

ABSTRACT

CHAUDHRY, HASSAN RAUF. Postponement and Supply Chain Structure. (Under the direction of Dr. George Hodge).

The purpose of this research was to develop a decision support model for aligning supply chain strategies with regards to postponement applications in the US textile and apparel industry. A case study based approach was used for this research to understand the impact of interaction among supply chain partners upon the adoption of postponement strategies. Leading organizations in the NAICS code of 424320 and 424330 (men's/boys' and women's/child clothing and accessory merchant wholesalers) in North Carolina were approached to study their supply chain practices. Four case studies, using structured interviews, were developed for this research.

It was found that different types of postponement strategies were adopted in the industry. Lack of informational linkage was cited as the biggest barrier towards the adoption of a postponement strategy. The research found that commodity type products are supported by adopting manufacturing and logistics postponement strategies in combination which require the value chain to have access to the latest sales data and trends. Products which have new design elements in addition to some elements being repeated from a prior season are better managed with manufacturing postponement requiring information and data sharing across the value chain. In such kinds of products access to sales data would not add much unless the value chain partners operate at a higher level of relationship and integration with shared designing and operational responsibilities. For products which are highly seasonal and have a

short life cycle are better supported by adopting purchasing postponement strategy requiring relational linkage among the partners.

Postponement and Supply Chain Structure

by
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PREFACE

This dissertation is structured in the form of three papers. The first chapter or paper deals with a literature review for the postponement area. It concludes with the gaps in the postponement area. The second chapter or paper consists of four case studies which represent the data collected for this study. The third chapter or paper builds upon the first two papers to analyze the data in light of supply chain partnerships and relationship literature and presents a conceptual decision making tool for adoption of postponement strategies. The three papers are followed by a joint reference list and appendices.

CHAPTER I - POSTPONEMENT: A SUPPLY CHAIN STRATEGY

Introduction

Postponement is defined as the delaying of value adding activities until demand pattern becomes visible (Boone et al., 2007; Yeung et al., 2007). Constantly changing market scenario and unstable demand makes it infeasible to stock all types of products based on forecast (Yang and Burns, 2003). Moreover making to forecast, increases the risk of stock out for some products while increases the obsolescence costs for others. Many authors view postponement as a strategy to move towards mass customization (Yang et al., 2004b).

Background

Consumer demands are changing much quickly in terms of product variety and costs (Tachizawa and Thomsen, 2007; Vonderembse et al., 2006) resulting in shortening of product life cycle. The internet equips the consumer with plethora of information (Vonderembse et al., 2006) to find out about competing products, special offerings and the prices. Internet technology on the other hand also provides the manufacturers or sellers with immense powers to improve their performance. The competitive environment is forcing the organizations to adopt new strategies to cope with the ever changing market conditions.

The changing business scenario leaves a firm incapable of responding individually to the environment, so the focus has shifted from a firm level perspective to the enterprise concept encapsulating entire supply chain, with supply chains competing against supply chains rather

than individual competitors (Tachizawa and Thomsen, 2007; Vonderembse et al., 2006; Yang et al., 2004b). This makes the interaction complex, and the dynamics of all the players affect the performance of the whole supply chain. The extended enterprises which are better aligned to respond to the consumer demands collectively stand to gain advantage against their competition (Waller et al., 2000).

The success of the supply chains depends on getting the right product at the right place at the right time and at right cost (Mason-Jones et al., 2000). To achieve that, firms or supply chains are not only required to be internally aligned but also aligned with the external environment. The understanding of the external environment equips the supply chain to adopt a competitive strategy (Mason-Jones et al., 2000; Vonderembse et al., 2006). The strategies are focused towards customer satisfaction by lowering the costs and matching the demands (Waller et al., 2000). The strategies also derive the way the supply chains are designed so as to respond to the market requirements.

Postponement

Postponement involves delaying the product customization activity till more data is available regarding the market demand. The point in the supply chain, at which the customers places an order or gives information regarding demand pattern, is termed as the Order Penetrating Point (OPP). It is also termed as the 'Decoupling Point' (DP) in the supply chain, as it differentiates between the two segments of the chain, one segment which operates without fair amount of information regarding final demand while the other which operates after

clarity on customer demand has been achieved (Figure 1). The demand during the first phase is forecast based while during the second phase is actual order based (Yang & Burns 2003).

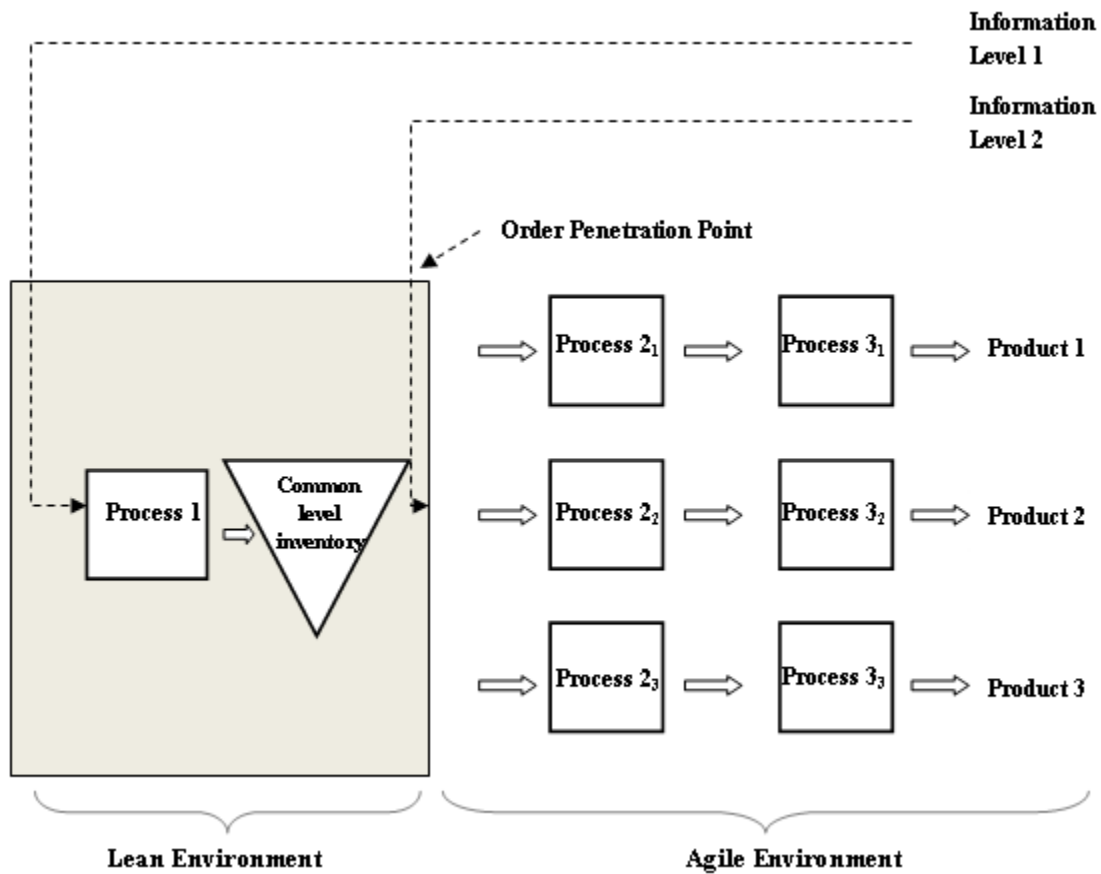


Figure 1: Postponement process flow

The OPP or the DP depends on market and production related factors such as lead time, demand variability and product design and change with any change occurring in the supply chain dynamics from the suppliers to the end customers (Yang & Burns 2003).

The postponement literature generally talks about single DP however Garcia-Dastugue and Lamber (2007) mentions the importance of multiple decoupling points where information regarding demand is available in phases. For example, rather than waiting for information regarding all variables at one point and delaying all activities close to the customer end, the product can be moved forward in the process as the information for different variables become available.

Although much has been written about the postponement strategy, its antecedents and outcomes, there is still limited literature on its implications on the supply chain structure. Moreover there are very few studies that have studied the postponement phenomenon with regards to the Textile and Apparel Industry despite the fact that this industry entails a variety of products from fashion to special purpose technical products, involves local as well as global sourcing with multi tiered supply chains and operates under an increasingly competitive scenario. In presence of intense competitive environments, postponement or delayed differentiations provides the textile and apparel organizations a strategy to become responsive.

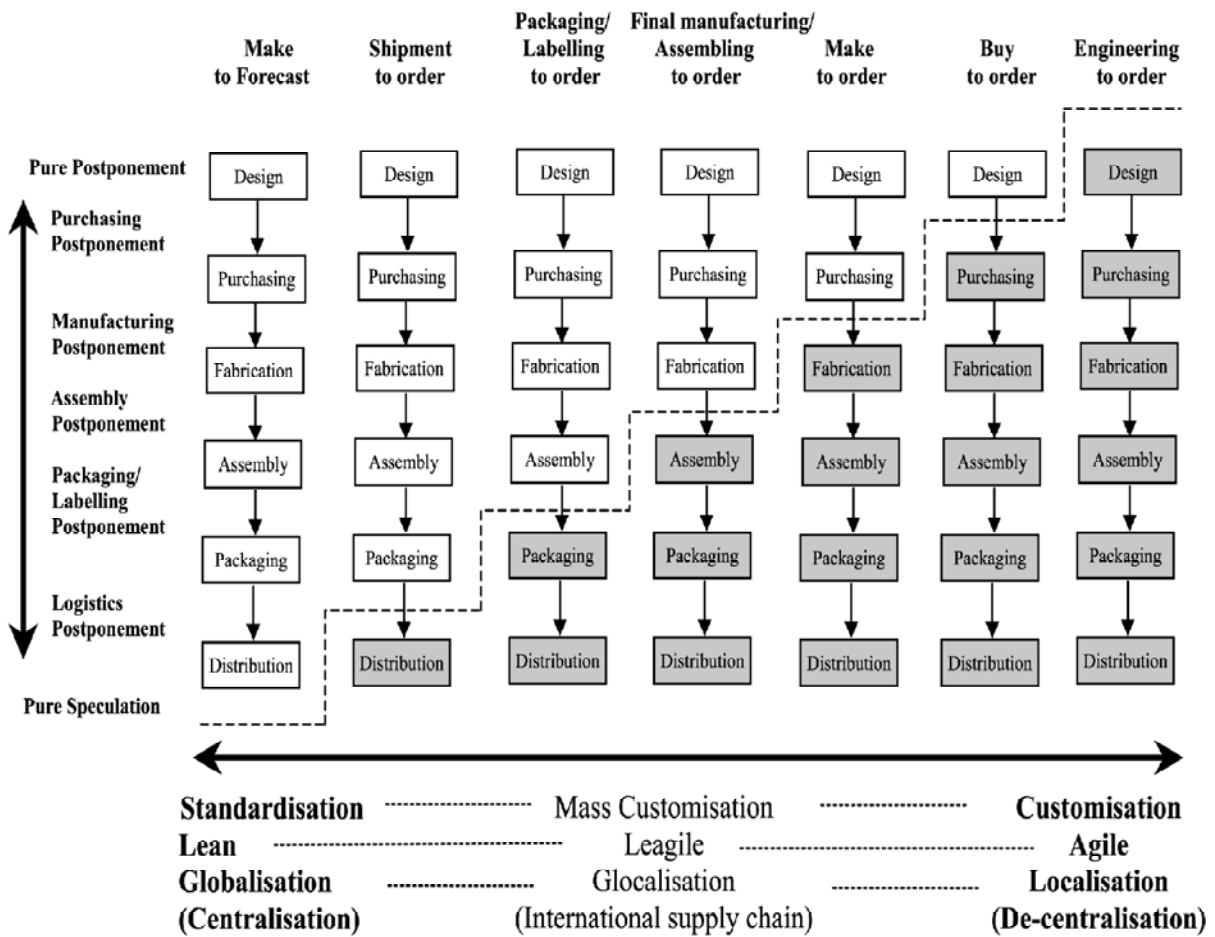
Purpose

The purpose of this paper is to review the postponement typologies presented in the literature as well as the factors affecting its adoption. The paper also looks at the gaps identified by the literature and potential future research with regards to textile and clothing industry.

This chapter is divided in to two sections. First section looks at the postponement models or typologies identified by the literature. The second section looks at the implications and the factors affecting the choice of a postponement strategy.

Postponement Models

The literature on postponement has discussed various models covering a continuum from pure standardization (different models relate to this as make to stock, zero postponement, total speculation) to customization (make to order, full postponement). As shown in the Figure 2 (adapted from Yang and Burns, 2003), the continuum consists of various strategies based on placement of decoupling point at different stages in the value chain. Some researchers have also devised postponement typologies based on the timings of order entry and Product Differentiating Activity (PDA)



Source: Adapted from Yang and Burns (2003)

Figure 2: Strategy continuum

Postponement typology based on value chain activity

Based on the review of 15 studies, Table 1 was developed to summarize the terminologies used to define different postponement types. These define postponement on the basis of

activities or place to differentiate between different postponement types. The check marks in front of every study indicate the postponement terminology used for that study. The following section summarizes these terminologies under product development, purchasing, manufacturing and logistics postponement.

Table 1: Postponement models

Paper	Postponement terminologies						
	MTS- MTO	Purchasing/ manufacturing /logistics	Time/ place/ form	Pack/label/ assembly/ manufacturing	Up/down stream	Speculation/ postponement	OPP
Lambel & Mintzberg (1996)	√						
Pagh & Cooper (1998)						√	
Battezzati & Magnani (2000)		√					
Waller et al. (2000)					√		
Van Hoek (2001)		√			√		√
Chiou et al. (2002)				√			
Olhager (2003)	√						√
Yang & Burns (2003)	√						√
Yang et al. (2004a)		√					
Yang et al. (2004b)		√					
Krajewski et al. (2005)			√				
Nair (2005)		√					
Boone et al. (2007)			√				√
Garcia-Dastugue (2007)			√				√
Yeung et al. (2007)	√						

Product Development Postponement

Product development postponement is considered extreme form of customization with all activities including product design taking place after the placement of an order. Moreover in this case, the customers are also involved during the design stage. Such strategy is preferable when long delivery times are acceptable for the downstream customers, since total customization approach results in increased delivery times. Product development postponement strategy is preferred in highly volatile environments, involving high levels of uncertainty in terms of consumer demands, technological developments and government regulations (Yang et al., 2004a). Customer inputs are incorporated at all stages of developments. Quality Function Deployment, Voice of Customer analysis, and other consumer insight gathering approaches such as Customer Relationship Management are used for design evolution during the development stage. A cross functional product development team becomes essential to gather information from all the internal as well as external stakeholders (Cooper, 2001).

The area of product development postponement has not yet been rigorously explored in the literature (Yang et al., 2004a). However the apparel industry offers few examples of product development postponement. Zara adopts a product development postponement strategy which is supported by making the designers develop articles using fabric that Zara holds in stock. High level of involvement as well as commitment is required from the upstream players in order to pursue the product development postponement strategy especially in the case where in-process inventory is not present. Toyota deals with the high levels of

uncertainty by letting their suppliers come up with novel ideas and designs without limiting them with strict specification constraints. The suppliers have total independence to explore different areas within a broad range of design specs. During that time, people at Toyota continue gathering market data on consumer demands and technological trends, till some convergence is achieved (Yang et al., 2004a).

Product development postponement in Figure 2 continuum is depicted by the Engineering to order or total postponement or pure customization strategy. Within this strategy there could be variations from design from scratch such as residential projects, which are designed to customer specifications to high tech IT projects which build upon previous platforms yet involving a high degree of newness and technical innovation. Product development postponement requires a high level of partnership in which buyers as well as the sellers are deeply involved in decision making (Lampel and Mintzberg, 1996).

Purchasing Postponement

In the case of purchasing postponement strategy, the purchasing of raw materials is postponed until the information on downstream demand becomes available. Purchasing postponement strategy is preferred when the demand is highly uncertain, raw material has high obsolescence cost and is of high value in terms of total product cost or ties up huge amount of working capital.

Purchasing postponement would work when the market lead time is greater than the manufacturer's production lead time plus the suppliers lead time (Yang et al., 2004a).

However, if the market lead time constraints the manufacturer from applying purchasing postponement, it can be adopted selectively for a range of products. This would be possible if the company is able to differentiate between base demand and surge demand. For base demand it can proceed with forecasted demand and purchase raw material or even proceed with production in case of longer production lead times. However for surge demand, the company can wait till demand pattern becomes available and then it can proceed to place orders.

In order to manage supplies for the surge demand, the manufacturers can have separate design of supply chain to deal with the surge demand, since under most scenarios regular production lead time for the surge demand would be greater than the market lead time. This design would be based on speed and agility with focus on fulfilling orders quickly rather than focusing lower cost by setting up fast production lines and purchasing raw materials from a different set of suppliers. However this would be feasible when the increase in cost due to fast paced production would be less than the gains accrued by adopting purchasing postponement strategy. This fact is highlighted by the postponement strategy adopted by Benetton, an apparel manufacturer, (Yang et al., 2004a) which separates between base demand and unpredictable demand. For the base demand, Benetton subcontracts to low cost sources which have higher lead times, while for the unpredictable part, they utilize their own flexible facilities which have higher operating costs.

However for purchasing postponement to work, it is imperative to have high level of collaboration between the manufacturers and the suppliers. Suppliers are required to respond to the downstream demand in minimum possible time so that the manufacturers can deliver within the market lead times, while resorting to purchasing postponement. In recent times e-market places have sprung up, enabling the manufacturers to get linked with the suppliers without any geographical constraints. This increases the options of the manufacturers to respond to actual demand. However, purchasing postponement strategy would be supported by having suppliers or their stock centers in close proximity to the manufacturers. Moreover this type of impulse buying contradicts the approach of developing long term relationships with the suppliers and could also jeopardize the relationships with the existing suppliers.

From a supply chain perspective, purchasing postponement involves shifting the ownership of the goods to the most suitable location. However in case of an imbalanced power structure, a manufacturer might force its suppliers to hold finished goods inventories in order to reduce its own risk and uncertainty cost. In this situation the suppliers are left with speculating the downstream demand, often resulting in the overall inventory buildup or 'Bullwhip' effect in the supply chain which reduces the efficiency of the entire chain (Yang et al., 2004a).

In textile and apparel supply chains, particularly for fashion products purchasing postponement is preferred. The fabrication is delayed till final demand becomes visible. In

some cases the knitters postpone the yarn purchasing function till details on fashion aspects such as textures and fabric weights become available.

Manufacturing Postponement

Manufacturing postponement involves delaying manufacturing activities and holding inventory in neutral form till the demand pattern becomes visible. Manufacturing postponement strategy works where there are multiple product derivatives, which could be due to different cultural, technological or market related issues. High product variation makes it difficult to forecast and hold inventory at finished stage.

Manufacturing postponement allows companies to operate without holding finished goods inventory while maintaining bulk of their inventories at pre-customized form. The inventory at this level has lower risk attached to it because their raw state permits them for wide usage variations (Garcia-Dastugue and Lambert, 2007). Manufacturing postponement is based on holding products at platform level later to be customized as per demand pattern. This is based on the principle that it is easier to forecast demand pattern at component level as compared to finished product stage (Yang et al., 2004a).

