's current problem in inventory levels. Further, investigating apparel industry's unique characteristics, such as various product line characteristics, customary practices of production system, and the traditional culture in channel relationship between supplier, manufacturer, and retailer will imply potential impediments to efficient SCM in the apparel industry. In addition, findings of this research would extend theory that relates apparel industry and inventory management.

Conceptual Framework for Research

The framework for the research, shown in Figure 1-1, depicts the three main factors of organizational innovation research: innovation, adopter characteristics, and performance of the innovation.

This framework is based on Subramanian and Nilakanta's (1996) review on organizational innovation studies. Research related to organizational innovation used the company as the unit of analysis. According to the authors, this kind of research is interested in the organizational characteristics of innovative organizations, and the effect of the adoption of innovations on organizational performance, assuming that organizations alter characteristics to adapt to the changing environmental conditions, adopter organizations have identifiable organizational characteristics that distinguish them from non-adopters, and innovations enhance the organizational performance.

In this study, SCM is the innovation. Potential adopter characteristics affecting the effect of the SCM are apparel manufacturers' product characteristics, production system, and retail customers. Each apparel manufacturers' characteristic is assumed to be different according to their level of SCM activity implementation, and the varying levels of the implementation will result in different performances in inventory performance in terms of the level and the type of inventory.

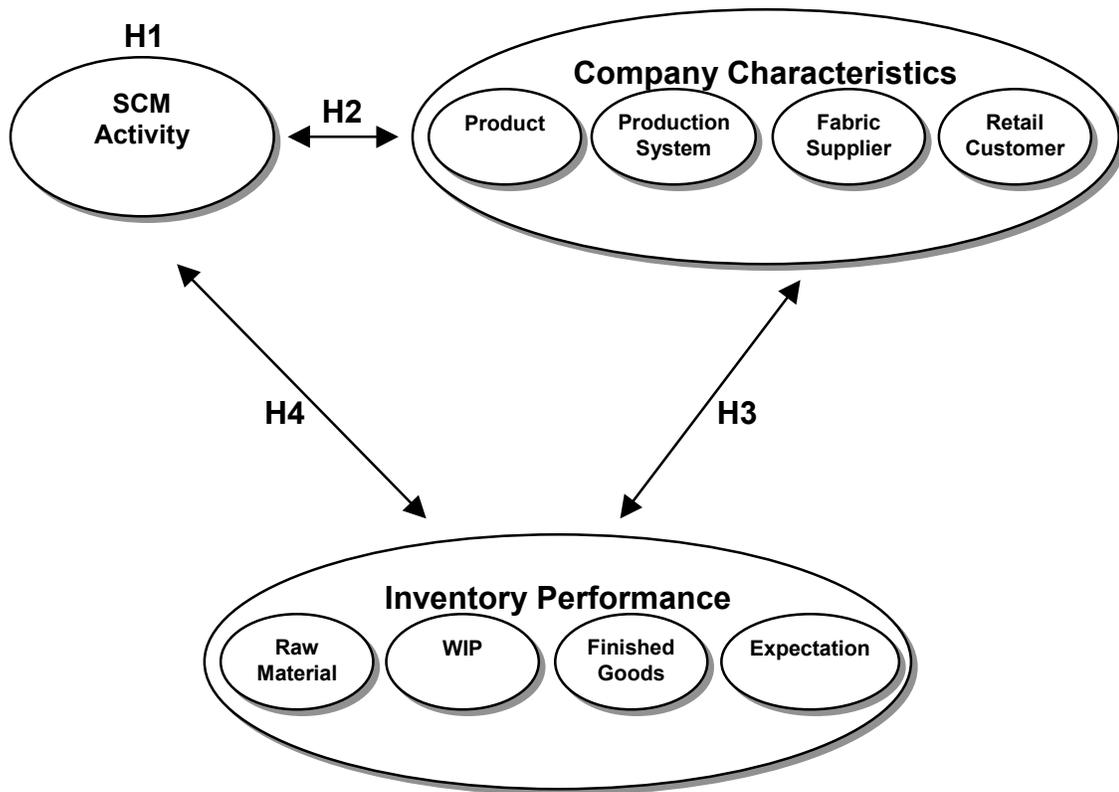


Figure I-1. Conceptual framework of the study

SCM Activities. SCM in this study is defined as the integrated network that encompasses suppliers at one end of the chain to final end-use consumers at the other end of the chain to provide higher value to consumers (Giunipero & Brand, 1996). This value is obtained by maximizing the concurrent information flow throughout the chain and collaboration between partners. The level of SCM implementation of apparel manufacturers will be evaluated by measuring the extent of SCM activities that are identified through extensive literature review and statistical analyses.

