

An Intelligent Supply Chain Management System to Enhance Collaboration in Textile Industry

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Abstract

The recent challenge in textile supply chain management is the development of collaboration network which accommodates diverse concerns of various participants while explicitly recognizing interdependencies and promoting effective relationship management. This study is designed to suggest a collaboration network model for textile industry and apply it to establish a desirable framework for the textile supply chain management. The collaboration network model, proposed in this study, is designed to facilitate positive collaboration from the supply chain of the textile industry. Utilizing the collaboration model, an intelligent textile supply chain management system is designed to improve customer services and delivery time, and to promote information sharing, and shorten product life cycle time. The primary goal of an intelligent textile supply chain management system is to promote corporate innovation and information sharing, and generate infrastructure which reduces the gap of the competitiveness across the textile supply chain and enhance the collaboration, which in turn improve the competitiveness of the textile industry as a whole.

Keywords: *supply chain, collaboration network, textile supply chain management*

1. Introduction

To search for the better answer of satisfying customer demands in the face of fierce global competition, companies have experienced dramatic changes in the way they operate. For more than a decade, companies have reengineered and restructured in an effort to improve efficiency and meet customer expectations. The goal is to develop value-added processes that deliver innovative, high-quality, low-cost products on time with shorter development cycles and greater responsiveness. In a global supply chain of textile industry, the main objective is to supply a quality product to customers at an affordable cost and to increase the profit margin for investors and shareholders. The product cost has mainly three components: (1) procurement of raw materials like yarn, fabric and supplies; (2) the production or the fabrication process; and (3) shipping to customers. Additionally, government stability, reliability, terrorism, sensitivity to commitment, and time of delivery are other factors.

United States and Europe are large markets for textile and government exports. The United States of America is the largest economy of the world and its people have the highest level of living standard. American people like to dress well and the USA is a very large market for businessmen dealing in textiles and garments. The designer firms like to make maximum use of global supply chain and utilize "low-cost countries" (LCC) as global source countries. The textile industry is composed of a) yarn b) fabrics and c) made-up articles. When world economy was booming between 2002 and 2006, goods and services worth 2 trillion dollars

crossed international border every single day. The world textile export grew during the same time at an average annual rate of 7.1 percent and exports from the emerging economies as a share of world export increased from 52.1% in 2002 to 57.4% in 2006. LCC's played an important role as sources of supply of yarn, fabrics, and made-up articles. However, LLC's increased then export in made up articles since 2002.

Recently, the Korean textile industry has experienced a rapid down of competitive edge in global market. The Korean textile companies, mainly small-medium sized, have focused on exporting fabric cloths based on mass production. The industry structure of heavy dependence on small-medium sized companies causes a lot of problems regarding its competitiveness because an obstacle for restructuring and the mass production of simple fabrics oriented products prevented the industry from differentiating products and introducing high value-added products. Furthermore, China and South-east Asian countries which benefited from low wages made inroads into existing overseas markets.

In an effort to overcome this kind of problems, various attempts such as the development of new products and production techniques, shifting to industrial materials, restructuring of the industry, and enhancing the overseas marketing campaigns have been launched. However, the significant outcome has not yet been realized except in some large-size companies. This was due to the fact that the small-medium sized companies had to deal with lack of financial resources and enterprise capabilities. With the rapid expansion of internet and more advanced information technologies has come up as a candidate to solve the down-sloping of competitive edge of the Korean textile industry, especially, the supply chain management (SCM) of the textile industry which constitutes very complex supply-demand structure and value chain.

The supply chain management has been accepted as an alternative to improve the competitive power. SCM became a general and strategic concept of dealing with efficient logistics and network collaboration within a same value chain. Attempts to apply Quick Response system to some Korean textile companies has not resulted in favorable outcome. Rather, misunderstanding of Quick Response as the introduction of new information technology, short delivery time improvement, and small-lot production has emerged with unexpected failures. The emphasis was given to increase productivity and improve efficiency level of logistics without concentrating on the entire supply chain and the collaboration of business partners. Research findings confirm that SCM has contributed to reduction of inventory and purchasing cost, shortening the business process, lead-time and sales promotion planning time, and enhancing delivery time, increasing sales revenue and decreasing defective rates.

This study is designed to explore a collaborative network model and an intelligent framework to effectively manage the textile supply chains which can be viewed as an innovative alternative to improve competitive power of the Korean textile industry. Developing an efficient supply chain does not only help companies reduce costs but also deliver better services to the customers while maintaining the quality of the products with the global standard. In order to fulfill research objective, a collaborative network model is suggested with the identification of critical success factors of textile supply chains and then an intelligent framework for textile supply chain management systems is proposed so that the Korean textile companies can find a solution to manage their structural drawbacks and effectively deal with strategic decisions to add values in their supply chains.

2. Literature Review

2.1 Supply Chain Management of Textile Industry

Supply chain management (SCM) is an approach that has evolved out of the integration of these considerations. SCM is defined as the integration of key business processes from end user through original suppliers that provide products, services, and information and hence add value for customers and other stakeholders (Lambert et al., 1998). The concepts of supply chain design and management have become a popular business paradigm in these days. This has intensified with the development of information and communication technologies that include electronic data interchange (EDI), the Internet and World Wide Web (WWW) to overcome the ever-increasing complexity of the systems driving buyer-supplier relationships. The complexity of SCM has also forced companies to improve online network communication systems.