Fashion apparel retail business is marked by high product obsolescence costs. This is because of the fact that product are planned long before the actual demand information becomes visible. Zara on the other hand has been able to capture market trends by reducing the time required to introduce new products. Among other steps, Zara uses manufacturing postponement to reduce its lead times. Zara concentrates its forecasting efforts on the kind

and amount of fabric it buys. Zara gains more speed and flexibility by purchasing more than 50% of its fabric un-dyed later to be used for various products and lines (platform based). It reduces the cost as well as the chances of forecast errors. In un-dyed form it is easier to convert fabric to other uses, while it gives Zara the flexibility to adapt to colors close to the selling season based on the immediate market needs (Ferdows et al. 2004).

Lampel and Mintzberg (1996) have used the term customized standardization for manufacturing postponement. They have cited examples of industries where customers are given options to customize their orders from a limited set of variables. According to them the basic design is not customized and all the components are mass produced for aggregate market.

Pagh and Cooper (1998) use the term Full postponement strategy for the above strategy, where the manufacturing and logistics operations are initiated after the customer orders. Manufacturing postponement strategy has been further classified by the place of the order penetration point in the value chain. Chiou (2002), Yang and Burns (2003), differentiate manufacturing postponement into packaging, labeling, assembly and manufacturing postponement. As shown in Figure 2, these strategies are represented by packaging to order, labeling to order, assembly to order and make to order strategies. The choice of a particular strategy is dependent on the amount of lead time acceptable to the market. In case the downstream customers are looking for more variety or customized products and accept

longer lead times in return, the Order Penetration Point would be pushed upstream to accommodate wider variety.

Make to order strategy corresponds with the manufacturing postponement strategy explained above starting with common components and proceeding with fabrication and assembly after demand visibility. In case the manufacturer gets components from the suppliers and simply assembles the product into finished form it can be considered as manufacturing or assembly postponement. However if a manufacturer performs multiple operations after the order receipt, it would fall under manufacturing postponement. The computer industry selling customizable product especially through the internet practice assembly postponement strategy. The customers select from various options such as color, memory specs, processors, and the companies such as Dell, HP and Compaq assemble the required models from components received from the Original Equipment Manufacturers (OEMs). Pagh and Cooper (1998), cites HP's example to exemplify assembly postponement strategy. HP postpones the final assembling step to the last stage at the local distribution centers and once demand becomes visible, final manufacturing/assembly activities such as power supply, packaging and labeling are carried out.

Labeling postponement is adopted when the products are marketed under different brand names or are distributed to different markets. For example at times the same OEMs are used by different brands for their products and the OEMs mark the products with labels after receiving respective orders. Similarly certain apparel distribution companies keep products

unmarked and upon receipt of orders from various institutions print their logos before dispatching the orders.

Packaging postponement strategy is adopted when the products are marketed in different bundles or package sizes (Chiou et al., 2002). The final packaging is delayed till orders are confirmed. Packaging activities are generally performed in the downstream locations such as centralized distribution centers.

Manufacturing postponement also affects upstream and downstream value chain relations. Distributors and retailers are performing most of the final postponed activities. The displacement of the final activities from the manufacturer downstream also depends on the nature of the activity and in case the manufacturer considers particular activity of strategic nature, it would try to keep it within its own facility rather than passing it downstream. Similarly manufacturing postponement puts pressures on the supplier networks, and in order to be successful in implementing postponement, a reliable supply base becomes essential to meet market lead time requirements.

Logistics Postponement

Increasing product variety and uncertain demand make it economically infeasible to hold minimum levels of SKUs at all locations. Logistics postponement involves a delay in the final movement of the goods. Instead of placing the goods at the final point in the supply chain, they are kept at a central location, with the aim of following the demand pattern for the final shipments (Yang et al., 2004a). This helps to reduce the inventories in the supply chain

(Pagh and Cooper, 1998) while at the same time improves customer responsiveness (Yang et al., 2004a). Maintaining inventories at final locations would increase the inventory costs while at the same time would result in stock outs at some locations and excess stock at other locations. Logistics postponement often involves the repositioning of the final manufacturing activities downstream (Yang et al., 2004a) closer to the end user. This helps particularly where local variations in terms of consumer preferences exist which could be better catered to by carrying out the final customization at the local distributor level. Logistics postponement suits those products which have higher inventory cost and lower transportation costs (Yang et al., 2004a). Logistics postponement in most of the cases requires a faster and more responsive transportation system and can result in higher transportation costs.

Postponement levels typology based on order entry point and product differentiating activity

According to Forza et al. (2008), most of the postponement typologies presented in the literature are not mutually exclusive and there is significant overlap among the different typologies. They have derived the postponement typology based on the Product Differentiation Activity (PDA) and Order Entry (OE). Based on these variables, Forza et al. (2008) have derived three form postponement strategies, namely, type 1, type 2 and type 3 postponements.

Type 1 postponement

According to Forza et al. (2008), Type 1 form postponement is one where the PDAs are delayed till the time of order entry which were previously performed on the basis of forecast.

Type 2 postponement

Under this type of postponement, the PDAs which were previously performed to forecast are still performed to forecast, however now these are performed close to the OE point.

Type 3 postponement

Under this type of postponement the PDAs which were previously performed on order basis are still performed on order basis, however these are closer to the order delivery times.

Factors affecting choice of postponement strategy

The impact of market, product and process related factors have been discussed in various postponement strategy papers (Battezzatti and Magnini, 2000; Aitken et al., 2003; Olhager, 2003; Yang et al., 2004; Yeung et al., 2007). The main factors are summarized below.

Lead time

One of the most important market factors regarding the decision to apply postponement strategy is the delivery time allowed by the market forces. If the customers are looking for quick deliveries, then it would be difficult for the manufacturer to push postponement upstream. For such products, delivery time would be the order winner so the manufacturers can reduce delivery time or reduce cost while maintaining the delivery time to secure orders.

Demand volatility and volume

Volatility in demand drives the strategy whether to make the products to stock or to make them to order. A product with volatile demand would favor postponement so as not to commit with finished goods inventory and to have more inventory at common component level. For stable demand pattern it would be economical to pursue a strategy based on speculation and forecast to enhance customer service and reduce costs. According to Olhager (2003), volume function is also related to demand variability function. Products with high volume have generally more stable demand pattern and thus makes them suitable for 'make to stock' strategy.

Product life cycle and product variety

Different stages of the product life cycle are characterized by varying market requirements. The introduction stage is marked by higher levels of uncertainty in terms of market response to the new product. At this stage it is preferred to make enough quantity to stock so that the market does not runs out of the product. But demand pattern could vary from one location to the other making stocking forecast more difficult. However, stocking too much of inventory could lead to losses if the demand does not pick up. Moreover if the product has multiple derivatives, it would be expensive to maintain minimum SKU level at all the retail places. Logistics postponement would suit this stage as the product could be held at central location or distribution center and based on demand pattern replenishments could be made. During the growth stage, as the demand patterns become visible, postponement could be moved

upstream, but still product availability is crucial during this stage, so manufacturing postponement at the distribution centers could be adopted. This would entail labeling and packaging postponement based on the demand pattern, while ensuring quick availability of product. During the mature stage, demand patterns become stable, offering benefits in applying efficient production principle with the focus towards capacity utilization and cost efficiency. During the last stages, when a product reaches maturity stage, different varieties are introduced. Inventory could be held at component level to reduce cost for derivative products (Aitken et al. 2003).

In addition, products with short life cycle require to be turned around quickly and the time window in which demand based replenishments can be made is small (Aitken et al. 2005).

Product characteristics

The design of the product determines whether they can be customized at the later stages or not. In order to adopt postponement strategy, the products need to be designed from common platform or components and that can later be customized by adding on components unique to a certain product. At Zara, the designers use same base fabric and accessories to design multiple products.

Moreover, application of postponement is driven by the number of planning points available in the process. In case of a job shop environment, involving number of different steps not inter-related, various operations can be carried out at different points depending when the demand data becomes available for that particular operation or function. For example, in case

of fabric having multiple finishes, fabric could be held at unfinished stage later to be customized with special finishes as more information becomes available. However, in case of a single stage process, as the one in fiber manufacturing, intermediate stages between raw material and finished product might not exist to adopt any sort of postponement other than full postponement.

Fashion products have shorter life cycles and they need to be developed as well as replenished in a short time span to avoid stock outs as well as obsolescence. On the other hand, commodity products, which have longer life cycles, can be developed with a focus on costs as opposed to turn around (Masson Jones et al. 2000). However in case of higher inventory holding costs, postponement can still be used to reduce inventory in the chain.

Implications of postponement

Cost implications of different postponement strategies

Pagh and Cooper (1998) have highlighted the cost implications of adopting manufacturing and logistics postponement strategies. The relationships are shown in Figure 3. Full speculation strategy (manufacturing and logistics planning based on speculations) results in higher inventory holding costs but on the other hand production costs decrease. Manufacturing postponement results in higher production costs because of the loss of scale economies. The inventory costs on the other hand are reduced. In the case of logistics postponement strategy, distribution costs are higher due to smaller shipments and faster

modes, inventory costs are reduced by holding inventories at a central location while the production scale economies are preserved. However in this case, inventory costs are higher than that for manufacturing postponement. Finally the full postponement strategy (manufacturing and logistics activities postponed) would result in lower inventory costs, whereas the production and distribution costs would increase.

		Logistics	
		Speculation	Postponement
Manufacturing	Speculation	<ul style="list-style-type: none"> • Low production costs • High inventory costs • Low distribution costs 	<ul style="list-style-type: none"> • Low production costs • Med. inventory costs • High distribution costs
	Postponement	<ul style="list-style-type: none"> • High production costs • Low inventory costs • Low distribution costs 	<ul style="list-style-type: none"> • High production costs • Low inventory costs • High distribution costs

Source: Pagh and Cooper (1998)

Figure 3: Cost implications

Manufacturing implications

Skipworth and Harrison (2004, 2006, 2008), in a series of publications, studied the implications of form postponement to manufacturing. They studied the impact on customer service, excess capacity and throughput efficiency, apart from other product and market related factors. Customer service was measured through order lead time, delivery reliability and ex-stock availability. Excess capacity was measured based on the available capacity that exceeded demand. They measured this based on process idle time or capacity utilizations.

Skipworth and Harrisin (2008) concluded that there should be a rapid reliable system of communication to improve responsiveness. Electronic Data Exchange (EDI) was highlighted as one of the mechanism to transmit data. They also highlighted that even basic type of order relaying mechanisms such as ones based on Just in Time (JIT) concept could also help improve responsiveness required for postponement application. They further highlighted the significance of components availability at short lead times and that could be done by working closely with suppliers. According to Skipworth and Harrison (2008), the manufacturing system must also be responsive enough to incorporate the market updates. This must be in addition to availability of excess capacity to respond to the demand variability during postponement application.

Supply chain implications

Relationship structure and information sharing

The external (market) and internal (product & process) characteristics have been mainly researched in order to determine their effects in selecting a suitable postponement strategy. The external and internal characteristics might be suited to a particular postponement strategy, however the supply chain dynamics might not support the desired strategy. Yeung et al. (2007) explored how the supply chain structure and information sharing patterns among the supply chain actors affects the postponement decision. They selected eight companies from China based on their supply chain structures and postponement strategy.

Yeung et al. (2007) categorized the supply chain relations as balanced and unbalanced. They categorized these on the basis of interdependency between the supply chain actors. If none of the customer accounts for a significant portion of the sales, then the downstream relationship between the manufacturer and customer is termed as balanced, with both parties not being entirely dependent on each other and without any party dictating its terms to the other. Similarly the upstream relationship between the manufacturer and the supplier is termed as balanced if raw materials can be sourced from multiple suppliers and the supplier is able to sell its products to multiple customers (manufacturers). On the other hand if the customer accounts for a major portion of the sales and suppliers are not able to locate multiple outlets for their products, then the relationship becomes unbalanced with customer enjoying excessive powers to dictate terms with its suppliers.

Yeung et al. (2007) proposed that in case of a balanced supply chain relationship, either speculation or production postponement should be adopted. They have argued that to adopt postponement a close relationship is required among the supply chain actors, whereas in case of a balanced structure information exchange tends to be more difficult to be practiced and the players tend to live in their silos. Hence a speculation based strategy works under such scenarios. However in case of a balanced structure and if information exchange pattern can be established, it would enhance the opportunities to adopt postponement and the supply chain as a whole would gain from it. In most of the cases falling under the balanced structures, the companies were following the speculation strategy. However in one case where the manufacturer was engaged in a two way information exchange with the customer,

production postponement strategy was working well. However since the manufacturer did not share much information with its suppliers, full postponement strategy could not be adopted. Without adequate information exchange the chances of not getting the raw materials in time increase and that could jeopardize the deliveries to the final customer. So the manufacturer preferred production postponement only.

In their other proposition, Yeung et al. (2007) observed that in the case of an unbalanced supply chain structure, either purchasing postponement or product development postponement have served the players better. According to them, an unbalanced supply chain has one company in leading position because of its market power and because of that it can force other players to share information and adapt their processes best suited to its schedules. This enables the supply chain actors to develop close relationships, which in turn makes a high degree of postponement more suitable to be adopted. In case there is only one customer, then the manufacturer has the opportunity to adapt its operations to suit the customer requirement. This gives an opportunity to the manufacturer to operate totally based on the downstream demands rather than speculating the schedules. However in the case of complex products the manufacturer would be required to invest in information sharing in order to support the postponement strategy.

When the manufacturer has a dominant role in the supply chain, then the customer has to adopt its procedures and policies suited to the manufacturer. The customer can either share information with the manufacturer extensively so that both of them can work jointly for

optimizing the processes. However in this case the manufacturer would be willing to adopt postponement strategies based on the benefits it perceives to achieve, which would force the customers to share gains with the suppliers in return for optimized deliveries. On the other hand, if the customer decides not to integrate its processes and information with the manufacturer, then it will have to accept the long delivery schedules as the manufacturer would tend to minimize its risk by adopting manufacture to order strategy.

Similarly the upstream relations in case of a manufacturer driven supply chain would also be driven by the dominant player. When the manufacturer has to purchase generic items or components, it can use the open market without building long term relationships. This would enable the manufacturer to adopt purchasing postponement strategy.

Virtual supply chains are also characterized by one dominant organizer which is more powerful than the rest of the players. All the players in the virtual network are required to have advanced information systems to share information extensively in order to survive in a high uncertainty environment. This makes product development postponement to be a suitable strategy.

Power structure and nature of contracts

Krajewski et al. (2005) explored the reaction strategies adopted by the suppliers to respond to short term schedule changes in build to order supply chains. They examined the supply chain relationships between a notebook computer manufacturer and five component suppliers.

Krajewski et al. (2005) discussed various strategies that suppliers use to respond to schedule changes. They discussed the use of contract restriction as one of the major strategy by the suppliers to deal with the uncertain environment. These restrictions determine the amount of flexibility available to the customers to change orders. In order to reduce uncertainty, the suppliers can restrict the customers in the amount of changes they can make in the contracts. Suppliers could also restrict the customers in the frequency of changes in quantities they can make after committing an order. Similarly the suppliers would like to restrict the customers from changing the delivery schedules.

Apart from contract restrictions, the suppliers' ability to create and update schedules on the basis of short term changes made by the customers gives them opportunity to react to the changes. These involve the exchange of information from the buyers side such as sales forecasts, production schedules and future shipping requirements. Having access to future information does not provide any benefit as long as the suppliers are not able to incorporate the information in its production schedules.

Krajewski et al. (2005) further elaborated on the availability of postponement options in order to respond to schedule changes. They discussed three forms of postponement. According to them the first type of postponement where the suppliers keep finished goods inventories, does not give the suppliers any flexibility because the product has already taken its final form. Using work in progress inventory gives the suppliers intermediate level of flexibility to respond to short term schedule changes since the product has already taken a

semi finished state. Holding inventories at component or purchased part level gives maximum flexibility to suppliers to adapt to short term changes made by the customers. However this strategy only becomes possible when the customers agree to longer product delivery times. Krajewski et al. (2005) further discuss the capability of the supplier to be flexible by keeping capacity slacks or having the ability to expedite the orders at low cost. Having flexible and cross trained labor gives the suppliers added ability to react to changes as well as process bottle necks.

According to Krajewski et al. (2005), the buyer supplier relationship is further driven by the player which has more power relative to the other players. A supply chain actor derives power over other channel members by having access to scarce resource such as access to raw materials, processes and technology, human expertise or even market access. Of the five component suppliers, two had a product of high value and complexity and enjoyed significant channel power (category A suppliers), while the other three had a product of low value and complexity (category B suppliers). Category A suppliers placed high restrictions on their customers in terms of the short term changes they could make to the schedules. This helped the suppliers to reduce uncertainty and this enabled them to keep less safety stock and apply postponement closer to raw material level. Category B suppliers gave significant liberty to their customers to make short term schedule changes, which increased the uncertainty in their operating environment and were forced to hold safety stock to respond to short term changes in schedules demanded by the customers. They had to rely on high levels of capacity slacks and expediting efficiencies to respond to short term changes since the

contracts gave their supplier considerable leverage to make short term changes. Moreover their flexibility was supported by cross trained work force to respond to demand changes. Category A suppliers on the other hand had low level of flexibility since they were able to reduce uncertainty through supply contracts.

Length of the supply chain

The length of the supply chain and the distance from the end consumers also influences the choice of selecting a postponement strategy. Brown et al. (2000) used the example of postponement strategy adopted by Xilinx. According to them the semi conductor manufacturers firms face uncertain environment because of their upstream position in the supply chain. An integrated circuit (IC) made by the semi conductor manufacturers passes through contract manufacturers, distributors and resellers before being passed on to the end consumers. This length of supply chain makes demand fluctuations severe for players situated upstream. This scenario forces the semi conductor manufacturers to hold high finished goods inventory levels for their customers. Moreover long development lead times make it difficult to develop a product on downstream demand. According to Brown et al. (2000), Xilinx used innovative postponement strategy to avoid excessive inventory but at the same time fulfilling their customers' requirements. Xilinx used a unique postponement strategy where the product final differentiation was delayed to a point where the customers configured the ICs to their requirement. Customers selected the ICs from a given specifications range and programmed them as per their intended use. But this specific type of postponement might only be applicable to a certain range of products. Xilinx also used

process postponement using inventory modeling, back end cycle time reduction and common component use based on aggregated demand.

Research gap

The research literature on postponement has highlighted potential research directions. It can be seen that common grounds exist between various studies. Lack of industry specific analysis has been emphasized by many researchers (Van Hoek, 2001; Chiou et al., 2002; Yang and Burns 2003; Krajewski et al., 2005; Yang et al., 2005; Boone et al., 2007; Garcia-Dastuge and Lambert 2007;Yeung et al., 2007). Moreover the areas that have been explored require better validation with the use of empirical tools (Yang et al., 2004a; Krajewski et al., 2005). There is further requirement to develop industry specific measures assessing the implementation of postponement strategy which would require further exploratory studies before moving on to empirical testing.