Product characteristics and demand uncertainty. One of the apparel manufacturer's characteristics explained in this study is product characteristics and related demand uncertainty. Many apparel companies, either manufacturer or retailer, deal with both fashion goods and basic goods to offer product variety to their customers (Standard & Poor's, 1998). In the old system, retailers ordered high volume in less variety of the products. Under QR, retailers claim to increase Stock-Keeping Units (SKUs) carried from manufacturers so that retailers can keep the total order quantity at the same level as in the old system (Iyer & Bergen, 1997). Although a manufacturing company handles only one product category, such as men's wear, they produce a variety of products within the category to meet the increased SKUs. Among SKUs, basic and fashion goods can be classified based on the volume of production, degree of style variation, and frequency of style changes (Lin, Kincade, & Warfield, 1995). Ko and Kincade (1998) used three characteristics to examine the relationship between product line characteristics and QR implementations for U.S. apparel manufacturers: product category (i.e., men's, women's, children's), fashion change (i.e., fashion, basic), and seasonal change (i.e., seasonal, staple). For example, men's wear products are considered to be a less fashionable item compared to women's and are usually considered to be more basic goods. Although the overall product classification is basic, some manufacturers of men's wear should have part of their product lines that are styled with the current trends and fashion in color and style choices for SKU level.

Managers make different decisions on volume and timing of raw material purchasing, production, and delivery based on product characteristics, such as the type of product (fashion goods or basic goods). Fashion goods are hard to forecast the demand, have high fashion level and seasonality, and have varied style change (Glock & Kunz, 1995). Basic goods are relatively easy to forecast the demand, have low fashion level and limited seasonality, and have a basic garment style that remains constant. Risk level involved with fashion goods is very high because of uncertain demand. Risk level associated with basic goods is low because of continuous and steady demand.

Production volume and a safety stock level for fashion goods are dependent on the early sales trend data because no previous sales data for a new style item is available. The decisions for basic goods can be derived from the historical data (Bhat, 1985). Decisions on how much to order initially for raw materials and how often to rebuy them would differ according to the product characteristics (Priyadarshi, 1996). Regarding the timing, manufacturers' decisions on the production of fashion goods should be timed to be as near to the selling season as possible. Decisions made closer to the selling season allow manufacturers and retailers to gather more market information, which reduces the uncertain factors in demand. However, this practice is rarely followed in the apparel industry.

To be more responsive to the market change, manufacturers need to reserve their production capacity for fashion goods until the selling season. Production of basic goods can be executed far in advance of the selling season because the production of basic goods is at a continuous and constant rate due to its stable demand pattern (Fisher, Hammond, Obermeyer, & Raman, 1997). These goods can be also continuously produced keeping a constant supply of inventory with automatic replacement programs.

The inventory level of raw materials for fashion goods might be higher in case they cannot procure the raw material after the item becomes popular. The lead-time for the procurement of raw materials is not easy to reduce. Fabric suppliers traditionally require long lead times and high volume orders because of their supplier restrictions and setup times. Apparel manufacturers have to have raw materials on hand at the receipt point in anticipation to meet the peak demand unless the source of raw materials ensures QR delivery (Fisher, Hammond, Obermeyer, & Raman, 1997). If they have the available production capacity, apparel manufacturers should not transform the raw material into finished goods because the holding cost of raw material is less than that of finished goods. In addition, if fashion goods are overstocked after the season, the depth of markdown becomes higher as time passes and is damaging to the company's financial situation. Finished basic goods may be resold in the same season next year at lower

markdown price or without markdown because of continuous style acceptance in basic goods.

Production system. Another characteristic of the apparel manufacturer in the conceptual framework is the production system. Apparel manufacturers are adopting several types of production systems and the product characteristic is highly related to the type of production system (Bailey, 1993; Lin, Kincade, Warfield, 1995). For example, basic goods can be manufactured in large quantities, with large cuttings, work bundles, and limited fabric, color, and trim variation. For basic goods, a traditional production system such as bundle system or progressive bundle system can be adopted because these systems focus on stability, inventory buffers, and economies of scale with few style changes. On the contrary, traditional production systems are not efficient for fashion goods, which involve great style variability with rapid changes and low production volume. The modular system or some type of flexible manufacturing can be adopted for the production of fashion goods (Bailey, 1993). Considering the required capital and training for production system changes, transition from the traditional production system to a flexible manufacturing system is limited for most apparel manufacturers (Jones, 1999; Kincade & Vass, 1998). Regardless of the type of current production system, when the manufacturer is dealing with both product categories (i.e., fashion goods and basic goods), inconsistency between production system and product characteristics can exist and cause inefficiencies. The existing production system may be one factor of inefficient inventory management in apparel manufacturing companies. Production system (i.e., bundle system, unit production system, modular system) also determines the production volume and timing. For example, the bundle system is suitable for high-volume and long-run production and modular system is for low-volume and short-run production. With the bundle system, the time of inventory such as WIP and finished goods staying in the plant is much longer than that with the modular system.