Supply chain management emphasizes the overall and long-term benefit of all parties on the chain through co-operation and information sharing. This signifies the importance of communication and the application of IT in SCM. Information sharing between members of a supply chain using EDI technology should be increased to reduce uncertainty and enhance shipment performance of suppliers and greatly improve the performance of the supply chain system (Srinivasan et al., 1994).

Companies need a large investment for redesigning internal organizational and technical processes, changing traditional and fundamental product distribution channels and customer service procedure and training staff to achieve IT-enabled supply chain (Motwani et al., 2000). The followings are some of the problems often cited in the literature both by the researchers and practitioners when developing an IT-integrated SCM: lack of integration between IT and business model, lack of proper strategic planning, poor IT infrastructure, insufficient application of IT in virtual enterprise, and inadequate implementation knowledge of IT in SCM. There is no comprehensive framework available on the application of IT for achieving and effective SCM. Considering the importance of such a framework, an attempt has been made in this paper to develop such a framework to provide more effective management of whole supply chain.

In a supply chain world, suppliers, finished goods producers, service providers, and retailers are required to create and deliver the best products and services possible. Collaboration enables a company to do exceptionally well a few things for which it has unique advantages. Other activities are shifted to channel members that possess superior capabilities.

However, there are several underlying themes. Outstanding supply chain companies stay customer-centric, focus on process management, invest in IT as a capability enabler, and are obsessed with performance measurement. Supply chain management is the collaborative design and management of seamless value-added processes to meet the real needs of the end customer. The development and integration of people and technological resources as well as the coordinated management of materials, information and financial flows are critical to successful supply chain integration. The primary of SCM is to establish unique value-added processes that satisfy customers better and more efficiently than the competition. Managing outstanding processes across functional and organizational boundaries require dramatic and often painful changes in both thinking and behavior.

The supply chain of the textile industry consists of the distribution structure which includes manufacturer, wholesaler, retailer, and consumer of raw silk, yarn, fabrics, dyeing, and apparel. The textile industry has a very complex value chain structure and requires a complex

processes to supply products to consumers. Even though the structure of supply chain is very complicated, the links of the supply chain is independently separated and the communication among the companies is carried out as needed without any particular methods.

Looking into the level of information systems based on the streams, most companies are very weak in sharing information and information technology capabilities. In terms of the IT infrastructure, broadband internet, point of sale (POS) and EDI (electronic data interchange) are common while ERP, SCM, CRM, and KM have been emerged as core parts of more advanced IT systems.

It was found that the textile companies are not actively utilizing the information sharing and therefore management of the generation, storage and distribution of information, is not systematically done. Furthermore, due to the short life cycle of the textile products, it is very difficult to standardize the products except some categories such as raw materials, yarn, gray fabrics, and the level of innovation is also extremely low.

2.2 Critical Success Factors of Textile SCM

Unlike the traditional approaches, SCM requires not only a practical change in the organization level but also a substantial change in the attitude and the corporate culture. The overall process of SCM comprises many critical factors for its successful operation. Various researches have been conducted to identify the characteristics of the critical success factors of SCM.

The widespread availability of highly advanced information and communication technologies provides companies with opportunity for a redesign of supply chains. Christiaanse and Kumar(2000) proposed general guidelines for ICT enabled redesign of supply chains focusing on the governance structure, supply chain participants, sequence of activities in the supply chain, and the coordination structures.

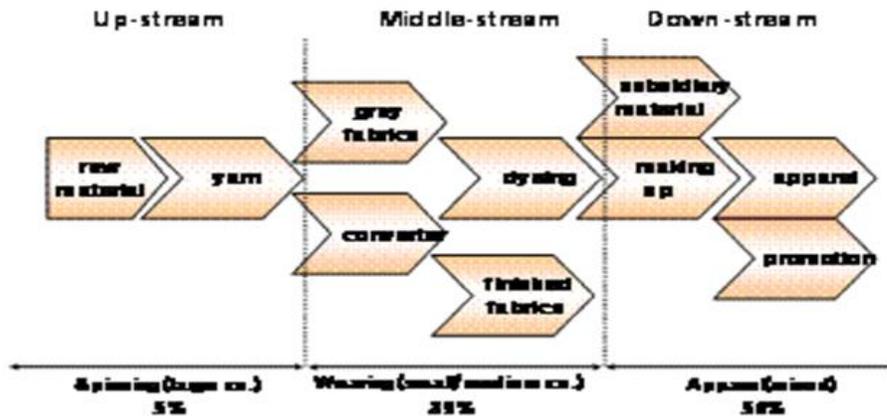


Figure 1. Supply Chain of Textile Industry

Kim (2000) suggested that CEO's recognition and support, level of information sharing, information technology, level of communication, trust level of integration and strategy of supply chain, cooperation and collaboration, value-added products/services, and organizational bottleneck are critical.

