AN INVESTIGATION INTO

APPAREL AND TEXTILE SUPPLY CHAIN DEVELOPMENTS

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ABSTRACT

This thesis explores the important and evolving concept of Supply Chain Management with particular respect to the apparel industry. This is a relatively recent management concept which attempts to view products from conception to consumption. Since it is so contemporary, research and literature surrounding the concept tends to be sparse. In addition, the literature tends to focus on supply chains within an organization or only segments of an entire supply chain. This thesis aims to address this gap by considering supply chains in entirety, across organizational and national boundaries, including people and policies as well as processes.

The approach taken in this thesis was to consider the development and management of supply chains within two very different market environments: the relatively slow-moving and derivative nature of the automotive market, and the fast-moving consumer goods in the highly innovative environment of apparel and textiles. The research focuses on the characteristics surrounding product development in the two environments. As a frame of reference and to facilitate structure, the research concentrates on three core units of investigation: networks and relationships, environment and organizational ecology and, finally, learning and systems. Three case studies are developed from within the apparel and textiles sector. The case studies were selected as a cross-section of the sector and each affords differing approaches and information regarding product development and innovation, as well as supply chain complexity. In order to balance the research, reference and comparison is often made to the well-documented automotive sector.

This thesis concludes that an holistic approach is critical to the future development of supply chains. The major output of the research is a model that recognizes the importance of this holistic approach to any survival strategy. The model highlights the importance of a balance between three critical factors in a rapidly changing business environment: socio-technical systems; people and policies; and key processes.

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CHAPTER 1 - THE APPAREL AND TEXTILE SUPPLY CHAIN

1. INTRODUCTION

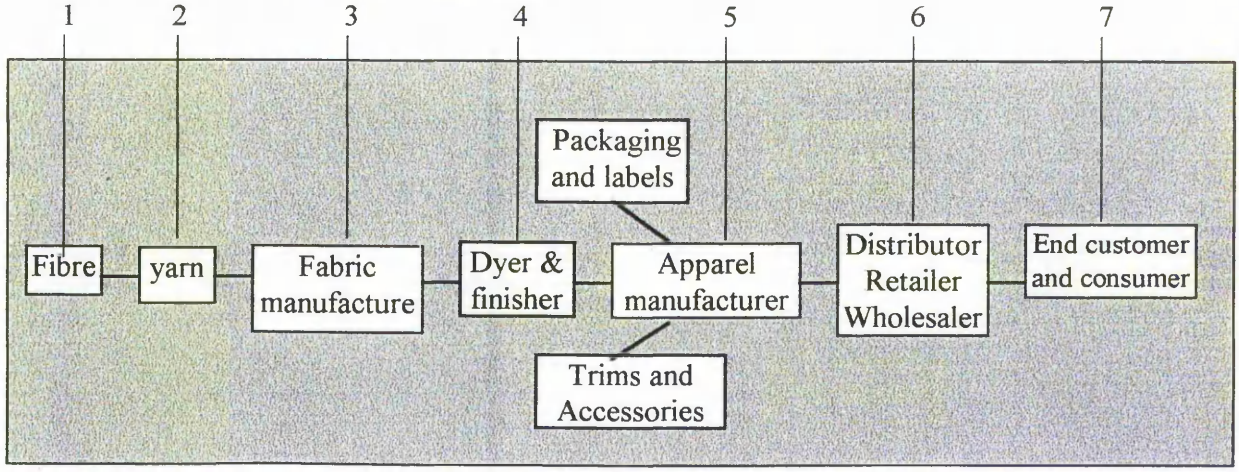
1.1. BACKGROUND

There is a basic human need for apparel and textiles. This need takes many different forms throughout the world. The main focus of this research is the UK apparel and textiles industry. The size of this industry is illustrated by the following statistics: the UK retail expenditure on clothing was £27.16 billion in 1998 (Office of National Statistics 1999a), the industry employed 313,600 people in 1998 (Office of National Statistics 1999b), the industry represents around 7.8% of manufacturing jobs in the UK and in 1995, there were 9,100 clothing manufacturing enterprises in the UK (Keynote 1996). To give you some idea of the structure of this industry, these enterprises are typically small in size with 63% employing fewer than 10 people and only 7% employing more than 100 (Centre for Work and Technology 1998).

The phasing out of the General Agreement on Tariffs and Trade (GATT) in 1994 will result in the removal of the quotas for apparel and textile imports by 2005. This has led to increased imports of apparel and textiles products into the UK, placing further pressure on the UK manufacturing sector.

The large high street retailers dominate the apparel and textile supply chain. This is described in detail later in this chapter. The apparel and textile sector's generic organizational structure for a supply chain has been schematically represented in seven main stages (see figure 1.1).

Figure 1.1 Generic supply chain model



Each of the stages 1-7 are points where value is added in the process. Although the supply chain is depicted as linear, in reality links are formed between the different sections such as, for example, the retailer and the yarn manufacturer discussing new developments in performance or colour palettes. The system is required to link all the components in the structure, and to control the information and the component variables in the environment with the minimum of delay, in order to reduce the risk of amplification of errors between the links.

Over the last decade, the retail environment has changed for apparel and textiles. There has been a move away from the traditional two ranges of products being offered: one range for Spring/ Summer, one range for Autumn/ Winter. Under traditional practice, the customer would be able to purchase the same products for a period of around six months. In addition the retailer had to commit to a product range approximately six months prior to the beginning of the season and had to hold the product either in distribution centres or in store stock rooms, awaiting the demand from the customer over the six month selling period. This method of carrying out business generated long lead times and created high levels of stock throughout the retail or manufacturer's section of the supply chain. Another drawback was the buyers' early commitment to large volumes of products in specific sizes and colours, without any prior knowledge of demand. Large amounts of waste were created due to the difficulty in predicting customer preferences six months ahead of the selling season. The consumer may have wanted the product but, due to uneven demand across the range of sizes and colours, may have been unable to obtain their size or colour preference. This uneven demand for sizes and colours created problems as the stock was ordered in ratio packs. The ratio pack of products delivered increased the chance of stock-out in specific sizes or colours and, when replenishment took place, the in-stock items would be replenished. This resulted in difficulties in monitoring true demand patterns for customer size and colour preferences, since lost sales could not be measured.

The early commitment to bulk quantities of products by the retail buyer meant that products which sold poorly could not be replaced mid-season with new merchandise. This resulted in retail floor space becoming cluttered with slow moving merchandise

that would remain in the store until the end-of-season sales. Forecasting demand for untried products is a difficult task and buyer errors are costly. The retailer wants to reduce the risk of forecasting by compressing the lead time from concept to product launch, reducing order size and stock holding, and trialing products in key stores before launching across all retail outlets..

The changes described above required the retailer to focus their management efforts on their supply chain and produced extensive changes to the pattern of business operations. The pattern changed from the original two seasons to as many as six or eight seasons per annum. Trialing products enabled size and colour ratios to become more accurate, with the supplier replenishment balancing the offer to the customer demand. These changes in operations were a move towards 'pulling' the product through the system, replacing the 'push' system which stock-piled products against an unknown demand. The retailers' aim was to reduce lead time and inventory while removing waste - thereby reducing both risk and cost, while increasing flexibility. The requirement made on the retailers' suppliers was for smaller order quantities, shorter lead times and greater flexibility within the actual selling period to allow for adjustment to style, colour and size. The hope was that this improvement to customer service, more closely matching demand patterns, would generate a larger share of the market.

The need for companies to survive in a rapidly changing industrial and market environment has focused apparel and textile management on the concepts of Supply Chain Management (SCM) and Quick Response (QR) in response to customer demand for greater flexibility and shorter lead times. The concept of Supply Chain Management (SCM) has become increasingly important to organizations over the last decade, as manufacturing and retailing companies seek ever-higher levels of efficiency. This concept evolution has been fragmented, and definitions vary from industry to industry , i.e. whether they originate from automotive, fast-moving consumer goods (FMCG), or apparel and textiles.

The apparel and textile industry has used the term Quick Response (QR) synonymously with the term SCM. The Textile Apparel Linkage Council (TALC, 1988) define Quick Response as:

> *A state of responsiveness in which a manufacturer seeks to provide a product to a customer in the precise quantity, quality, and time frame required. In doing so, lead times & expenditures for labour, materials and inventories are minimized, flexibility is emphasized in order to meet the changing requirements of a competitive marketplace.*

The QR focus has been on technological aspects of Computer Aided Design (CAD), Computer Aided Manufacture (CAM), Electronic Data Interchange (EDI), Electronic Point of Sale (EPoS), and Manufacturing Resource Planning (MRP11), along with simulation sourcing programme technology, such as the US Demand-Activated Manufacturing Architecture (DAMA), Macfarlane (1996). SCM can be assisted through the introduction of new technology. However, technology is only a tool which the organization has available, and which forms a small part of the overall system.

The apparel and textile industry, along with many others, has been required to change in order to meet the demands of its customer. The customer may be the sub-contractor, the manufacturer, the retailer, or the final customer - the consumer. In the case of apparel and textiles, the main driver for the development of the concept of SCM has been the retailer. The retailer has also demanded rapid product development to enable them to offer greater product variety to end consumers. Through these changes the retailer hopes to obtain competitive advantage by encouraging existing consumers to remain loyal, and by targeting potential growth areas, for both new and existing consumers, allowing them to expand their market share.

Customers have become more discerning and look for greater variety of products throughout the year. At the same time the high street retail competition is increasing though large retail groups still dominate the market. Seven major organizations now hold the majority of the retail market for apparel and textile in the UK. These are Marks & Spencer, Arcadia, Debenhams, Storehouse, Next, C & A and Littlewoods.

There is pressure from new entrants such as Oasis, New Look, Gap and Matalan, as well as from the branded niche sports market organizations such as Nike, Reebok, Speedo, Puma and Umbro.

Retailers have become more powerful as specialist and mixed retail stores account for 75% of clothing sales (Keynote 1996). The market is now 'customer-led' rather than 'production-led'. The key retailers now focus on 'own brand' products. Companies, like Arcadia, sell their clothing under such names as Evans, Principles, Dorothy Perkins, Hawkshead, Topman, Topshop, Burton and Racing Green. These are amongst the most dominant names in any retail high street.

Retailers have continued to grow their market turnover and trading profit while the major manufacturers, Courtaulds and Coats Viyella, have decreased their turnover and trading profit. This is illustrated in table 1.1. Some manufacturers have retail outlets such as River Island Clothing Co., Daks Simpson Group plc, Austin Reed Group plc, Aquascutum plc and Alexon Group plc. However, apart from River Island, they tend to target the middle to top end of the market sector.

Table 1.1 Power in the market environment

Company	Turnover 1994/5(£M)	Trading profit 94/95 (£M)	Turnover 1998(£M)	Trading profit 1998 (£M)
RETAILERS				
Marks and Spencer	6,451.2	854.5	8,243.3	1,116.7
Great Universal Stores	2,504.2	416.0	3,363.7	553.0
Debenhams	1,104.3	74.3	1,365.8	146.1
Arcadia	1,909.6	51.2	2,086.6	172.4
Storehouse	1,045.0	66.4	1,335.0	127.9
Next	652.9	81.6	1,239.1	115.6
Matalan	136.8	6.7	278.2	23.8
Moss Bros.	71.1	7.2	153.7	15.3
New Look	85.6	5.7	322.6	39.2
French Connection	70.5	6.8	117.2	10.6
MANUFACTURERS				
Coats Viyella	2,443.8	171.7	2,358.5	87.7
Courtaulds Textiles	922.5	50.1	909.7	44.6
Wm. Baird	530.0	24.3	534.0	26.5
Dewhirst	247.2	16.7	380.1	23.7
Stirling	95.1	3.7	115.1	6.7

(Source: Sequencer (CD-Rom) (1994-1999), London, FT Information.)

There have been accusations that retailers are holding their margin and squeezing the manufacturers (Keynote 1996). Early efforts to change buyer-supplier relationships were made by companies like Storehouse, who tried to work more closely with their key suppliers in an effort to improve both the relationship and the business. These efforts are on going and, so far, little progress appears to have been made (LATC 1997). More recently, even Marks and Spencer, who built their traditional reputation on close partnerships with suppliers, have reduced demand from UK suppliers from 90% 30 years ago to 65%, and this is expected to reduce further to some 50% (Barker 1999b). The more recent Marks and Spencer announcement indicates that

decline in UK manufacturing is accelerating (Minton 1999). This uncertainty confirms the need to research the supply chain management of this industry.

The apparel and textiles industry has seen marked changes and a move towards offshore sourcing. The gradual decline of manufacturing industry in the UK has been witnessed at first hand, for example, at Courtaulds the closure of 15 factories and the loss of 2,400 jobs during 1998 (Barker 1999a, p.24). Courtaulds Textiles employs 16,000 people in the UK and will continue to move its manufacturing base off shore. Courtaulds currently has 45% of its manufacturing capabilities outside of the UK (Luesby 1998). However, their design, development and distribution activities have remained in the UK. Companies like the Dewhirst group and William Baird are also experiencing the effects of a downturn in UK sales (Barker 1999b).

Supplier integration, flexibility and value analysis along the supply chain form some of the key elements for review in SCM. The 'lean concept' pioneered by Womack *et al.* (1990) can assist organizations in their efforts to remove waste and reduce the time to market. Through adopting the lean concept, companies are becoming more efficient, in an attempt to obtain competitive advantage. This is a prime consideration in the field of apparel and textiles where being 'first to market', along with product differentiation and cost efficiency, forms a key goal for many organizations.

> *As product diversity increases, there is a greater need for tactical and strategic information processing for product matters, e.g. there will be more technical operating problems and greater number of strategic product decisions. ...product complexity or heterogeneity leading to decentralized decision-making and communication patterns.*
> (Egelhoff 1982, p.312)

In the case of apparel, the desire is to increase information flow and to make decisions to manufacture at the latest possible time thereby giving increased flexibility and basing decision-making on the demand from the customer.

1.2 THE AIM OF THE INVESTIGATION

The research aim is to investigate the components and procedures that are necessary for supply chain development within the apparel and textiles sector. The purpose is to identify the benefits and barriers that occur in the supply chain in relation to the main

functional areas of the retailer, apparel manufacturer and material supplier. This research addresses: the environment and organizational ecology; network and relationship issues; learning and systems aspects. The focus is on product development and the supply of new styles, as this is critical to the fashion apparel sector.

1.3 THE PRINCIPLE OBJECTIVES OF THE RESEARCH

The focus for this research work is to understand and identify the stages, processes and procedures, timescales, and characteristics of the apparel supply chain. This requires the evaluation of best practice in the apparel supply chain as well as in other industries. The objectives are: to develop an understanding of the apparel supply chain; to review supply chain management theory and best practice; to investigate the applicability of this to apparel; to identify issues impeding progress; to identify what apparel companies consider to be best practice, including examples from other sectors. The proposal is the development of recommendations for improvement in supply chain management and the generation of a model.

This research will therefore address the three key areas of environment and organizational ecology, network and relationship, and learning and systems aspects of product development, rather than the technology that has been used to support the process.

1.4 THE MAIN RESEARCH QUESTIONS:

Can apparel and textile companies adopt the SCM methodology used by other industries (the automotive sector) to develop and manage their supply chains?

The body of research knowledge has, until recently, focused on one specific industry sector - the engineering and automotive industry. The Western automotive industry has adopted the practices of Japan in an attempt to challenge and retain market share in this highly competitive environment. Can this westernized concept of SCM be adopted in the apparel and textile industry to obtain competitive advantage?

Are the benefits of developing collaboration and Quick Response to the market of *mutual* competitive advantage?

The Quick Response movement originated in America where heavy competition from foreign imports was threatening one of the country's main employers. The US Government and the apparel and textiles industries invested heavily to try and compete in this environment of cheap imports.

Can the Quick Response concept, developed for this industry sector, increase the product offer to the customer and decrease the development time for products, while increasing flexibility in the supply chain and creating mutual benefit? In 1995, mutual benefit for companies, within these developing supply chains, appeared to be unclear in the area relating to risk and investment (KSA industry benchmarking study 1995).

Can the network methodology, used in the automotive industry, be employed in the apparel and textile sectors?

The apparel and textile industry has existing, well-established network systems but these have tended to consist of informal, piecemeal connections. Can the practical application of a more structured network be employed within this environment and market place, and are companies prepared to collaborate within these networks?

These research questions form a framework for focusing the evidence of existing theoretical concepts and contemporary models of SCM. The questions also form the basis for the design of the research methodology.

1.5 RATIONALE - SCM IN A CONTRASTING INDUSTRY SECTOR

The existing weight of current research knowledge has been in the automotive, electronics and aerospace fields, with little documentation in the field of apparel and textiles (except in the area of technology and supply chain simulation). There have been government initiatives to encourage research in other sectors. An example is the Apparel and Textile Challenge initiative, which researches apparel and textiles supply

chains and provides workshops for developing links across the key supply chain members (Watson 1999).

There is huge potential to improve apparel product lead times. Examples of typical supply chain lead times in apparel and textiles are: for men's slacks 34 weeks, for nylon parkas 48 weeks, and for bedsheets 31 weeks. These examples include the waiting time for scheduling, receipt of raw materials and transportation. However, the actual machining time to manufacture these products is around 10-15 minutes (Macfarlane.J, *et al.*, 1996).

This research study reviews the automotive sector concepts in SCM and applies some of the tools and techniques to the apparel and textile industry to see if the methods can be transferred. Case studies exist in manufacturing and distribution, but there are few examples of product development. Research is limited in these areas and the research aims to fill this gap and to add to the current body of knowledge on SCM.

1.6 PREPARATION FOR THE RESEARCH

The initial preparation for the research involved developing an understanding of supply chain practices in other industry sectors. This was carried out by taking part in site visits to various exemplary organizations who could demonstrate current 'best practice' in quality, design, and operations in manufacturing environments.

Further sources of information included: the Nottingham Trent University Centre for Work and Technology, the Department of Trade and Industry, the Chartered Institute of Purchasing and Supply, the Institute of Logistics, the East Midlands Quality Club, the Centre for Research in Strategic Purchasing and Supply at Bath (CRiSPS), the Lean Enterprise Centre at Cardiff and the Textile Institute.

Invaluable insight was gained as an interviewer during the early stage of the research, through participation in Supply Chain Management benchmarking studies of the apparel and textile industry. The Work and Technology Programme at The Nottingham Trent University carried out the first study as a joint project in 1996. They were the UK partners, for this study which was part of a wider study carried out

with the Harvard Centre for Textile and Apparel Research, funded by the Alfred P Sloan Foundation. The second benchmarking study was initiated by the Apparel and Textile Challenge, reviewing current industry practice in SCM within apparel and textiles. Kurt Salmon Associates and the Work and Technology Programme in Nottingham carried this out. Over 65 companies participated 1996/ 7. Questionnaires were used, supported by interviews during completion. The benchmark exercise was then used in pilot studies with domestic suppliers to target performance improvement, They achieved a 30% reduction in inventory within the supply chain and a 50% increase in the number of stock turns per annum.

The Apparel and Textile Challenge is a body that has been established with Government (DTI) sponsorship and industry support from the British Apparel and Textile Confederation (BATC) and the British Retail Consortium. Its aim is "to develop more effective UK supply chain partnerships" in this sector by promoting workshops and industry meetings. Over 200 leading apparel and textile companies have participated in workshops and training in supply chain management, using the principles of best practice to develop supply chains and negotiate with partners (Apparel and Textile Challenge 1998).