Suppliers. Apparel manufacturers purchase textile mill products (i.e., fabrics, yarns) or other accessories from upstream suppliers in the supply chain. These raw materials are necessary to build a complete garment. Many textile companies specialize

in specific types of products and have differing levels of technical sophistication, capital intensity, and vertical integration (Jarnow & Dickerson, 1997); however, most fabric suppliers are large companies and are equipment intensive.

In selecting suppliers, many criteria are used because suppliers can generate uncertainty in the supply chain. Suppliers with ability to reduce uncertainty in raw material supply can make improvements in the buyers' inventory performance (Davis, 1993). Suppliers' performance in delivery (i.e., speed, reliability, product availability), price, total cost, characteristics of relationship with buyers (i.e., trust, close relationship, dependence) have been a major concern in purchasing decision for the buyer because of the effect these variables can have on inventory performance (Doney & Cannon, 1997; Goffin, Szejczewski, & New, 1997). Therefore, with what kind of suppliers apparel manufacturers are working should be closely related to the manufacturers' inventory level.

Retail customers. The last characteristic of the apparel manufacturer is retail customers. Retailers can exert bargaining power on manufacturers in their business relationships by demanding higher quality products or more service. Retailers may also cause manufacturers to compete against each other (Porter, 1979). In the apparel industry, retailers have traditionally been considered to have more power over manufacturers because they can influence consumers' purchasing decisions and easily find substitute suppliers (JuHone & Morganosky, 1995). Iyer and Bergen's (1997) mathematical models demonstrated that without retailers' commitment to acceptable service levels and required volumes for production, apparel manufacturers may not be better off than they were under the old system even if they adopt QR.

The magnitude of a retailer's power over manufacturers will vary according to retailer characteristics. Park (1996) found that retailers' organizational characteristics were important determinants in buyers' selection of promotional services from manufacturing. Are manufacturers consolidated with retailers? Are retailers willing to participate in SCM? Are retailers enough big to have power to control manufacturers in

managerial decisions? What kind of relationship do retailers have with manufacturers, adversarial or collaborative? Answering these questions would help identify the relationship of manufacturers with retailers. Characteristics of relationship with retailers may affect the manufacturers' willingness to change the way apparel they manage inventory. Because the demand for a certain product is uncertain, manufacturers need to forecast jointly with retailers. Customers such as retailers obtain real sales data and build a customer base. Their cooperation with manufacturers in sharing information of end-customers' demand characteristics would reduce the error in manufacturers' determining the volume of raw material and production.

The level of inventory within the type. The level of inventory can be measured by use of performance metrics such as inventory turnover ratio, ratio of aggregate inventory value to annual sales, and aggregate inventory value (Tersin, 1991). To measure the level of raw material inventory, weeks of supply can be used. The type of inventory that a manufacturer can hold is determined by the time differences between raw material acquisition point and production point (i.e., raw material), production initiation point and production completion point (i.e., WIP), and production completion point and product shipment point (i.e., finished goods) (Tersine, 1991). In this study, weeks of supply (WOS), working batch size, excess/surplus inventory, and inventory turnover ratio will be used to evaluate the raw material, WIP, and finished goods inventory performance of apparel manufacturers. Weeks of supply (WOS) is the number of weeks a company takes to exhaust the raw material inventory on hand. Working batch size is determined by the number of pieces that is handed out from one operation to another during production. Excess and surplus inventory is the leftover products after selling season because the demand for which is no longer occurring. Inventory turnover ratio refers to the velocity with which materials move through a company. A higher WOS, a larger batch size, a higher excess/surplus inventory, and a lower inventory turnover refer to a higher level of inventory in the company. Besides, on-time delivery rate, order lead-time for raw materials, shop lead-time, and order lead-time to retailer will be measured to examine the time factor in inventory performance.

Research Questions

Based on the concerns for the level and type of inventory and the objectives of the study, the following questions are presented:

- 1) Do apparel manufacturers show different levels of SCM activities?
- 2) Are apparel manufacturers' different levels of SCM activities correlated with company characteristics in terms of product characteristics (i.e., fashion goods, basic goods), production system (i.e., bundle system, progressive bundle system, unit production system, modular system), fabric suppliers (i.e., total cost, delivery performance, nature of the relationship), and retail customers (i.e., cost-orientation, size, nature of the relationship, type)?
- 3) How do apparel manufacturers' characteristics (i.e., product characteristics, production system, fabric suppliers, retail customers) relate to inventory level within the type?
- 4) How do the levels of manufacturer's SCM activities relate to inventory performance of apparel manufacturers in terms of inventory level within the type?