With regard to the relationship between customer and supplier, Sarkis and Sundararaj(2002) focused on two dimensions such as organizational structure and electronic commerce environment, which will influence the formation process for the collaborative

relationship. According to Park (2002), CSFs of SCM can be classified into 4 categories such as environmental factors, organizational, information systems, and partnership factors. The environmental factor includes the effort for the expansion of SCM and change in recognition of SCM while organizational factor consists of CEO's recognition and support, change in employee's attitude for SCM and education. The information system factor includes the level of development of the internal information systems and standardization while the partnership factor identifies that among supply chain members as critical. People and business processes are also needed to undertake significant change in adaptation of IT. Kurupparachchi et al (2002) mentioned that the changes are often drastic and sometimes cause intra-organizational conflicts. Integration of the supply chains activities and business processes before implementation of IT in SCM is needed.

Lee and Keencade (2003) identified six dimensions of SCM processes such as partnership, information technology, management flexibility, performance measurement, management practice, understanding characteristics of demands, Lee et al.(2002) evaluated SCM activities based on there categories of management factor, information technology factor, and relationship factor.

Ross (2001) emphasized the importance of vision and objectives of supply chain and also pointed out building collaborative partnership, maximizing the capacity through interactions among partners, and utilizing the information technology to achieve successful SCM. Hong et al. (2004) suggested four categories to measure the performance of SCM in fashion apparel industry. These include organizational factor, management factor, information technology factor, and relationship factor. In this study, critical success factors of textile SCM are identified as shown in table1. The factors are classified into four categories such as environmental, management, information technology, and collaborative relationship factor.

2.3 Network Collaboration

A firm's position in the network is dependent upon the nature of the direct and indirect relationships it has with other actors in the network (Johanson & Mattsson, 1992). As firms are as much the product of their relationships and network position as they are the result of the firm's own strategic actions and intentions (Hakansson & Ford, 2002), attention is gradually shifting from the control of business networks to one of greater participation and adaptation in which the participating firms must be more flexible and adaptable (Wilkinson & Young, 2002).

As a network is a set of connected relationships between firms (Hakansson & Johanson, 1993), effects will flow through the various relationships that the focal firm has established with other connected actors. Connectedness is the extent to which exchange in one relation is contingent upon exchange in another (Cook & Emerson, 1978). Moreover, two connected relationships can be directly or indirectly connected to many other relationships that may have some bearing on each firm as part of a larger business network (Anderson, Hakansson, & Johanson. 1994). Thus, collaboration within one relationship will affect relationships with other closely connected actors, making the collaboration process and its outcomes contingent upon the goals of the network rather than the dyad.

Hakansson and Ford (2002) describe how firms embedded in business networks are interdependent on other firms in the network. This interdependence implies that firms have limited discretion to act or to build independent strategy (Gadde et al., 2003). As a result, the outcomes of the firm's actions are strongly influenced by the attitudes and actions of those firms with whom the focal firm has relationships.

Table 1. Critical Success Factors of Textile SCM

Critical Success Factors	Characteristics	Remarks
Environmental Factor	Education level for SCM Continuous investment CEO's recognition and support Enhancing production and distribution system Empowerment level	Halldorsson, et al (2007) Kim (2000) Park (2002) Hong (2004)
Management Factor	Integrated inventory and cost control Integrated quality control Exploration of new approach for integration of SCM activities Purchasing of raw materials based on demands Production cycle and capacity based on demands Small lot production, order and distribution	Movahedi (2009) Park (2002) Lee and Keencade (2003) Lambert (2000)
Information Technology Support	Building efficient logistics networks Material requirement planning and JIT system Standardized bar code system Technology for rapid response to customer requests Knowledge management systems Group decision support systems	Lee and Keencade (2003) Hong (2004) Park (2002) Lavassani, et al (2009)
Collaborative Relationship	Efficient and frequent interaction among members in supply chain Listening to customers for their strategic requests Information sharing for production, sales, demands forecasts Collaborative planning Sharing the business strategy Sharing the technology	Ross (2001) Hong (2004) Halldorsson (2007) VICS (2010) Gadde (2003)

But who are the relevant others and how can they be determined? Network structure and network position affect how network collaboration will occur and between which network actors' collaboration will take place. Developing an understanding of network structure will enable firms to consider with whom they may be directly or indirectly affected and affected by. However, a business network does not have a natural centre or clean borders making network structure a fluid concept that invariably changes over time (Hakansson & Snehota, 1995).

2.4 Collaboration in Network Organizations

Networks organizations can be described by the density, multiplexity, and reciprocity of ties, and a shared value system that defines membership roles and responsibilities (Achrol, 1997). If the overall collaborative efforts of the network are well directed, the network may become more of a network organization than a network of linkages. Examples can be derived from technology networks where R+D organizations, products, and distributors closely coordinate their activities to provide new products to the market in a timely manner.

Networks have both economic and social dimensions that are important for the optimal operation of the network. This implies that many aspects of business relationships cannot be formalized or based on legal criteria (contracts) (Gadde et al., 2003). Collaboration involves both aligning the economic goals and aims of the network and the development of the social dimensions - in particular, mutual trust and commitment.