The role of organizational culture and structure in the implementation of postponement strategy needs to be explored further (Yang et al., 2004b; Yang et al., 2005; Nair 2005). Some researchers (Krajewski et al., 2005; Yeung, 2007) have explored the implications of relational factors such as power structure, information exchange, contract limitations, in adopting postponement strategy. However they have highlighted the need of further research for industry specific analysis and global differences. Further there has been some work done on implementation of postponement under different form of market uncertainties, however supply side uncertainties needs to be further explored. In addition, the impact of supply chain

supply chain structure and relationships on adopting different postponement types needs to be explored further.

Conclusion

Mostly automotive, computers and electronics industries have been covered in the research while the upstream manufacturing sector needs further exploration. The textile and apparel industry presents excellent opportunity of research, given its product variety and global supply chain settings. The length of apparel supply chains starting from fibers and yarns presents opportunities to study the upstream implementation of postponement strategies.

Research papers on textiles and apparel industry during the past decade have mainly explored the areas of supply chain performance and the use of e-commerce. Dickerson et al. (2004) have explored the determinants of e-commerce adoption in the US apparel industry. Cagle and Hodge (2004), have developed a taxonomy of e-business models being used in the textile industry. However these papers have not looked at the particular impact of adopting e-commerce models on postponement strategies. On the other hand studies exploring the supply chain areas in textile and apparel industry have mainly looked at the sourcing patterns (Gereffi, 2001), impact of fast fashion on supply chain practices (Barns and Lea-Greenwood, 2006) and cultural impact on supply chain performance (Chen et al., 2007). Only two studies (Bruce et al., 2004, Lam & Postle, 2006) have looked at the adoption of supply chain strategies in the textile and apparel sector. Bruce et al. (2004) have discussed supply chain strategies using four case studies in the textile and apparel sector. They have highlighted

lean, agile and le-agile approaches. However even for the two examples on le-agile approaches, they have highlighted the sourcing, manufacturing and relational aspects without exploring the use of postponement strategies. Lam and Postle (2006) have used the Fisher's model (1997) of efficient versus responsive supply chain strategies. They have highlighted the importance of holding work in progress inventories (greige goods) along with the significance of information sharing for a responsive strategy. The adoption of postponement strategy in the textile and apparel sector needs further research to bring it at par with research carried out in IT and automotive industries. Moreover the textile and apparel sector further presents the opportunity to study the consumer/retail as well as industrial segment individually.

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CHAPTER II - POSTPONEMENT APPLICATION IN THE TEXTILE AND APPAREL INDUSTRY

Introduction

Consumer demands are changing quickly (Tachizawa and Thomsen, 2007; Vonderembse et al., 2006) resulting in shortening of product life cycles. The situation has been further exacerbated for the manufacturers by the ubiquitous use of internet which equips the consumer with information (Vonderembse et al., 2006) about competing products, special offerings and the prices. The changing business scenario and shortening of product life cycles make it difficult for the organizations operating under this environment to forecast their production requirements. Excess production based on forecasts leaves them with unused inventories with little salvage value while on the other hand under production could result in lost opportunity. For industries with multiple levels in value chains, it becomes difficult to respond to the changes within the season (Hopp, 2007).

Textile and apparel industry

The characteristics of the textile and apparel industry, such as increased competition, short product life cycles, long production cycles and increased fragmentation, make the task of matching supply with demand all the more difficult. Figure 4 shows a general textile and apparel value chain. However, the value chain structure differs based on the product category and product ownership. For example, in the case of hosiery products such as socks, the tier I includes the fabrication and final processing with yarn at tier II, where as for apparel

products tier I consists of the apparel manufacturing while tier II consists of textile manufacturing. Similarly where a brand is owned by an organization, which does not have a retail setup or sells through multiple distribution channels, there is further extension in the value chain towards the downstream end.

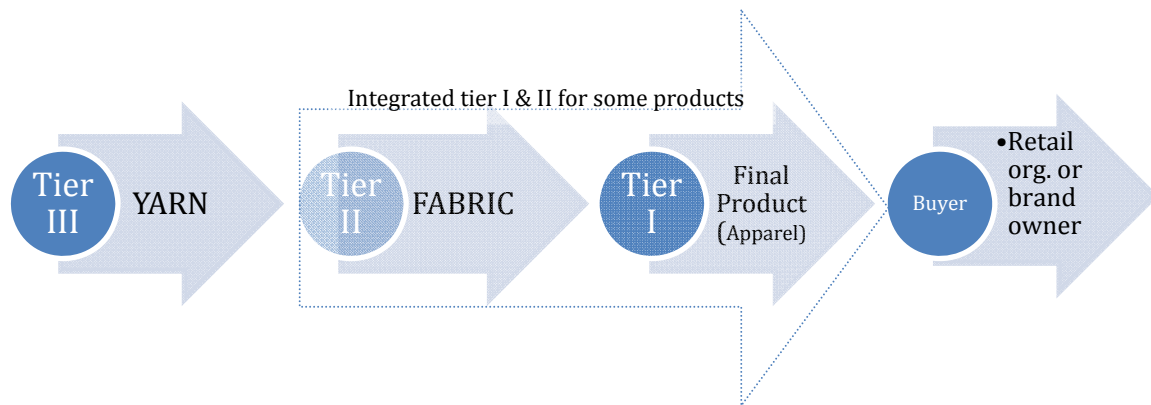


Figure 4: Textile and apparel value chain

Postponement

Postponement is one of the strategies used to reduce production cycle times and time to market in order to respond to the changes in downstream demand on a real time basis. Postponement involves delaying the product customization activity till more data is available regarding the market demand. The point in the supply chain, at which the customers places an order or gives information regarding demand pattern, is termed as the Order Penetrating Point. It is also termed as the ‘Decoupling Point’ (DP) in the supply chain, as it differentiates

between the two segments of the chain, one segment which operates without fair amount of information regarding final demand while the other which operates after clarity on customer demand has been achieved. The demand during the first phase is forecast based while during the second phase is actual data based (Yang & Burns 2003).

Postponement Models

The literature on postponement has discussed various models covering a continuum from pure standardization (different models relate to this as make to stock, zero postponement, total speculation) to customization (make to order, full postponement). These models include product development, purchasing, manufacturing and logistics postponement.

Product Development Postponement

Product development postponement is considered extreme form of customization and is preferable when long delivery times are acceptable for the downstream customers, since total customization approach results in increased delivery times. Product development postponement strategy is preferred in highly volatile environments, involving high levels of uncertainty in terms of consumer demands, technological developments and government regulations (Yang et al., 2004a).

Purchasing Postponement

In case of purchasing postponement strategy, the purchasing of raw materials is postponed until the information on downstream demand becomes available. Purchasing postponement

strategy is preferred when the demand is highly uncertain, raw material has high obsolescence cost and is of high value in terms of total product cost or ties up huge amount of working capital.

Purchasing postponement would work when the market lead time is greater than the manufacturer's production lead time plus the suppliers lead time (Yang et al., 2004a). However, if the market lead time constraints the manufacturer from applying purchasing postponement, it can be adopted selectively for a range of products. This would be possible if the company is able to differentiate between base demand and surge demand. For base demand it can proceed with forecasted demand and purchase raw material or even proceed with production in case of longer production lead times. However for surge demand, the company can wait till demand pattern becomes available and then it can proceed to place orders.

Manufacturing Postponement

Manufacturing postponement involves delaying manufacturing activities and holding inventory in neutral form till the demand pattern becomes visible. Manufacturing postponement strategy works where there are multiple product derivatives, which could be due to different cultural, technological or market related issues. High product variation makes it difficult to forecast and hold inventory at finished stage.

Manufacturing postponement allows companies to operate without holding finished goods inventory while maintaining bulk of their inventories at pre-customized form. The inventory at this level has lower risk attached to it because their raw state permits them for wide usage variations (Garcia-Dastugue and Lambert, 2007). Manufacturing postponement is based on holding products at platform level later to be customized as per demand pattern. This is based on the principle that it is easier to forecast demand pattern at component level as compared to finished product stage (Yang et al., 2004a).

Fashion apparel retail business is marked by high product obsolescence costs. This is because of the fact that product are planned long before the demand information becomes visible. Zara, a leading fashion apparel retailer, on the other hand has been able to capture market trends by reducing the time required to introduce new products. Among other steps, Zara uses manufacturing postponement to reduce its lead times. Zara concentrates its forecasting efforts on the kind and amount of fabric it buys. Zara gains more speed and flexibility by purchasing more than 50% of its fabric un-dyed later to be used for various products and lines (platform based). It reduces the cost as well as the chances of forecast errors. In un-dyed form it is easier to convert fabric to other uses, while it gives Zara the flexibility to adapt to colors close to the selling season based on the immediate market needs (Ferdows et al. 2004).

Logistics Postponement

Logistics postponement involves a delay in the final movement of the goods. Increasing product variety and uncertain demand makes it economically infeasible to hold minimum

levels of SKUs at all locations. Instead of placing the goods at the final point in the supply chain, they are kept at a central location, with the aim of following the demand pattern for the final shipments (Yang et al., 2004a). This helps to reduce the inventories in the supply chain (Pagh and Cooper, 1998) while at the same time improves customer responsiveness (Yang et al., 2004a). Logistics postponement in most of the cases requires a faster and more responsive transportation system and can result in higher transportation costs. Logistics postponement suits those products which have higher inventory cost and lower transportation costs (Yang et al., 2004a).

Postponement in US textile and apparel industry

Aim

The aim of this paper is to explore the applications of postponement in the textile and apparel industry with a particular focus on the supply chain structure, relationship and enabling activities supporting postponement strategy across the supply chain.

Methodology

The nature of research determines which research methodology needs to be employed. For this study, qualitative research method was chosen, since it focuses more towards exploratory and theory building nature of research especially where there is a lack of existing theories (Creswell, 2003).

Different strategies are adopted for conducting qualitative research. For this research, a case study approach within the qualitative method was adopted. The purpose was to explore the application of postponement with the objective of gathering considerable data from an organization or multiple organizations to develop the clearest possible picture of the phenomenon (McCutcheon and Meridith 1993).

To explore the application of postponement in the textile and apparel industry, the scope was limited to the US industry and within the US it was further limited to the North Carolina. For this study the population was defined as the organizations falling within the NAICS code of 424320 and 424330 (men's/boy's and women's/child clothing and accessory merchant wholesalers). The population was further focused down to organizations with over 50 employees and having annual sales greater than \$20 million. Given the exploratory nature of research, industry leaders in terms of sales and number of employees were contacted first, in order to have knowledge about their organizational practices.

A protocol was developed to conduct and guide the data collection process (Appendix I). A protocol is more than an instrument, it also contains the procedures and general rules that are used in seeking information. It also indicates the sources of information (Voss et al. 2002; Yin, 2009). The protocol was used to increase the reliability of data collection especially in case of multiple cases (Yin, 2009). These studies were conducted in light of the protocol developed based on the literature in postponement and supply chain relationships area.

Case studies

Before the data collection stage, Industrial Review Board (IRB) approval (Appendix II) was obtained for field research. Structured interviews were conducted with Vice President level supply chain/procurement/quality personnel at the selected companies. These interviews were conducted either over the telephone or in person at site locations. After the interview, the data was structured in the form of case studies and submitted to the respondent for review and consent

Company A

Company background

Company A is one of the leading apparel organizations in the world with multiple brands targeted towards diverse consumer segments and annual sales greater than \$1 billion. It operates in Jeanswear, Image-wear, contemporary, outdoor and sportswear segment and enjoys a dominant position in most of the segments. Outdoor and Jeanswear comprise over 70% of its total sales.

The company owned brands are distributed through multiple channels. Some brands are distributed via owned retail outlets while others are sold through specialty stores, chain stores, mass merchants, upscale department stores and mainline department stores. Almost one quarter company A's sales are generated from its international operations.

Sourcing strategy

The company maintains a multiple sourcing structure. It has its own apparel manufacturing facilities in addition to a strong sourcing organization which sources products from across the globe. It owns apparel manufacturing plants in Central America which are focused towards the US Jeanswear market covering almost half of the volume in this category. Bulk of its sourcing is from the Asian countries and is managed through its sourcing office in Hong Kong. A small proportion of its products are also sourced from European countries, and these include high fashion articles or products designed for the European market. Company A's position in its value chain is shown in Figure 5. The shaded parts of the circles highlighting value chain activities depict the ownership status for Company A.

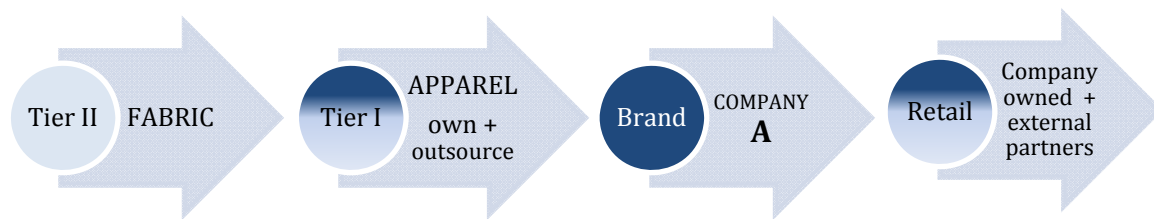


Figure 5: Value chain for Company A

Sourcing from the Americas

Company A sources bulk of its traditional Jeanswear brand from the Americas. The Denim fabric for these products is sourced from the United States as well as from Central America and is then sent over to the Central American apparel manufacturing facilities owned by the company. This fabric sourcing arrangement is supported by the US trade agreements which let the company bring back garments duty free by using fabric manufactured in the United States. The duty advantage and the manufacturing expertise have allowed the company to continue with its American manufacturing operations whereas most of its competitors have let go of their manufacturing capabilities and have replaced them mainly with sourcing through Asian countries. Apparel manufacturing capabilities let the company turn around their basic products in half as much time taken by other manufacturers.

Under this model the sourcing team works directly with the denim fabric mills in the US. The requirements are directly handed over to the fabric mills which send the fabric to Central American apparel manufacturing locations. The manufacturing facilities upon receipt of fabric proceed according to the plans handed over by the sourcing team.

The denim fabric mills operate with the company in a 'Just in Time' manner and upon receipt of purchase orders dispatch the goods within one to two weeks time. The purchase order acts more as a goods dispatch order rather than a manufacturing start order. The mills get their visibility from the seasonal booking charts which also include tentative dispatch dates. The purchase order incorporates the sales trends by adjusting the delivery schedules if required.

Asian Sourcing

Bulk of contemporary and fashion brands sourcing is done from the Asian region. The Asian sourcing is managed by a sourcing office in Hong Kong. The company office works in collaboration with the apparel and fabric manufacturers, however the linkage with the fabric mills is different than the one with US Denim mills. For Asian sourcing, the fabric mills work in liaison with the apparel manufacturers in addition to the sourcing and operations office for planning and scheduling activities.

Postponement application

Product development postponement

New product development is carried out via multiple routes. The fabric mills and apparel manufacturers bring their developments to the design team. This is based on their experience and knowledge of the market. The other route is that the design team selects styles for a season based on the current fashion trends. Once styles/designs are selected, the sourcing team works with the fabric mills and the apparel manufacturers to develop the prototypes. Once the prototypes are approved for designs and product testing, a range of other samples are prepared for approval purposes before product buy orders are placed with the apparel manufacturers.

The pricing issues are finalized during the development process where the sourcing teams talks directly to the fabric mills as well as the apparel manufacturers. The product buy orders are issued three to four months in advance of the expected delivery dates.

The sourcing team is working towards devising a more collaborative strategy to reduce the time to market for new products. The new strategy envisions bringing all the concerned parties from designers to fabric mills together for product development.

Manufacturing postponement

In the case of the carryover (repeat) orders, advance forecasts and projections ranging from five to six months are given to the fabric mills and apparel manufacturers (for both sourcing models). These are followed by the buy orders which are issued three to four months in advance of the delivery dates. This enables the apparel manufacturers to have the raw material (fabric in this case) ready by the time buy orders are placed. The fabric vendors are also required to hold inventory buffer of grey (unprocessed) fabric for carry over orders for certain styles.

Supply chain interaction

The company's relationship with their vendors (apparel manufacturers) is based on long term orientation. For most of its vendors, company A is the major buyer. Most of its vendors are strategically oriented with the company and generally have one year advance visibility for their orders.

The communication between the company A and its vendors takes place at multiple levels. There is a strategic exchange of information with the top level of management of their vendors and then there is a tactical level exchange on regular/seasonal basis. In addition the vendors are periodically updated on the forecasts. This sharing of information is extended to the fabric mills as well. The apparel manufacturers are linked with the company's system to update their production status. However sourcing team at company A expressed their desire to enhance the informational linkage with their vendors for two way data sharing.

In Asian sourcing model, the fabric purchase is between the apparel manufacturers and fabric mills, although the mills get advance forecast sharing from the sourcing team at Company A, however, they coordinate their production schedules with the apparel vendors. At times, the sourcing team has to step in for settling disputes for delivery schedules and pricing issues. The sourcing team also expressed their desire for enhancing relationship between the apparel vendors and the mills. In case vendors have unused inventory because of forecast deviations, the company helps them in consuming the unused inventory, either by holding for future use or by coordinating within brands for consuming fabric.

Company A closely monitors the general outlook of their vendors and assists them when required. The assistance is provided in terms of advance payments, technical advices and at times in shape of advance order bookings. Few years back, one of Company A's US fabric supplier's operations were closed down and it was approached for assistance by an investor interested in restarting the operations. Company A rendered its support for restarting the

operations by buying capacity for basic fabrics with bulk runs. Since then, the supplier has worked exclusively for Company A. The company is also working with that vendor for supplying some short run value added products. Company A also helped couple of its Asian apparel vendors to stay afloat by assisting them with advance payments and orders.

Company A's contracts with its vendors have traditionally been 'gentleman's promise' or 'hand shake' based with less emphasis on terms. The price negotiations were previously tilted in Company A's favors whereas now they are moving towards adopting a 'win-win' strategy with the intentions of looking after the benefits of the vendors as well.

Company A uses state of the art Material Resource Planning (MRP) system to run its operations. However it is only connected to the Point of Sale (POS) systems of few of its customers (retailers, departmental stores, mass merchants etc), from where it gets daily updated and then consolidates them into first and second round of forecasts for its vendors before placing the buying orders. Company A is looking for enhancing the POS linkage especially for its carry over business.

Company A has been able to reduce its time to market over the years and has attributed its success to better coordination and more streamlined linkage with its supply chain partners, however the sourcing team cited the cost of technology as the major hurdle for tighter integration across the supply chain.

Company B

Company background

Company B is a manufacturer and a distributor of socks for men, women, boys, girls, toddlers and infants. It operates in the athletic, dress and casual wear segment of the socks industry. The majority of its products cater to the athletic segment while a minor segment caters to the men and women dress and casual wear socks.

Company B owns sock manufacturing and distribution facilities in the US as well as in Central America. Apart from in-house manufacturing, it has joint ventures with Asian companies in various parts of Asia. It sources the bulk of its production from these venues. Apart from in-house manufacturing, Company B also outsources its products from countries like China. Products for the dress and casual segment are generally outsourced.

Company B also owns two distribution centers in the US where it consolidates all its production and shipments (imports) before dispatching to the customers. Company B operates through different distribution channels.