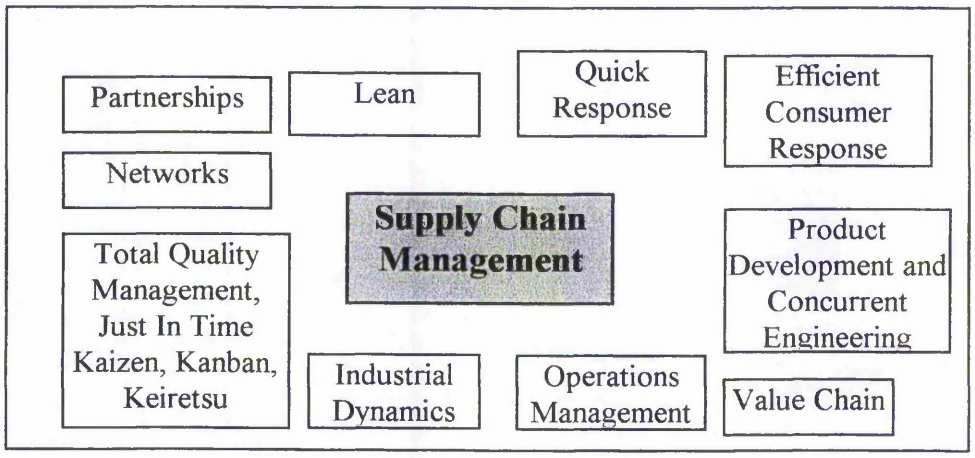
The use of benchmarking studies has given the apparel and textile industry sector an overview of supply chain management implementation. However, the practice of benchmarking against the best in the industry could result in the possibility of producing imitators without changing the core culture of the organization. It does not take the people or the competitive environment of the future into account. Benchmarking gives only a snapshot of the present and an insight into the past and its environment during the product's conception and development. Organizations have to plan for the future environment. Peters and Waterman's book *In Search of Excellence* (1995) illustrates how companies tried to copy the 'best'. Unfortunately many organizations so defined have since fallen from grace and some had disappeared by the early mid-1990s. This leaves a question mark over planning for future survival.

1.7 THEORETICAL REVIEW

A review of general management theory and supply chain concepts is required to underpin research in apparel and textiles and within other industry sectors. The literature is fragmented across different disciplines. The key areas include logistics, purchasing, business management, marketing, engineering, and information technology. The challenge has been to connect the disciplines and the fragmented concepts in order to form a framework that covers the whole concept of SCM.

The scope of the research is a comparison of the UK apparel and textiles sector with the automotive sector, where best practice in supply chain management is well-researched. A wide review of the subject concept and sub-categories is required in order to form a starting point for defining the concepts of Supply Chain Management and Quick Response. These will be discussed in detail in Chapter 2. The subject concepts and sub-categories that were selected for review are illustrated in figure 1.2.

Figure 1.2 Subject concept and sub-categories for literature review



The main sources of literature have been grouped under their category headings.

Partnerships: Macbeth and Ferguson (1994), Moss-Kanter (1996).

Lean: Womack *et al.* (1990), Lamming (1993), Womack and Jones (1996), Karlsson and Ahlstrom (1996).

Industrial dynamics: Forrester (1961), Towill (1997a).

Quick Response: Schonberger (1987), Hunter (1990), Stalk and Hout (1990).

Operations management: Monden (1983), Shingo (1985), Schonberger (1987), Womack *et al.* (1990).

Competitive advantage: Porter (1990), Goldratt (1990), Macbeth and Ferguson (1994).

Value chain: Porter (1990), Christopher (1992b).

Networks: Harland (1994), Hines (1995a).

Total quality management (TQM) and just in time (JIT): Deming (1982), Shingo (1985), Womack *et al.* (1990), Lamming (1993), Hines (1995).

Product development/ concurrent engineering: Stalk and Hout (1990), Merli (1991), Clark and Fujimoto (1991), Womack *et al.* (1990), Lamming (1993), Dimancescu and Dwenger (1996), Cusumano and Nobeoka (1998).

Information Technology (IT): Konsynski and McFarlan (1990), Holland (1995), Cunningham and Tynan (1990).

1.7.1 Supply Chain Management past and present

Although he referred to the subject as 'Industrial Dynamics' the research of Forrester (1961) forms an early insight into SCM. He described a framework for integration across functional boundaries using a step approach to understand industrial systems. His work illustrates the effect of demand amplification and 'noise' on the supply chain, creating a distortion of the real demand and supply of the product. This 'noise' is generated by the individual functions adjusting the real demand to the forecast demand, which then becomes further distorted as it is again adjusted at each functional boundary. This area of literature has been expanded in chapter 2.

Some of the early SCM research, in the UK, was carried out by Baxter, Ferguson, Macbeth and Neil (1989), and examined multinational enterprises and relationships within these supply chains. Macbeth and Ferguson (1994) developed this work further, where the concept of 'partnerships sourcing' became the main focus of their SCM research.

Research by Womack *et al.* (1990) introduced the 'lean' supply concept based on work carried out in the automotive industry and good practice in Japan, focusing on

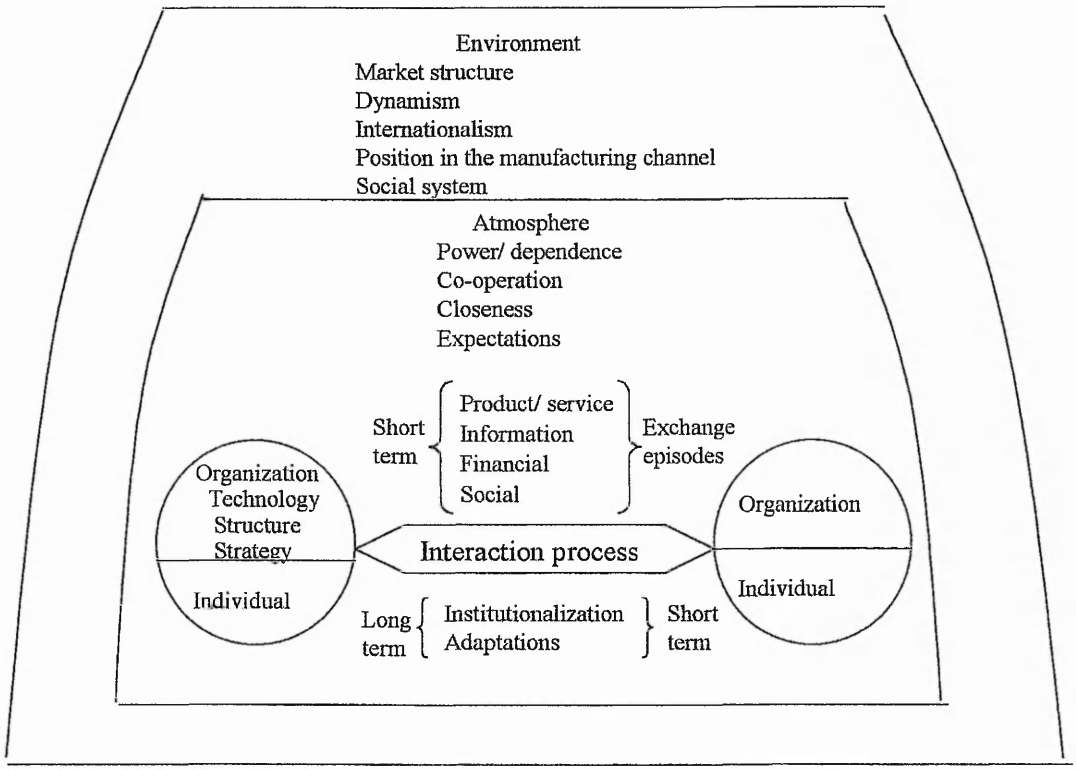
the removal of waste throughout the supply chain and the organizations' efforts to add value. The Japanese have influenced the research theory through their insight into automotive production techniques at Toyota e.g. continuous improvement and non-stock production, Shingo (1988). Hines (1995a) researched Japanese network methods and has expanded the knowledge to include their adoption in the UK car industry.

The development of new company structures, supply chain networks and partnerships have been researched by Lamming (1993), Macbeth and Ferguson (1994), and Hines *et al.* (1995), as part of a strategy to manage the process from conception to finished goods to the end customer. Carlisle and Parker (1989), Christopher (1992b), Macbeth and Ferguson (1994), Hines (1994) and Rich and Hines (1996) have covered the topic of company relationships. The literature review will also consider previous apparel industry research, although to date most of the research has been done in other industry sectors.

Supply Chain Management is an organic concept which alters with the constituent variables, environment and market, and which changes to meet the demands of the supply chain's customers - being dependent on their level of power to make this happen.

The interaction model described by Hakansson in figure 1.3 depicts some of the variables under consideration within supply chain management. These are the external environment of the supply chain, and their position in relation to the market. The key features are the internal atmosphere of the supply chain participants, their inter-dependence, their type of relationship and their power over each other. The model also includes the interaction process, information exchanges which occur between the organizations, and the long or short-term nature of these interactions. This model forms a starting point for the review process of supply chains for the study.

Figure 1.3 Interaction model



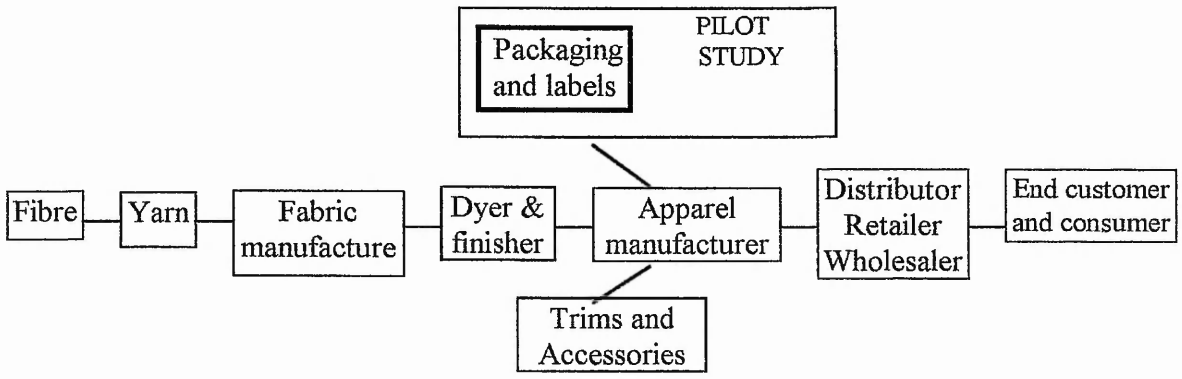
(Source: Hakansson, H. ed., 1982, p. 24)

1.8 SUPPLY CHAIN MANAGEMENT - PRIMARY RESEARCH

The research requires a sound methodology to be used and early consideration of the case study method showed it to be most appropriate. Case study methodology has been used in the research of Womack *et al.* (1990), Macbeth and Ferguson (1994) and Hines (1994) as a means of understanding the whole organization and its related supply chain. However, a review and analysis of other methods was undertaken, as can be seen in chapter 3, in order to justify this approach.

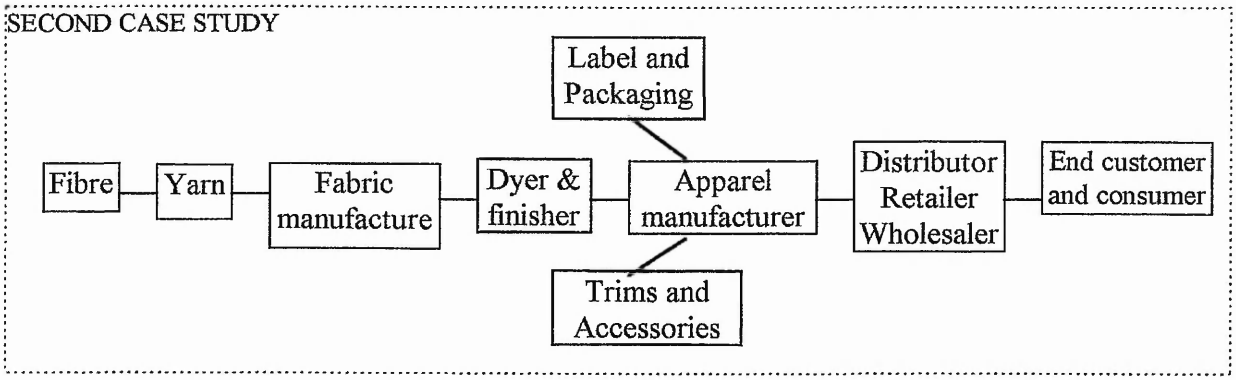
Having selected this approach to collecting data, a pilot case study was required in order to initiate and trial the methods, tools and techniques for further case studies. The pilot study was to be on a section of the supply chain. The section selected was packaging (see figure 1.4). The first study was to be of a simple supply chain consisting of one product, and was to use a questionnaire and semi-structured interviews. This required access to key people and demanded only a short time scale to collect the SCM data.

Figure 1.4 Pilot case study
Duration of data collection period: one week



The second case study was to cover the whole supply chain of a company producing a single product type, which was to be derivative in nature and to have a low degree of innovation (see figure 1.5). The organization was to have the external elements of the supply chain within easy distances of the manufacturer and was to supply to the home market. This study was to benefit from a higher level of access and an extended period of data collection.

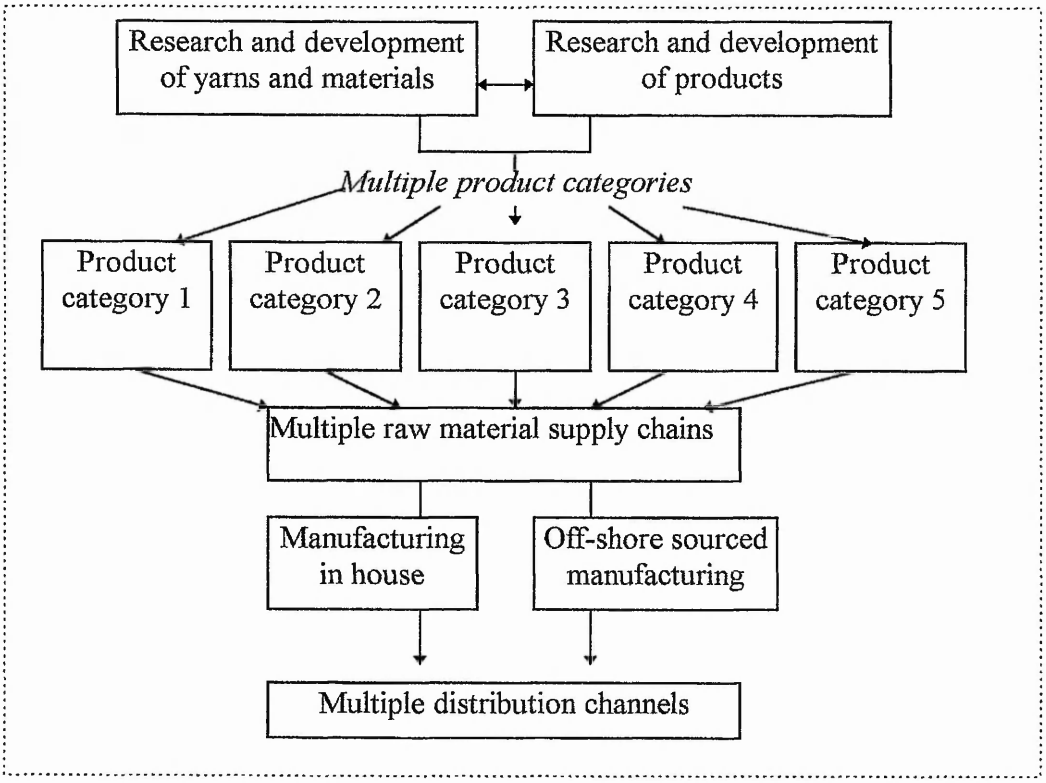
Figure 1.5 Case study 2 - Simple single supply chain producing single product type (low innovation).
Duration of data collection period: two weeks



The third case study was to be a long-term one, with the researcher located within the organization, and an internal champion who was to assist with access and opportunities (see figure 1.6). The organization was to produce a variety of product types, have a high level of innovation, and was to have multiple supply chains and locations, as well as a complex market environment. The products were to be complex, and to be both made in-house, and out-sourced in a global context. This

case study provided a truly representative example of the depth and complexity of the fashion supply chain.

Figure 1.6 Case study 3
Focus on product development (organization has multiple supply chains and high degree of innovation).
Duration of data collection period: one year



The use of three case studies was to build on the selected methods and improve the process and learning that was gained from the pilot study, through the medium-term study to the long-term major case study. The case studies would become more complex in terms of: their structures, products, and, degree of innovation. In addition, the researcher's role would move from being an enquiring visitor to being located within and participating in the main area of investigation for a period of a year and so becoming absorbed into the organization.

1.9 THE ANALYSIS OF THE RESEARCH

SCM is an evolving management concept that lacks clear boundaries. The management philosophy relating to the researcher's investigation falls into three main categories: systems theory/ socio-technical theory, contingency theory and learning theory. These were used to explore the evidence, and ascertain the relevance of specific theories to the area of research being explored. These theories will be discussed later in chapter 2.

The review of the management theory forms a theoretical framework, which can then be used to review the core units. The SCM concepts and sub-categories are then reviewed. Taken as a whole, these topics form the core units for consideration in the implementation of the supply chain management process. The units that link the research questions are:

1) the environment and organizational ecology;

2) networks and relationships;

3) learning and systems.

These units are referred to throughout each stage of this research and form the focus for the research results, analysis and conclusions.

1.9.1 Environment and organizational ecology

> *The environmental contexts in which organizations exist are themselves changing at an increasing rate, and towards increasing complexity.*
> (Emery and Trist, 1965, p.21)

These 'environmental contexts' are both the internal and external environments that influence the strategy and policy that the company adopts. The external factors include the economic climate both within the UK and internationally. This subject is currently creating a great deal of pressure for many companies because of the economic uncertainty in Russia, Latin America, and the Asian economies. Child (1972) said that 'environmental conditions are subject to the strategic choices of organizations,' while Mintzberg (1979) said that 'an organization's strategy should mirror or reflect the most critical or constraining elements of the environment.' Organizations may find difficulty in singling out the main elements in the present

economic climate. The strategy for many apparel companies was to expand markets in the countries mentioned above. These markets were considered by many to be the answer to the problem of how to grow market share. The rapid decline of these economies has had repercussions across most industry sectors. This is discussed in the pilot (Mulberry case study, chapter 4).

Egelhoff (1982) makes a highly relevant point about the difficulty of surveying organizations and their environments. He notes that the companies sampled are those surviving; those that did not survive are omitted.

Government legislation and initiatives influence development programmes, which in turn effect the market environment. An example is the recent initiative to invest in training for the electronics industry, particularly in the area of semi-conductors. The government sought inward investment from companies such as Siemens. The market for semi-conductors collapsed, partially due to supply exceeding demand but also due to foreign competition. As a result, the manufacturing investment from Siemens and the UK government has been lost.