Trust is the critical determinant of a good relationship (Dwyer, Schurr, & Oh, 1987). Anderson and Narus (1990) view trust as the belief that the partner will perform actions that will result in positive outcomes for the firm and not to take unexpected actions that may result in negative outcomes. Moorman, Deshpande, and Zaltman (1993) define trust as the willingness to rely upon an exchange partner in whom one has confidence. They describe trust as a belief, a sentiment, or an expectation about an exchange partner that results from the partner's expertise, reliability, and intentionality.

Power is an essential characteristic of social organization and an inevitable instrument for inter-organizational coordination. While the power to coordinate is the prerogative of the dominant firm, the use of reward power, coercive power, and legitimate authority is seldom conducive to the evolution of network organizations (Achrol, 1997). Furthermore, the more a single firm seeks to control the network, the less effective and innovative the network will become (Hakansson & Ford, 2002). Where development processes are directed by just one firm, there is a greater risk that the network will become a hierarchy with the reduced potential for innovation (Gadde et al., 2003).

Communication has been described as the glue that holds together a channel of distribution (Mohr & Nevin, 1990). Communication enables information to be exchanged that may reduce certain types of risk perceived by either one of the parties to the transaction (McQuiston, 1989). Any uncertainty about a customer's or supplier's organizational structure, viability, methods of operation, technical expertise, or competence can be resolved by communication between the parties. Communication not only improves a firm's credibility but may also provide a convenient and simple means of gaining knowledge about the market (Cunningham & Tumbull, 1982).

Communication may also facilitate other elements of the interaction, such as adaptations by suppliers and customers to the design or application of a product, or the modification of production, distribution, and administrative systems by either party. While effective communication may enable the firm to differentiate its product from the competitor's offerings (McQuiston, 1989), meaningful communication and cooperation between firms is a necessary antecedent of trust (Anderson & Narus, 1990).

In an increasingly dynamic and turbulent market environment, a firm's ability to develop and successfully manage its relationships with other firms is emerging as a key competence and source of sustainable competitive advantage. Ritter, Wilkinson, and Johnston recognize that firms are embedded in a network of ongoing business and nonbusiness relationships that both enable and constrain the firm's performance. While many business managers may perceive that they are in total control of these relationships, most inevitably discover that they themselves are subject to the control and influence of others.

In textile supply chains, the cycle of materials flow from supplies until it reaches the customer and takes place among separate and very often independent organizations. This may result in serious inefficiencies. In order to develop efficient supply chains, all participating supply chain partners need to develop mutual agreements on their goals and objectives. They need to establish mutual agreements on their goals and objectives. They need to establish mutual understanding of their mission, strategy, and policies. Also members of the chain need to trust each other and share information it would further enhance their productivity if they develop compatible organizational culture. In Korean textile industry it is quite complicated because there are many diverse groups involved dealing with imports and exports.

2.5 Collaborative Supply Chain

Supply chain collaboration is often defined as two or more companies working together to create a competitive advantage and higher profits that cannot be achieved by acting alone (Simatupang and Sridharan 2005). The close cooperation among partners engaged in joint efforts to effectively meet and customer demands with lower costs is the major concern. The advent of supply chain collaboration creates the need, at the inter-organization level, to pay special attention to the understanding of collaboration in order to prepare the partners to create collaborative efforts successfully (Lambert et al. 2004).

Figure 2 shows a simple structure of collaborative SC with two players that serve the same consumer. The consumer can be included in the collaborative system if he takes a greater participatory role in the making and delivering of a product. The following properties are inherent in a SC: the retailer has decision rights (e.g. end customer demand) and internal costs and revenue. The supplier also has its own decision rights (e.g. delivery and production setting), private information (e.g. product characteristics) and internal costs and revenue.

Dilemma of supply chain collaboration

When partners involve in collaboration, there is a dilemma between accommodating decisions that take into account the interest of the supply chain as a whole and preserving decisions in the interest of an individual enterprises. A conflict resolution diagram can be employed to capture and describe the dilemma of supply chain collaboration between taking decisions based on link-centric-measures and taking decisions based on supply chain-wide measures. As shown in figure 2, Goldratt (1944) and Dettmer (1998) explain that the diagram dilemma can be read: ‘taking decisions in the interest of the supply chain (P1) is in direct conflict with taking decisions in the interests of individual company (P2)’. Frequently, individual enterprises tend to make decisions in the interests of their individual enterprises rather than considering the holistic supply chain.

The first key assumption is that the partners often think that supply chain collaboration means a decrease in bargaining power to minimize costs. They presume that minimizing costs of each partner of the supply chain will improve the performance of the whole supply chain. Often, each individual company focuses its decisions to maximize myopic revenue (i.e. sales from immediate downstream partners) and minimize myopic costs (i.e. buying from immediate upstream partners) rather than to maximize the overall market expansion of the entire SC. See Goldratt (1944) and Dettmer (1998) for further explanation on the conflict resolution diagram.