Company B owns license for various product brands for which it manages the whole supply chain till the point of display at the retail locations. It also has its own brands which are managed similar to the licensed products. In addition to the licensed products, it also manufactures private labels which are owned by the department stores. Apart from

providing services to the private labels, it acts as an Original Equipment Manufacturer (OEM) for some national brands as well.

Sourcing strategy

In terms of operational and sourcing strategy, products can be divided into two categories. One category is of new products while the other falls under the category of replenishment orders. New orders are further subcategorized into two types, one which are stand alone, one time contracts for national brands where quantity and delivery dates are confirmed at the time of order placement while the others are ones which are fulfilled as replenishment programs. Company B's position in its value chain is shown in Figure 6.

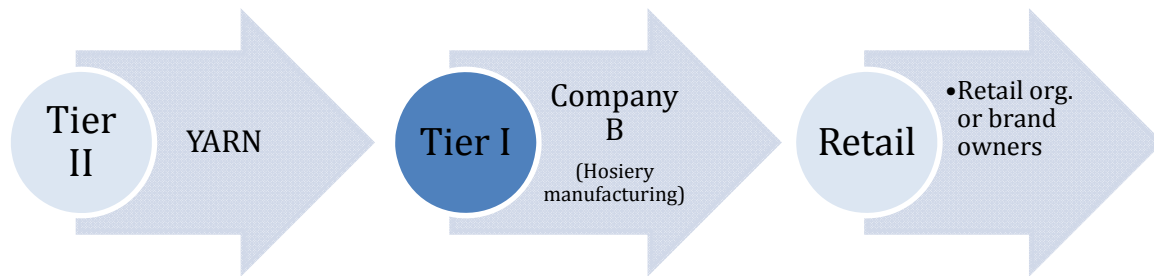


Figure 6: Value chain for Company B

Postponement application

Product development postponement

The new product lines, private labels as well as licensed products, are developed in coordination with their customers. Once the concept or idea has been mutually discussed, it is passed on to the development team in order to develop prototypes and to carry out the required product testing. Once the prototypes are approved by testing as well as the design and sales teams, production orders are initiated.

The development process can take anywhere from three to six months depending on the nature of the product. However in order to reduce the time to market for the new products, at times yarn for the initial order or delivery is purchased even before the production orders are initiated. This is done any time between the prototypes have been tested and finalization of orders. There are different factors which lead to the earlier procurement of yarn, such as in the case when the yarn is of commodity nature and can be used for other products, or due to better coordination and the history of interaction that enables the team to predict and make forecast before the orders have been finalized.

Manufacturing postponement

The majority of Company B's business is for replenishment orders. Once the new products have been introduced and placed on retail shelves (licensed products and private labels), these are managed as replenishment orders. The replenishment programs are managed via

Vendor Managed Inventory (VMI) linkage. In VMI linkage, the tier I vendor (in this case Company B) is outsourced not only the manufacturing and sourcing responsibilities but also the inventory management and product availability functions as well. This is made possible by Electronic Data Interchange (EDI) linkage that connects the vendor to the Point of Sale (POS) locations and enables it to access the sales trends as well inventory position of a particular stores and once the inventory reaches a certain level, products are replenished from the inventory maintained by the vendor. The sales data enables the vendor to make forecast for future sales in order to manage their production schedules.

Company B is connected to its customers' POS locations and receives the POS data on daily basis. The analysts in the forecasting department consolidate the data being received from all retail locations and then analyze the data on regular basis in order to study the trends and update the forecasts, for a particular time bucket, with the planning department. The planning department, which keeps track of inventory in the supply chain, consolidates the requirements and initiates production orders based on the forecast updates. The forecasting analysts also coordinate with the customers' forecasting departments while making the forecasts.

The POS data is not passed on upstream to Company B's supply chain partners from where it sources a portion of its orders. Rather they work in collaboration with the planning department which converts the forecasts into production orders for the upstream locations (in-house manufacturing as well as outsourced operations).

The replenishment programs are based on particular seasons. For example for a six month replenishment program, Company B breaks up the program into different phases. During the production for first phase, while it waits for the forecasts from the POS data, it starts to prepare for the second phase production based on the initial POS projections. This preparation in most of the cases includes procuring yarn for the next phase even before the systems triggers the production order for the next phase. However for some special cases, where the product with same construction is required for multiple downstream outlets, Company B even knits the product before hand and once the production order is triggered by the system, it proceeds to finish and pack the product.

Logistics postponement

All the products either manufactured within Company B's own facilities or outsourced are brought to either of its two distribution centers. Based on the updated forecasts (from the time production was triggered) and the inventory positions at different retail locations, goods are routed to retail locations as per requirement. For example if a particular region is showing a higher sales trend, then more goods would be channeled to the stores of that region. Moreover, within regions, more quantity is routed to high selling stores.

Supply chain interaction

Company B works jointly with its downstream partners (brands, departmental stores, mass merchants) for product development and maintenance for both licensed products as well as for private labels. Joint efforts are carried out for strategic planning as well as tactical

planning. Strategic planning includes developing joint strategies which include developing new products, developing new capabilities and looking for new partners, based on market trends. Company B went into international expansion to set up a manufacturing facility in Central America in order to feed their customer's expansion in Central American market. Company B works jointly with its customers for developing product lines based on the market feedback and developing sales plans for different seasons.

Company Bs' major customers keep track of their vendors' financial performance as well. Company B has never faced a need of any financial assistance from their downstream partners but their customers have often lent a helping hand to their other vendors in their time of need. Similarly Company B monitors the financial health of its vendors and often helps them out financially when needed. Financial help is provided mostly in shape of making advance payments to their vendors.

Company B shares its strategic plans with its vendors. These plans are shared through quarterly or sometimes even bi-weekly meetings. These meetings are carried out in person or via conference calls.

Company Bs has a strategic relationship with its customers as opposed to tactical and order based relationship. The focus is on reducing the cost of the entire end to end process and ensuring the availability of goods with minimum inventory in the pipeline. Price once agreed is seldom revisited unless there are drastic changes in the raw material prices which bring both parties to the table for a just resolution of prices.

Company C

Company background

Company C specializes in the athletic, custom, uniform and novelty sock markets. Founded in 1980s, the company has become one of the major suppliers of collegiate logo socks in the United States with annual turnover between \$10-100 million.

Company C manufactures products under different brands. For one of its brands, the customers have the opportunity to build and design sock products specifically to meet their needs. Customers can provide their own designs or utilize the company's design team to customize products. Under this brand, customized products are manufactured for the collegiate market, school uniform and athletic market, corporations and private interests.

Another brand provides consumers with the performance they require on the athletic field or in the gym at an affordable price. The products include technology for improved fit and comfort as well as high performing yarns, moisture management and durability. This brand caters to various categories of sports such as soccer, baseball, basketball, football, volleyball, etc.

Customers

Company C distributes its products through sporting goods retailers, college bookstores, mass merchants, grocery stores and drug store chains. One third of its products are routed via the book store channel, one third are routed as private labels of independent wholesalers

through mom & pop store and the remaining one third are routed through convenience stores and drug store chains. It also sells its collegiate products to one of the leading mass merchant.

College book store category is further subdivided, on the basis of management and ownership, into stores that are managed by organizations operating multiple stores versus stand alone stores operated by the universities. One of Company C's major customers is a national book store chains that is the biggest college book store operator in the United States. This store operator has divided its stores into different categories based on store size. The core products for these stores are ordered and managed by the operator. However, the store managers also have the authority to place orders, up to a certain amount, directly to Company C, based on their judgment. This operator uses an automatic replenishment system for maintaining inventories in the stores. Once the inventory falls below certain amount, an order is initiated with Company C. The inventory levels are set for each category of stores based on their size and store traffic.

Company C also sells to other organizations that run a number of stores. In addition, there is a large number stand alone stores which contact Company C directly for their merchandize. Based on their purchase history and fashion trends, Company C offers them alternate designs as well.

Private label wholesalers consist of another category, which further sell their products to mom & pop stores. Company C offers them new designs every season based on the fashion trends. They place small orders and require a four weeks turnaround time.

There is a category of specialized apparel stores with their major business coming from college apparel sales. These also carry other accessories such as socks with college logos, but these accessory products represent a small proportion of their total sales. They place their orders directly with Company C.

Company C also sells their college logo socks to a leading mass merchant, which comprises 10-15% of its sales. Individual stores carry collegiate products for universities around those stores.

Designs

Company C has a design team that designs new products based on the regional as well as national fashion trends and these products are offered to their customers every season. These involve new designs, patterns and colors for the college products.

Sourcing strategy

Company C manufactures three fourths of its sales volume in its own manufacturing facility while outsources the rest of the production to offshore facilities mainly in Asia. It operates on a lead time of four weeks for repeat orders while it adds additional two weeks for orders requiring new artwork. Company C does not have any order minimums. Company C's position in its value chain is shown in Figure 7.

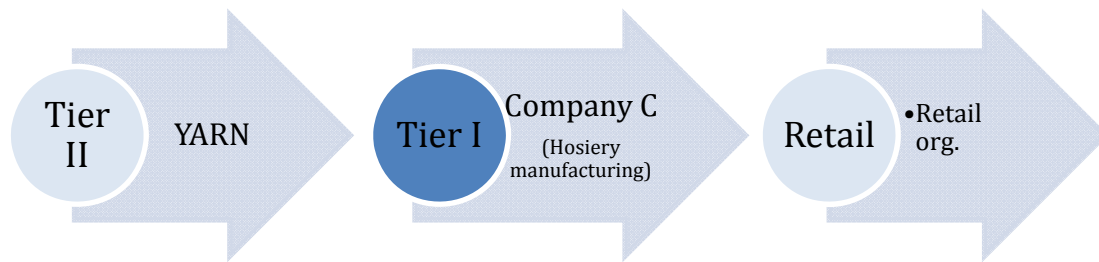


Figure 7: Value chain for Company C

Raw material procurement

Company C places its orders for yarns based on its order trends and historical sales pattern. The procurement lead time from most of the yarns it buys is greater than one month. As a result Company C places its orders for yarns well in advance of their usage and without having concrete knowledge of order placements. At any given time, Company C carries over one hundred colors of yarns in its inventory to fulfill downstream demand. Company C's purchases are a fraction of its suppliers' sales and it does not have any information integration with its upstream suppliers.

Postponement application

Product development postponement

New products are developed and presented to the customers by Company C on seasonal basis. It makes use of its past sales and current fashion trends to design new products. One of its major customer shares their sales reviews with company C on regular basis. It helps them

in identifying the designs that perform well in the market later to be used as the basis for new developments. However in the case the customers do not provide any feedback, company C proceeds with its own judgment for assessing new trends and downstream requirements.

Manufacturing postponement

The production time lines for Company C require it to purchase its raw materials based on forecast and adopt manufacturing postponement. The design element does not allow Company C to proceed before order confirmation while the long lead times for the raw materials do not let it to postpone raw material purchase until it receives order confirmations.

Logistics postponement

Company C sales to the mass merchant are through individual stores, which contact Company C directly and requires it to turn around the order within a week's time. In order to cater to their demands, Company C carries finished goods inventory for these individual stores and dispatches the goods from this stock once its receives orders from the individual stores. The inventory is maintained on the basis of the sales history to individual stores.

Supply chain interaction

College book stores

The large book store chain has recently started to give Company C more visibility into its sales patterns and efforts are being made to share point of sale data between the two organizations. These two organizations do not have point of sale linkage, but Company C

does get point of sale information, however the information lags in time. In addition, Company C also has an analyst located at the customer's site to feed information. The Company C's sales team meets with the customer as well as the store buyers twice a year in order to gauge reaction to new styles and designs. Company C enjoys a cordial relationship with this organization. Based on the company's observations and suggestions about the problems in the inventory system, the store operator made changes in the system that improved coordination between the two organizations.

For the rest of the college stores, Company C does not have any operational linkage with them and cannot access their sales trends. These stores place orders directly to the company which it turns around in four weeks. However, often times such stores run out of inventory and individual stores have to wait till the next shipment.

Apparel stores

These stores do not have sophisticated replenishment systems and often run out of their products in socks category. Company C does not have any communication linkage with these stores. The main reason cited behind this lack of integration was technology and cost. Company C has offered these stores to set up a feed system to manage inventory levels.

For one of their larger customer, with whom Company C has a prior history of working and has knowledge of their historical sales trends, it knits the products ahead of time to cater to the demand surge which occurs around August, their peak season.

Mass Merchant

Company C does not have any sort of informational linkage with the stores to access the inventory levels and sales trends at the store level.

Company D

Company background

Company D is one of the leading life style companies in the fashion world. It owns multiple brands targeted towards the high end fashion savvy consumers with annual turnover of over \$1 billion. It focuses primarily on men and women apparel. In addition to these divisions, it has footwear, dresses, collection and leather divisions. Within every division, Company D has sub categories targeted towards different segments.

Company D reaches its consumers via company owned stores in the US and around the world. It is expanding its reach to the international consumers by opening stores in Europe and Asia. Company D label is also sold via upscale department stores such as Macy's, Dillard's, etc. The merchandise to be presented on the retail shelves is also advised by the Company D team in most of the cases in department stores. In addition, it operates an online site for consumers to make purchases from home.

Company D maintains distribution centers in the Eastern region of the United States, where it consolidates the shipment coming from different parts of the world and dispatches them to the stores in different part of the US. Almost 60% of its products are routed through its

distribution centers while the rest go directly to the retail locations using the services of third party logistics.

Sourcing Strategy

Company D outsources 100% of its merchandize. It contracts with apparel manufacturers around the world. 80% of its merchandize is sourced from Asia countries, with major portion coming from China. The rest of the merchandize is sourced from the Americas. In addition, it sources high priced upscale products from Europe. These comprise 1-2% of its total merchandize.

Company D operates sourcing offices in Asia and Europe. Company D is adding other Asian countries such as Sri Lanka, Bangladesh and Malaysia, to its supply base. This strategic decision to expand supply base was based on different factors including price, political situations, trade legislations and risk mitigation. Company D's position in its value chain is shown in Figure 8, with shaded circles highlighting activities under its ownership.

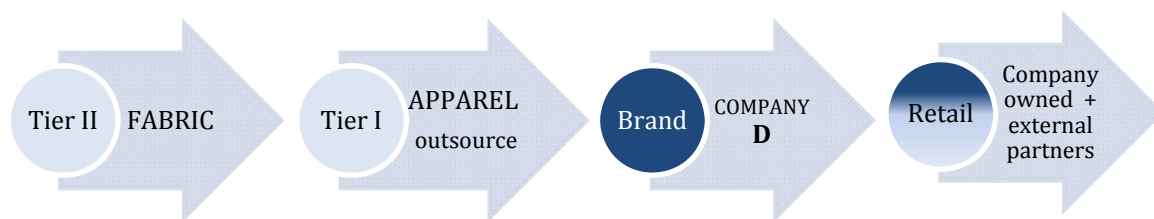


Figure 8: Value chain for Company D

Postponement application

Product development postponement

Company D is a design driven company with a high emphasis on quality. The design team initiates the concepts for new products. The designers seek inspiration from the latest fashion trends around the world, their internal library and from the vendors as well. The product development team works with the fabric mills and the apparel manufacturers to initiate ideas, to develop prototypes and to streamline processes.

The concepts are converted into prototypes in sixty to ninety days depending on the complexity of design and raw materials used. The prototypes also undergo different testing procedures to ensure product integrity. The design and sale team review the marketing aspects of the prototypes. Once approved, the prototypes are handed over to the sourcing team. The entire process, from concept to store shelf could take anywhere around ten months varying with the product complexity and scope. The high end labels can take even longer to reach the shelves. During the development process, the product development team also works on pricing issues with the fabric and apparel vendors.

Purchasing postponement

Once new developments have been approved and selected, the sourcing team issues purchasing orders to the apparel manufacturers. The purchase orders are issued three to five months in advance of the required delivery times. The sourcing team specifies the fabric

source to the apparel manufacturers but the purchasing orders for the fabric are issued by the apparel manufacturers.

Majority of the product lines are developed for every season and do not fall under replenishment program i.e. there are not any repeat orders. However, Company D's iconic products such as the golf shirts and the khaki trousers are managed as carryover orders under replenishment programs. However, these are not managed on continuous replenishment cycle, rather the sourcing team places orders based on the purchasing patterns at the retail locations. The apparel vendors for these programs do not have access to point of sale data, but they build inventory based on sales history.

Supply chain interaction

Company D works on longer term relationship basis with its vendors with bulk of their sourcing coming from a limited number of suppliers as compared to the total size of the supply base. Since the orders are placed for every season, with limited number of carryover items, Company D reserves capacities with its apparel vendors in advance for every season. Some of its apparel vendors work exclusively for the company while rest work for other customers as well but have dedicated lines and capacities where only Company Ds products are made.

The company is not linked to its apparel vendors via any Electronic Data Interchange linkage and hence its vendors are not able to track the sales trends. The vendor base has different

software platforms and technology is considered as one of the main hurdles in integrating the supply base.

For the replenishment categories, Company D works with two to three large apparel manufacturers. These manufacturers are selected on the basis of the capabilities such as capacities as well as their locations. Price negotiation process is based on mutual agreement and a 'win-win' scenario is sought during the process.

The company provides assistance to its fabric and apparel vendors when required. The assistance is provided in areas such as washing and dyeing capabilities. At times Company D also recommends operational consultants to its vendors to assist them in their process improvement activities.

Company D adds new vendors in its supply base through a rigorous review process. Information regarding vendors' financials, processes and supply chain are sought before adding them in the supply base. Company D has the policy of helping out strategic suppliers when in distress to keep their sources secured.

The company coordinates with its key fabric and apparel vendors regarding the business outlook and its vendors make investments in areas such as printing, embroidery, technology, when required. The company shares strategic information such as market outlook and future visibility with its large vendors.

Conclusion

The textile and apparel industry is characterized by short product life cycles, high product variety (Bruce et al., 2004) and increased competition. To stay competitive the extended organizations have to match supply and demand to reduce obsolescence and opportunity cost. This paper presented four case studies in the textile and apparel industry. Analysis of four companies highlighted two examples of logistics postponement, three examples of manufacturing postponement, one example of purchasing postponement and three examples of product development postponement. The nature of product and downstream demand impacts the choice of postponement strategy. Company D operating in high fashion segments with majority of products with new designs for every season has to wait till the designs and styles are finalized before placing orders. This is because of the volatility of consumer demand that makes it difficult to commit designs and fabrics in advance. However, to ensure enough capacities for a season, company D reserves capacities with its vendors in advance of every season. Company A on the other hand has a range of products ranging from new styles to repeat designs for every season. For newer products it operates with product development or purchasing postponement but for carry over orders it works with manufacturing postponement with its fabric vendors working on advance forecasts while its apparel vendors proceed after style and order finalization. On the other hand Company B operating in commodity markets holds in-process and finished goods inventory for most of its orders before orders are finalized, and uses manufacturing and logistics postponement to optimize its supply chain. Companies operating with manufacturing and logistics postponement share

data across their supply chain extensively while companies adopting purchasing postponement work towards fostering relationships across their supply chains.