1.9.2 Networks and relationships

The second of the core unit areas for analysis can be termed 'network structures' and examines the flexibility, interface and influence of the product development process within these networks. This section includes the 'organizational relationships' which occur internally and externally, and the nature of these relationships - that is, whether they are adversarial or collaborative. The research investigates what form the relationship takes, who the organizations have formed relationships with, and what function they perform within the chain. It also considers the role of managers within the organization and their responsibility within the organizational structure. A review is carried out of the 'organizational structures' that are in place or are being developed. These may form new sub-structures such as cross-functional teams, which may operate both inside and outside the organization. Within this section, the learning issues of the organization are addressed.

1.9.3 Learning and systems

The third core unit is learning, which plays an important role in apparel and textile product development. The network that will create the new product development may be working as a unit across company boundaries for the first time. The companies have to learn about each other's organizations, systems and people in order to carry out successful product development. Intra-company learning is also critical, as the organization may be dealing with new processing or networks, which require change and shared learning. The personnel who have learnt through participation in a team are often disbanded at the end of the project. However, the learning that has occurred can then be transferred by some of the original team members by their participation in a new team formation.

1.10 SUMMARY

This chapter has introduced the questions and the boundaries of the research within the context of apparel and textiles and has provided a brief outline of the methodology. An overview plan for the combined strategy for research and contents of this thesis are schematically represented in figure 1.7.

The theoretical basis is established in the next two chapters for the case study Supply Chain Research in chapter 4. The analysis of results in chapter 5 leads to the conclusions in the final chapter, which shed new light on our understanding of the apparel supply chain.

Figure 1.7 Structure of Research

CHAPTER 1: THE APPAREL AND TEXTILE SUPPLY CHAIN

BACKGROUND RESEARCH ON SUPPLY CHAIN MANAGEMENT AND QUICK RESPONSE

ESTABLISH NETWORK OF CROSS-DISCIPLINE CONTACTS IN ACADEMIC AND INDUSTRY INSTITUTIONS - Institute of Logistics, CRiSPS, CIPS, Apparel and Textile Challenge, E.Midlands Quality Club, Lean Enterprise Research Centre

CHAPTER 2: THE CONCEPT OF SUPPLY CHAIN MANAGEMENT

MANAGEMENT THEORY-
Investigate management theory to establish a framework for the research: Environment and organizational ecology, networks and relationships, learning and systems.

CONCEPTS AND MODELS
Within the framework established above review the concepts and models which most closely fit the research objectives: QR, Lean, ECR, Product development, concurrent engineering, value chain, Industrial dynamics, operations management. TQM, JIT, Partnerships, Networks

On going research and network development with academic and industry bodies

CHAPTER 3: INVESTIGATIVE TECHNIQUES

Research methodologies reviewed and method selected: Qualitative, Case studies, participant observation, interviews and questionnaires quantitative, benchmarking

CHAPTER 4: CASE STUDIES

CASE STUDIES
Open dialogue with selected companies and obtain agreement for research access for pilot studies, medium term and longitudinal case study organizations

Case study field research - qualitative and quantitative analysis

On going research network development

CHAPTER 5: RESEARCH RESULTS AND ANALYSIS

Research analysis, implications and theory versus practice

CHAPTER 6: DISCUSSION AND CONCLUSIONS

Discussion and Conclusions
Scope for further research

CHAPTER 2:
THE CONCEPT OF SUPPLY CHAIN MANAGEMENT

2.1 INTRODUCTION

This chapter will be divided into two sections - general management theory and supply chain management. The first section (2.2) covers the selection of a theoretical framework from the core disciplines of management. The selected theories are: systems and socio-technical theory, learning theory and contingency theory. These theories assist in describing the effect of changing variables and can be related to organizational ecology. The literature research is exploratory in nature and further questions will be raised when carrying out the review.

The second section of the chapter (2.3) relates to the direct field of research on Supply Chain Management. In the writings of Macbeth and Ferguson (1994), Womack and Jones (1990), Christopher (1992b) and Hines (1994), some of the main issues are the environment and organizational ecology, network and relationships, and learning and systems. As mentioned in the aims of the investigation (1.2), this research addresses the networks, relationship, and environment aspects of product development. These areas are also used to review the Supply Chain Management concepts (see section 1.9), and will help to focus the analysis of the variables which are involved.

The sources of the literature available spanned many disciplines including engineering, logistics, human resource management and purchasing. Access to academic researchers and industry practitioners was sought to supplement published work.

Disciplines encompassing Supply Chain Management

As described in the summary of the research strategy at the end of chapter 1, the review of management theory is required to support the areas of investigation and to create a framework for the SCM research. Therefore the focus is on networks and relationships that involved systems, and people's interaction with systems. The first area was systems theory and socio-technical systems theory. The second area was the environment and organizational ecology where contingency theory and the variables

of environment, degree of uncertainty, structure scale and scope apply. The third area was learning and systems, and learning theory was reviewed. Learning is required to take place both within and between companies and involves strategy, structure, policy making and the development of opportunities across organizations.

> *In turbulent times, the company's ability to experiment and change appropriately is a vital part of what it means to be a learning company...being able to learn from the past is an important step in moving to the present and into the future.*
> (Pedler *et al.*, 1997, p. 53)

The first review was of system theory, which assists in understanding the whole structure, including the process, procedures and people of an organization.

2.2 - THEORETICAL FRAMEWORK

2.2.1 System theory

This theory has been used across many disciplines as a method of review for "psychologists, sociologists, economists and political scientists" (Kast and Rosenzweig 1985). The system model has been found to be particularly relevant in organizational research where a cross-disciplinary study is required, as well as when looking at the whole system. System theory is defined as

> *an organized, unitary whole composed of two or more interdependent parts, components, or sub-systems and delineated by identifiable boundaries from its environment suprasystem. The term 'system' covers a broad spectrum of our physical, biological, and social world.*

They describe the system theory approach as one that looks at a subject

> *as a whole, an entity in its own right, with unique properties understandable only in terms of the whole, especially in the face of a more traditional reductionistic or mechanistic focus on the separate parts and a more simplistic notion of how these parts fit.*
> (Kast and Rosenzweig, 1985, p.103-4)

Management has had phases of focusing on sections of the business for improvement. Now they are taking a different perspective and are focusing on the whole organization. The move is away from the mechanistic approach that creates a piecemeal transition sub-optimising the company. The internal mechanisms of the organization are all interrelated and as a result create a reaction along the links when one of the pieces of the whole is changed. This is described as a 'holistic' view, in that the system is composed of sub-systems that come together as a whole entity. The

sub-systems form the framework and cannot be researched independently, but only as part of the system.

Ackoff (1960) defines a system as 'any entity, conceptual or physical, which consists of interdependent parts'. Within the context of an organization, a management philosophy, communications, controls and learning, come together to form the system. He defines the main variables as the structure of the organization and the means and type of communication that takes place. This includes the procedures that are used by management to make decisions. The concept of SCM spans several disciplines. When one particular discipline dominates the system decision-making aspects of SCM may create problems. Ackoff says that the key representative from a discipline will consider his viewpoint for decision-making to be the most appropriate. However, as the system requires to be treated as a whole as described above, the approach to the decision-making process should be made holistic. This holistic view is needed as we can see from the example given below.

> *'Do it right the first time.' A lofty ring it has. But how could a man make it right first time when the incoming material is off-gauge, off-colour, or otherwise defective, or if his machine is not in good order, or the measuring instruments not trustworthy?*
> (Deming, 1982, p.66).

All the elements in the supply chain have to operate as one unit. According to Senge (1990), 'Systems thinking' is needed more than ever because we are becoming overwhelmed by complexity.

System Structure

Koehler (1938), Bertalanffy (1950), and Kast and Rosenzweig (1985) depict systems as either 'open' or 'closed' systems; they are referring to the boundaries which are established within the system. Closed systems have formal boundaries which are often defined by their function. Open systems have more 'permeable boundaries' which allow organic movement of boundaries. This movement is a requirement in a changing environment. However, in the context of organizations with open systems there is a risk of creating greater complexity. This can lead to greater specialization and a resulting increase in departmentalization. As apparel and textiles are operating

within an ever-changing fashion environment, it would appear that the open system would be more appropriate as it allows greater structural flexibility.

The closed systems are present when the organization considers how they should be structured on a permanent basis. This system develops difficulties when it has to operate in a changing environment, as it is unable to alter its structure to meet the new demands that are made on the organization (Kast and Rosenzweig 1985).

Socio-technical systems relate to the human and technological integration that is achieved within a system. Technology requires inputs that it can then process into outputs, usually as information, reports and designs. The socio-technical system can be measured to see how successful it is in creating the outputs. This can be done by interviewing the personnel in the sub-system to establish if the outputs match the user's requirements, and to see if outputs assist them to perform their tasks (Hakansson 1982; Kast and Rosenzweig 1985; Bijoterveld and Huijgen 1997).

The apparel and textile industry employs around 313,600 people. Several thousand organizations are involved in a multitude of supply chains (Oxborrow 1998). Therefore there is likely to be considerable scope for human and technological integration of systems.

The environment of the system

Organizations increasingly have to be able to integrate their systems with their customers and suppliers. This creates an even more complex socio-technical system structure. The current external environment creates reactive strategies from management, as they are unable to control the forces that are radically redefining their marketplace. This can be seen at present in the economic crisis across parts of Asia and Latin America, and the way this affects the supply strategies in UK automotive and apparel and textile organizations.

Pedler *et al.* (1997) describe how the rapid change of an organization's social and economic environment has created difficulties when attempts are made to control the operating environment through external regulation. In apparel and textiles this

external regulation has previously taken the form of import quotas, international trade agreements, such as the Multi-Fibre Agreement, and EC directives. The limitations of systems theory are that it only creates an overview of an organization and it tends to make generalizations about the structure once it has been established (Kast and Rosenzweig 1985). Goldratt (1990) describes one of the possible drawbacks of systems design as 'lack of action but a great deal of deliberation'. Internal conflict within the organization also arises between 'people and machines, time and money, standardization and flexibility, and functions and systems' (Goldratt 1990, p.10). As a result the contingency theory approach was examined. This is more concerned with the variables which an organization has to address while working in a changing environment. Each organization is treated as being different.

2.2.2 Contingency theory

Contingency theory relates to the uncertainty and complexity of organizational environments. It looks at the degree of centralized/ formalized or decentralized/ non-formalized structure, procedures and decision making within a company. The contingency theory debate has taken different forms - Burns and Stalker (1994) focused on innovation, Woodward (1980) was concerned with levels of technology determining the organizational structure, Child (1984) was interested in organizational structure, job design and control, and Lawrence and Lorsch (1967) researched how organizations operate in relation to the requirements placed on them by their external environment. Research by Egelhoff (1982) reviewed the structure and organizational strategy and Donaldson (1987) analysed strategy and structural fit.

Contingency theory has, in the main, been developed through field research (Donaldson 1995). The contingency perspective is that the organization has to cope with complex situations and recognizes the need to use contingency concepts in an attempt to survive in their environment. This requires a higher degree of knowledge relating to the intra- and inter-organizational relationships and systems.

> *In effect, systems concepts and contingency views cannot provide general principles for managing all organizations, but they can provide important guidelines for organizational diagnosis and managerial actions in specific situations.*
> (Kast and Rosenzweig, 1985, p.119)

Contingency theory focuses on the environment, structure and learning. The environment in which the organization operates, the size of the company and the complexity of scale and scope of the organization. Also how the company uses learning in current development of SCM strategies.

Environment *Internal and External*

The term 'environment' in this case relates to the organization's ability to obtain, within its suprasystem, resources such as money, raw materials and information. The organization needs resources to create outputs, to meet its goals and objectives and to survive.

The environment and organizational relationship, linked to 'the free marketplace', being determined by the pricing mechanism (Kast and Rosenzweig 1985). They appreciate the need to develop new approaches to interorganizational integration. Carlisle and Parker (1989) describe some of the alternatives as developing win-win situations and improving organizational relationships.

However, they warn that when the free market is composed of only a few major companies the market has to be regulated externally. This regulatory body seeks to re-instate a balance within the social system where large, multi-national companies control large sections of the marketplace. As described in chapter 1, a few key players dominate the UK apparel retail sector of the high street and as a result they have great power over the market environment.

Causal texture of the environment

Emery and Trist (1965) divide the 'causal texture' into four areas: 'placid, randomized environment' (where the organization is working independently and in a localized manner), 'placid, clustered' (an expanding organizational environment that has a hierarchical approach), 'disturbed, reactive' (where several companies form an oligopoly and compete through strategies and tactics to out-manoeuvre the competition), and 'turbulent fields' (this revolves around the whole industry as the environment within which the industry competes). Turbulent fields place demands on competing organizations to work together in order to survive.

The last area, that of turbulent fields, can be seen to operate in the apparel and textile sector. Indeed turbulence is increasing as the Multi-Fibre Agreement is being removed, allowing free trade globally. Along with this UK apparel and textile companies have a high dependency on the large conglomerates in the high street. Furthermore, the economic environment of their new markets in Russia and in developing countries in Asia, resulted in an increase in environmental uncertainty. The adaptation to these environments has resulted in the refashioning of the organization. The inter-organizational system is like an amoeba changing its shape to adapt to its environment or market.

The organization works within an environment and with market variables such as whether change is rapid or static, whether markets are stable or unstable, and whether they are complex or simple. A complex market is one that has a high degree of diversification and a wide product offer. An unstable environment creates problems for decision making as it is unclear which way the market is going. Clearly fashion apparel is both complex and unstable.

Structure

Child (1984) divides contingency theory into 'structural contingencies'. He says the design of the organization is dependent on the policy that is set for the company in relation to its different fields of activity. Focus for these activities may include quality, finance or product development. Then the establishment of these core activities will form the framework for the structure. The structure must be aligned with the companies' operations.

> *There are deep-seated conflicts in many fields about the legitimate objectives of institutions...a formal structure cannot of itself resolve these differences in a way that integrates people's actions in an effective manner.*
> (Child, 1984, p.15)

Structure is present to offer mechanisms and frameworks for decision making and these include how operations are to be carried out and how performance will be measured. However, he also says that the people within these structures perceive senior management as perhaps having a different agenda. Structures may be regarded as 'a means of repressive or exploitative control, and hence something to be resisted or even sabotaged' (Child 1984, p.15). These thoughts were reiterated during the

primary research case studies interviews. The choice of organizational structure will reflect the culture being promoted within the company. Also the structure will be effected by the environment, and by the complexity and scale of the organization.

The relationship within organizational structures is an organic form and no 'one way' creates the same result when transplanted into similar organizations. In the area of apparel and textile product development there is a need to find a network of companies. They will be required to work closely with the organization and be capable of integrating into the structure:

> *Fit relationship, in which good 'fit' means that the organization's structure is well suited to exploiting the resources of its environment.*
> (Egelhoff, 1982)

Burns and Stalker (1994) and Lawrence and Lorsch (1967) developed the contingency approach with their views that structure alone does not create an organization. Factors of environment and size, and other contingencies, played a major role. The situation variances will determine the structuring of an organization, but, this will require regular re-evaluation. They defined the main variables of a company as task uncertainty, size, strategy and environment.

Legge (1978) describes contingency theory as a combination of socio-technical system analysis and structural functionalism. 'Socio-technical system analysis' has two areas of concern - the degree and type of technology used in the workplace and the effects on the social relations. There are variables in the environment of the organization's system that form characteristic behaviour.

'Structural functionalism' is the structure/s of the organization and the inter-relationships between these structures and the variables of the environment. Legge describes the system as survival-orientated due to its ability to adjust, and maintains that functional actions or environment may have a positive or negative effect on the organization's survival. Organizations, environment and relationships have to be taken holistically in order to draw a conclusion on the appropriate course of action to meet the desired objective when problem solving.

Mechanistic and organic systems

Mechanistic systems break down problems by function and generate functional resolutions. The organization implements functional processes, performance measures and roles and responsibilities within a hierarchical structure, with little opportunity for questioning the system superiors. Decisions come from the top and communication is limited to reporting personnel. The knowledge within the supply chain remains within the functional boundary. Mechanistic structures and systems are formally set within a stabilized technical and commercial environment. The mechanistic approach can be described as one which can frustrate the organization's effectiveness when conditions change.

However, with organic systems there is cross-functional transfer of knowledge and expertise, and tasks are viewed from a holistic perspective. The responsibility is shared both horizontally and vertically in the supply chain and devolved decision-making occurs. The organization devolves power and expects commitment from employees, which results in success of the company (see figure 2.1).

Figure 2.1 Mechanistic and organic systems

MECHANISTIC	ORGANIC
Breakdown of problems, which concern the organization, into functions	Cross-functional knowledge transfer
Functional resolution to problem instead of a holistic approach	Tasks viewed as part of a 'whole' process
Functional performance measures instead of holistic measures for the concern	Holistic view of tasks; tasks continually reviewed for improvement
Roles, responsibility and processing methods defined	Responsibility sharing horizontally and vertically within the organization
Hierarchical organizational structure, as a means of communication and control	Personnel commitment is to the organization not the function
Decision-making at the top of the hierarchy; no autonomy for functions	Devolved decision-making in the interest of the whole company
Communication limited to direct report personnel	Open communication
Very limited powers of decision making	Flat structure with devolved authority
Not able to question the system superiors	Encouraged to question, commitment is to the success of the company
Functional knowledge and skill is compartmentalized	Cross-functional expertise is important

(Source: adapted from Burns and Stalker, 1994).

This indicates that the 'organic' approach would be best for apparel and textile SCM development, because of the changing needs for technology advancement and the constant redefining of the required structure/ networks.

Task contingency

This relates to 'task uncertainty' and describes how a structured, predictable organization usually has the desire to centralize control and formalize procedures. However, when the tasks become unpredictable and more uncertain the management tends to become more informal and decentralized. Burns and Stalker (1994) describe the formal, centralized approach as mechanistic, and the informal and decentralized approach as organic. Their view of these approaches is that

> *both types represent a 'rational' form of organization in that they may both, in our experience, be explicitly and deliberately created and maintained to exploit the human resources of a concern in the most efficient manner feasible in the circumstances of the concern.* (Burns and Stalker, 1994, p.119)

Lawrence and Lorsch (1967) include the behaviour of these differentiated sub-systems, not just the operational task functions (the behaviour attributes will be seen

subjectively by the sub-systems). The more dissimilar departments are, the more integration is required to align them. 'Integration' refers to the activities that come together to complete a task. The task relates to the entire process cycle from, in the case of the current research, product development concept to launch to the final customer. This cycle incorporates all organizations involved in the task, including the host organization and those sub-contracting, supplying or receiving finished product for the end consumer.

However, Child (1984) views task contingency as limited as research evidence is inconclusive when reviewing the company's performance against the organizational design matched with the key contingencies.

Multiple contingencies

These can best be described by an example in retailing:

> *In multiple retailing companies, indicators of complexity include the range of products offered, diversity of product range, and variability between outlets in terms of size, location and product mix. ... Moreover, greater complexity was accompanied by a more decentralized pattern of decision making. When unpredictability, complexity and the burden of information processing are all very high, then decision-making may have to be diffused throughout the organization, formalization is more of a hindrance than a help, and management's best bet is probably to rely upon cultural control.*
> (Child, 1984, p.167)

Child's statement applies to an even greater extent in today's environment. Apparel retail companies have expanded their ranges over the last decade from two main ranges to four, or in some cases six, ranges per year, with at least as much, if not more variety in each range. The product offer has therefore increased and the retailer has had to deal with greater complexity and unpredictability as their ranges expanded. The structure of the supply chain has changed and many of the tasks have moved up the supply chain to the manufacturer.