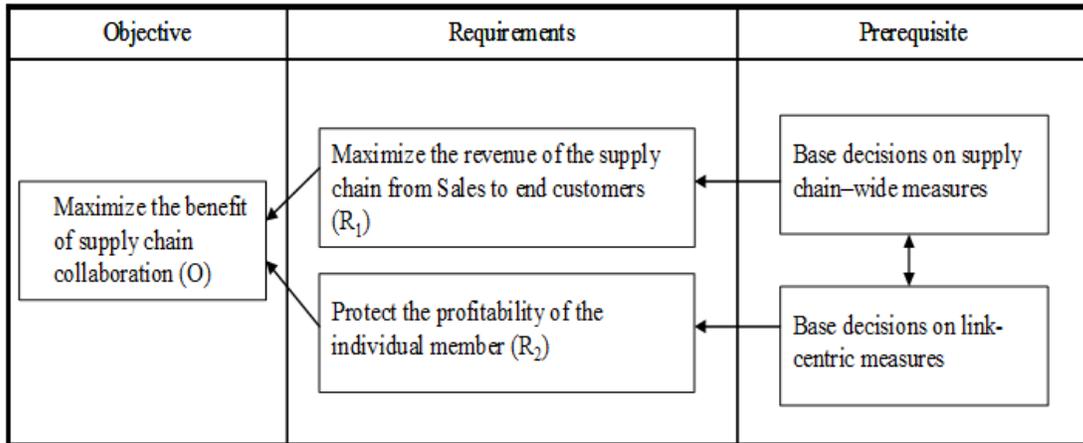


Figure 2. A Dilemma of Supply Chain Collaboration (Goldratt, 1994)

In order to minimize the effect of the dilemma of SC collaboration, a more consistent definition of this concept must be developed, defining the various attributes and their interaction. In 2004, Simatupang and Sridharan proposed such a definition and characterized supply chain collaboration using five elements, as shown in figure 3, which include appropriate performance system, information sharing, decision synchronization, incentive alignment and streamlined inter-enterprises business processes.

Collaborative strategies

Different collaborative strategies such as QR, ECR, VMI, or CPFR have been proposed. While the primary concept and philosophy are seemed to be common, the difference between these strategies is not always obvious, this section will provide a brief description of these strategies.

1) Quick response (QR)

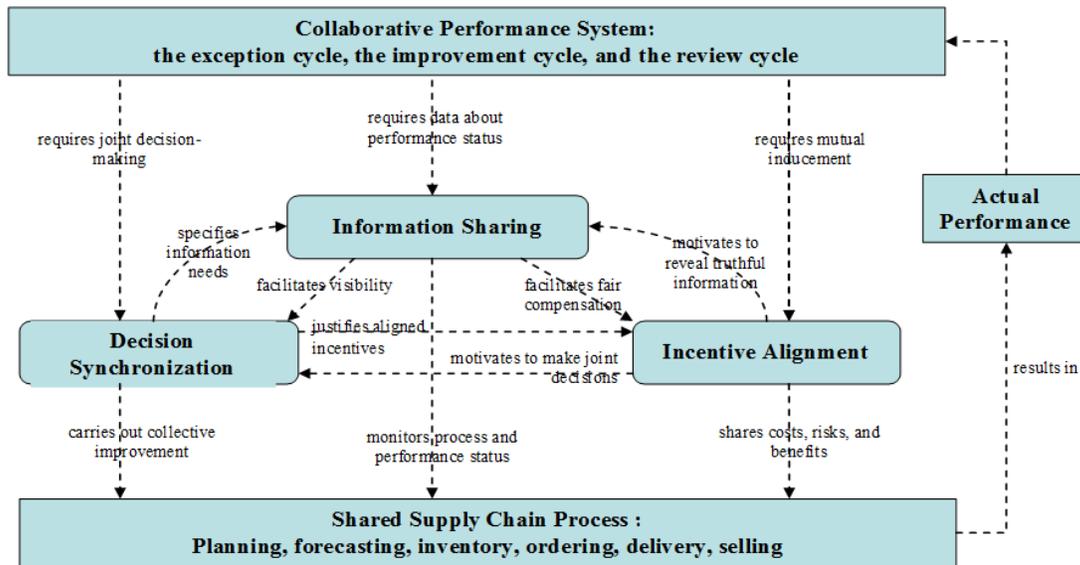


Figure 3. An Empirical Study of SC Collaboration (Simatupang and Sridharan, 2004)

Owing to the intense competition in the textile industry, leaders in the US apparel industry formed the ‘Crafted With Pride in the USA Council’ in 1984 (Alberto and Zamolo 2005). A SC analysis was conducted under this Council and the results showed that the delivery time for the apparel SC was 66 weeks from raw materials to consumer and 40 weeks of which were spent in warehouse or in transit. In order to reduce the lead-time and inventory cost, a (QR) strategy was developed to address this issue (Troyer and Denny 1992). A QR is a strategy where the retailers and the suppliers work together to serve consumer needs quickly by information sharing (Troyer and Denny 1992). Under this strategy, suppliers receive point of sale data from retailers and use this information to synchronize their production and inventory control with actual sales. The retailer makes decisions to generate orders. Using point of sale data, the supplier makes decisions to improve demand forecasting and production scheduling (Schonberger 1996).