The preliminary findings deviate from the ones concluded by Yeung et al 2007. According to them, supply chains with imbalanced power structures i.e. supply chains with one leading organization in terms of power, should follow product development and purchasing postponement while supply chains with balanced power structures should follow manufacturing and logistics postponement. Company B, while working with a big mass merchant, which has the lead role, adopts logistics and manufacturing postponement. Similarly Company A postpones its manufacturing operations despite being one of the largest apparel organizations in the world. Although the data collected for the cases did not focus on the power and dependence aspects, and focused more on the interaction routines, this lack of agreement with the earlier studies warrants further research in the area of postponement enablers in the supply chain structure.

Contribution

This paper has sought to contribute to the application of postponement in the textile and apparel industry. The cases illustrate the use of different postponement strategies depending on the nature of products and downstream demand. The cases have also shed some light on the supply chain structures supporting different strategies. It is proposed that further research should be carried to enhance scholarship exploring supply chain relationships for individual postponement strategies and to assess if regional differences exist across the globe and

whether there exist inter industry differences. Moreover the companies considered for this research had different distribution channels, further research is needed to assess if the differences in distribution structure impact the postponement applications. In addition, it remains to be ascertained as to how the difference in value chain structures i.e. the number of tiers (for example, apparel versus hosiery) affects the postponement strategies.

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CHAPTER III - POSTPONEMENT AND SUPPLY CHAIN STRUCTURE

Introduction

Matching supply with demand is a challenging task especially for industries where supply is planned well in advance of the actual occurrence of the demand (Cachon & Terwiesch 2008). Taking a firm position on order placements can either result in supply falling short of actual demand with opportunity lost for sales or demand falling short of the supply with left over and excess inventory with decreased selvage value (Cachon & Terwiesch 2008). Both of these scenarios can impact business negatively by either resulting in unsatisfied customers turning to competitors or loss in terms of disposing excess inventories.

There could be different strategies to deal with this situation. One of such strategy is delaying the product differentiation and holding inventory at a generic level, which can be used later without any loss in actual value, till more information is available on downstream demand. This delayed differentiation is termed as postponement (Cachon & Terwiesch 2008).

The literature further distinguishes between various types of postponement depending upon the activities that are postponed till the availability of further information. Logistics postponement is where goods are made to forecast but are dispatched based on actual demand or order confirmation. Manufacturing postponement is where the raw materials are purchased based on a forecast but the manufacturing activities are carried out based on actual demand. Similarly purchasing postponement is where the procurement of raw materials is

done based on the order. In the case of product development postponement even the design activities are postponed till order placement (Yang & Burns, 2003).

Postponement has remained an active area of research in operations management area. Some studies have explored the factors affecting the choice of postponement strategies such as lead time, demand variability, product life cycle and product characteristics (Battezzati and Magnini, 2000; Aitken et al., 2003; Olhager, 2003; Yang et al., 2004; Yeung et al., 2007). Some studies have looked at implications of different postponement strategies, such as cost implications (Pagh & Cooper, 1998) and manufacturing implications (Skipworth and Harrison, 2004). Other studies have looked at the impact of relationship structures (Yeung et al. 2007) and power structures (Krajewski et al. 2005) on postponement implementation.

Significance of study

Lack of industry specific analysis has been emphasized by many researchers (Van Hoek, 2001; Chiou et al., 2002; Yang and Burns 2003; Krajewski et al., 2004; Yang et al., 2005; Boone et al., 2007; Garcia-Dastuge and Lambert 2007; Yeung et al., 2007).

Mostly automotive, computers and electronics industries in assembly sector have been covered in the research on postponement while the manufacturing sector needs further exploration. The textile and clothing industry present excellent opportunity for research, given its product variety, complexity and global supply chain settings. The length of apparel supply chains starting from fibers and yarns presents opportunities to study the upstream implementation of postponement strategies as well.

Research papers on textiles and apparel industry during the past decade have explored the areas of supply chain performance and the use of e-commerce. Dickerson et al. (2004) have explored the determinants of e-commerce adoption in the US apparel industry. Cagle and Hodge, (2004) have developed a taxonomy of e-business models being used in the textile industry. However these papers have not looked at the particular impact of adopting e-commerce models on postponement strategies. On the other hand studies exploring the supply chain areas in textile and apparel industry have mainly looked at the sourcing patterns (Gereffi, 2001), impact of fast fashion on supply chain practices (Barns and Lea-Greenwood, 2006), cultural impact on supply chain performance (Chen et al., 2007), coordination mechanism through vertical integration, coordination and third party sourcing (Cao et al. 2008), management of communication across UK retailers and Chinese manufacturers (Chen et al. 2007) and buyer's relationship quality perception with suppliers (Choo et al.2009). Only two studies (Bruce et al., 2004, Lam & Postle, 2006) have looked at the adoption of supply chain strategies in the textile and apparel sector. Bruce et al. (2004) have discussed supply chain strategies using four case studies in the textile and apparel sector. They have highlighted lean, agile and le-agile approaches. However even for the two examples on le-agile approaches, only the sourcing, manufacturing and relational aspects have been highlighted, without exploring the implementation of postponement strategies. Lam and Postle (2006) have used Fisher's model (Fisher, 1997) of efficient versus responsive supply chain strategies. They have highlighted the importance of holding work in progress inventories (greige goods) along with the significance of information sharing for a responsive

strategy. The adoption of postponement strategy in the textile and apparel sector needs further research to bring it at par with research carried out in IT and automotive industries.

One of the existing studies on implications of postponement on supply chain structure was carried out on Chinese companies around the Pearl River Delta. Yeung et al. (2007) proposed that in case of a balanced supply chain relationship, either speculation (no postponement) or production postponement should be adopted. They have argued that to adopt postponement, a close relationship is required among the supply chain actors, however, in case of a balanced structure information exchange tends to be more difficult to be practiced and the players tend to live in their silos. Hence a speculation based strategy works under such scenarios. However in case of a balanced structure and if information exchange pattern can be established, it would enhance the opportunities to adopt postponement and the supply chain as a whole would gain from it.

In their other proposition, Yeung et al. (2007) observed that in the case of an unbalanced supply chain structure, either purchasing postponement or product development postponement have served the players better. According to them, an unbalanced supply chain has one company in leading position because of its market power and because of that it can force other players to share information and adapt their processes best suited to its schedules. This enables the supply chain actors to develop close relationships, which in turn makes a high degree of postponement more suitable to be adopted.

Yeung et al's (2007) study was not an industry specific study with subjects ranging from electronics, toys, shoes and apparel categories. There was one case study on a firm in textile and apparel sector which worked as a turnkey shirt manufacturer.

The authors of the study highlighted the need to identify whether region specific or industry specific patterns existed. Secondly the model in terms of its usefulness was more of an academic nature only, since the structure was assessed on the basis of dependence, which for short to medium term is considered something external to an organization's control. There is no solution for an organization wanting to move from one postponement strategy to another. Similarly there has not been any differentiation made between product development and purchasing postponement strategies and manufacturing and logistics postponement strategies.

Research Purpose

The purpose of this study is to define the current situation of postponement application in the US Textile and Apparel industry, assess the barriers and the relationships among the supply chain partners, the industry's response to the barriers and to develop a conceptual model for aligning supply chain strategies in US textile and apparel industry for postponement application.

The study would help practitioners identify requirements from their supply chain structures based on their postponement strategies and would aid them in make necessary changes in order to better align their supply chain structure to the support the application of postponement strategy.

The decision making process would be facilitated by a conceptual model that would address the interaction between the postponement strategies and relationship structure. The model would help to identify a suitable supply chain structure supporting a particular postponement level. The purpose of using the relational constructs, instead of dependence based constructs for this study, is not only to differentiate between the four postponement strategies identified earlier, but also make it useful in terms of its application for organizations to align their postponement strategies with corresponding supply chain structures.

Relationship structure

Current economic environment is categorized by scarce resources, increased competition and faster rate of change (Lambert et al. 1996). Rapid changes in technology, competitive environment and other pressures are making organizations realize the importance of developing cooperative relationships such as alliances, partnerships and network organizations, with other firms (Ring & Van de Ven 1992).

Partnerships help reduce cost and time to market, achieve better service and quality. Relationships can be costly and still might not achieve the desired results (Rinehart et al. 2004). As a result executives are looking towards partnerships as a source of competitive advantage and the ability to develop and sustain a partnership that gives organizations a competitive advantage (Lambert et al. 1996). Collaboration and partnerships are becoming the main focus in gaining competitiveness (Donaldson and O'Toole, 2000). However to develop and sustain a partnership has cost attached to it which dictates that all relationships

should not be pursued as partnerships rather the need for partnership or level of partnership should be dictated by the need and purpose (Lambert et al. 1996). (A more detailed version of relationship structures is given in the Appendix IV)

Relationship Attributes

All relationships have some basic attributes which differentiate between the strength and level of a relationship.

Trust

Trust is the willingness to rely on the exchange partner and to have confidence in that partner. It is the expectations about exchange partner's expertise, reliability and intentionality (Ganesan, 1994). The presence of trust makes the environment suitable for making relation specific investments. It also promotes more informational transparency.

According to Ganesan (1994), reputation of exchange partner, satisfaction in prior exchanges and experiences and specific investment made by the partners act as antecedents of trust. Ganesan (1994) has also divided trust into two components, which are credibility and benevolence. Credibility is measured through expertise, reliability, consistency, stability and control; whereas benevolence consists of motives, intentions, and characteristics attributed to the partner.

Commitment

Relationship commitment is the willingness to invest in relationship specific resources. Relations specific assets or asset specificity is referred to investment in partner specific physical or human assets whose redeployment involves significant switching cost (Kwon & Suh, 2004). Commitment has been classified into normative and instrumental commitment. Normative commitment is a mutual commitment between exchange partners based on sharing of relationship specific resources from both sides. On the other hand, instrumental commitment is the commitment or investment made by one partner based on the influence of the other partner. According to Zhao et al. (2007), normative relationship commitment by the supplier will have a stronger impact on the customer integration than instrumental commitment from the supplier.

According to Dyer and Singh (1998), greater investment in relation specific assets would result in greater protection against opportunism which would increase the volume of exchange.

Communication

Trust and electronically mediated exchange (internets, intranets, electronic mails or electronic data interchange) act as antecedents for collaboration in the supply chain. Supply chain literature has considered information technology as an important determinant in developing an integrated supply chain structure (Kwon & Suh, 2004, Myhr & Spekman,

2005). Information sharing results in reducing stock outs as well as safety stocks (Ghosh & Fedorowicz, 2008)

The attributes of info exchange include depth, intensity and sharing mechanism (Ghosh & Fedorowicz, 2008). The depth is defined by the levels of management (top, planning, operational) at which information is exchanged. Intensity is concerned with the frequency of information exchange. Sharing mechanism not only concerns the physical structure, i.e. the hardware part, but also the routines as well.

Joint activities

Joint activities are those where the exchange partners combine resources (physical, monetary and especially human), to work jointly towards mutual goals. Joint activities create greater integration between the exchange partners (operational as well as cultural) which help enhance collective performance. Such activities also reinforce the trust and relationship strength and develop understanding at organizational as well as personal level. These activities include design and development, analysis and cost targeting, long term planning etc. (Heide and John, 1990).

Contracts

Contracts highlight authority and responsibility structure and help in sharing risk across partners (Ghosh & Fedorowicz, 2008). According to Lambert et al. (1996), the type of a contract tells a lot about a relationship with strong relationships being governed by least

specific or unwritten agreements. In such cases contracts evolve into relationship guiding principles with more emphasis on relationship strengthening and less emphasis on price.

Expectation of Continuity

It is the perception of bilateral expectations of future interactions and the anticipated duration into future rather than historical duration to date. This perception increases the extent of joint action (Heide & John 1990). Investment in relationship specific assets acts as an indicator of expectations and intentions regarding continuity of relationship.

Dependence

Dependence is the extent to which the resources provided by the supplier or the customer (sales avenue) are critical and for which there are few alternatives available (Duffy, 2008). The magnitude of dependence is measured by the proportion of purchase or sales from a particular supplier or to a customer to total purchase or sales.

Typologies

This section highlights the relationship typologies identified in various studies. The constructs used in developing the typologies have also been summarized here.

Tangpong Model

Tangpong et al. (2008) used relational constructs such as relational norms, trust, information exchange and long term orientation as well as power constructs such as dependence to classify the relationships into market, power, autonomous and constrained relationships.

Humphries Model

Humphries et al. (2007) used creativity, stability, communications, reliability and value as their relationship classification constructs to classify relationships into poor, evolving, moderate and good relationships.

Donaldson & O'Toole Model

Donaldson & O'Toole (2000) used relationship strength to classify their relationship model. Relationship strength takes into account the behavioral process as well as the economic content. Behavioral process variables focused on the social process of exchange and were characterized by trust, commitment, cooperation, mutuality and equity. The action part of the relationship captured the economic content and was measured by nature of help rendered, action taken on requests, joint dispute resolution, nature of agreements (formal or informal), information sharing, investment in resources and if adaptations were made in relationship. They classified relationships into bilateral, recurrent, dominant partner and discrete relationships.

Ring & Van de Ven Model

Ring & Van de Ven (1992) typology used risk and trust as the variables for defining relationships. They proposed four structures based on different levels of risk and trust. They proposed market based structures for low risk and low trust situations, hierarchical structure for high risk and low trust situations, recurrent contracts for low risk and high trust situations, and relational contracts for high risk and high trust situations.

Duffy Model

Duffy (2008) used relational constructs to classify relationship types. These included trust, commitment, relational norms and conflict resolution and classified relationships into limited coordination, high coordination and partnerships.

Rinehart Model

Rinehart et al. (2004), used trust, interaction frequency and commitment for classifying their relationship typology. They classified relationships into non strategic, administered, contractual, specialty contract, partnerships, joint ventures and alliances.

Lambert Model

Lambert et al. (1996) used planning, joint operating control, communication, risk/reward sharing, trust and commitment, contract style, scope and financial investment as the key attributes to classify the relationship structure. Planning was measured based on the style, level and content while for communication they measured the routines, balance of communication as well as the mechanism. Contract style was measured through time frame and coverage, while for scope they measured the share and the value added. Investment was measured based on financial, technology and people. They classified the partnership types as under:

- Arms length: These are non strategic exchanges of generic products with availability of multiple sources. Parties involved treat these as one time event with the primary focus towards cost.

- Type I: These are limited partnerships with a short term focus. Partners involved in this exchange coordinate activities and planning and such exchanges generally involve single divisions within each organization.
- Type II: The exchange partners move beyond coordination toward integration of activities with a long term focus. In this type of partnership, multiple divisions or functions are involved with the partnering firms.
- Type III: In this type of relationship, partners share operational integration and see other party as an extension of their own firm (Lambert et al. 1996).

The Type III relationship was followed by joint ventures and vertical integrations in Lambert's typology, however the focus was to categorize the supply chain partnerships only.

Classification selection

The relationship typologies presented can be categorized into two types. One which categorizes the relationships in terms of qualitative variables such as poor relationship, bilateral relationships etc (Tangpong et al 2008, Humphries et al 2007, Donaldson and O'Toole 2000, Ring & Van de Ven 1992), while the other which categorizes relationships in terms of content variables, for example, contractual, administered (Rinehart, 2004), coordination (Duffy 2008) and Type I, Type II (Lambert et al, 1996). Of these two, the second category of typology was selected for this study because of its objectivity which would make its practical interpretation easier and measureable.

Of the three typologies falling in the content category (Rinehart, Lambert, Duffy), Lambert's typology was selected to categorize the relationships for this study. Rinehart's typology had seven categories which could make data codification more difficult, while Duffy's typology had less details in terms of relationship codification process as compared to the process presented in Lambert's study, which is shown in Appendix III.

Methodology

Given the preliminary stage of research in the postponement and supply chain area, qualitative research method was chosen for this study. Qualitative method of research focuses towards exploring phenomena and theory building where there is a lack of existing theories (Creswell, 2003). Within the qualitative research area, it was decided to adopt the case based research methodology, since the purpose was to develop an understanding and a clear picture of a phenomenon (McCutcheon and Meridith 1993).

Case study limitations

Case based research has certain limitations when compared to other quantitative methods. These include time requirements, contacting companies, identifying relevant contacts and getting appointments. In addition, there are still other concerns that have been raised against the case method design. These include lack of rigor and statistical generalization, sample size, lack of establishment of causal relationship, convenience sampling and researcher's biasness. However a thorough study design and process can make case based research more rigorous and reliable (McCutcheon and Meridith, 1993; Yin, 2009).

Population

For this study the population was defined as the organizations falling under North American Industry Classification System (NAICS) code 424320 and 424330 which include Men's/boy's and Women's/child clothing and accessory merchant wholesalers. The search was narrowed down to the establishments in this category in North Carolina. The search was further narrowed down on the basis of size of the organizations and only those companies were included which exceeded annual sales of \$20 million or had over fifty employees. Based on this list, the leading companies on both scales were contacted for developing case studies. It was tried to have some diversity by not developing case studies on organizations dealing in similar product categories. Based on the principles highlighted by Yin (2009) and the number of cases used by Skipworth and Harrison (2004), it was decided to develop three to six case studies based on willingness of the participants as well as the time constraints for the study.

Case Data

Before the data collection stage, the research purpose, methodology and the protocol were presented to the Industrial Review Board (IRB) for review and approval (Appendix II). The protocol was used as an interviewing conducting guide to maintain reliability during the data collecting process. The questions in the protocol act as reminders and help to keep the investigator not to miss out on any required information (Yin, 2009). The questionnaire in case of case study research is different from survey tool and is supposed to be flexible

enough to incorporate the emerging issues during the data collection process. The categories in the protocol (Appendix I) consisted of the relationship attributes used in the literature namely trust, commitment, joint activities, communication, contract type and orientation. Before using the protocol to conduct the case studies, it was tested with the industry experts, faculty members and through a pilot study. Based on the feedback, certain changes were made in the protocol. The major change was eliminating the questions pertaining to the perception regarding the dependability and trustworthiness of a supplier or a customer. Structured interviews were conducted with senior management personnel including President and Vice Presidents at the selected companies.

These interviews were conducted either over the telephone or in person. After the interview, the data was structured in the form of case studies and submitted to the respondent for review and consent. The details of the case studies have been presented in paper on postponement applications in the textile and apparel industry (See chapter 2). The case data collected is summarized in the Table 2. The columns represent the relationship attributes for which data was collected during the interview and is based on the protocol categories. The first four columns describe the company details and the postponement strategy example, while the attribute columns describe the content of relationship for the particular value chain which implements the said postponement strategy.