2.2.3 Learning theory - in organizations

The third theory has links with the development of Supply Chain Management where the organizations are creating new systems and structures. They wish to learn from this process and change and encourage people to disseminate their learning to other

parts of the organization. It is concerned with organizational learning, reviewing organizational awareness-raising and defences to learning (Arygris and Schon 1978 and Arygris 1990), as well as the development of five stages for the creation of learning as a whole organization (Senge 1990). Also linking learning with a collective approach to organizational policy and operations, and individual views for ideas and actions (Pedler *et al.*, 1997).

Learning in organizations has been revitalized in the 1990s by researchers such as Senge (1990) and Pedler *et al.* (1997). Senge (1990) highlighted the need to re-introduce the learning factor and he describes five convergent dimensions that are creating learning organizations: system thinking, personal mastery, mental models, building shared vision and team learning. 'System thinking' relates to events in time and space which form a whole - a conceptual framework for viewing patterns with a view to change. 'Personal Mastery' describes the need for lifelong learning and effectiveness at work, as part of an organization's key resource. 'Mental models' challenges our beliefs about why things can and cannot be done, and rationalizes them. The 'building of a shared vision' is often described in the form of a mission statement with values and goals for that organization. These are shared and applied across all levels of the organization. With 'Team Learning', Senge draws a comparison between dialogue and discussion. 'Dialogue' referring to a free flowing of meaning through a group, which allows the group to discover insight not attainable individually.

Pedler *et al.* (1997) developed three stages which learning companies could achieve. These have been schematically represented in figure 2.2.

Figure 2.2. Learning companies

STAGE 1 'Surviving'	STAGE 2 'Adapting'	STAGE 3 'Sustaining'
Companies who have established procedures and processes and where problem-solving is normally carried out as a 'fire-fighting' exercise.	Companies who are aware of current and predicted environment changes and adapt accordingly.	Companies who are able to influence and are influenced by their environment and have a symbiotic, adaptive approach to their relationships.

(Source: adapted from Pedler *et al.*, 1997)

Pedler *et al.* describe Argyris and Schon's 1978 work on organizational learning as creating a revival in the concept of a learning organization. They present their concept of single and double loop learning. Single loop learning looks for the mistakes and rectifies them, while double loop learning looks at the process or practice and questions its validity. They said that companies who operate a double loop learning process are not in great evidence. Their third concept of 'deutero' learning involves the organization's groups learning. They investigated the reasons for success or failure in learning. These include conflicts relating to how learning is facilitated, preferences in the mode of learning, and problems in developing positive organizational practices.

The team approaches to learning within organizations have focused on the sharing of information. This encourages the team to think outside of its functional boundary. It is believed that teams who have an open dialogue can learn faster than individuals because learning is shared and information is disseminated. It is anticipated that it would be 'worthwhile' to attempt this approach later in the case study. This could raise awareness of functions and processes, disseminate information rapidly and get "buy-in" by the team members for resulting changes to the process. The team could be made up of members with expertise in different disciplines, such as finance, marketing, sales and product development.

With the discussion of management and their role in regard to learning it is also important to remember that the manager has to learn to manage his environment and learn from the experiences. A manager's role has been described thus:

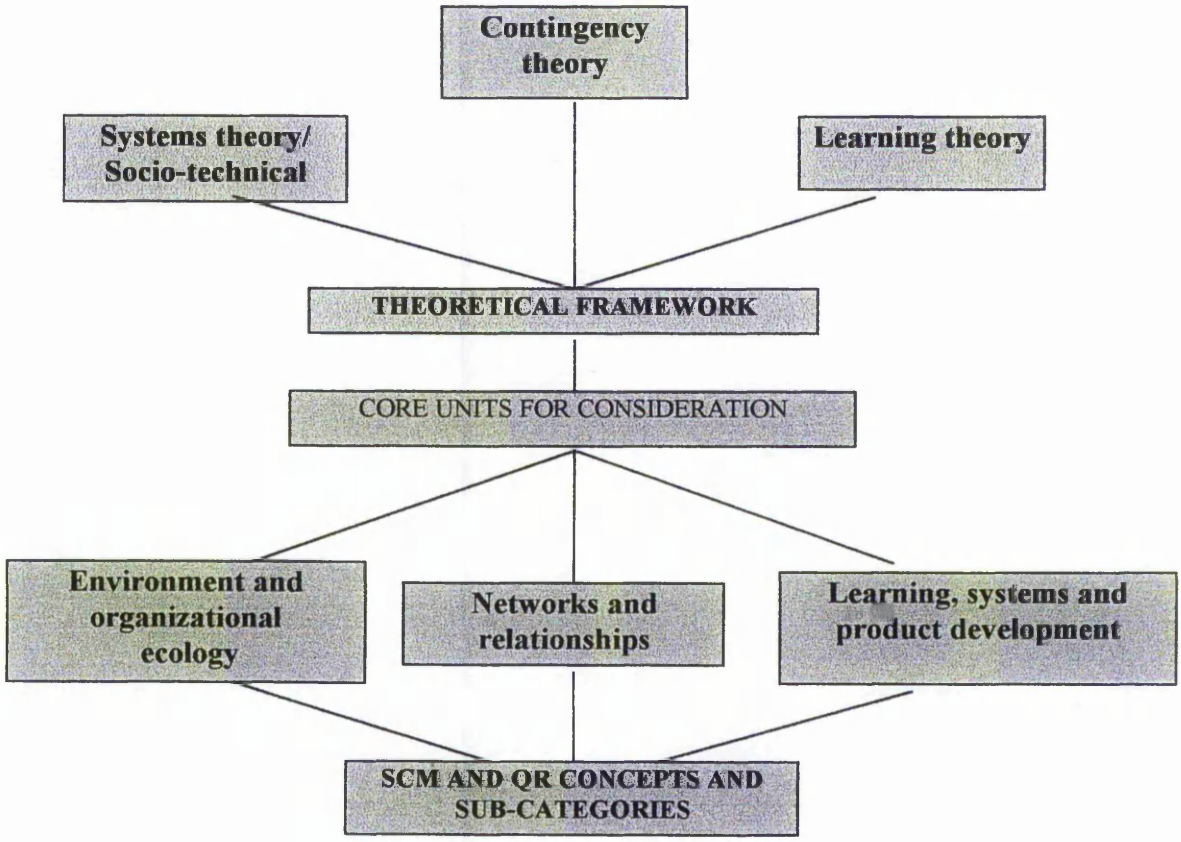
> *In addition to handling exceptions, managerial work involves performing a number of regular duties, including ritual and ceremony, negotiations and processing soft information that links the organization with its environment.*
> (Mintzberg, 1975, p.50).

He describes how one of a manager's key functions is his/ her external network and includes the exchange of informal information that is then relayed to the manager's lower echelons.

2.2.4 Theoretical overview

The three management theories of systems, contingency and learning as reviewed above can be analyzed for their relevance to the three core units under investigation: networks and relationships, environment and organizational ecology and learning and systems. These units then form the background for reviewing the SCM concepts and sub-categories (the relationships are illustrated in figure 2.3).

Figure 2.3 Levels of investigation



2.2.4.1 System/ socio-technical theory

Networks and relationships

The positive aspects of using system or socio-technical theory for this research are that it is relevant to a cross-disciplinary study, that it reviews the interdependence across departments and integration, that it uses a holistic approach to an organization, and that both the human and technical aspects of systems are considered.

The negative aspects are that systems can create an increased risk of departmentalization and complexity, which may result in a great deal of deliberation without actual action.

Environment and organizational ecology

The positive aspects when using open systems are that it allows the creation of permeable boundaries between functions and integration, that the sharing of information will create greater opportunity for flexibility and complex network development. The negative aspect is that closed systems do not take consider the changes in the organization's environment, that mutation within the system may occur due to the complexity and changes and that system specificity with one or a few suppliers may create a barrier to the organization.

Learning and systems

The positive aspects are that information can be shared, that there should be an increased interface with other functions, and that the level of awareness is raised across the system's functional boundaries.

The negative aspects are that it does not address the issue of learning organizations or the need for progression and continuous improvement; that the data is disseminated across the system but not necessarily as information; that the system may take considerable time to change to a new set of variables. Furthermore, there is the issue of the system creating unwanted organizational behaviour e.g. when individual or departmental performance criteria are mis-matched to the overall goals of the company, adversarial behaviour occurs within the company.

2.2.4.2 Contingency theory

Networks and relationships

The positive aspects of contingency theory application are that it can be used in a complex environment and concentrates on the core activities, that the organization structure can be flatter and more flexible to allow for restructuring and reorganizing the work methods while taking into account the changing environment.

The negative aspects are that, in order to keep the organization flexible, it considers personnel to be more dispensable; that it requires a management culture to be open, which is not always easy to achieve in a highly competitive environment. Also that the organization has to allow time for balancing the strategy, the process model building and include time for the feedback and decision-making. Organizations do not always consider the period of time required for development.

Environment and organizational ecology

The positive aspects are that the theory addresses the environmental uncertainty and is able to manage a high degree of variability, that there is promotion of role deformalization to create more permeable boundaries and more flexibility, that both the organization and the environment in which it operates are considered. Also that a high level of integration can be achieved and that the organization is survival-orientated and encourages experimentation and change.

The negative aspects are that the interrelationships of process and environment may not be addressed due to the complexity of the variables. Organizations have gone through many changes in the last decade and conflict arises where functions feel under threat of change and where erosion of responsibility or boundaries is an issue. This can create defensive or disruptive reactions. Rapid environment changes mean that no 'one way' will resolve the structure, system, human and environment aspects of an organization. The process will be organic with a long term perspective.

Learning and systems

The positive aspects are that decentralized decision making allows the organization to be more autonomous. The theory promotes greater flexibility of the organization. The negative aspects are the outsourcing of specialist knowledge, as and when required, which may result in the permanent personnel not keeping pace with current organizational needs because training and knowledge transfer from the specialist to the key personnel may not occur. Organizations may not allow enough time for diagnostic analysis, and control may become more complex as the support systems have devolved decision-making. The need for a strong organizational structure becomes essential.

2.2.4.3 Learning theory

Networks and relationships

The positive aspects are the team approach to learning, which allows faster transfer of knowledge, so that personnel are able to adapt more quickly to change. Learning theory promotes the opening up of the knowledge base, including deutero[1] and double loop learning processes. It changes how people view their job and role within the organization or network. It allows them to question, take responsibility and make changes for positive practices. Collaboration is assisted by sharing function information which then raises cross-functional awareness and generates a more adaptive environment.

The negative aspects are that it requires long-term commitment from the organization and management are required to act strategically. Personnel have to be released from the practical aspects of day-to-day operations, a move away from functional mind-sets. Collaboration across the functions may occur but perhaps not participation.

Environment and organizational ecology

The positive aspects are that the team approach can build on shared goals and objectives, and raises awareness of procedures and processes. Personnel buy-in for a change process is more likely to achieved where there is agreement on shared goals.

The negative aspects are that personnel already have well-established defence mechanisms to resist learning and change, established during previous organizational change, which resulted in job losses. Personnel may use the informal systems to bypass the organization's formal system.

Learning and systems

The positive aspects are the promotion of awareness to investigate why learning has not occurred on a previous occasion. Conflict resolution is addressed, and positive organizational practices are established, rather that obstructive ones. The organization establishes shared information across the company or in some cases the

[1] Deutero learning is about learning about learning; reviewing previous learning and understanding why successful learning did or did not take place. The evaluation of the learning activity is carried out as a group to develop strategies for future learning activities.

supply chain. The negative aspect is that there is a possibility that informal systems may by-pass the organization's preferred approach.

Having established the general management theory base for this research, the specifics relating to SCM concepts and modules can now be addressed.

2. 3 SUPPLY CHAIN MANAGEMENT - CONCEPTS AND MODELS

2.3.1 Introduction

The management theory researched in the first part of this chapter can now be used as a framework to review the concepts and models of the research. The subject concepts can be categorized as Supply Chain Management, industrial dynamics, partnerships, lean, Quick Response, networks, Total Quality Management, Efficient Consumer Response, product development, concurrent engineering, operations management, value chain and competitive advantage (see figure 1.2). Each of these aspects will be analysed using the core units for consideration: environment and organizational ecology, networks and relationships, and learning and systems (see section 1.9).

SCM and QR Definitions

First let us be clear about our definitions in an apparel industry environment. The topics of supply chain management and quick response can mean different things to different people and different industry sectors, and it is therefore important to clarify what we are accepting as the definition at the start of the review.

SCM

> *A system whose constituent parts include material suppliers, production facilities, distribution services and customers linked together via a feedforward flow of materials and feedback flow of information.*
> (Stevens, 1989).

QR

> *QR is a management system or mode of operation for a business or an entire industry to deliver the required goods to the customers with a minimum of lead time.*
> (AAMA, 1987, American Textile Manufacturers Institute)

For the purpose of this research the term Supply Chain Management will be used. The main concepts for this Supply Chain Management research are found in the literature of: partnership sourcing, lean thinking, industrial dynamics, and Quick Response and their application for product development/ concurrent engineering.

2.3.2 Supply Chain management concepts

This section aims to provide a solid SCM theory base along with some of the tools and techniques which have been used successfully to review supply chains. March and Simon (1958) describe how many problem-solving examples are complex, and how, in order to cope, tools and techniques have been developed to focus the individual or group on the key areas of the problem. Some of the tools used for SCM are: Pareto analysis, value chain mapping, relationship maps, product variety funnel and quality filter mapping. Difficulties arise with some of these tools when operating in a new network developing leading-edge products and where historical data is not available; this can occur in apparel and textiles.

There has been a lack of clear consistent solutions for developing the SCM concept and often piecemeal solutions are used, driven by current fads. SCM implementation typically requires a review, by the whole organization, of strategy, systems, processes and people. This needs support from the top through to the lower levels of the organization. There does not appear to be any 'quick fix' solution to SCM development.

2.3.3 Management initiatives of the last 40 years

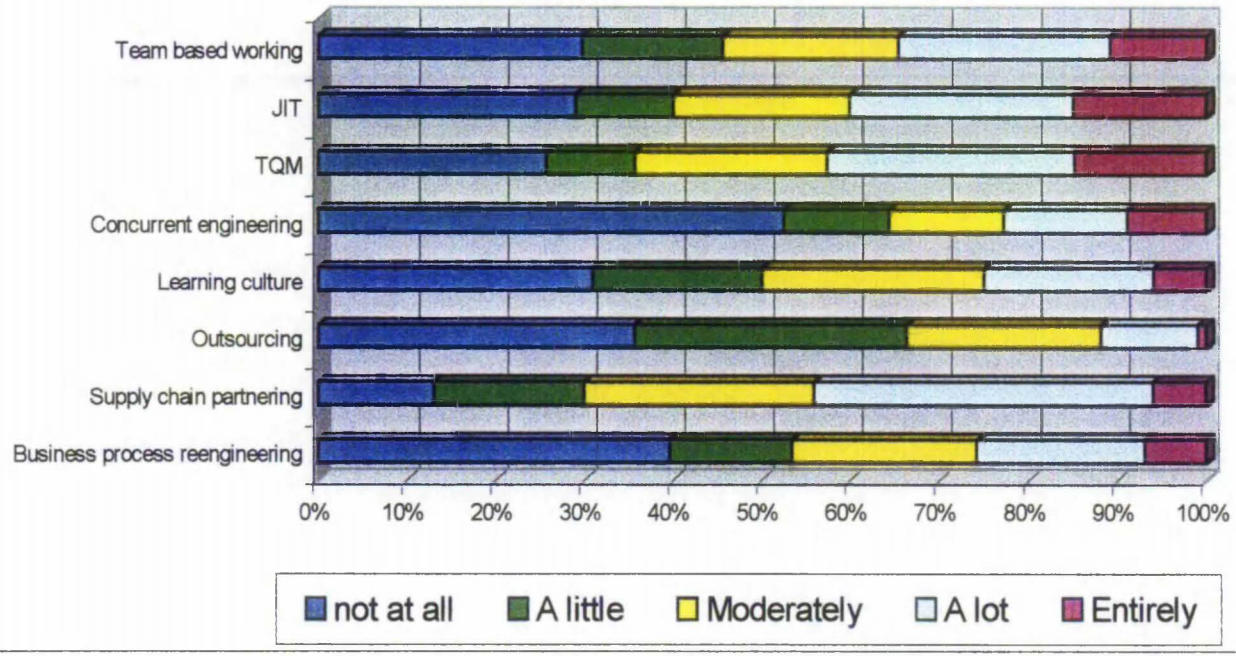
Research by Waterson *et al.* (1997) at the University of Sheffield specifically reviewed the initiatives that organizations have attempted to implement. They carried out a survey of 564 companies across 15 manufacturing sectors with a size variance of 150-1000 employees. The survey reviewed the UK's manufacturing practices spanning the last 40 years and looked at the initiatives and their resulting impact on success or failure. However, Waterson *et al.* (1997) appreciated that it was difficult to measure an initiative's effectiveness, due to more than one initiative being implemented at any given time. 49 of the surveyed companies were textile or apparel/ finished clothing-related.

The initiatives have become more prevalent in the 1990s, as can be seen from figure 2.4 (Waterson *et al.*, 1997). The most prevalent practice in 1996 appears to be supply chain partnering and the least prevalent was concurrent engineering. Their findings indicated that supply chain partnering, TQM, teamworking and IT integration have formed a cluster of practices in which most companies have participated.

However, they said that they had only a 50% chance of meeting the objectives for the organization concerned. Figure 2.5 shows the timescale for these concept introductions with a rapid increase in the application of TQM, JIT, concurrent engineering, team-based working, learning culture, supply chain partnering and business process reengineering in the last decade. Outsourcing is the least applied concept with only 40% of companies taking this approach.

The effectiveness of these initiatives, in the area of responsiveness, is indicated in figure 2.6. Supply chain partnering, business process reengineering, concurrent engineering, team based working, JIT and TQM come high on the list as a means for improvement. Outsourcing and learning culture are considered to be less effective in achieving the company's objective of greater responsiveness. As Figure 2.6 illustrates, concurrent engineeering is considered to be quite effective, but it has not been widely adopted.