Efficient consumer response (ECR)

Similar to the textile industry, a group of grocery industry leaders created a joint industry task force called the efficient consumer response (ECR) working group in

1992 (Kurt et al. 1998). ECR strategy aimed at making the SC more competitive and bringing greater value to the consumer. Manufacturers, wholesalers and retailers work together as business allies to reduce total system costs, inventories and physical assets while

improving the consumers' choice of high-quality, fresh products. From ECR, the concept of CRP is developed (Alberto and Zamolo 2005).

Continuous replenishment policy (CRP)

CRP strategy reorganizes the traditional system of ordering and replenishment characterized by the transfer of purchase orders from the distributor to the supplier. CRP is a process of restocking where the producer sends to the distribution centre full loads whose composition varies according to sales and in conformity with a prearranged level of stock. In an advanced form of CRP, suppliers may gradually decrease inventory levels at the retail store or distribution centre while the service levels are satisfied.

Vendor managed inventory (VMI)

It represents the highest level of partnership where the vendor is the primary decision-maker in order placement and inventory control (Alberto and Zamolo 2005). Under a VMI system, the supplier decides on the appropriate inventory levels of each of the products (within previously agreed upon bounds) and the appropriate inventory policies to maintain these levels (Simchi-Livi et al. 2000).

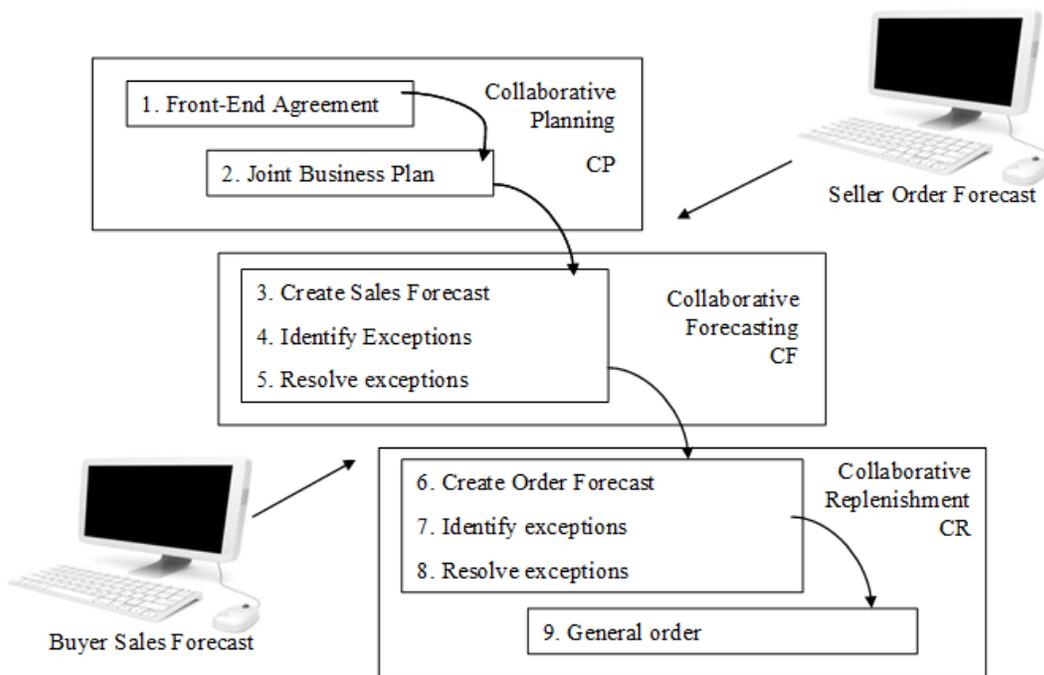


Figure 4. The Nine Steps of CPFR Process (Hammond and Larry, 2001)

Collaborative planning, forecasting and replenishment (CPFR)

CPFR, introduced by the voluntary inter-industry commerce standards (VICS) association, began first with a pilot program between Wal-Mart and Warner-Lambert, called CFAR (collaborative forecasting and replenishment). CPFR is a set of business processes that are established and empowered by a formal agreement to cooperate on strategy, tactics and execution by resolution of exceptions. Figure 4 depicts nine steps of CPFR process.

However, the basics of CPFR are straightforward: first, the partners share information about demand. If the buyer is a manufacturer or assembler then demand is generated by the manufacturer or assembler's trial master-production schedule. Then, significant differences between the buyer's and seller's demand forecast, labeled 'exceptions', are discussed and resolved. These are steps 3-5 above. Then, buyer and supplier share plans for orders that the buyer will place with the supplier, based on the shared demand forecasts. Again, exceptions are identified and resolved (steps 6-8). Subsequently, using the shared order plan, actual orders are generated (step 9). The foundation for steps 3-9 is the so-called 'front-end agreement', under which the roles of the buyer and supplier and their capabilities to perform these roles are assessed. In this step, targeted performance and measures are also adopted. In step 2, strategies and tactics are specified in detail.