Table 2: Case descriptions

Case	Product/ market	Prod type	Linkage	Strategy	Communication	Joint activities	Commitment	Contract	Orientation
A	Apparel	Fashion	Upstream	Prod dev postponement	Strategic long term vision sharing Concept sharing Tactical level info exchange All levels of management	Product development	Company A provides technical and financial assistance Order placements	Less specific Win-win	Long term strategic orientation Company A major customer
	Jeanswear	basic	Upstream 2 nd tier	Manufacturing Postponement	Strategic info exchange Planning/forecasts info Seasonal forecasts Production flows One year advance visibility	Joint problem solving	Both sides committed Company A - ensures order placements and helps in case of unused inventory	Long terms hand shake based	Partnerships Long term
	Apparel	Fashion	Upstream 2 nd tier	Purchasing postponement/ Manufacturing Postponement	Advance forecasts are provided prior to purchase orders Tier 2 vendors hold work in process inventory Tactical level info exchange All levels of management	Joint problem solving	Company A helps in case of unused inventory Order placements Company A provides technical and financial assistance	Less specific Win-win	Long term strategic orientation Company A major customer

Table 2 (continued)

Case	Product/ market	Prod type	Linkage	Strategy	Communication	Joint activities	Commitment	Contract	Orientation
B	Socks	Basic	Down- stream	Manufacturing Postponement	Strategic level as well as tactical level POS data access Inventory level info At multiple management levels	Strategic planning Trend analysis Forecasts Product development and reviews Cost reduction	Product management activities handed over to vendor Manufacturing locations Technology investment	VMI Long term	Strategic
	Socks	Basic	Down- stream	Logistics Postponement	Strategic level as well as tactical level POS data access Inventory level info At multiple management levels	Strategic planning Trend analysis Forecasts Product development and reviews Cost reduction	Multiple distribution centers	VMI Long term	Strategic

Table 2 (continued)

Case	Product/ market	Prod type	Linkage	Strategy	Communication	Joint activities	Commitment	Contract	Orientation
C	Socks	New designs on a basic product	Down-stream	Manufacturing Postponement/ Product development postponement	Strategic as well as tactical Automatic inventory and replenishment system Lagging POS data Analyst co-located at customer's site Product sales reviews	Inventory planning Sales performance reviews	Continuous efforts from both sides to improve processes	Less specific	Partnership
	Socks	New designs on a basic product	Down-stream	Manufacturing Postponement	Little to none Order placements No visibility into sales pattern	Little to none	Little to no commitment	Contract specific	Order to order
	Socks	New designs on a basic product	Down-stream	Logistics Postponement	Order placements No visibility or POS information	None	Holds inventory 1 week order turnaround	Contract specific	Vendor-buyer

Table 2 (continued)

Case	Product/ market	Prod type	Linkage	Strategy	Communication	Joint act.	Commitment	Contract	Orientation
D	Life style apparel	Fashion, Seasonal	Tier 1 & 2	Prod dev postponement/ Purchasing postponement	Business outlook sharing with key vendors Visibility of orders shared with key vendors	Product development Process improvement Product enhancement	Company D reserves capacities in advance Company D provides assistance in technical areas and recommends consultants Company D works with limited number of suppliers Financial help for strategic supplier when needed Vendors make investments on recommendations from Company D	Order based	Company D is the major or only customer for all vendors
	Life style iconic	Fashion/ Carry over	Tier 1 Vertical operators	Purchasing/ Some manufacturing postponement	Business outlook sharing with key vendors Visibility of orders shared with key vendors Vendors do not have access to POS data	Forecasts Process improvement Product enhancement	Vendors hold inventory based on sales history Vendors make investments in operational areas on recommendations from Company D Limited vendors	Win-win	partnership

Cross case analysis

The examples within the individual cases have been arranged across the axes representing postponement and relationship types as shown in Figure 9. The relationship axis represents the supply chain partnerships based on the typology presented by Lambert et al. (1996). Multiple examples of postponement application were found within each company in the sample. The highlighted boxes in the Figure 9 indicate the presence of an example in the data set.

Partnership types	Type III				
	Type II	Company B	Company A, Company B, Company C	Company A	Company A, Company B, Company C
	Type I			Company D	Company D
	Arm's length	Company C	Company C		
		Logistics postponement	Manufacturing postponement	Purchasing postponement	Prod. Dev. postponement
		Postponement types			

Figure 9: Case example shown across relationships and postponement types

Relationship categorization

The companies in the sample presented multiple examples of different postponement strategies for various categories of products. Some companies adopted different strategies within the same value chain while others had different value chains for every strategy. The vertical scale of the matrix was slightly changed from the Lambert's scale (Lambert et al 1996) based on the data and represent relationships that were observed in the data sample.

For company A, its supply chain relationships were found to be as per Lambert's definition of Type II relationships. The feature of this interaction included information exchange at strategic and tactical level, joint planning, advance visibility of requirements, joint problem solving, long terms placements and consumption of unused inventory, open contract type and long term orientation.

Company B's relationship with its downstream partners was also found to be close to Type II relationships of Lambert's typology. It had all of the attributes on company A's relationship but in addition it was also linked to the POS locations of its customers and it worked jointly with its customers for planning and projections. Although its interaction was more integrated and at a higher level than company A's in terms of informational linkage, yet it was not at Type III level in which different constituents of the value chain operate like one organization.

Similarly one of company C's value chains was found to be close to Type II relationships based on the level of integration and information sharing and the trust factor between the organizations. Although the POS linkage was missing, yet the organizations were involved in

data sharing, joint analysis and planning. Company C's relationships in other value chains were more as per arm length relationships as they involved spot transactions, no data sharing, and had a short term view.

Company D's relationships were observed to lay in between Lambert's Type I & II relationships. There was little sharing in terms of tangible information, however overall business outlook was shared with the value chain members. More efforts were made in commitments category with Company D making commitments for future order flows by reserving capacities and their vendors making investments where advised. It was more than Type I but lacked the integration found in other Type II examples.

Since most of the relationships fell in Type II category, it was deemed necessary to further differentiate among them to make the analysis more objective and clear for the users of the model. Type II relationships were further divided into data sharing and relational types based on the focus of the relationship. For example, company B's relationship was more geared towards information integration whereas Company D's was more commitment and relational based. Similarly data sharing based relationship was further divided based on the mechanism of information exchange. In the case of Company B, data sharing was through technological and POS linkage, whereas for one of the Company C's cases, it was without POS linkage and for Company A, it was in the shape of sharing advance forecasts. The updated model is shown in Figure 10. This would be useful for the managers while formulating relationships based on postponement strategies or for different categories of products.

Partnership types	Informational integration Type II	Company B	Company B		Company B
	Data sharing Type II		Company A, Company C	Company A	Company A, Company C
	Relational linkage Type I & II			Company D	Company D
	Arm's length	Company C	Company C		
		Logistics postponement	Manufacturing postponement	Purchasing postponement	Prod. Dev. postponement
		Postponement types			

Figure 10: Data representation across modified fields - General analysis

Logistics postponement

Company B has access to Point of Sale (POS) data of its customers. Based on the POS data, it plans and sources its replenishments. Once goods are ready, at their in-house manufacturing units or at their partners' premises, they are sent over to one of two distribution centers in the United States. During the course of the replenishment, the sales trends are updated based on the continuous feed from the POS data. Based on the updated sales trends and statistics,

goods are directed to one of the two distribution centers. Once goods have reached the warehouse, they are directed towards either the individual stores or local warehouses of downstream customers based on the inventory levels and sales projections at individual locations.

In the case of Company C, it also practices logistics postponement with one of its downstream customer which is one of the biggest mass merchants in the United States. Company C neither has any access to the POS data nor does the customer shares any trends and statistics with the company. Company C operates with a four weeks lead time, however this customer requires a one week turnaround time. Moreover because of the nature of the product, every store or a group of stores have products which are different from the products in the rest of the country. In order to fulfill one week turnaround requirement, Company C carries a finished goods inventory for the major groups of stores. The orders placed by the individual stores are the only stats available to Company C and it establishes the inventory level based on the order placements by the individual stores.

In case of the Company C's example, the inventory is carried based on the forecasts made by the vendor (Company C), whereas the customer (Company C's downstream customers) does not participate in the forecasting process. This forces the vendor to carry finished goods inventory all the time. Carrying finished goods inventory has a cost attached to it and in addition there is a higher chance of product obsolescence since the forecasts are not based on

real data and do not have the customer's input in them. At times this could also result in non availability of product in case of sudden shifts in the market trends.

The other two boxes, for which no example was available and which were not highlighted in the logistics postponement column, can be analyzed individually. These represent the interaction between relational supply chain and logistics postponement and Type II data sharing and logistics postponement. The data sharing Type II and logistics interaction can work only in case of slow moving goods or goods with stable demand pattern. However, excess inventory would have a cost attached to it which needs to be justified against excess investment in data sharing. Fashion products with short life cycles seldom have predictable demand which would make this box/strategy infeasible for fashion products.

The relational linkage would not add much value in the case of logistics postponement since it does not involve data sharing as one of its characteristics. Without data, inventory would have to be stored and that has a cost attached to it as explained earlier. However the amount of inventory can be reduced by holding it at a central location (Hopp, 2007), but in that case every individual location would be required to maintain a reorder point high enough to service customers during replenishment cycle thus increasing the inventory in the system. Moreover frequent replenishments of small shipments would increase the transportation cost as well.

Analyzing the logistics postponement column, the first row suits ideally for adopting logistics postponement and involves seamless data sharing from the POS location across the

supply chain. In the case of Company B's example, the manufacturing and assembly operations were vertically integrated and data was shared across the chain, whereas in the case of de-integrated supply chains, the data must be transmitted to the upstream level in order to service the customers with optimal inventory levels. One important aspect highlighted by the Company B's case was transfer of product maintenance to the vendor and that included self order generation by the vendors in the supply chain without waiting for customer's go ahead. This saves time as well as avoids duplication of efforts. Moreover Company B had made investment in setting up distribution centers to cover their downstream market. In terms of investment it would be pertinent to highlight that the size of an organization and its turnover plays an important role in determining the extent of investment. Company B's size and turnover made it economically feasible for it to invest in technology and infrastructure. On the other hand, for Company C or any organization of its size or smaller, investment in POS linkage might not be feasible based on the cost benefit analysis. Moreover the power structure in the value chain also impacts the choice of postponement strategy, for example, in Company C's case, its customer, the mass merchant had the clout to enforce its policies and made Company C adopt logistics postponement without the required data sharing.

For less fashion and more commodity type products having stable demand, data sharing without technological integration can also deliver although with certain demand and supply mismatch costs attached. The lower two boxes would be sub optimal with chances of obsolescence and stock out costs in addition to inventory carrying costs.

Manufacturing postponement

The data collected for this research had four examples for manufacturing postponement. Company B postpones manufacturing, under the replenishment programs, by buying yarn before the orders are initiated. Company B works on replenishment programs by breaking the flow of deliveries into different phases. Every phase is initiated after the sales data and inventory levels in the supply chain have been analyzed. Company B purchases yarn for every phase before the order for that particular phase is initiated. Sales projection trends developed by the analysts allow Company B to proceed with the yarn purchase before time. In addition to purchasing yarn based on forecast, Company B even proceeds with the knitting process for some products, before the orders have been initiated. Advance knitting is done for products which have a common platform, i.e. where same basic product is used in multiple derivative products that are required by different customers. In addition, the access to POS data and the sale trends also allows Company B to proceed with the knitting process.

Company A also uses manufacturing postponement for its products sourced from the Americas as well as from the Asian region. It coordinates the sourcing of the denim fabric from US suppliers such that the suppliers have the goods ready by the time they receive the purchase order. This is made possible by sharing the forecasts with the fabric supplier well in advance of the actual buying season. The suppliers proceed with the production plans based on the projections, but dispatch goods once purchase orders are received. The purchase orders capture the deviations in actual requirement from the ones in the forecast. The product

in this case is of basic nature with a life cycle spanning many years with minimal product changes and hence the minor deviations in forecasts do not have significant financial repercussions. Secondly the close interaction of the vendors with Company A, lets the vendors proceed with the production well in advance because of Company A's commitment to them even in case of changes in market forecasts. Similarly, for its products sourced from the Asian region, Company A coordinates with its tier I and tier II vendors for production forecasts and schedules. The purchase orders are placed with the apparel vendors (tier I) three to four months in advance of the required delivery dates, however Company A furnishes its tier I & II vendors with the first round of projections five to six months in advance followed by another update on projections before the order placements. By the time the purchase orders are placed, the fabric suppliers have the fabric ready to be dispatched to the apparel manufacturers. In this case the size of the Company A relative to its supply chain partners and its role as a channel leader also helps in coordinating and managing the operations it in terms of adopting manufacturing postponement strategy.

Company C also uses manufacturing postponement for its production. The impetus behind using manufacturing postponement is the short lead time required by its downstream customers. Company C works on a 4 weeks delivery time, whereas the lead time for its raw materials (mainly yarns of different colors) is four to six weeks. As a result, Company C has to place its yarn orders well in advance of the actual orders received from its downstream customers. The yarn orders are placed based on the forecasts and the projections developed by Company C for its downstream demand. The difference between manufacturing

postponement strategies of company A and C is that the volume is greater in the case of Company A and secondly the nature of product is such that it lets Company A hold inventories at intermediate stages such as yarn, un-processed fabric, dyed fabric, etc. On the other hand, in the case of Company C the volume is low and the process i.e. socks manufacturing, does not have intermediate stages to hold inventory.

Company C works with two types of customers for which it uses manufacturing postponement or for whom Company C buys yarns based on forecasts. One type has a close interaction with Company C, while the other has an only order based type of interaction. In the case of the customer with close interaction, Company C and the customer share strategic as well as tactical level of information. Company C has access to the sales trend data and has an analyst co-located with the customer to share trends and projections. These forecasts help Company C to plan its production and inventory requirements before the placement of actual orders.

On the contrary, for the customers who do not share any data on their sales trend, Company C has to plan raw material requirements on forecasts which are based on the order history of the customers. These forecasts do not incorporate the current market trends. As a result Company C has to carry extra inventory to cater to any unforeseen spikes in their orders.

Analyzing the manufacturing postponement column based on the data, seamless data sharing from the POS location across the supply chain, suits ideally for adopting manufacturing postponement. In case of Company B's example the manufacturing and assembly operations

were vertical, whereas in other case of de-integrated supply chains, the data must be transmitted to next tier at upstream location in order to gain advantage of data sharing and servicing the customers with optimal inventory levels. Similar to the logistics postponement case, the transfer of product management and maintenance to the vendor supported this strategy. For commodity type products that have some fashion content, such as new colors or design modifications, data sharing without technological integration (POS access) can also help to adopt manufacturing postponement although with certain demand and supply mismatch costs attached. However, in the case of Company C, where the products had some fashion content and manufacturing had to be initiated after the order placement, data sharing enabled better forecasting for raw material procurement. However for certain smaller customers which buy directly and do not have regular requirements, for example college teams or clubs or small institutions, they would always have an arm's length relationship with their product source while the source would still work on manufacturing postponement strategy.

Similarly in case of Company A, with an extra tier in their supply chain as opposed to the cases of companies B & C, it shares advance forecast based on the sales data with its vendors. This allows its vendors, especially upstream fabric manufacturers to make preparations earlier. The second round of forecast triggers production at tier II level where as the tier I waits for the actual purchase orders. However purchase orders are still based on forecasts and in most of the case ahead of the selling seasons. This highlights two aspects, one which is the lead time and transit time, which in Company A's case is greater than

company B & C's case and hence require them to initiate production earlier. Secondly the data has to be shared with tier II vendors as well in order to cut down the time, because if tier II vendor would start after receipt of final purchase order, the lead time would increase with little advantage in terms of added market information. Company A adopts manufacturing postponement in its supply chain, whereas if individual tiers are analyzed, tier II proceeds with forecast and has the goods ready to ship once it receives the purchase order thus adopting logistics postponement at tier II level, where as tier I postpones manufacturing till they receive the purchase orders. While all this is still ahead of actual selling season so the whole process is based on forecast with perhaps the final shipping (from regional warehouses to individual stores) based on following some actual sales trends. However a POS linkage for the supply chain partners and shifting of product planning and management activities upstream (apparel manufacturers) can help reduce the time to market and reduce supply chain mismatch costs, but only in the case where the vendors have the capability to turn around the orders within the selling season.

Purchasing postponement

Company D uses purchasing postponement for its sourcing from the Asian region. Company D is a lifestyle brand with short product life cycles. For most of its products, the upstream partners proceed with the manufacturing once an order has been confirmed by the sourcing team. The purchase orders are placed with the apparel vendors which in turn place the fabric orders with the fabric mills. The fabric mills proceed upon receipt of order. Since most of the

placements are for products with new designs or products with little repeat purchases, the exact order details are only available once sales and sourcing plans are finalized. As a result the vendors also do not have any advance details other than general product category or tentative quantities. However, to avoid lack of capacity availability at its vendors, Company D makes capacity reservations well in advance of the purchasing seasons. This makes it easier for the vendors to plan production in advance and keep capacities vacant for Company D's orders. The size of Company D also plays a role in making the capacity reservation process work. In the case of negative deviations, Company D has other programs which can be placed to compensate vendors' vacant capacities.

In order to maintain a close interaction with its upstream partners, Company D works with a limited number of suppliers by placing 80% of its orders with 20% of its vendors. Company D is the major customer for most of its vendors. Company D provides technical assistance to its vendors and recommends operational consultants when needed. Company D provides financial assistance to its key vendors when needed in order to secure its key supply base. Its vendors make investments in operational areas such as printing, embroidery, etc. based on recommendations made by Company D for the business outlook.

Company A also uses purchasing postponement for its short life cycle product categories that have only one seasonal window for sales. There is not any separate set of vendors that work for this category, rather the difference is in the way the information flow is managed and the timelines for this category of products. In the case of this category, Company A places orders

once the new designs and products are confirmed by the design and sales teams. Although the upstream vendors (apparel and fabric manufacturers) have advance indications of future placements, they do not proceed till final purchase orders are received as opposed to the case where the fabric manufacturers proceeds based on the advance forecasts. In this case the advance forecasts only indicate the expected volumes and product category details.

Analyzing the purchasing postponement column, there were only two examples, one in the relational box for company D and the other in data sharing type for Company A. Although the interaction for Company A with its vendor was categorized as Type II data sharing (since there was no distinction in the vendors for this category of postponement from others) yet the actual interaction was quite similar to Company D's example in case if product categories where purchasing postponement is used, are seen in isolation. Consequently, Company A was placed in the relational linkage category, along with Company D, for purchasing postponement strategy as shown in figure 11. One reason of having limited examples could be the limitation of the study method of having a limited sample size. The other reason could be that either this interaction presents the most optimal strategy for the product categories under consideration. In terms of product category, both company A and D use purchasing postponement predominantly for products which have new designs or specifications (apart from the case where Company D uses purchasing postponement for

Partnership types	Informational integration Type II	Company B	Company B		Company B
	Data sharing Type II		Company A, Company C		Company C
	Relational linkage Type I & II			Company A Company D	Company A Company D
	Arm's length	Company C	Company C		
		Logistics postponement	Manufacturing postponement	Purchasing postponement	Prod. Dev. postponement
		Postponement types			

Figure 11: Data representation across modified fields - Strategy specific analysis

carryover products) and have short life cycles generally spanning one seasonal cycle with little chances of product replenishments within the season. For both companies, even their tier II vendors begin production after the issuance of final purchase orders. Any other strategy under these circumstances would be sub optimal or infeasible. For example following a purchasing postponement strategy for products with a life cycle of one season

and having POS access for the vendors or sharing POS data in any other way (top two boxes of purchasing postponement column) would not add to supply chain's capabilities unless the vendors have the capability to furnish replenishments within the season based on the purchasing trends. One example is of Zara which uses a vertically integrated structure to follow the strategy of within season replenishments (Ferdows et al., 2004). Looking at purchasing postponement case in isolation, where the vendor is not providing any other service such as VMI for any other category of products, POS access with technological investment would mainly go unused.