Figure 2.4 Prevalence of UK Manufacturing Practices in 1996
Source: Waterson *et al* (1997)



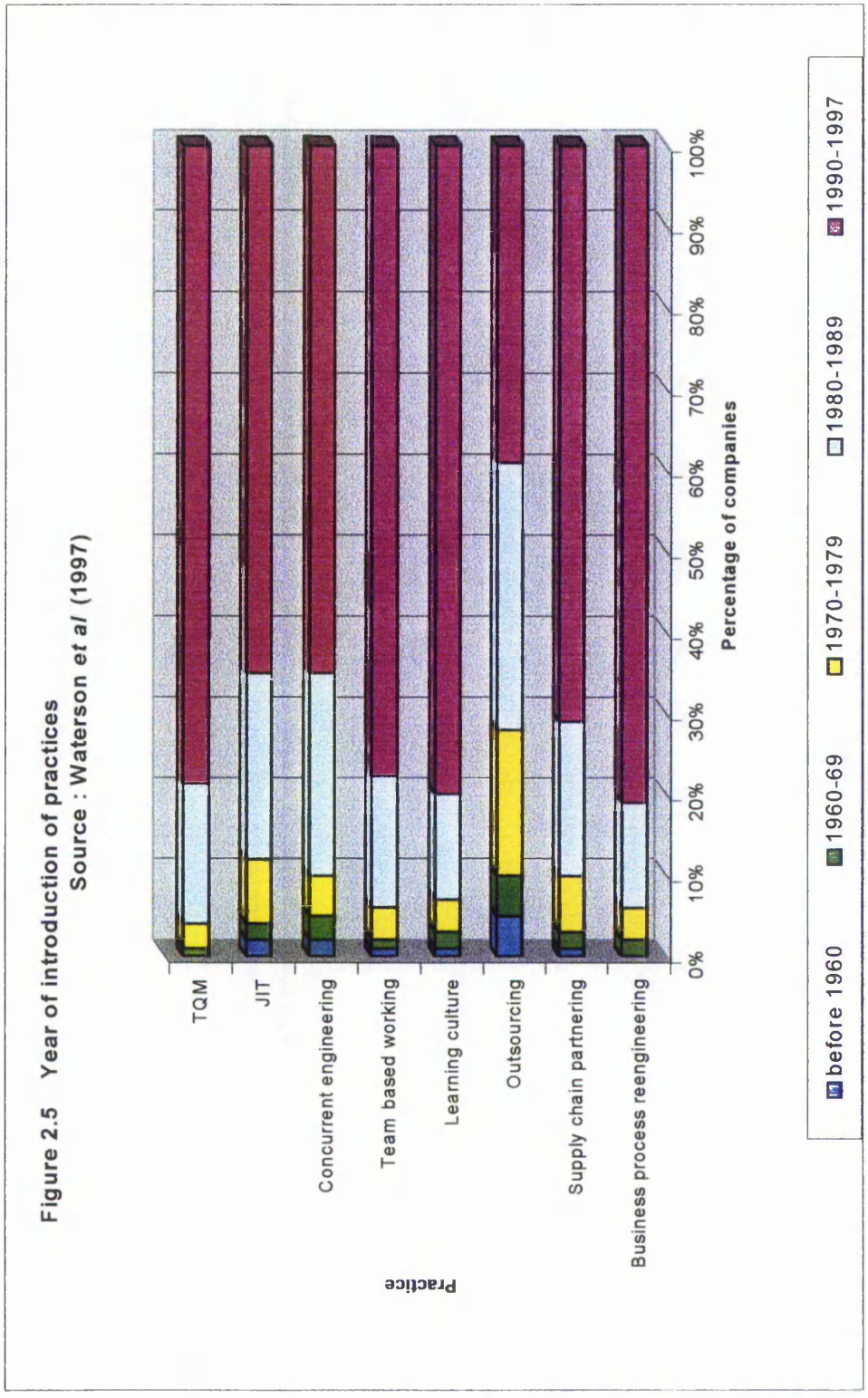


Figure 2.5 Year of introduction of practices
Source : Waterson *et al* (1997)

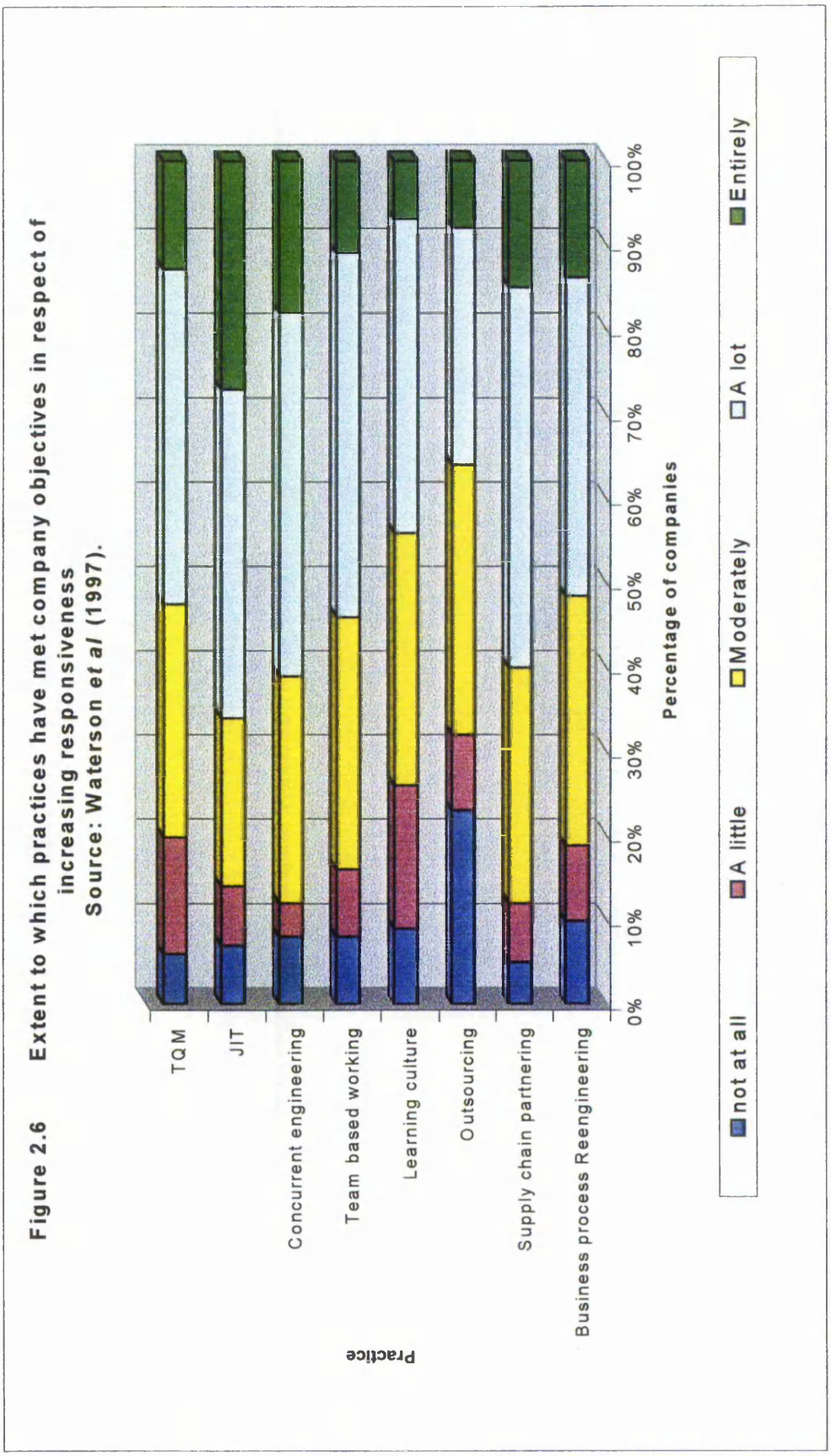


Figure 2.6 Extent to which practices have met company objectives in respect of increasing responsiveness
Source: Waterson *et al* (1997).

The research by Waterson *et al.* (1997) highlights the change that has occurred in management methods which attempt to resolve problems in any specific area. However, by reviewing problems in isolation and not considering the whole organization, they create change and potential problems in the next section of the supply chain. There may be gains within a section of the supply chain but they are lost further down the chain. The approach of piecemeal solutions driven by current fads has resulted in a rollercoaster of change.

One of the earliest examples of SCM thinking can be seen in the work of Forrester (1961). In his book *Industrial Dynamics*, he describes the effects of poor systems and information exchange, which he calls feedback theory.

2.3.4 Industrial dynamics

> *Industrial dynamics is a way of studying the behaviour of industrial systems to show how policies, decisions, structure and delays are interrelated to influence growth and stability. It integrates the separate functional areas of management - marketing, investment, research, personnel, production and accounting.*
> (Forrester, 1961, preface vii).

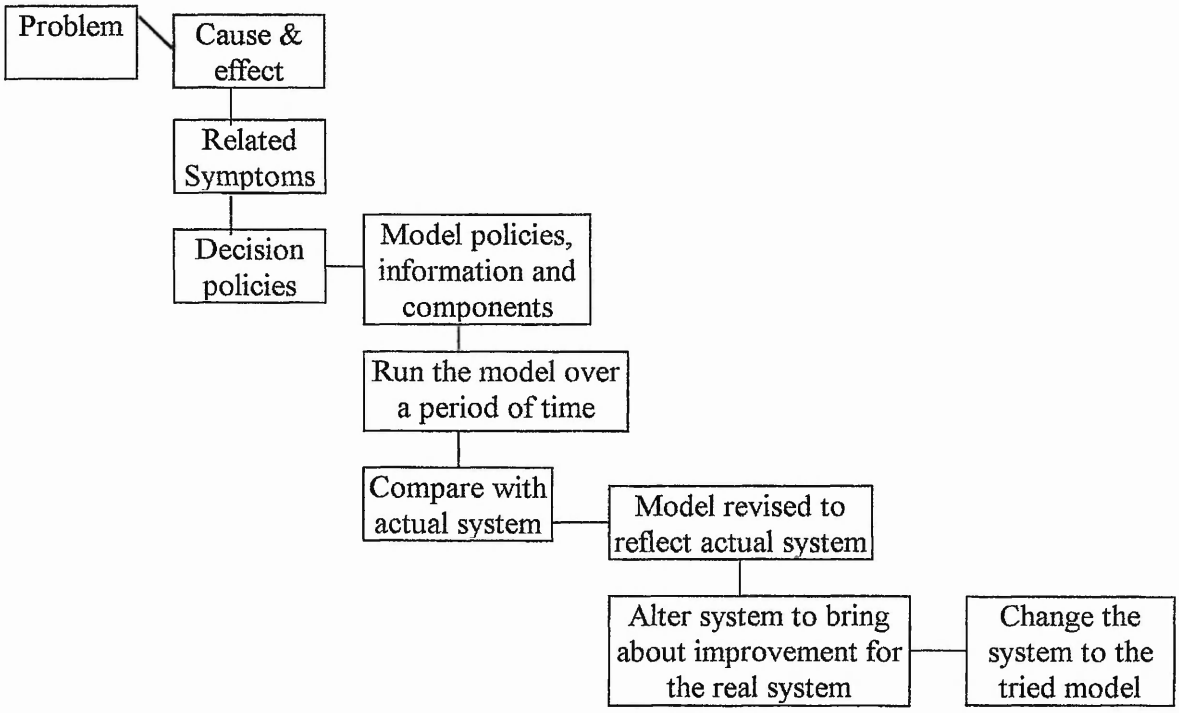
Forrester (1961) described four underpinning requirements for the organization. Firstly, the theoretical understanding of information systems which form the basis for setting goals, and the understanding of the quantitative business information. Secondly, the review of the reasoning behind the decision-making process. Thirdly, the modelling of the business and the influence of the computer on the system. Finally, the awareness of how the functions interact. He describes this interrelatedness of the system and the requirement for understanding thus:

> *The interconnections, the compatibility, the effect of one upon the other, the objectives of the whole, the relationship of the system to the users, and the economic feasibility must receive even more attention than the parts, if the final result is to be successful.*
> (Forrester, 1961, p.6)

Forrester's information feedback system, schematically represented in figure 2.10, describes how a decision, when acted upon, may result in a change to the current

environment, and will therefore effect future decisions. This links with the socio-technical theory (see section 2.2.1).

Figure 2.7 -Forrester's Information Feedback System



(Source: Schematic representation adapted from Forrester 1961)

The model starts with a problem which has a cause and an effect linked to related symptoms and a decision policy. A model is generated of the components, and of the information and policy, and they are compared and reviewed with the existing system. Model revision can then be made to fit with the actual system and alterations are made to bring about improvements. The model is then tested and modifications made if required.

His information feedback control loop created a system that continuously regenerates in a changing environment. The information which travels through the system, results in an action and adjustment in an attempt to control the connected components of the system. This system highlights the fact that it is not just the components that the system is comprised of, but the effect of the variables, e.g. 'structure, delay and amplification' on the interaction of the components which forms the basis for

understanding the system structure and behaviour, as well as how management attempts to control the process. The Massachusetts Institute of Technology produced a simulation programme that illustrates the Forrester theory, referred to as the Beer Game (Berry and Towill 1995).

The key to balancing the system is, according to Towill (1997b), to improve the information frequency and remove the 'noise' by the use of a filter process. The term 'noise' represents inaccuracy caused by delay or distortion or interference created from shared resources. The system decision-makers have to ensure that the information is not being distorted by human intervention, e.g. increasing buffers of product or inventory. The effect of this distorts the information both up and down the supply chain. The system has to be as simple as possible to remove delays and the need for forecasting. Complexity results in unstable operating behaviour and creates a disturbance which he terms 'rogue information'. This amplifies the true position and generates inaccuracy referred to as 'demand amplification'.

The desire to remove the need for forecasting and to reduce time required prior to manufacture has led to: reduced lead times, time compression throughout the supply chain and a move to Just in Time (JIT) manufacturing. Time compression has been a concept under investigation by Forrester (1961), Stalk and Hout (1990) and Womack and Jones (1996). The desire has been to create a smoother flow and shorter cycle times, in an effort to remove unnecessary fluctuations that are generated by time delay and the balancing of the flow of information and raw materials.

Summary on industrial dynamics

Supply chain systems have in many cases been technology-driven, perhaps relying on preparatory generic systems. This could be considered to be too simplistic as each system has different environments within which they operate. Attempts to improve dynamics alone can lead to demand amplification and more problems for the supply chain. The human aspects of this interrelationship of SC members have not always been part of the equation. The work on partnerships starts to address some of the social and strategic aspects involved in SCM which industrial dynamics highlighted.

2.3.5. Partnerships

> *Partnership sourcing is where customer and supplier develop such close and long-term relationship that the two work together as partners. It isn't philanthropy; the aim is to secure the best possible commercial advantage. The principle is that teamwork is better than combat. If the end-customer is to be best served, then the parties to a deal must work together - and both must win. Partnership sourcing works because both parties have an interest in each other's success.*
> (Sir Derek Hornby, cited in Macbeth and Ferguson, 1994, p.3.)

The partners work together to remove non-value added activities, reduce the lead time and focus on continuous improvement to customer service. Partnerships, in most cases, require systems in order to operate (Macbeth and Ferguson 1994). These may be technically driven via EDI, EPoS, CAD/ CAM, or they may be the agreement of procedures which are not technology-based. The technology takes the form of a tool to facilitate the process and is not the answer in itself.

Companies have linked their supply chain partners as a means of survival in a rapidly changing environment. The reason they are teaming up is to gain advantage from strategic and operational integration, removing waste from the chain and as a result improving their competitiveness. Partners have to agree a system that meets the needs and expectations of all parties to the supply chain. This includes performance measurement and audit trails for improvement purposes. 'Partnership sourcing recognizes IT for what it is - a major challenge to existing systems, attitudes, structures and behaviour' (Macbeth and Ferguson 1994, preface viii).

It is only by questioning present practices, and discussing alternative ways of carrying out the same operation, that greater efficiency can be generated. Some of the issues which partnerships generate revolve around 'confidentiality, access control and data manipulation' (Macbeth and Ferguson 1994). The initiator for the partnership also brings into the equation the power issues within a partnership.

<u>Selecting Supply Chain Partners</u>

Moss-Kanter (1996) has seven criteria which she considers are 'fundamental for an effective partnership' (see figure 2.8).

Figure 2.8 Moss-Kanter's seven criteria for effective partnership

* **Importance** - must be strategically significant
* **Investment** - both parties must be willing to invest
* **Information** - must have good exchange of information
* **Integration** - must connect at many levels
* **Interdependence** - cannot exist without each other
* **Institutionalisation** - must have formal mechanisms, need a structure
* **Integrity** - active respect in the relationship, mutuality and trust.

(Source: Moss Kanter, cited in Braithwaite, 1996.)

Partnerships require a long-term commitment by companies and a great deal of time and resources will be required in order for them to succeed. As a consequence of this, partnerships must be 'Important' and therefore 'strategically significant'. Partnerships require 'Investment' and the organization has to select a few key suppliers and/ or customers with whom they wish to form a partnership. All the parties must 'be willing to invest' their resources on developing this link. The 'Information' flow is critical and parties must 'have good exchange of information'. 'Integration' both internally and externally is required to 'connect at many levels' of the supply chain. 'Interdependence' of the partners focuses the partnership as they 'cannot exist without each other'. 'Institutionalisation' of the organizations is achieved with 'formal mechanisms' and 'a structure'. 'Integrity' between the partners requires the partners to show 'active respect in the relationship, mutuality and trust'.

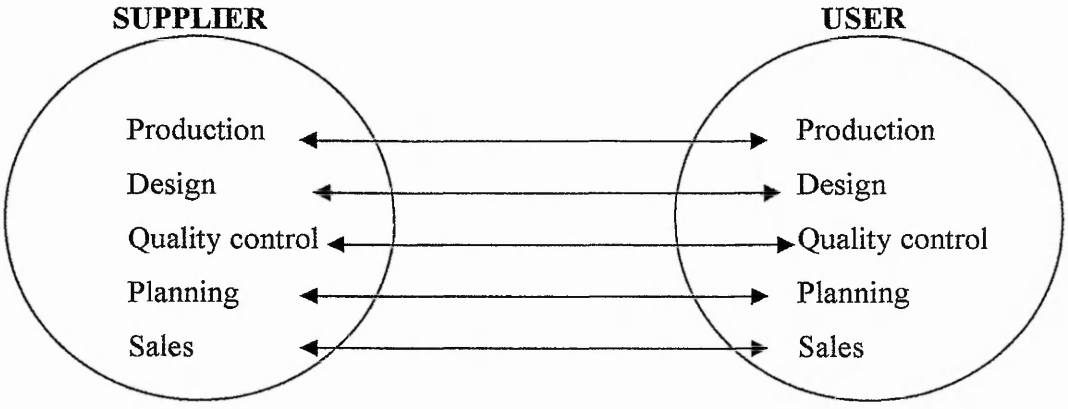
Strategic Partnerships require the host company to work directly with first tier suppliers (suppliers who directly supply into the customer), and indirectly with second and third tier suppliers on strategic supplier development. In order to achieve greater competitive advantage and mutual benefit, first tier suppliers are required to develop the suppliers in the second tier (Hines 1994). However, in apparel and textile companies it is common for the retailer to work with the yarn or fibre companies who would be considered the lowest tier within the structure (see chapter 4 case studies research).

Macbeth and Ferguson (1994) describe partnerships as working together to remove non-value-added cost from the supply chain, reduce lead times and improve quality. Non-value-added cost is waste that occurs during the process. Taiichi Ohno defined

these wastes when he worked on the Toyota Production System in the 1950s (Monden 1983). They are: overproduction (producing unsold stock), waiting (for information, raw materials or part assemblies), transportation (unnecessary movement of goods usually prior to or between tasks where temporary storage may occur), inappropriate processing (carrying out tasks which are superfluous to requirements of manufacture and or customer), unnecessary inventory (usually based on manufacturing economies of scale, which create poor visibility along the supply chain), unnecessary motion (governed by the ergonomics of the task and operative), defects (a quality issue of failing to produce at the required specification, requiring continuous improvement and TQM). According to Bicheno (1998), Ohno also considered 'untapped human potential' as a waste. Bicheno adds 'inappropriate systems' due to management's desire to automate. He feels that organizations should consider simplifying the process or attempting to understand the system requirements before investing in a system which does not assist the decision-making. The final addition concerns the waste of energy and water, and environmental waste. This has been highlighted in the introduction of environmental policy and government legislation, such as that on waste packaging.