3. Design of Collaborative Textile Supply Chain Management System

3.1 Collaborative Network Model

The collaborative network model is the communications and operations framework of a textile supply chain, shown in Figure 5, that links textile suppliers, business partners and customers together as one cohesive, collaborating entity. A collaboration network is a series of value added-processes/stages owned by one or more enterprises, starting with material/information suppliers and ending with consumers (Papazoglou et al., 2000; Gek Woo et al., 2000). Each intermediate stage is a supplier to its adjacent downstream stage and a customer to its upstream stage. That means that participants may assume many different roles in a supply chain network, but all relationships come down to a supplier and a customer role. The collaborative network model efficiently utilizes information and knowledge, competes on agility and speed, and views collaboration as a competitive strategic weapon. A supply chain must coordinate with each other in order to optimize the process within a supply chain (Cooper et al., 1997). Collaboration between suppliers, manufacturers and retailers can improve the number of satisfied customers by reducing lead times, improving service levels and decreasing costs.

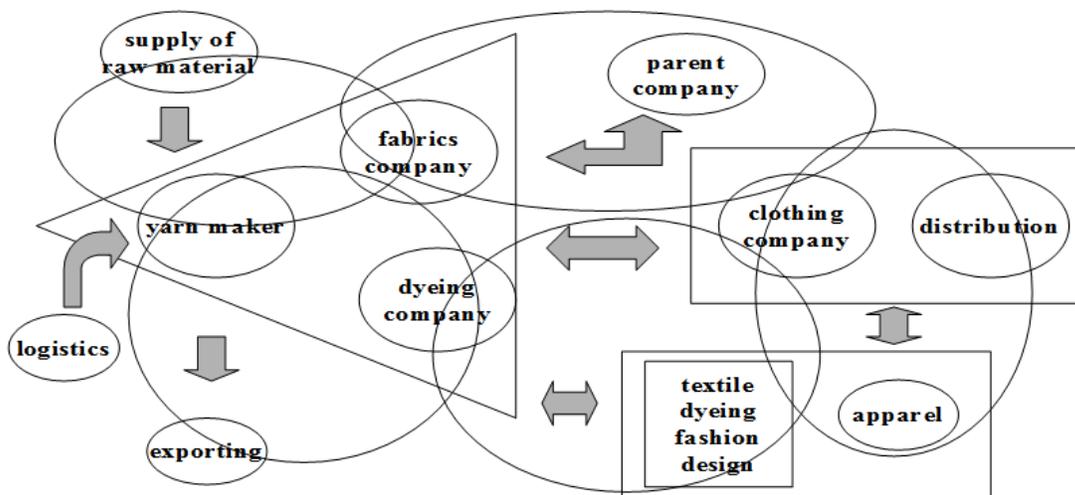


Figure 5. Collaborative Network Model

The collaborative network model is developed in order to integrate the technical and organizational infrastructure, to facilitate business communication between the participant members, to identify and synchronize the specific roles and responsibilities of the partners, to organize the relationship interface between the partners, and to enable intelligent decisions based on knowledge acquisition. The model provides a useful framework for the planning, implementation and evaluation of supply chain collaboration in practice. The primary objectives of the model are as follows: First, it is developed to coordinate the activities of each partner and the transition between partner exchanges. Second, it is designed to facilitate the efficient flow of products, services down the supply chain minimizing the cost and the time while maximizing the quality, service and credibility. Third, it seeks to match the supply with the market demand, based on partners' relationship management and knowledge. Finally, the use of collaborative network model is expected to provide a mechanism for companies to control and coordinate on transaction costs as it improves information flows and helps reduce uncertainty.

3.2 A Framework for Intelligent Textile Supply Chain Management System

An intelligent textile supply chain management system enables members of the textile supply chain to be equipped with the collaborative management and monitoring of disparate companies-members of the supply chain. It captures the required information and sets the procedures and accountability, performance measurement criteria, and capabilities to resolve exceptional cases. This provides companies with flexibility and control for effective business models, and generates a mechanism to analyze and understand the impact of collaborative business processes on its own operations (Mamoukaris, et al., 2000). Business partners in a collaboration networks make cooperative efforts in the forecasting, purchasing, production and inventory management and synchronize delivery and distribution schedules. An intelligent textile supply chain management system standardizes best practices through out supply chain, using appropriate technology to reinforce relationships between business partners.

An intelligent textile supply chain management system captures and stores partners' transactions and supply chain activities through various touch points, and data from transactional systems and external sources. A centralized partner data warehouse with a reliable, scalable and highly available storage infrastructure solves the problem of data integration of diverse data assets. Figure 6 depicts the basic components and architecture of an intelligent textile supply chain management system.

The output of the intelligence module should be delivered as an extensible application that uses a set of partners' profile and profitability models and reports. Partners' analysis results should integrate with supply chain management decisions in order to transform partners' information into building better relationships. A data mart, in the context of a PRM system, is a decision support system incorporating a subset of the partners' data focused on specific supply chain applications or activities. Data marts allow for greater flexibility or increased performance. However, the data mart must be incorporated into the overall partners' data warehouse and managed and populated from this central data warehouse.

Supply chain partners in a collaborative network need a comprehensive view of their business, and greater insights into supply chain channels and process to improve decision making and business operations, as well as to adapt systematically and rapidly to market fluctuations. The e-supply chain intelligence module tracks collaborative channel events and processes, and extracts and presents decision oriented information.