The third option in this column, i.e. arm's length relationship, could still work in this case and in the short term could seem more lucrative because of minimum relation building efforts. However on the down side there could be issues of quality and consistency which can cost a lot, especially for world class brands. Moreover other hidden costs such as vendor search costs, monitoring costs, and poor quality costs could overtake the costs of maintaining a relationship based strategy. In addition, there could be chances of lack of capacity availability for products requiring specific physical and technical capabilities. However there is a need to further explore the above argument.

In the case of commodity natured products, having data sharing relationship would demand the adoption of manufacturing or logistics postponement strategy. However the box representing the arm's length relationship can deliver in case of low value commodity products because of lack of any special technical requirements. On the other hand, high

market value brands would still operate in the relational strategy area even for commodity products in order to maintain quality of products as well as their brand reputation.

Product development postponement

Companies A & D work with their vendors to develop new products. They share long term strategy with their vendors. This is achieved by active interaction at all levels of management with their vendors. Both companies are the major customers for most of their vendors and with vendors' routines and visions aligned with their strategies. The product development efforts of the vendors are focused towards their customers' requirements and this is made possible by sharing of strategic vision and direction.

Both companies have tacit commitment with their strategic vendors especially ones involved in active product development. They provide technical assistance to their vendors for process and product improvement. The prices are negotiated during the time of product development while Company A tries to ensure equitable share for its vendors by adopting a win-win strategy. Company A has a Type II data sharing relationship yet in case of product development postponement there is very little interaction in terms of data sharing. Based on this, the relationship would fall under Type I & II relational similar to Company D's relationship, but since Company A used same value chain, the matrix shown in Figure 10 placed company A in Type II data sharing for product development postponement, however for analyzing the trends Company A was placed in relational linkage category for purchasing and product development postponement categories as shown in Figure 11.

Company B & C also adopts product development postponement by developing new products for their customers. Their product development efforts are directed based on the feedback from their customers on the market trends. The feedback and joint review on products in addition to the access to POS data helps both companies to assess the market response while developing new products. This results in increased success rate for the new products.

In the case of Company B, while developing new products in collaboration with its downstream customers, it purchases yarn before the finalization of the product or order. This helps Company B to proceed with the knitting as soon as the products are finalized without further waiting for yarn procurement. Company B is able to proceed with yarn procurement before order finalization because of the fact that in these cases the yarn to be used has commonality with other products and can be used for other products even if the orders do not materialize. In addition Company B's history of interaction routines with their downstream customers as well as the knowledge of market via POS data enables it to predict their behaviors.

The product development postponement column has companies in commodity type business adopting Type II data sharing relationship across the supply chain, while fashion oriented product makers adopting a more relational based strategy. One reason for this diversion in strategies could be the particular business dynamics for certain categories. There seems to be more delegation of product development in case of commodity businesses like hosiery

examples in this data whereas in the case of fashion categories the designing functions still seem to be governed by the channel leaders, the brand companies. Another possible reason could be the location factor, since the hosiery organizations were based in the United States with more access to the US market trends and knowledge of tastes whereas the vendors in fashion categories were from Asia and the geographic and cultural barrier might be an impediment in the eyes of the brand organizations with regards to market understanding. However it would be interesting to see how these brand organizations manage their commodity, for example hosiery, businesses. Based on the data, since company A and D did not have POS linkage with their vendors, they would still be in the relation and product development postponement interaction area. The reason for this could be the lack of technological linkage as pointed out by the respondents or the policy of the channel leaders to control the designs and the designing process. Further research could answer these questions. However the arm's length relationship strategy would be sub optimal in case of product development since the brand owners (commodity as well as fashion) want their vendors to actively participate in the process by presenting designs to their design teams. In addition an active participation by a vendor during the design process helps reduce the time to market (Cooper, 2001). However there is a need to further explore the pattern of exchanges in the product development column based on product type, location and organizations size and strategy.

Propositions

Figure 12 presents the propositions for relationships types that best support postponement strategies for different categories of products based on the length of their life cycles. These propositions are based on the methodology adopted and the data collected for this research.

Relationship types representing partnerships	Informational integration Type II	Commodity	Commodity		Commodity
	Data sharing Type II		Commodity, Fashion carry over		Commodity
	Relational linkage Type I & II			Fashion, short life cycle	Fashion
	Arm's length	Special case	Optimal for certain cases		
		Logistics postponement	Manufacturing postponement	Purchasing postponement	Prod. Dev. postponement
	Postponement types				

Figure 12: Conceptual model showing postponement types across partnership types

The highlighted boxes of the matrix indicate a successful implementation of a particular postponement strategy based on the collected data. Different product categories appear along different postponement strategy columns, however the product development postponement column has all categories of products since there is some product development or at least some product enhancement being carried out for all categories of product at any stage of product life cycle. This development goes on simultaneously with the regular product sourcing and manufacturing activities for the existing products and once development are finalized the initial flow of orders is generally managed under purchasing postponement strategy. Based on this argument, if only the first three types of postponement are considered, namely logistics, manufacturing and purchasing, where some processes are based on forecast while the rest are postponed, there is a shift from informational linkage to relational linkage as postponement shifts from logistics towards manufacturing as shown in Figure 13 which shows the successful cases of postponement implementation. Similarly the data set for this study suggests that commodity type products are better managed by having informational linkage across the supply chain with delegation of product management functions to the vendors, whereas the fashion category products require a more relational management of the supply chain.

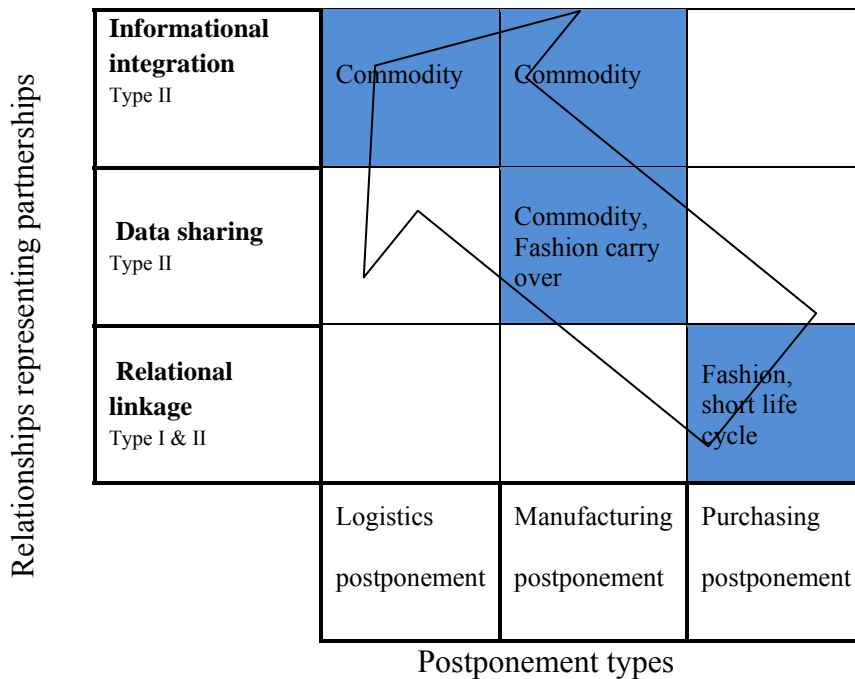


Figure 13: Relationship trend across postponement types

Conclusion

1. The consumer apparel industry, falling in NAICS code of 424320 & 424330 dealing with apparel merchants and wholesalers, uses varying levels of postponement as a strategic tool to compete in the market place. The level of postponement is driven by the type of the products and the position of the organization in the value chain. The postponement applications are supported by most suitable supply chain structures that are warranted by the dynamics of a particular value chain. The postponement

applications include logistics postponement mainly for commodity type products such as socks, manufacturing postponement for commodity as well as fashion carry over products and purchasing and product development postponement for fashion and new products.

2. Lack of informational linkage across the value chain is considered as the key barrier towards the application of postponement strategy especially in case logistics and manufacturing postponement. The requirement of linkage to the point of sale locations for implementing logistics postponement and linkage across the chain for ready access to updated data require significant investment on part of the supply chain members.
3. Various types of relationships exist among the value chain partners in the US textile and apparel industry. Some relationships have higher trust level signified by higher commitment levels. In terms of communication, there exist multiple levels of interaction among the supply chain partners along with varying levels of joint efforts towards improving interaction and solving problems. The contracts have longer time frame and are less specific in terms of terms and condition and the firms hold longer term view towards relationship continuity. Within this setting some relationships have higher level of information linkage such as point of sale data sharing while some have data sharing without the upstream partners having access to point of sale data. The former have been termed as informational linkage type of relationships while the later have been categorized as data sharing type of relationships within the Type II

category presented by Lambert et al 1996. On the other hand, there are some relationships which have lower level of communication and interaction with limited level of data sharing, whereas in terms of contract type and relationship orientation these have similar characteristics to Type II relationships. These have been characterized as relational linkages since these have characteristics of both Type I & II relationships as based on model presented by Lambert et al (1996). In addition some value chains have arm's length relationship and have order based relationship without any recurring pattern of information exchange or any sort of joint activity. The parties involved in this sort of relationship interact on requirement basis rather than any long term orientation basis. There was no true Type III example encountered during this study. Although Company B came closest to having a Type III relationship in terms of having a systemized communication system and working jointly with its customers, yet it fell short in terms of level of trust and openness to each other. There were still elements of buyer supplier orientation rather than an extended enterprise view. Similarly Company A's relationship with one of its denim fabric vendor, which worked exclusively for it, could be termed as a higher level relationship yet it fell short of true Type III integration.

4. Organizations which operate in the commodity market have been driven by the competitive environment as well as the downstream retailers to make the technological investment required to adopt postponement strategy. However some organizations have worked around it by passing on data to their upstream partner on a

lagging basis, which although falls short of the required access to the market trends required for logistics postponement implementation, but still helps in the case of manufacturing postponement strategy especially where planning and delivery horizons are longer (over a month) and response time allows use of lagging data. For short life cycle fashion products, which are generally manufactured in one flow without any replenishment plans, brand organizations work on long term basis with their upstream value chain partners and reserve capacities in advance so as to have manufacturing options available close to the selling season.

5. The conceptual model presented in Figure 13 highlights different supply chain relationship scenarios for logistics, manufacturing and purchasing postponement strategies. As new products are introduced, they can be better managed by adopting purchasing postponement strategy since at that time very little information exist on downstream demand. However as the product moves along the life cycle curve towards maturity stage and transform into commodity type products, they can be supported by adopting manufacturing and logistics postponement strategies, which require the value chain to have access to the latest sales data and trends. However, products which have a short life cycle and are phased out after one season and are managed by placing only one order prior to the actual selling season, access to sales data would not add much and would be better supported by adopting purchasing postponement strategy requiring relational linkage among the partners. In the case of short life cycle products, the access to point of sale data would only be beneficial if

the value chain partners operate at a higher level of relationship and integration with shared designing and operational responsibilities along with the capability to turn around products within the selling season.

Areas for future research

The population for this study was defined as organizations falling under the NAICS codes 424320 and 242330 dealing with apparel merchants and wholesalers. The sample included two organizations which owned fashion apparel brands and managed the supply chain while the other two were hosiery manufacturers. Within the defined population, there are other product categories such as women legwear, outdoor specialty clothing, childwear, etc. which could have different dynamics in terms of implementing postponement strategies. Similarly this research dealt with the organizations towards the downstream end of the value chain and lacked evidence from the upstream players in the value chain such as the fabric and yarn manufacturers. However, the model would still be helpful for the upstream members in understanding postponement dynamics in the downstream part of the value chains. Moreover the data did not cover the industrial products segment which has different dynamics when compared to the consumer and retail segment. In addition, the segments dealing with the industrial products such as the automotive products or decorative products such as awnings, which operate through different downstream channels to market, need to be explored further for assessment of postponement implementations.

The brand organizations studied for this research were among the leading organizations in the world with operation established around the world. Such organizations have different requirements when compared with small to medium organizations and hence the strategies for large organizations might not work in the settings of small to medium sized organizations in the same segment.

Some boxes in the interaction matrix were empty, i.e. there was absence of any data in certain relationship and postponement interaction areas. This could be due to the limitations of methodology or sampling or due to the sub optimality or infeasibility of the said interaction. However further research would be needed to prove either of the propositions. Moreover there was no Type III relationship encountered in the study, further research could be carried out to classify the relationships in the textile and apparel value chain or to assess the reasons of non existence of certain types of relationships.

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APPENDICES

Appendix I: Protocol

1. *Product types and categories* (majority of products): The details from this element of the check list in conjunction with the elements 2 and 6 would help to achieve the objective of explaining the situation of postponement application in the US Textile and Apparel industry. The following sub categories within this element would be explored.

- a. Physical Process.
- b. Varieties of products.
- c. Do some products have same raw materials, base products?
- d. Life cycle.
- e. Category: consumer or industrial.
- f. Business process/value chain.

Adapted from Mason Jones et al. 2000, Aitken et al. 2003, Aitken et al. 2005.

2. *Markets* (for majority of products)

- a. Nature of demand.
- b. Repeat or new business.
- c. In case of both, business process for both.

Adapted from Mason Jones et al. 2000, Aitken et al. 2003, Aitken et al. 2005.

3. *Postponement level*: This element of data collection guide would help to achieve the second objective of defining the level of postponement application in the US Textile

and Apparel industry. Details shown in Table 3 would be used in conjunction with the details from relationship level and internal operations elements in developing a conceptual model for devising supply chain strategies based on the required level of postponement application.

Table 3: Data collection guide for assessing level of postponement

Postponement level	0-20%	21-40%	41-60%	61-80%	81-100%
Prod. development postponement or Engineered to order					
Purchasing postponement or Purchase to order					
Manufacturing postponement or Manufacture to order					
Logistics postponement or Ship to order					

Source: Adapted from Yang et al., 2005

- Which type of products fit which box in above table?
4. *Barriers to postponement*: This element would help to achieve the objective of categorizing the barriers to postponement application. The categories of barriers listed below would be discussed and their impact would be sought.
- a. Operational control.
 - b. Cultural / organizational.
 - c. Supply management.

- d. Customer coordination.
- e. Supply chain coordination.
- f. Product characteristics.

Adapted from Yang et al 2005

5. *Relationship level*: This element would help to achieve the third objective of categorizing the relationship levels across the supply chain in the US Textile and Apparel industry. Details under this element would also feed into the fourth objective of identifying the strategies that have been adopted in response to barriers to postponement (supply chain relationship strategies) and would be used in developing a conceptual model for devising supply chain strategies based on the required level of postponement application. Details in below mentioned categories would help to define the relationship levels.

a. History

- Volume of business.
- Ratio of business (customer/vendors).

b. Long term aspect

- What are your expectations for relationship continuation?
- Which practices work towards relationship improvement (Training, investment)?

c. Trust & Commitment

- Has there been any relationship specific investment (Downstream/upstream)?
- Do you look for or get assistance in time of need (Downstream/upstream)?
- What is your partner's attitude towards your problems (Downstream/upstream)?
- Do your partners share strategic information?

d. Communication

- What sort of communication linkage is there with your partner organizations?
- What sort of personnel level contact is there with your partner organizations?
- Data sharing (how and what).

e. Joint activities

- Planning/warehousing, product development, problem solving.
- Which approach is followed for problem solving (team based)?

f. Contract type/price setting

- Which sort of contracts does your organization have with your supply chain partners (Long term or from order to order)?
- How are prices and other issues finalized (Negotiation type, cordial, tough bargaining)?

Adapted from Lambert et al. 1996, Rinehart et al. 2004, Duffy 2008.

Appendix II: IRB approval document

North Carolina State University is a land-grant university and a constituent institution of The University of North Carolina

**Office of Research
and Graduate Studies**

NC STATE UNIVERSITY

Sponsored Programs and
Regulatory Compliance
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From: Debra Paxton, IRB Administrator
North Carolina State University
Institutional Review Board

Date: April 12, 2010

Project Title: Postponement and Supply Chain Structure in the US Textile and Apparel Industry

IRB#: 1112-10

Dear Dr. Chaudhry and Dr. Hodge:

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.2). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:

1. This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.
2. Any changes to the research must be submitted and approved by the IRB prior to implementation.
3. If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Sincerely,

Deb Paxton
NCSU IRB

Appendix III: Relationship codification table

Constructs	Arm's Length	Type I	Type II	Type III
Trust & commitment	No trust	Limited to honest dealing	More trust, Partner viewed as most favored	Total trust
Communication	No non routine communication Use of individual systems Ad-hoc when transacting	Limited to critical issues Use of individual systems Ad-hoc between individuals	More regular and at multiple levels Joint modification of individual systems Limited but scheduled, some routine	At all levels, more open sharing Joint/customized electronic communication Systemized communication
Joint activities	None None	Parties may suggest changes to other's system Limited joint efforts (issues based)	Parties may make changes to other's system after getting approval Joint problem solving teams	Parties can make changes to other's system without getting approval Joint teams in multiple areas
Contract type	Order based Negotiations for every contract	Short term based with specific in nature Negotiations with some consideration to relationship	Longer time frame and general in nature Less of negotiating type, more relationship based	Handshake based relationship with a general contract outlining basic philosophy guiding the relationship Follows general principles
Long term aspect/expectations	Missing	Short term	Medium to long term	Long term

Source: Adapted from Lambert et al 1996.

Appendix IV: Relationship structure

Partnerships help reduce cost and time to market, achieve better service and better. Relationships can be costly and still might not achieve the desired results (Rinehart et al. 2004). As a result executives are looking towards partnerships as a source of competitive advantage and the ability to develop and sustain a partnership that gives organizations a competitive advantage (Lambert et al. 1996). However, to develop and sustain a partnership has cost attached to it which dictates that all relationships should not be pursued as partnerships rather the need for partnership or level of partnership should be dictated by the need and purpose (Lambert et al. 1996).

Importance

Current economic environment is categorized by scarce resources, increased competition and faster rate of change (Lambert et al. 1996). Rapid changes in technology, competitive environment and other pressures are making organizations realize the importance of cooperative relationships with other firms such as alliances, partnerships and network organizations (Ring & Van de Ven 1992). Relationship decisions are gaining importance in current environment (Tangpong et al. 2008). Collaboration and partnerships are becoming the main focus in gaining competitiveness (Donaldson and O'Toole, 2000).

Relationships can be costly and still might not achieve the desired results (Rinehart et al. 2004). As a result executives are looking towards partnerships as a source of competitive

advantage and the ability to develop and sustain a partnership that gives organizations a competitive advantage (Lambert et al. 1996).

THEORIES OF EXCHANGE

The interfirm exchanges have been explained under different theories. These include the Transaction Cost Economics (TCE) theory, resource based theory and the relational based theory. The transaction based approach views cooperation only necessary to the extent that it facilitates the transaction and these would be efficient only when they represent a cost efficient management structure. TCE sees two polar worlds and makes an assumption that the managers base their decisions on cost considerations. This theory generally ignores the implications of trust resulting from repeated transactions (Ring & Van de Ven 1992). Moreover it treats each transaction between companies as independent event (Ring & Van de Ven 1992).