Partnerships are assisted by change to the structure of the inter-organizational interface, assisted by building the relationship between the partners (Johanson 1982). The inter-organizational contact was primarily the buyer and seller and in many cases the buyer acted as the intermediary between the suppliers functional areas and his/ her own functional areas. The structural change was that two or more organizations should encourage inter-company communication with their counterpart in the supply chain, e.g. production manager from the supplier communicating with the production manager of the user. This is then replicated between the other functions of design, quality control, planning and sales (see figure 2.9).

Figure 2.9 Counterpart contact



(Source: Johanson, 1982, p.320.)

The purchasing role, rather than buyer-seller role, requires continued co-operation and dissemination of the culture of continuous improvement. The strategy and operational knowledge are shared to maximize competitive advantage

Business network models

In order to assess the position of a company, for progress within a network, the Strategic Competitive Positioning Model, a four stage model was developed (Hines 1994, see Figure 2.10). Each stage has to be achieved before progression to the next. The model starts with Stage 1, 'Price Competition', a one-off purchase. The supplier offers a basic product with no added value service. The product is price-critical and suppliers are switched frequently. At Stage 2, 'Quality Competition', the purchase is probably made annually on the basis of the lowest cost. There is limited exchange of information, and low involvement. Stage 3, 'Close Co-operation', is based on a long-term relationship between buyer and seller organizations and proactive frequent interactions. Quality is a business requirement and some design capability is expected. Stage 4, 'Strategic Partnership', is the formation of a strategic network with a lifelong commitment to achieving competitive advantage. They would be proactive, and have integrated design with the host organization, along with open book costing, TQM and JIT capabilities.

Figure 2.10 Supply chain positioning matrix

	Price Competition	Quality Competition	Close Co-operation	Strategic Partnership
Impact on supplier	Stage 1	Stage 2	Stage 3	Stage 4
1. Buying criteria	Lowest price	Lowest cost	Maximum mutual benefit	Maximum network benefit
2. Purpose of Supplier	To supply goods the customer does not make	To supply goods the customer cannot make	To provide possible benefits & advantages	To provide mutual competitive advantage
3. Relationship type and length	Adversarial; short	Arms length/ variable	Close/ long	Strategic/ lifetime
4. Customer Involvement in supplier activities	Little or none from purchasing	Sporadic by purchasing and/ or quality	Frequent from many functions	Often from many process improvement teams
5. Interaction with supplier	One-off or infrequently	Annual negotiation or quality audit	Frequent problem solving activities	Often seeking areas of competitive advantage
6. Overall Relationship description	Traditional/ reactive	Developing/ reactive or proactive	Progressive/ proactive	Network/ interactive
7. Quality requirements	Minimal or none	Quality control	Quality assurance/ TQM	TQM spread to own suppliers
8. Delivery requirements	Minimal	Timely	Pseudo JIT	True JIT spread to own supplier
9. Cost requirements	Lowest price by tender	Lowest cost by negotiation	Stable/ non inflationary	Target continuing/ kaizen reductions
10. Design requirements	None	Limited (customer design)	Design ability with customer	Integrate design with customer and suppliers
11. Technological requirements	None	Limited (customer technology)	High with joint sharing with customer	Essential with joint sharing with customer and suppliers
12. Co-ordination by customer	None	By occasional one-to-one meeting or standard letters	Yearly supplier conferences	Kyoryoku Kai (cascading down tiers
13. Development by customer	None	Quality control instructions/ audit feedback	One-to-one consultant/ audit problem solving	One-to-one and group activities with Kyoryoku Kai
14. Reliance on grading	None	Some reliance on reactive scores	Heavy reliance or reactive and predictive scores	Some reliance particularly on predictive scores
15. Data interchange	Little/ infrequent at operational level only	Limited/ sporadic at operational level only	Detailed and frequent at operational level and occasionally at strategic level	Detailed and frequent at strategic and operational levels
16. Cost transparency	None	Occasional but very limited	Transparent at highest tier buyer-supplier level	Transparent throughout supplier levels
17. Level of pressure	Low/ medium	Medium/ high	Very high	Very high and transmitted to own suppliers
18. Number of suppliers	Very high and unstable	High and relatively stable	Low and very stable	Very low and very stable
19. Asset specificity	None/ very low	Low/ medium	High	Very high and high/ very high with own suppliers
20. Tiering structure	None	Flat pyramidal	Steep pyramidal	Network format

(Source: Hines, 1994 p.228-229.)

Partnerships challenge existing business practice as they involve a change in culture, structure, systems and mind-set. The reduction in the supplier/ customer base results in increased customer focus and service. However, this could create a higher level of risk, as limiting the selection to a few suppliers restricts an organization's ability to meet new requirements (Sportsco case study chapter 4).

The Nissan Motor Manufacturing UK (NMUK) established key drivers which they used to create their partnerships. These are

> *common aims and aspirations (mutual trust), long term relationship, single sourcing, clearly understood responsibilities, a small supply base, the concepts of continuous improvement.*

They use the following criteria to assess supplier compatibility:

> *management attitude, technical ability (design & development), manufacturing ability, how well does a supplier understand and control his processes, financial viability, and systems and procedures.*
> (NMUK, 1995, p.146-7.)

They also hold an annual supplier conference for a general review looking at planning, setting new targets and goals and ongoing *kaizen*. The partnership can focus its efforts to greater effect as a team than as individual companies developing independently.

Collaborative advantage

The partnership can develop skills within their supply chains which are difficult to replicate and therefore create an advantage where there was a threat of new entrants into the market-place. This can become a defensive and pro-active action in an uncertain environment. This is definitely an attribute for an apparel and textiles supply chain where copy products can rapidly enter the market. However, Macbeth (1998) warns that these structures are damaged if old practices persist. There has to be a recognition that partnerships have survival needs.

> *Collaborative relations are unlikely to be fostered if clients continue to use contracts based on disincentive and blame apportionment.*
> (Thompson & Anderson, 1997)

Lamming (1997) makes the comment that there is a need for companies to work collaboratively while effectively managing the issue of power. In the apparel and textiles sector, power resides with the retailer (see chapter 1). This implies the need

to recognize and manage what can be regarded as 'senior' and 'junior' partners in a supply chain.

Collaboration in apparel and textiles

Concerns were expressed at a recent apparel industry workshop (The Apparel & Textile Challenge 1997). Paul Davis (Apparel and Textile Challenge 1997) made the following points. The manufacturers, he said, 'were battle weary' and that perhaps this was affecting the response to the partnership initiative. It was also felt that changing the culture from a closed to a more open approach was the most difficult task and that the retailers focus was still on price. He said retailers had talked about an open partnership but were not acting in an open manner. There was a need for the partnership philosophy both to be understood at top CEO level and to be disseminated through the organization, with reward for collaboration. He suggested that the industry was very hierarchical in structure and management attitudes had been difficult to change. The issue of cross-functional teams was brought into question due to the balance of power being heavily weighted in the retailers favour and that shared cost information was one-directional. The behaviour from the retailer and particularly the buyer was perhaps partially due to their organization performance measures. Buyers were often measured on "intake margin" the margin = (the price - (manufacturing cost of the garment + standard overhead and shipping). The out-source price would normally be below the locally sourced product. However, it would not be based on total cost which could include large bulk ordering, higher inventory levels, quality issues, the cost of buyer/ quality, and site visits internationally. These are just some of the additional variables to total cost of acquisition. Intake margin also has little relation to the product's success at point of sale - i.e. the volume of products sold at full price or discounted throughout their life cycle.

Summary of partnerships

Successful partnerships are not easy to achieve. Partnerships take time and effort to build, which requires long-term commitment. To obtain the desired competitive advantage, strategy and management attitude require alignment. Collaboration across a supply chain can alter the relationships in a positive manner.

2.3.6 Lean

The term 'Lean' was described by John Krafcik from MIT in the 1980s (cited in Cusumano and Nobeoka 1998, p.4). The 'Lean' concept originated in Japan and was transplanted to America and the UK. The work of Womack *et al.* (1990) raised the awareness of organizations in the West of the benefits of working with suppliers to remove waste from the supply chain.

'Lean Supply' is the Lean production concept developed by Womack *et al.* (1990). This was developed in the automotive sector as a strategic model for assembler-supplier relationships. The 'Lean Thinking' concept was developed further by Womack and Jones (1996). Lean thinking has 5 principles.

> *Precisely specify* value *by specific product, identify the* value stream *for each product, make value* flow *without interruptions, let the customer* pull *value from the product, and pursue* perfection.
> (Womack and Jones, 1996, p.10)

Value is reviewed through open discussion between supplier, customer and end user to determine the criteria for assessing the value of the product. Once the criteria for value have been established, the process can then be reviewed using various tools and techniques. The pull of the supply chain means that the product is being manufactured to an order that has an end customer waiting for receipt. The perfection is the product being manufactured with the minimum of resources and waste, on a pull system to the final customer, with the minimum of lead time and to an agreed target price.

At first Japanese led the Lean change (Womack *et al.* 1990, Lamming 1993), helped by the earlier work of Deming, Juran, and Taiichi Ohno. However, adoption by non-Japanese companies was based on the development of a model created in 1988 for the International Motor Vehicle Programme (IMVP). This was superseded by the Lean Production model of Womack *et al.* (1990). The lean concept, defined by Karlsson and Ahlstrom (1996) encompasses product development, procurement, manufacturing, distribution and the enterprise (see figure 2.11). They describe the changes to improved performance in lean production, including continuous improvement, removal of waste, right first time, JIT, multi-functional teams working towards integrated functions, and the decentralization of the decision-making

function. Their objectives are to remove non-value activities, remove non-essential inventory (finished goods and work in progress), reduce the batch size and lead time, create total quality and increase flexibility in the process. They also suggest the removal of storage, and implementation of cellular manufacturing. Integrated strategic management with vertical information systems is required. They recommend customer involvement in design and engineering, leading to fewer suppliers offering sub-systems of the product. The final objective is to support a global approach to the enterprise development, and network and knowledge structures, that support the lean enterprise.

Figure 2.11 - Lean production

Lean production

Lean development	Lean procurement	Lean manufacturing	Lean distribution	Lean enterprise
Supplier involvement		Elimination of waste	Lean buffers	Global
Cross-functional teams	Supplier hierarchies	Continuous improvement	Customer involvement	Network
Simultaneous engineering	Larger sub-systems from fewer suppliers	Multi-functional teams	Aggressive marketing	Knowledge structures
Integration instead of co-ordination	Zero defects /JIT			
Strategic management		Vertical information systems		
Black box engineering		Decentralized responsibilities / integrated functions		
		Pull instead of push		

Fundamental principles

Multifunctional teams

Vertical information systems

No buffers

No indirect resources

Networks

(Source: Karlsson and Ahlstrom, 1996, p.26.)

The information systems are vertical within this model, but horizontal information is as critical as vertical (Sportsco, case study, section 4.4). There is also a need for

continuous improvement and operating cross-functional teams across all of the above sub-headings (Womack and Jones, 1966).

Lamming (1993) produced a model of lean supply (see figure 2.12). The model describes the characteristics of the automotive industry supply chain, which operates on the global level. This was very sector-specific but gives an overview of global manufacturing/ assembly supply chain operational attributes. The focus is on quality, cost, delivery and innovation linked to relationship development, alliances and collaboration. Cost transparency and technical information exchange would be expected along with investment and capacity management to meet peaks and troughs of demand.

He describes Lean supply theory as interorganizational collaboration linked to strategy, innovation and competition, with value analysis for waste removal and increased customer service and quality, the shift in emphasis being away from a one-to-one inter-company interface and towards dependence on a group interface.

Figure 2.12- Lean supply characteristics

Factor	Lean supply characteristics
Nature of competition	Global operation: local presence Based upon contribution to product technology Organic growth and merger and acquisition Dependent upon alliances/ collaboration
Basis of sourcing decisions	Early involvement of established supplier in new vehicle Joint efforts in target costing/ value analysis Single and dual sourcing Supplier provides global benefits Re-sourcing as a last resort after attempts to improve
Role/ mode of data/ information exchange	True transparency: costs, etc. Two-way: discussion of costs and volumes Technical and commercial information Electronic data interchange *Kanban* system for production deliveries
Management of capacity	Regionally strategic investments discussed Synchronized capacity Flexibility to operate with fluctuations
Delivery practice	True JIT with *kanban* Local, long-distance and international JIT
Dealing with price changes	Price reductions based upon cost reduction Mutual agreement on quality targets Continual interaction and *kaizen* Perfect quality as goal
Role of R & D	Integrated: assembler and supplier Long-term development of component systems Supplier expertise/ assembler systems integration
Level of pressure	Very high for both customer and supplier Self-imposed Not culturally specific

(Source: Lamming, 1993 p.194.)

Summary of Lean

Lean, although originally industry-specific, is now being used outside the automotive sector. The focus is on the following key elements: removing waste, reducing lead times, concentrating on adding value to a product, and the integration of strategy and cross-functional interaction, in the effort to create flow. This concept can encompass all the elements of the supply chain, and applies across internal and network boundaries.

2.3.7 Quick Response

A study in Quick Response was carried out by Andersen Consulting in 1989 which stated that the retail industry in America could save $9.6 billion (Dolen *et al.*, 1989). This could be achieved through developing Quick Response strategies and substantial investment in technology. The study focused heavily on retail and the benefits were generally from a retail perspective. They looked at improving visibility in store, limiting the initial quantity commitment for a product and reducing operating expense. The Quick Response (QR) Conference in 1993 launched the concept and promoted the technology aligned to it. QR was originally manufacturer-driven, looking at the whole supply chain, now it is retail driven focusing on the reduction of retailers' operating expenses. Examples of the concept in practice are: advance shipping notices, scheduling of delivery windows at goods inwards warehouses and cross-docking. These practices are now more widely acknowledged, along with the use of satellite-linked transport systems which can locate vehicles '*en route*' and communicate any changes or updates to the driver while they are off-site.

Schonberger (1996) described a case study of the application of Quick Response within a textile setting, which was successful in achieving shorter lead times. Milliken, a Chicago based textile-chemical company, initiated a plan to integrate the sequence of the supply chain and they called this programme 'Quick Response'. Electronic Point of Sale (EPoS) barcoding information was the key contributor to the plan, using retail sales as the driver. They linked the chain from fabric through production and into the department store. A target was set to reduce the lead time from eighteen months to three weeks and it was achieved in a few chains.

> *Quicker response includes time-to-market, supply chain reaction time, flow time through the support offices, cycle time through the plant, delivery time to the external customer, and service recovery time when things go wrong.*
> (Schonberger, 1996, p.31)

Schonberger described three phases of change which companies go through when implementing a QR strategy. Firstly the re-engineering of 'customer-focused operations' concentrating on continuous improvement, directly linked to customer demand. Secondly the removal of functional silos in 'customer-focused support

functions' and the re-engineering of critical processes. Finally 'strategic collaboration', where joint goals are set between supplier and customer. Representatives from different tiers of supply work together for new outcomes. Cross-functional operational problem solving is the key to decision making for the good of the enterprise.

Researching Quick Response in the apparel and textile sector Hunter (1990), looked at the operational costs of an order, transport of the goods from supplier to goods-in and the processing of goods-inwards prior to despatch as floor-ready merchandise. He reviewed the format and costs for order processing including communication systems, marketing process, selling and customer service process, calculation of the purchasing cost for the product including travel, salaries, and the site cost for the organization. This was particularly relevant where out-sourcing was carried out in the Far East or at other locations a considerable distance from head office. Hunter felt that the loss of revenue for the manufacturer and retailer may be due to forced mark-downs, stock-outs, and the accumulative cost of carrying inventory.

In the 1960s and 1970s the manufacturing in apparel and textile companies had been based on mass-production, long runs and large batch sizes, and on production lines of sequential and single-skilled operators. In order to facilitate QR and shorter lead times, a new method of manufacture was considered. The Toyota Productions System (Monden 1983) was adapted for this sector as the Toyota Sewing System (TSS). Started in the 1980s, it was used to manufacture car seats and had two primary goals, cost reduction and improved throughput resulting in the use of less resource to produce the same product. This was brought about by implementing methods of JIT manufacture, automation, problem solving, defect control and the creation of a flexible workforce. The Textile Clothing Technology Corporation (TC^2) in the USA used the TSS method to reduce buffers between machinists and reduced the cycle time from 10 days to 3 minutes (Hunter 1990).

The automobile industry invested in automation and the use of robots to reduce the labour element of the process, and the apparel and textile centre also experimented with this course of action. However, apparel and textiles companies had problems with the material-handling aspects of the machines, which had to manipulate a wide

variety of fabrics. The variety of products being manufactured was also a problem for the automation of the industry. Investment in automated machinery was not conducive to flexibility and return on investment was limited to the size of the market in the UK. In the apparel and textile industry, the labour element of manufacture accounts for approximately 20-30% of the product cost and a further 10-27% was accounted for by the overheads for holding inventory. $TC^{2.}$ in the USA drew the conclusion that automation was therefore not the area to focus on. The main areas of co-ordination and response time to market were more critical for apparel and textile Supply Chain Management.

Quick Response and technologies

Kamal Sehdev (1994) identified five areas for strategic garment manufacture. The first was technology for rapid data collection and exchange: Electronic Data Interchange (EDI), Electronic Point of Sale (EPoS) and Universal Product Code (UPC). The second was replenishment, involving the generation of purchase orders automatically calculated on specific lead times. This brought about a 99% improvement in customer service and a 21% reduction in inventory with a reduction of 96% on stock-outs. The third was partnership, which is active co-operation in assessing and improving the supply chain, along with shared forecasting. The fourth was product development, with point-of-sale data collection being used on trial runs. This required the monitoring of product sales by the retailer, by style, colour, size, quantity, time and method of payment. The last was supplier responsibility - the idea that the supplier has the responsibility for the garments from the fibre stage through to their display in-store.

The Quick Response concept was followed by vendor managed inventory (VMI) and then Efficient Consumer Response (ECR). ECR has three key areas: 'efficient replenishment, efficient assortment and efficient promotion'. 'In 1992 K-mart had two hundred suppliers who were operating under a vendor-managed inventory system' (Schonberger 1996, p.142).

Efficient replenishment relies on PoS data and access to retail inventory holding, with the supplier ensuring continuity of supply. Efficient assortment is also called 'category management'. This is where the retailer records consumer preferences and,

based on sales figures, aims to increase sales and customer service within a designated area of the retail store. Efficient promotion concentrates on customer demand and actual sales and is not based on forward buying of special offers.