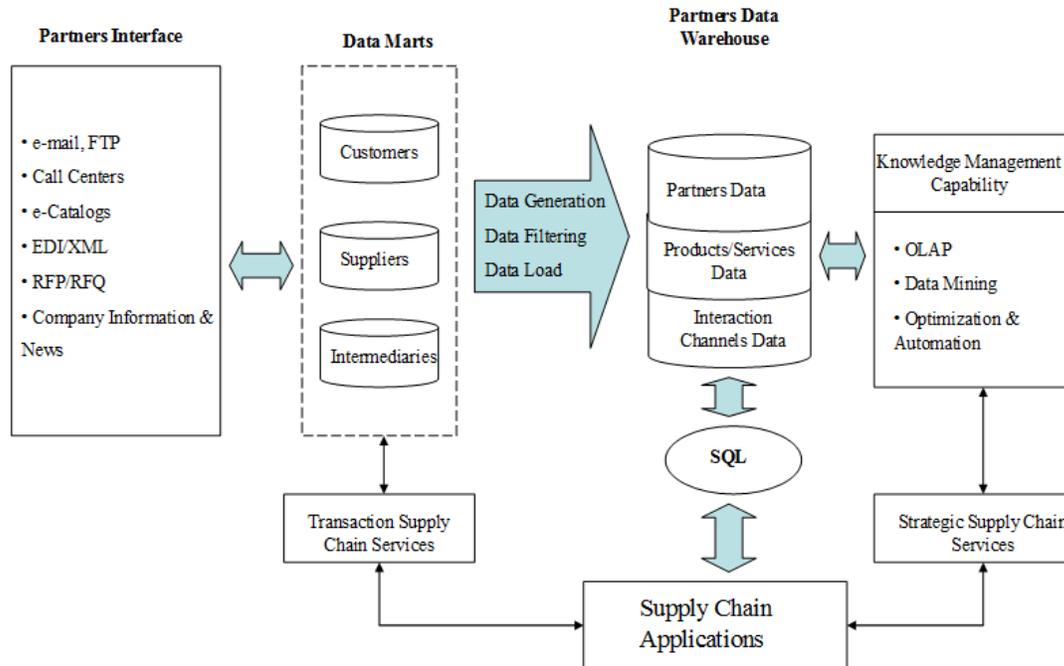


Figure 6. An Intelligent Textile Supply Chain Management System

Partners' data analysis processing allows e-supply chain network members to derive information and partners' intelligence from data warehouse systems by providing tools for querying and analyzing data, leading to multidimensional view of the specific partners. Knowledge management capabilities such as analysis software, data mining software, optimization and automation software, web-enabled technology, and campaign management software can be used in order to transform the data from the partners' data warehouse and the supply chain applications in useful partners' knowledge. (Warkentin et al., 2001). The output of partners' data analysis is useful to evaluate partners' readiness to collaborate and to compare and analyze real-time business performance and customer satisfaction.

The utilization of an intelligent textile supply chain management system is expected to help the supply chain be intelligent and effective with its expandable characteristics which can accommodate e-Procurement, drop shipping, vendor managed inventory, and collaborative planning, forecasting, and replenishment. It can also be applicable in developing collaborative/joint marketing plans, promotion, advertising and shipments.

4. Conclusions

As Korean textile industry is facing severe competition and losing competitive power due to the low labor cost of other Asian countries such as China, Vietnam, India, Indonesia, and Bangladesh, it needs to develop an effective strategy which delivers innovative, high quality, low-cost products on time with shorter product life cycle time and better customer services. As the global competition becomes more fierce and the customer expectation gets higher, many companies have turned to supply chain management to leverage the resources and build more collaborative business relationships.

Effective management of supply chains has become recognized as a core competitive strategy. As organizations continuously seek to provide their products and services to customers faster, cheaper and better than the competition, managers have come to realize that

they cannot do it alone; rather, they must work on a cooperative basis with the best organizations in their supply chains in order to succeed. Members of a supply chain network in a virtual environment use technology and management collaboratively to improve business operations in terms of speed, agility, real-time control, and customer response. Moving from traditional supply chains to virtual chain networks requires that partners focus on communications, relationships, and knowledge. Business is about an integrated set of relationships. Technology, quality, cost availability and collaborative business practices are important to each business partner in the supply chain network. Once partners enter into a business relationship mutual success will depend on trust, information and knowledge sharing, communication, and co-owned product service design and performance measures.

The collaborative network model introduces textile supply chain collaboration framework where the necessary modules are designed in order to guide partners of a virtual network to achieve strategic and tactical capabilities. Information technologies such as data warehousing and knowledge management systems, integrated telecommunications networks, multimodal transportation systems, commercial and service support, technical and organizational infrastructure, are the main elements supporting an intelligent textile supply chain management system.

The intelligent textile supply chain management system proposed in this study will allow companies to build or dissolve relationships quickly and efficiently as appropriate, and measure channel performances to boost and improve profitability and deliver transactions and customer satisfaction. As companies in a supply chain shift their business models to work in virtual networks, the form of relationships becomes critical to success. A network's success will strongly depend on its relationships with its business partners and on its customer/partner knowledge assets. The success of textile supply chain will depend upon the choice of the specific partners in the supply chain and on the way in which they co-operate efficiently and effectively with each other.

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