The resource theory sees partnerships or exchanges as a mean to gain access to unique resources to attain a competitive advantage. On the other hand the relational view sees alliances as a choice made by the organizations (Donaldson and O'Toole, 2000).

Based on literature reviewed for his research, Gulati (1995) mentioned high transaction costs in market based structure leads to promoting hierarchical structures. However he argues that these two extremes should not be seen as part of a polar world, rather there exists mechanisms in between to reduce transaction costs, especially when transactional costs are

not high enough to justify vertical integration but still are high in case of market based arrangement, an intermediate mechanism called alliance is followed (Gulati 1995).

Governance

Because of the competing interests of the organizations in a supply chain, a mechanism must be in place to direct the relationship and reduce the threat of opportunism. This mechanism is known as a governance structure (Ghosh & Fedorowicz, 2008). The mechanism to match the most appropriate structure to the corresponding exchange is referred to as governance (Donaldson and O'Toole, 2000). As the level of risk increases, so does the complexity of governance structure (Ring & Van de Ven 1992). Different types of inter-organizational relationships dominate in different situations, and they produce different outcomes (Golicic et al. 2003).

Relationship governance structures fall under three categories (Rinehart et al.2004). These are

- Market governed,
- Relationally governed: Multiple classes, and
- Alliances, ownership/equity governed

The literature has classified alliances as equity and non equity based alliances. Equity based alliance are those in which either two firms join resources to create a joint venture in shape of a new entity or one firm takes minority share in the other. Non equity based alliances or

relationally governed structures could include unidirectional agreement such as licensing, second sourcing, distribution agreement or bidirectional agreements such as, joint contracts. Dyer and Singh (1998) have argued that minority stakes can be seen in terms of relation specific investment and hence would fall under relationally governed structures as opposed to equity based alliances or structures. Gulati (1995) has argued that higher transaction costs (while comparing equity and non equity alliances) would favor equity based alliances (Gulati 1995).

The choice of a particular governance structure has been explained differently by the relational content based approach and the dependence based approach. The relational approach sees cooperative efforts, trust and relational norms as governance mechanisms, whereas the dependence based view sees power as the governing mechanism in an exchange relationship where power is driven by the degree of dependence in an exchange (Tangpong et al. 2008).

RELATIONSHIP ATTRIBUTES

All relationships have some basic attributes which differentiate between the strength and level of a relationship.

Trust

Trust is the willingness to rely on exchange partner and to have confidence in that partner. It is the expectations about exchange partner's expertise, reliability and intentionality (Ganesan,

1994). Trust reduces perception of risk and increase confidence (Ganesan, 1994). Trust results in reducing transaction costs by foregoing redundant and non value adding activities such as multiple inspections and screenings (Ganesan, 1994, Kwon & Suh, 2004). The presence of trust makes the environment suitable for making relation specific investments. It also promotes more informational transparency.

Trust brings predictability which otherwise is attained by devising a detailed contract to make partner's behavior predictable. However in presence of trust firms may not find the need to rely on detailed contracts (Ganesan 1994).

Ghosh & Fedorowicz (2008) categorized trust to be constituting of four attributes namely calculative, competence, integrity and predictability. According to them, calculative part is the assessment of likely level of cooperation from the exchange partner. Competence is the assessment of technical expertise and operational, human and financial strength of an exchange partner. Integrity results from fulfilled promises, loyalty and consistency of performance. While predictability defines to what extent exchange partner's actions can be forecasted.

Handfield and Bechtel (2002) have categorized trust into cognitive and affect based trust. Cognitive trust results from reliability, cultural/ethnic similarity and credentials. According to them, these attributes help the initiation of a relationship and are more significant at start of a relationship. The affect based trust results from interaction frequency and the behavior of the exchange partner. This is more ex post type of trust with some prior history of exchanges.

According to Ganesan (1994), reputation of exchange partner, satisfaction in prior exchanges and experiences and specific investment made by the partners act as antecedents of trust. Ganesan (1994) has divided trust into two components, which are credibility and benevolence. Credibility is measured through expertise, reliability, consistency, stability and control; whereas benevolence consists of motives, intentions, and characteristics attributed to the partner. According to Ganesan (1994), both dimensions of trust are important but only credibility is a significant predictor. This is similar to the affect based component highlighted by Handfield and Bechtel (2002). This view is also supported by Ring and Vane de Ven (1992). According to them, trust emerges over repeated transactions between both parties and greater trust leads to lesser risk (Ring & Van de Ven 1992). Outcome of trust is belief in positive outcome from partner's actions (Kwon & Suh, 2004).

Commitment

Relationship commitment is the willingness to invest in relationship specific resources. Relations specific assets or asset specificity is referred to investment in partner specific physical or human assets whose redeployment involves significant switching cost (Kwon & Suh, 2004). Commitment has been classified into normative and instrumental commitment. Normative commitment is a mutual commitment between exchange partners based on sharing of relationship specific resources from both sides. On the other hand, instrumental commitment is the commitment or investment made by one partner based on the influence of the other partner. According to Zhao et al. (2007), normative relationship commitment by

the supplier will have a stronger impact on the customer integration than instrumental commitment from the supplier.

Relation specific assets have been divided into physical assets (fixture and tooling), dedicated assets (capacities), human assets (customer specific learning, training, and people with special skills), site assets (specialized machines, proximity). Of these site and human assets are considered more influential for relationships and results in tighter integration, communication and alignment between partners (Handfield & Bechtel, 2002).

Asset specificity leads to trust and increased information exchange, which reduces uncertainty and increases the level of trust (Kwon & Suh, 2004). There is a positive relationship between the level of trust and commitment (Kwon & Suh, 2004). Moreover, relation specific investment increases the extent of joint action (Heide and John 1990).

According to Dyer and Singh (1998), greater investment in relation specific assets would result in greater protection against opportunism which would increase the volume of exchange and hence there would be a greater potential to generate relational rents.

History of exchange

Transaction cost theory views interaction between organizations as onetime exchange with every subsequent exchange unrelated to the previous one. According to Gulati (1995), onetime event assumption made by the transaction cost theory is inappropriate when firms repeatedly enter into transactions with each other. One consequence of such repeated

interactions in emergence of trust and which plays an important role in the choice of governance mechanism. According to Gulati (1995), greater the number of previous alliances (history of transactions), the less likely the alliance is to be equity based and the exchange partners would not feel the need to safe guard the transaction through investments as their experience with the exchange partner would make other party's behavior more predictable.

Communication

Trust and electronically mediated exchange (internets, intranets, electronic mails or electronic data interchange) act as antecedents for collaboration in the supply chain. Supply chain literature has considered information technology as an important determinant in developing an integrated supply chain structure (Myhr & Spekman, 2005). Effective planning is based on information exchange and trust (Kwon & Suh, 2004).

Information sharing has been considered as the most important factor in managing the supply chains (Kwon & Suh, 2004). Solutions to reduce uncertainty include forming strategic alliances and collaborative planning to manage flow of information (Kwon & Suh, 2004). Information exchange reduces uncertainty and indirectly improves the level of trust (Kwon & Suh, 2004). People in high trust environment are not afraid to share information. (Kwon & Suh, 2004). Sharing of simple information is not enough to enhance the level of trust unless it includes critical information on all aspects such as operations, planning and strategic level as well (Kwon & Suh, 2004).

Performance is based on coordination which in turn is dependent on the level of information exchange. The enablers for information exchange and hence better coordination are trust, bargaining power and contract types (Ghosh & Fedorowicz, 2008). Lack of coordination leads to higher inventory in the system, longer delivery times and higher wastages (Ghosh & Fedorowicz, 2008). Information sharing results in reducing stock outs as well as safety stocks (Ghosh & Fedorowicz, 2008)

The attributes of info exchange include depth, intensity and sharing mechanism (Ghosh & Fedorowicz, 2008). The depth is defined by the levels of management (top, planning, operational) at which information is exchanged. Exchange partners sharing information at operational level in addition to planning and strategic level would be said to have greater depth of communication. Intensity is concerned with the frequency of information exchange. Sharing mechanism not only concerns the physical structure, i.e. the hardware part, but also the routines as well.

According to Dyer and Singh (1998), greater investment in interfirm knowledge sharing routines would increase the potential for generating relational rents by increasing the partner specific absorptive (knowledge) capacity (know how part of knowledge, other is the information part, which can be easily coded, and is dependent to the extent the partners have developed interaction routines) and better alignment of incentives (to encourage reciprocity and avoid free riding).

Joint activities

Joint activities are those where the exchange partners combine resources (physical, monetary and especially human), to work jointly towards mutual goals. Joint activities create greater integration between the exchange partners (operational as well as cultural) which help enhance collective performance. Such activities also reinforce the trust and relationship strength and develop understanding at organizational as well as personal level.

Organizational boundaries become penetrated by the integration of activities that traditionally are considered buyer's responsibility and vice versa. These activities include design and development, analysis and cost targeting, long term planning etc (Heide and John, 1990).

Scope of efforts under taken ex ante to verify the supplier's ability to perform as expected, such as examining operation, technical, financial and human capabilities and verification of suppliers increase the extent of joint action (Heide and John 1990). Relation specific investment also increases the extent of joint action (Heide and John 1990).

Contracts

Contracts highlight authority and responsibility structure and help in sharing risk across partners (Ghosh & Fedorowicz, 2008). According to Lambert et al. (1996), the type of a contract tells a lot about a relationship with strong relationships being governed by least specific or unwritten agreements. During the early stages of relationship development, trust vacuum is filled by formal contracts which over time lead to informal contracts under higher

level of trust in the relationship. Contractual understandings facilitate the development of trust during the initial phase of the relationship, however the evolution of trust is based on commitment of assets and satisfactory record of performance (Handfield and Bechtel, 2002).

There is an interrelationship among trust, power and contract type (Ghosh & Fedorowicz, 2008). Initially trust depends upon contracts, reputation and prior experience. Contracts, during the earlier phases of a relationship or for market based structures, are driven by pricing mechanism which entails all the perceived risks and generally intense negotiations take place for settlement of a price. Later on as communication starts to flow and transactions take place, it keeps on feeding into trust (Ghosh & Fedorowicz, 2008), and contracts evolve into relationship guiding principles with more emphasis on relationship strengthening and less emphasis on price.

Expectation of continuity

It is the perception of bilateral expectations of future interactions and the anticipated duration into future rather than historical duration to date. This perception increases the extent of joint action (Heide & John 1990). Investment in relationship specific assets acts as an indicator of expectations and intentions regarding continuity of relationship.

Dependence

Dependence is the extent to which the resources provided by the supplier or the customer (sales avenue) are critical and for which there are few alternatives available (Duffy, 2007).

The magnitude of dependence is measured by the importance or proportion of purchase or sales from a particular supplier or to a customer to total purchase or sales.

TYOLOGIES

This section highlights the relationship typologies identified in various studies. The constructs used in developing the typologies as well the measures used for the constructs have also been summarized.

Tangpong model

Tangpong et al. 2008 used relational constructs such as relational norms, trust, information exchange and long term orientation as well as power constructs such as dependence to classify the relationships. They devised the following typology:

- **Market relationships:** These have low relationalism and low dependence and they lack cooperative efforts or joint activities. These are marked by an environment lacking collaboration, are short term oriented and are not likely to combine resources.
- **Power relationships:** These are marked with low relationalism and but high dependence. These relationships are short term oriented with partners resorting to opportunistic behaviors.
- **Autonomous:** These are high on relationalism but low on dependence, partners adapt to respond to uncertainty, cooperate to achieve positive outcomes through joint problem solving, information exchange, and knowledge sharing.

- Constrained: These are high on relationalism as well as high on dependence. There is less exploitation as compared to power based relations and have some aspects of long term approach, but overall these are less in terms of creativity and innovation when compared to the autonomous relations (Tangpong et al. 2008).

Duffy model

Duffy (2008) used relational constructs to classify relationship types. These included trust, commitment, relational norms and conflict resolution. Trust was measured based on integrity, honesty and fair dealing of the partner. Commitment involved the intention of the exchange partner to develop a relationship in the future measured by willingness to invest in relationship. Relational norms included mutuality of interest and risk/reward sharing mechanism. The last construct was conflict resolution which was assessed by the mechanism in place to resolve conflicts. Duffy (2008) classified relationships as under:

- Limited coordination,
- High coordination, and
- Partnerships.

Attributes:

- Level of operational integration highest in partnerships, next in highly coordinated ones and lowest in limited coordination types.

- Magnitude of interdependence highest in partnerships, next in highly coordinated ones and lowest in limited coordination types.
- Level of trust, commitment, relational norms and functional conflict resolution highest in partnerships, next in highly coordinated ones and lowest in limited coordination types (Duffy, 2008).

Humphries model

Humphries et al. (2007) used creativity, stability, communications, reliability and value as their relationship classification constructs. They measured creativity from the degree of innovation (which in some other studies have been measured by expertise). Stability was measured by the extent of relationship specific investment (other studies named this construct as commitment or investment). Communication was measured by the quality of relationship communication, reliability was measured by effectiveness and efficiency of joint operations (joint activity) and value was measured by the degree of share of joint relationship outputs (risk/rewards sharing). They used following classifications:

- Poor relationships: These types of relationships have lowest satisfaction level and involve adversarial conditions with average level of product quality and communication. Exchanges take place in an exploitative environment without any consideration for reciprocity.
- Evolving relationships: These have moderate satisfaction and low level on reliability dimensions (low trust). In these types of relationships some adversity still exists,

these are categorized as being in development phase with the will to cooperate growing among the exchange partners.

- Moderate relationships: These have satisfaction level above mean with communication below this level. These have greater incidence of cooperation, coordination and collaboration, reciprocity without any exploitation and a cultural match.
- Good relationships: These have highest level of satisfaction, high interdependence, cooperation, coordination, collaboration, information sharing, trust and joint sharing of benefits (Humphries et al. 2007).

Donaldson & O'toole model

Donaldson & O'Toole (2000) used relationship strength to classify their relationship model. Relationship strength takes into account the behavioral process as well as the economic content. Behavioral process variables focus on the social process of exchange and are characterized by trust, commitment, cooperation, mutuality and equity. This is termed as the belief part of the relationship and is measured by things like history of promises, nature of exploitations if any, friendliness of behavior, loyalty, (fair) dealing and interest in longevity of relationship. According to Donaldson and O'Toole (2000), the action part of the relationship capture the economic content and is measured by nature of help rendered, action taken on requests, joint dispute resolution, nature of agreements (formal or informal),

information sharing, investment in resources and if adaptations were made in relationship.

They classified relationships as under:

- **Bilateral relationships:** These are high on both beliefs and actions, partner firms believe in relationships, are loyal, willing to act, make significant investment and extensive adaptations in relationship.
- **Recurrent relationship:** Under this kind of relationship, partners are positively disposed though do not see relationship as bilateral and are only looking for efficient and dependable source. This is a limited scope relationship (for example focusing on Just in Time (JIT) efforts) with high procedural commitment and low strategic commitment.
- **Dominant partner:** Such relationships are managed by a dominant partner and are low on relationship strength as compared to the bilateral or recurrent relationships.
- **Discrete relationships:** These types of relationships have low levels of belief and action content and thus are rated lowest in terms of relationship strength (Donaldson and O'Toole, 2000).

Rinehart model

Rinehart et al. (2004) used trust, interaction frequency and commitment for classifying their relationship typology. They measured these constructs at two levels; at personal level and at organizational level. Trust was measured at personal level through familiarity and personal character of the other party while at organizational level it was measured through credibility,

capability and relationship specific investment. Interaction frequency was measured at personal level through communication frequency and at organizational level through business volume. Commitment was measured at personal level through dependence and at organizational level through investment in relationship (Rinehart et al. 2004). The classification based on these constructs is shown in the Table 4.

Table 4: Relationship classification

	Non strategic	Administered	Contractual	Specialty contract	Partnership	Joint venture	Alliance
Communication	Lowest	Above median	Below median	Below median	Median	Above median	Highest
Dependence	Lowest	Above median	Below median	Below median	Median	Highest	Above median
Investment	Lowest	Below median	Median	Below median	Above median	Highest	Above median
Personal character	Below median	Lowest	Median	Above median	Above median	Below median	Highest
Capability	Below median	Lowest	Median	highest	Above median	Below median	Above median
Volume	Above median	Below median	Highest	Lowest	Below median	Median	Above median

Source: Adapted from Rinehart et al. 2004

Ring & Van de Den model (ring & van de ven 1992)

Ring & Van de Ven (1992) typology used risk and trust as the variables for defining relationships. They proposed four structures based on different levels of risk and trust. They proposed market based structures for low risk and low trust situations, hierarchical structures for high risk and low trust situations, recurrent contracts for low risk and high trust situations and relational contracts for high risk and high trust situations. These structures are explained as following:

- Market based transactions: These are characterized by short term, bargaining relationships, generally for non specific items for which alternate buying and selling avenues are available. Both sellers and the buyers are considered to be equal and legally free. The contract specifies all the terms and expectations from both parties in detail. Dispute resolution is done through legal proceedings (Ring & Van de Ven, 1992).
- Hierarchical structures: These are suitable for unique transactions involving high investment in transaction specific assets where the terms are dictated by the authority/superiors (Ring & Van de Ven 1992).
- Recurrent contracts: These involve repeated exchange and moderate asset specificity. Parties are independent yet embedded in a relationship. Contract is more driven to achieve motives rather than efficiency alone with alternate methods for conflict resolution (Ring & Van de Ven 1992).

- Relational contracts: These involve long term and highly specific investments with disputes settled through internal mechanisms. Long term relationship is sought to overcome the potential of opportunistic behaviors (Ring & Van de Ven 1992).

Third form can feed into the fourth type. Even in case of relational contracts, if risk increases greater than the reliance on trust, relationship/contracts can move back towards hierarchical such as joint ventures, equity sharing to offset the increased level of risk that is not counter balanced by level of trust (Ring & Van de Ven 1992).

Lambert model

Lambert et al. (1996) used planning, joint operating control, communication, risk/reward sharing, trust and commitment, contract style, scope and financial investment as the key attributes to classify the relationship structure. Planning was measured based on the style, level and content while for communication they measured the routines, balance of communication as well as the mechanism. Contract style was measured through time frame and coverage, while for scope they measured the share and the value added. Investment was measured based on financial, technology and people. They classified the relationships as under:

- Arms length: These are non strategic exchanges of generic products with availability of multiple sources. Parties involved treat these as one time event with the primary focus towards cost.

- Type I: These are limited partnerships with a short term focus. Partners involved in this exchange coordinate activities and planning and such exchanges generally involve single divisions within each organization.
- Type II: The exchange partners move beyond coordination toward integration of activities with a long term focus. In this type of partnership, multiple divisions or functions are involved with the partnering firms.
- Type III: In this type of relationship, partners share operational integration and see other party as an extension of their own firm (Lambert et al. 1996).

The Type III relationship was followed by joint ventures and vertical integrations in Lambert's typology, however the focus was to categorize the supply chain partnerships only.