Summary of Quick Response

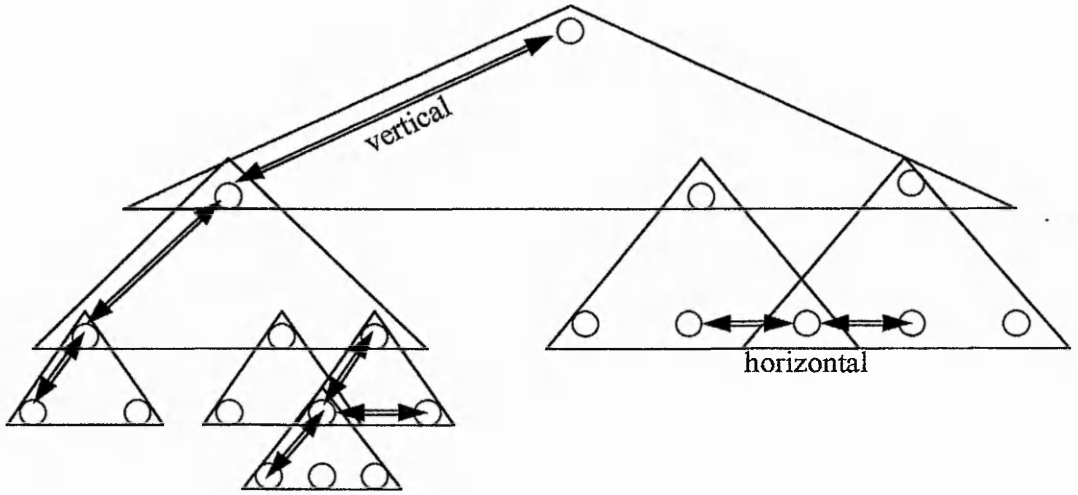
Sehdev omits the development and use of Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) technologies and their use in concurrent or joint product development and rapid prototyping. These technologies have increased in value especially where a supply chains geographic location has spread to joint ventures around the world and where companies are multi-sited. The sophistication of these technologies has grown over the last decade. However, the actual use of these technologies has initially been by the largest of the manufacturers, such as Coats Viyella and Courtaulds. These organizations have close links with a few key customers and have systems which integrate with their customer. Integration is usually only achieved where long-term relationships have been established. Some retailers have stipulated some technology, EDI for example, as a pre-requisite for doing business (British Home Stores, Tesco, Marks and Spencer).

Hunter (1990) states that the reasons for non-adoption of QR were attributable to the cost of putting this form of manufacturing into practice, to poor levels of co-operation from other links in the supply chain, to lack of basic knowledge of the approach and its implementation, and to the inability of the companies in the supply chain to agree on a policy and process. It is also interesting to note that he uses the term 'active co-operation' along with 'partnership', which could infer that there are degrees of co-operation and that some buyer-supplier partnerships may involve passive co-operation.

2.3.8 Networks

Companies usually work within a network that operates both within and between companies and includes suppliers (direct and indirect), manufacturers, warehousing and distribution (including shipping), and the customer (internal and external). A generic model of a network is illustrated in figure 2.13.

Figure 2.13 Networks



(Source: Likert, 1967, p. 156.)

Likert described this integrating structure as overlapping which has 'linking people' - people who assist the free flow of information within the organizational system on both a vertical and a horizontal plane.

Hakansson (1987) describes how a network's main components of actors, resources and activities are linked and form a 'dependency' on each other, their goal being to provide an effective output product or service. To maximize the benefit from the network, the supply chain must create seamless links along the chain, both for goods and information. Hines (1994) describes this as 'network sourcing'. Macbeth and Ferguson (1994) describe it as 'partnership sourcing'. This process of network or partnership sourcing has the potential, when used to its full measure, to be one of the primary means of achieving competitive advantage. This has been exhibited by Japanese automotive assemblers and has been part of their consequent success in world markets today (Hines 1994). Within the Japanese automotive network a tier system of suppliers exists. The assembler is the customer for the product and they would only normally be concerned with the first tier supplier; the first tier supplier would control the second tier suppliers.

Inter- and intra-company interface must be developed in order to achieve a successful network. Customer and supplier have to select partners carefully and develop a long-term network philosophy. The network requires shared risk, shared product development, and supplier product and process innovation. However, in the apparel sector, the retailer may initiate a copy product from a different supply chain, causing friction with the original manufacturer and his suppliers.

Hines (1994) describes how Japanese networks are more successful than their Western counterparts. He says that they dedicate both time and resources to developing the supplier and encouraging a close relationship. He describes the West as having a poor record in supplier investment and development. Japan has developed Supplier Associations, '*Kyoroku Kai*', within their networks, to allow a synergy to develop between strategy and operations. The outcome has been a greater exchange and sharing of information, knowledge and skill between customer and supplier, and between supplier and supplier. The supplier associations are mainly operational in automotive areas. The transplant of supplier associations from Japan to the West has proved culturally problematic. However, Hines maintains that given time, Western models that carry out adaptation and development of a sustainable infrastructure can resolve these problems.

Successful network sourcing may result in improved 'cost, quality, delivery, new product development and supply chain flexibility' (Hines 1994, p.291). Cost savings are achieved through waste minimization, process development and exchange of technology and skills. Lamming (1995) describes the implementation of a supplier development programme throughout a network as 'external resource management'.

Apparel and textile networks take the form not of tiers, but of a matrix. The automotive industry relies on sub-assemblies to produce the end-product. The components that make up the product for apparel could have part-assemblies of pleating or embroidery. Product differentiation often comes from the raw material suppliers and therefore having close links with them is critical. The high level of innovation and the high volume of product introduction in apparel and textiles

requires several networks to link into the host organization and to be developing new products simultaneously.

Network Development

At the Council for Management Annual Conference Moss-Kanter of Harvard Business School, said that companies will require 'concepts, competencies and connections' in order to survive the rapid changes ahead (cited in Braithwaite 1996). She described the **'concepts'** as an 'innovation culture', where employees are encouraged to think 'outside the box'. They are empowered to play, have a healthy irreverence for existing process and operations and open their minds to alternatives. However, it is acknowledged that few companies have developed the process sufficiently to handle the risk that is required for such change. **'Competence'** is the ability to make the concepts operational. This involves the development of a positive culture that empowers people and treats them with respect. **'Connections'** means the development of extended network sourcing for Quick Response. In order that a company can operate it requires connections - a 'symbiotic relationship'. In this, Moss-Kanter is in agreement with other writings on the development of networks sourcing as a means of competitive advantage and survival (Christopher 1992b, Macbeth & Ferguson 1994 and Hines 1995). Her assertions apply particularly to the apparel and textiles network. She observed that in many cases the lack of basic foundations impeded a relationship from developing successfully.

With network development and an understanding of the whole process, rather than just one section, waste minimization can occur across the supply chain. Areas such as duplication, unnecessary processing, double handling, waiting time between processing and the distance the product travels during processing can be investigated and waste removed. Savings on cost, quality and logistics can be achieved, resulting in increased flexibility and improved processing for new product development.

Conclusions

Network development is critical to the SCM concept. The ability to link an organization's resources, improve flexibility and remove waste along the chain can only contribute to the strength of the group of supply chain companies.

This leads us into the next concept of total quality as a method of waste removal and the need for a holistic approach to quality within the entire supply chain.

2.3.9 Total Quality Management (TQM)

This concept often applies to manufacturing. However, it also applies to the accurate processing and exchange of information. Therefore it has been reviewed but does not form part of this study. This research does not focus on such general principles even though the philosophy of TQM is a pre-requisite for efficient Supply Chain Management. The TQM tactics include value analysis, engineering, Statistical Quality Control, and Just In Time. The authors reviewed included Deming (1982), Shingo (1985), Womack *et al.* (1990), Lamming (1993), and Schonberger (1987).

2.3.10 Product development

The product development value stream for a product is defined as

> *the set of all the specific actions required to bring a specific product (whether a good, a service, or, increasingly, a combination of the two) through the three critical management tasks of any business: the* problem solving task *running from concept through detailed design and engineering to production launch, the* information management task *running from order-taking, through detailed scheduling to delivery, and the* physical transformation task *proceeding from raw materials to finished product in the hands of the customer.*
> (Womack and Jones, 1996, p.19.)

Levels of innovation vary within the apparel and textile sector. However, the more innovative the product, the higher the chance to launch your product to the market without competition. Products that have low innovation are often easy to copy and competitors can rapidly gain from your investment in research and development. In apparel and textiles the supply chain usually generates new products every six months. In some cases this happens every two months. New styles, designs or new types of product are created, such as the fleece jacket which is currently so popular.

Companies who wish to expand their market often focus on product development to increase their market segment and maintain their existing customer base while maintaining high levels of customer service.

Innovation and customer assessment

> *A consumer can seldom say today what new product or new service would be desirable and useful to him three years from now, or a decade from now. New products and new types of service are generated, not by asking the consumer, but by knowledge, imagination, innovation, risk, trial and error on the part of the producer.*
> (Deming, 1982, p.182.)

> *...some innovations are so dramatic that existing customers are not always the right people to evaluate them.*
> (Macbeth & Ferguson, 1994, p.35.)

Supply chains can differentiate themselves through Quick Response, by reducing the composite lead times of the supply chain, resulting in faster response from order to delivery. This can be achieved where a customer selects a product, using a group of fixed raw materials, which are then customized. The product is manufactured and delivered in a short period of time. A manufacturing system which is modular allows for fast change over between products and for a high degree of flexibility in manufacturing methods, through the use of multi-skilled operatives working across several operations, to produce the variations which the customer requires (Hunter 1990).

Concurrent Engineering

This refers to the simultaneous design and development of a product by multiple contributors to the supply chain. This may require technology such as computer aided design (CAD), computer aided manufacture (CAM) and computer aided engineering (CAE) (Clark and Fujimoto 1991). Telecommunications allow multi-site development across different geographic locations, making immediate discussion and changes possible. Cross-functional project teams can be used to accelerate the development process and - hopefully - remove the need for rework and build for manufacture issues. This already occurs in apparel and textiles - in print and lace designs for use in garments, for instance.

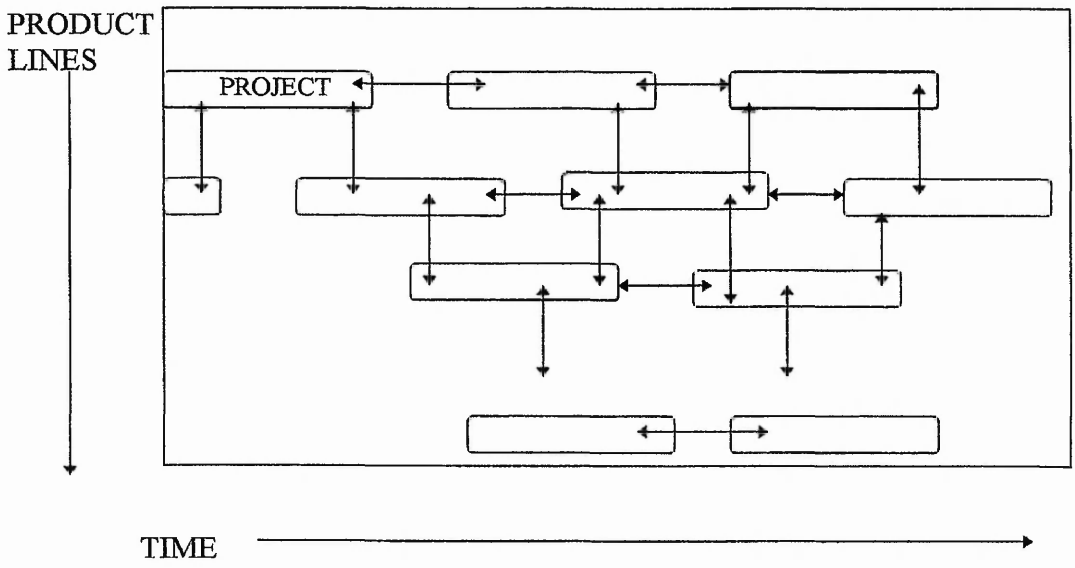
The concurrent method of product development requires a cross functional team of experts to be involved at all stages, but crucially at the early stages. This allows issues to be raised that could cause problems at a later stage in development

(Cusumano and Nobeoka 1998). Cusumano and Nobeoka describe concurrent technology transfer, where the overlapping of activities allows project members to share either information or knowledge during the development process on multiple projects. Functions can also operate in parallel development in order to reduce the lead time. The cross-functional team will also open up a dialogue across functions and assist in removing functional barriers to the development. The design process should be in close collaboration with the customer and also with the supplier of the raw materials, as issues of manufacture will be reflected both upstream and down the supply chain.

The product development process can be broken into the following categories: organizational structure, strategy, information systems (technology-based and people-interaction-based) and the organization's competitive objectives and competency. Using the above categories, Cusumano and Nobeoka explore the area of project management, and the use of multi-projects strategy as a means of transferring knowledge and technology concurrently across the projects. They call this approach 'technology leveraging'. The rapid transfer allows companies to open new markets for their products and therefore create competitive advantage. They show projects as having inter-product line relationships and/ or a general relationship to the product line. Their model of multi-project product development is shown below in Figure 2.14.

Several projects will be in action at the same time, with transfer of knowledge and technology a key part of the multi-project function. The organization's investment in the product development research and development activities can then be maximized across the portfolio of products that are being offered in the market-place.

Figure 2.14 Multi-project management



(Source: Cusumano and Nobeoka, 1998, p.3.)

Multi-project management has existed for many years in apparel and textiles with three projects (seasons) of products being manufactured, developed or researched at any given time. This overlap does require time management skills of the product project team. The same product team would be managing all the projects. They would tend to have a range of products created from a set of silhouettes and would use different fabric or print combinations in order to create the appearance of a new product.

Confidentiality

The threat of product development information being exchanged with a supplier's other customers prior to launch is of concern. However, the consensus response to joint product development in the automotive sector was as follows:

> *since cars are always examined in minute detail by competitors - sometimes prior to launch - an assembler would know immediately if such a leak had taken place and end the relationship... The lean supplier will take care to protect technology developed with one customer from reaching another, at least until it becomes public domain.*
> (Lamming, 1993, p.197.)

After such time patent/ licences will be in place.

In apparel and textiles, the concern is more with confidentiality between the manufacturer and the retailer, as the retailer has the opportunity to switch supplier of the product after a great deal of research and development has already occurred. This is especially true where the branding is the preserve of the retailer via 'own-brand labels'. As joint product development has taken place, the retailer considers the product to be their property. The companies that formed the Burton Group (now Arcadia) had an agreement on prototype ownership with their suppliers prior to commencing development (Bull 1995). This is the Group's claim to copyright for any product which had had some input from the buyer. The supplier would hope that if they lost one development, a substitute product would be made available for them to manufacture. The apparel sector has difficulties with enforcing style copyright, and brand identity can also be damaged by counterfeiting, which is notorious within the fashion business.

In the automotive sector, 'at the start of production the customer will undertake to purchase parts for the life of the product' (Hines, cited in Lamming and Cox 1995, p.152.). It is different in the apparel and textile sector - the apparel and textile supplier may go through the research and development and prototype stages without getting the order for the product. Even if the supplier does get the product order, this may be shared with another supplier, where the second supplier may not have been carrying out research and development. The other area - supplying the product for its life cycle - may not occur. In some cases an alternative supplier or off-shore supplier will be brought in for the second order once the retailer knows that it is selling. This is done to get a reduced manufacturing cost for the product, but omits the recovery cost of the research and development carried out by the original supplier.

Product Development Stages

When future product development occurs with a new model in the automotive industry, the suppliers for that type of product will bid for the part. This allows for competition in the supplier market, ensuring the suppliers strive to improve and problem-solve with their customer. The preparatory stage involves value analysis of existing products, detailed analysis of competitors, products and processes, and process improvements in the manufacture. The concept stage is carried out by the design function and involves the co-

ordination of the different inputs: individual parts, sub-assemblies or systems. The design development stage requires the supplier to have a larger role than the customer company and involves the customer's purchasing department to participate and take joint responsibility with their design department.

The concept of 'design for manufacture' (DFMA) is promoted by Boothroyd and Dewhurst (Bicheno 1998). They focus on reducing the number and variety of components that go into a product design. The concept is to involve people across the functions at the beginning of the design phase so as to ensure that problems for manufacturing the product a recognized early in the product development phase.

The consequences of poor product development were reflected in problems in later stages of production where cost is incurred through delay, rework and redesigning (Schonberger 1996).

> *R & D is the key to developing proprietary process and product expertise, it influences all other manufacturing decisions even those involving roles and relationships with supplier.*
> (Haas, 1991, p.13-14)

Comparisons can be drawn between the car industry and the apparel industry in the power struggle of the few. In the automotive industry, the course of action is the acquisition of competitors in an effort to obtain greater market share and gain economies of scale. In apparel and textiles, the high street lost a great deal of its independent stores because of its inability to compete on price with the large retailers, and because of the cost of rates for their premises. As a consequence some differentiation of products was lost - in many cases, similar products can be purchased across a range of outlets. The UK apparel market is dominated by seven major players who disguise their presence in the high street through the use of various trading names (see chapter 1, p.5).

The removal of textile trade barriers, and in many cases quotas, has eliminated most of the barriers for product entry. The companies who do manage to become suppliers will achieve a high degree of market penetration. The European market has not been so heavily controlled by the large multiples, as independent traders are still well in

evidence throughout many European countries. However, retail chains like Zara are rapidly increasing their market share in France, Spain and Germany.

Product development time- for automobiles

In 1987, new product introduction was approximately 4.6 years (Lamming 1993). It was reduced to 3.8 years for Toyota in 1990 (Womack *et al.*,1990); in 1998 it was 3 years (Bates and Croom 1998). This was in comparison to USA product development, which took 5 years. The time from concept to launch is still being eroded, in an effort to gain more market share through increased volume of new product developments. Greater collaboration with component suppliers has helped to achieve this reduced lead time (Womack *et al* 1990, Lamming 1993). The issues for product development in the car industry have been to reduce the lead time for new product development and to offer the customer more variety.

Lean versus Functional Management

Cusumano and Nobeoka (1998) described lean product development management, as apposed to functional product development management, as requiring overlapping development between the functions (see figure 2.15). This was to decrease the time products take from concept to launch, and to increase the shared learning across projects. Lean management is characterised by quick and frequent product innovation with augmented improvements to the product, and by joint product development. The projects overlap, with a focus on integration and time compression. They operate with a high-level project manager and the project is formed from cross-functional teams. The characterisitcs of functional management are that it is slow to introduce new products, that product changes are radical rather than incremental, that the project manager does not have a high level decision-making ability and that the project is sequential, relying on departmental continuity and specialization within the sections.

Figure 2.15 - Lean management versus functional management

Lean management	Functional management
Rapid model replacement	Slow model replacement
Frequent model-line expansion	Infrequent model-line expansion
More incremental product improvements	More radical product improvements
Heavyweight project managers	Lightweight project co-ordinators
Overlapping, compressed phases	Sequential, long phases
High levels of supplier engineering	High levels of in-house engineering
Design team and project manager continuity	Departmental membership continuity
Good communication mechanisms	Walls between departments
Cross-functional teams	Narrow skills in specialized departments

(Source: adapted from Cusumano, 1994 cited in Cusumano and Nobeoka, 1998, p.5.)

Lean product development requires the companies to have reciprocal sharing and development of knowledge/ capability:

> *New product development in lean production begins with a very large team of people who see their position in the team as equally important to their position in their functional department. A great deal of effort is spent in defining specifications and sorting out problems at this stage. Investment in time at the early stage of the project helps to save time later.*
> (Lamming, 1993, p.128.)

Product development takes three main forms: customer specificity (few built at a high price), mass production (large volume, little customer specificity), and Lean production (customer specificity is high and the pricing structure is middle to low). The early product development process tended to be linear and vertical with an 'over the wall' mentality - meaning that once their section of the development was completed it disappeared over the functional wall to the next section. With Lean production development there were feedback loops to the process, which required problem-solving along each individual function this helps to eliminate waste, especially in the time spent on the product development process.

Womack *et al.* (1990) illustrates the changes that were made in Japanese car development when the concept of Lean was applied to the process. The time from concept to launch was approximately 20% faster and the number of people involved in the project team was approximately 46% less than the number employed by their European counterpart. The Table 2.1 gives further detail of the Lean concept of producing more with less. The time taken to prototype the product in Japan is 6.2 months; in America it is 12.4 months.

Table 2.1 Product prototypes

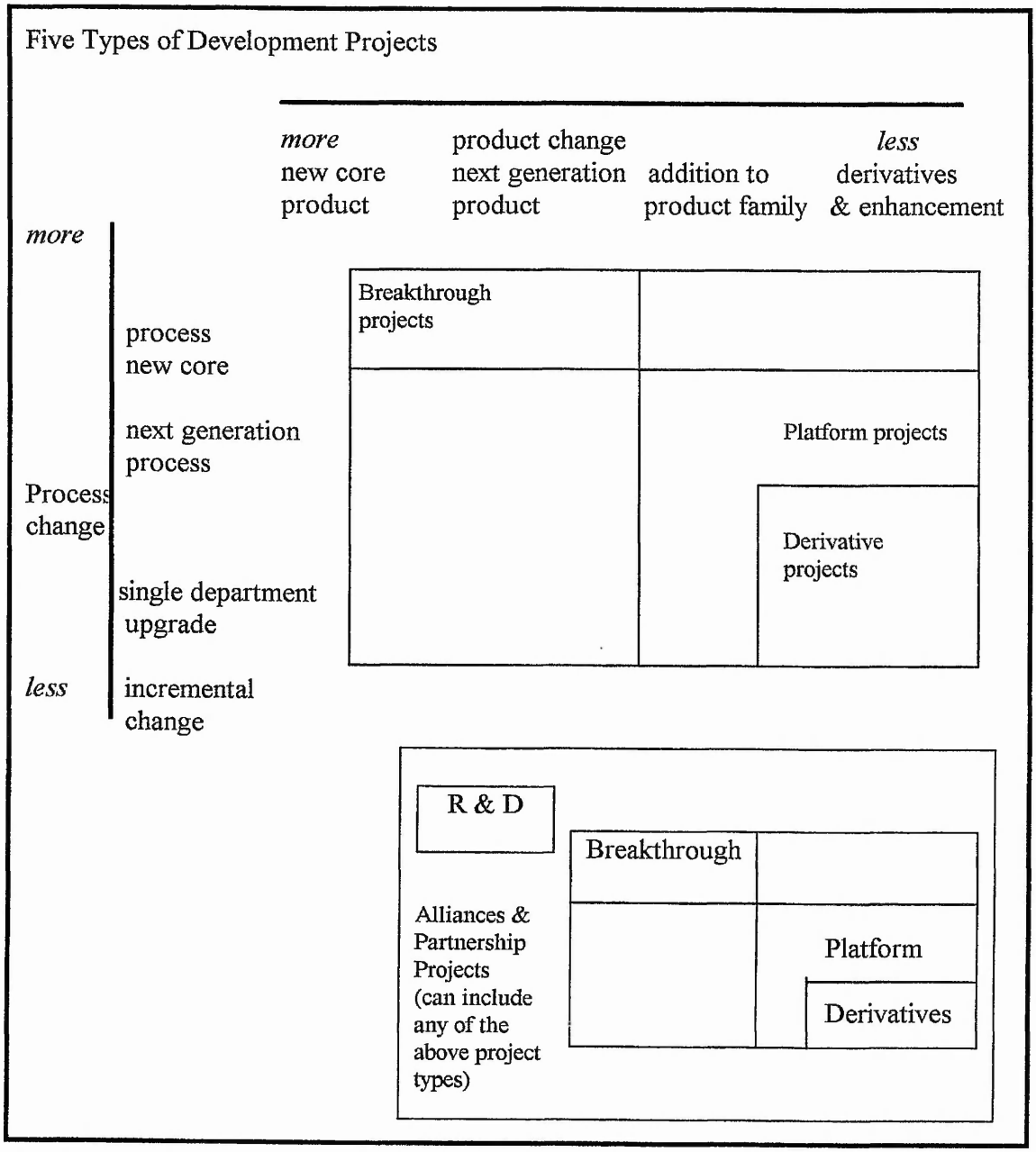
	Japanese (lean) producers	American (mass) producers	European (mass) producers
Average engineering hours per new car (millions)	1.7	3.1	2.9
Average development time per new car (months)	46.2	60.4	57.3
Number of employees in project team	485	903	904
Number of body types per new car	2.3	1.7	2.7
Average ratio of shared carry over parts(%)	18	38	28
Supplier share of parts engineering (%)	51	14	37
Prototype lead time (months)	6.2	12.4	10.9
Supplier share of total engineering effort (%)	30	7	16
Time from production start to first sale (months)	1	4	2

(Source: Clark *et al.*, cited in Womack *et al.*, 1990, p.118.)

Types of product development

Many companies operate a stage-gate process when they are developing products (see figure 2.16). The five types of development projects are: breakthrough; platform; derivatives; research and development, often of raw materials or technology (which potentially then become commercial development); and alliances and partnerships projects. The last may involve the main organization to a greater or lesser degree depending on the organization's capability (Stevens, Wheelwright and Clark 1992, see figure 2.16).

Figure 2.16 Development projects



(Source: Stevens, Wheelwright and Clark, 1992.)

The three main categories of product are: breakthrough (leading edge products often using new technology); platform (several products are created using the same platform or base); derivatives (this refers to the product having the same appearance but having additional extras or slight modifications which are not readily apparent at first glance). In the case of the automotive industry, the new product derivatives are

built on the same platform, but they have a different body built onto the platform often with the same components under the body.

Apparel innovation

In apparel and textiles examples of breakthrough, platform and derivative product development for fibre types are limited barely reaching double figures, but with yarns, variations occur in structures, blends and thickness. These are then used to develop fabrics using multiple yarns in a variety of knit and weave structures. The fabric can then be put through different finishing processes - dyeing, chemical treatments and proofing or bonding. New fabric structures could be developed which absorb or dissipate moisture or which allow a sportsperson to challenge existing product performance for aerodynamic or ergonomic qualities. The customer does not always appreciate the benefits of the innovation. This also opens up the possibility of a company making its own products obsolete, as it creates a product that the customer will select in preference to the existing one.

Market research: short run trials

Fashion apparel is a product which has a short life-cycle and in response to this, the customer, in this case the retailer, has developed a process of trialling products in their key stores. They measure customer demand and decide whether to open the offer to all stores or discontinue the product offer. The method of Quick Response is used to satisfy this demand on a short time scale (see section 2.3.7). The product demand will also be measuring the demand by colour and by size to optimize the ratio for the product offer. With apparel it can be difficult to profile the customer that will actually purchase the product and even more difficult to determine the physical size of those customers or their colour preferences.

Joint product development

Joint product development of apparel and textiles raises questions of ownership of the final product and of who is allowed to manufacture the development and recover the cost of research and development. The time period that the manufacturer is allowed to produce the product also becomes a primary consideration. Clark & Fujimoto (1991) describe joint product development as the early involvement of key personnel

from the customer and the supplier. The inter-company exchange of personnel may also occur where long-term problem-solving is required.

Conclusions

There are similarities between product development in the apparel and textiles and automotive sectors. However, there are differences in the frequency and number of products that are developed by each sector each year. Apparel and textiles frequently develop new raw materials, while the automotive sector focuses on new finishes to existing raw materials. The use of breakthrough, platform and derivative product would equate with apparel where silhouette would be substituted for platform. Ownership of the prototype development and subsequent manufacture of the product is not established in apparel and textiles. The investment by the apparel manufacturer into research and development has not been recognised.

2.3.11 The value chain

The value chain, according to Porter (1990), is a combination of inputs and outputs - be they material or information. They fall into 'primary activities' - those which are directly related to the processing, and 'support activities' - which, as the name implies, support the processing with research and development, purchasing and resources. For example, the support activities for a branded clothing company are heavily weighted towards research and development and marketing. Porter's strategy for competitive advantage is to create a balance in the value chain that focuses on the critical issues for servicing the customer. Each link in the value chain has to be co-ordinated and 'trade-offs' may be required between these links in order to optimize performance and minimize cost. Each supply chain will be individually configured although several elements of the chain are shared across different supply chains. In smaller companies you may find that functional boundaries have been removed when one key player works across functions, having the effect of shortening the supply chain processes.

2.3.12 Competitive advantage

Competitive advantage can be achieved when there is an opportunity to offer a customer a unique product or service. The customer has to be persuaded that they

would like the supplier as a preferred supplier, over the competition, due to the added value that the supplier can offer. This could be achieved by reduced lead times, Quick Response, the removal of a task from the buyer which simplifies the transaction, ease of doing business or faster and more frequent introduction of new products or ranges. The benefits must outweigh the costs of operating or changing a supplier account.

A new product offer for the customer could mean encouraging them to increase the frequency and volume of purchases. This is important in the area of fashion where the product is, in many cases, easy to copy, which makes speed to market an advantage in new product development. A limited window of opportunity may be created by seasonality, or the uniqueness of the product. The following could be a description of organizational competitiveness:

> *The parameters that dominate a company's competitive edge are its products (both the quality and the engineering aspects), the price (which translates into margins and investment per unit) and responsiveness (due date performance, as well as quoted lead times). All three methods point to the fact that material inventory has a devastating impact on all of the above parameters, and thus to enable the increase of throughput in the future, it is vital to reduce inventory in the present.*
> (Goldratt, 1990, p.117.)

Competitive advantage is not meeting the customer's specifications for supply, but surpassing their standards while lowering the cost (Macbeth and Ferguson, 1994). The definition of competitive advantage is different according to your position within the system:

> *To firms, competitiveness mean[s] the ability to compete in world markets with a global strategy. To many members of congress, competitiveness mean[s] that the nation had positive balance of trade. To some economists, competitiveness mean[s] a low unit cost of labour adjusted for exchange rates.*
> (Porter, 1990, Preface xii).

The people in the company are one of the main critical elements of the supply chain, and they form the links that make the system work (Hines 1994).

According to Drucker (1991), Hahn *et al.* (1990), Christopher (1992b) and Macbeth and Ferguson (1994), it is critical to a company's market advantage that they invest

time evaluating their customers, and review what the purpose of the company is regarding that customer.

> *Those features of a product/ service package that persuade customers to deal with a business because it is differentiated in some unique way that other businesses cannot exactly replicate.* (Macbeth and Ferguson, 1994, p.31.)

Competitive advantage is transient because of replication and extensive use of reverse engineering in many market sectors, and it may be difficult to differentiate a company's products from those of its competitors. Porter and Millar (1985) describe four areas in which the company can be differentiated from the competition: price, quality, innovation and volume/ variety flexibility. They say that companies looking for competitive advantage require the development of strategy in more than one of these areas.

Porter's (1990) generic strategies based on the earlier 1985 work (see figure 2.17) show the three key strategies: differentiation, cost and focus.

Figure 2.17 Competitive advantage

		COMPETITIVE ADVANTAGE	
		Lower cost	Differentiation
COMPETITIVE SCOPE	Broad Target	Cost Leadership	Differentiation
	Target	Cost Focus	Focused

(Source: Porter, 1990, p.39.)

Cost means producing the product at the lowest possible cost, but this does not mean selling it at the lowest possible price. Porter also describes cost savings achieved through economies of scale; reductions in cost in proportion to the volume of products being produced. Holland (1995) describes the use of inter-organizational information systems as a means of reducing the time to market through rapid information flow across the supply chain participants and as a result reducing the cost. The UK apparel sector has used information systems to transfer information rapidly,

and some benefits have been achieved, but they find it difficult to compete on cost against Third World labour.

Differentiation, Porter's second area of competitive advantage, means differentiating the company from the competition by the product/ service that is offered to the customer, satisfying or exceeding the customer service requirements. The organization focuses on offering their customer a uniqueness that is not easily copied and which the customer would value.

> *Differentiation results, fundamentally, from the way a firm's products, associated services and other activities relative to competitors, affect its buyer's activities. There are many points of contact between a firm and its buyers, each of which represents a potential source of differentiation.*
> (Porter, 1990 p.43.)

Differentiation can take various forms - service, quality, product innovativeness, response time uniqueness and cost. The combination of technology and knowledge of the customer can realize the opportunities for moving the customer to decide to source from a given company, rather that its competitor. An example of this could be a 24hr response time to a product order. UK apparel companies compete on fashion design and increased product offer - introducing more ranges per season as a tactic against the lower cost but longer lead time of a product sourced from the Far East.

Focus, the last strategy, looks at specific niche markets and products where the product has to be the best in the market-place for price and customer service, e.g. hi-tech performance garments, or brands and promotions.

Conclusion

Competitive advantage relates to the previous section of network development where flexibility and access to supply chain resources contribute to a supply chain's competitive advantage, and ultimately to the reason for customer selection.

2.3.13 Concepts summary

There are key similarities between the SCM concepts and the models outlined in the previous section. The common issues identified are strategic structural and operational integration, value chain identification, continuous improvement, cross-

functional problem-solving, pro-active collaboration, removing waste and operating to a pull system. The potential outcomes are increased flexibility, reduced operating costs, reduced lead time and inventory and competitive advantage of one supply chain over another competing chain.

Early adoption of SCM concepts has been piecemeal in nature and many organizations have followed current management fads (see section 2.3.2). The review of SCM concepts highlights the requirement for the SCM to be perceived holistically. The organization needs to select the appropriate group of concepts to apply, and link them with supporting organizational strategy, for SCM to be successful and sustainable within the internal and external environments in which they operate. The organization also has to consider the theoretical framework (see chapter 2, section 2.2) relating to the theories of systems, contingency and learning. If the organization is to be successful, it requires strategies and policies which will support the development and application of the concept of SCM and an integrated approach to SCM. It is within this context that the core units of environment and organizational ecology, networks and relationships, and learning and systems have to be considered.

CHAPTER 3 - INVESTIGATIVE TECHNIQUES

3.1 INTRODUCTION

There is a wealth of information in other industry sectors on Supply Chain Management adoption and application. However, there are few examples of research in the apparel and textiles sector. This research is looking at Supply Chain Management 'best practice' in the apparel and textile sector, with a focus on product development.

In this chapter the various data-gathering approaches are reviewed so that the most appropriate methods can be adopted for research in an apparel and textiles setting. The research questions are discussed in chapter 1, section 1.4, along with the context and areas of the proposed research. A review of qualitative and quantitative methods is required to establish their suitability in relation to the theoretical framework (discussed in Section 2.2). This is linked to the core units of environment and organizational ecology, networks and relationships, and learning and systems within an organization's supply chain. Also the methodology has to allow for the review of the supply chain concepts (see chapter 2, section 2.3) within an organizational setting. The research methodology has to address all the above issues within the time frame available and take into account accessibility of the supply chain partners.

The research carried out in previous projects with The Nottingham Trent University Centre for Work and Technology involved benchmarking, questionnaires and face-to-face interviewing methods (see chapter 1, section 1.6). These projects included the studies for Kurt Salmon Associates, and the Apparel and Textile Challenge (ATC), which were both carried out in the apparel and textile sector focusing on supply chains. The benchmarking questionnaire focused primarily on senior management level and was the viewpoint of one or two personnel within each company. This restricted the research in relation to the cross-functional aspect of supply chains. The research methods employed were more quantitative and positivist in nature to allow for generalization of data. From this early work the conclusion was drawn that benchmarking was good for generalizing and forming an overview of an organization or an industry sector, but was limited in depth and lacking in cross-functional

interviews across different levels of an organization. Benchmarking is reviewed in greater detail later in the chapter, but it will be shown that extended case-study investigations offer the best opportunities for the depth of research required.

The key theory investigated in chapter 2 fell into three main areas: systems/ socio-technical theory, how organizations learn, and the contingency theory for managing unpredictable environments. The methodology for the research into apparel supply chain development has to address each of these aspects of the group of organizations under review. The first area of socio-technical systems theory requires an understanding of the organization's formal systems and the level of communication which is available to personnel throughout the structure of the company. A review of the informal systems is required to understand the interaction and communication by personnel across the departments and management structure. The method of data collection has to be cross-functional and look across the various levels of the organization involving individual and group communication methods.

The second area, contingency theory, relates to the organization's work within an environment, which in apparel and textiles is rapidly changing. So the methodology has to be flexible, to accommodate the changes that occur during the period of research. The organic nature of the organization's environment would appear to lend itself to the case study method of research (Burns and Stalker, 1961). The investigation of the organization's internal and external environment involves discussion with as many sections of the supply chain as possible. The research of a complete supply chain involves a series of locations, structures, levels of complexity, systems and relationships. The method of data collection has to be semi-structured to allow for collation and generalization, and yet still allow an open dialogue to occur between the researcher and the supply chain under review. The organizational policy and structure form an important area of the research environment, illustrating where and how the supply chain development can occur, and the responding behaviour and involvement of the personnel.

Thirdly, it is apparent that the rapidly changing environment of apparel supply chains requires the linked organizations to learn, and to adapt their socio-technical systems

to their environment as quickly as possible. Methodology is required to review the organization's learning strategy - to look at how the organization attempts to sustain a learning capability which involves individual and team practices, and at their approach to rapid learning through proactive sharing and collaboration across functions.

3.2 PHILOSOPHY AND PERSPECTIVE

There are differing general philosophical approaches to the various research disciplines: scientific or social sciences. However, business management research intersects with various schools of thought, and as a result the epistemological framework for research study in this subject is formed from a range of theoretical and empirical knowledge. The knowledge base being reviewed originates from social science, psychology and economics. In business management research it is common for a range of methodologies to be combined. However, philosophical conflict occurs across academic boundaries and disagreement on research approaches follows.

3.2.1. Naturalism or Positivism?

The first area under review is the approaches taken from positivist and naturalist perspectives. These two views advocate the subjective interpretation and the objective measurement respectively, and form the two poles of the argument on social behaviour, disagreeing over whether the subject can or cannot be separated from external stimulus. The naturalist philosophy

> *concludes that it is individuals' interpretation which is necessary and sufficient for social scientific explanation and that the purpose of research is to understand the process of interpretation for any given subject.*
> (Wass & Wells, 1994, p.3)

Naturalists consider the process of interpretation as critical to understanding the given subject, believing that conceptualization and interpretation by the subject will explain their view of the reality of their social environment. The naturalist argues that the real world ceases to exist outside of their consciousness. They focus on defining and interpreting the behaviour from the subject's viewpoint, and it is the subject's

interpretation which is critical to the empirical research (Wass and Wells 1994, Burrell and Morgan 1979). The opposite view to naturalism is positivism.

Positivism is grounded in the natural sciences, from scientific experiments, and attempts to create 'laws', which objectively identify patterns of behaviour through measurement. It is based on the hypotheses of objectivity - that a 'causal relationship' exists between subject and 'independent objects', that the relationship is observable and measurable and that the experiment can be replicated (Wass and Wells, 1994). The resulting output should explain past experiences and predict what will occur in future observations (Gill and Johnson, 1997); they therefore infer that humans are 'things' which do not have an internal logic of their own.

3.2.2 Realism

Realists believe the real world exists separately, having a reality external to a subject's subjective conscious (Wass and Wells, 1994). However, the subject perceives their world through their subjective conscious and their actions towards the world will be based on subjectivity. We make assumptions and base our perceptions on past experience and knowledge, which we use to understand, in this case, the business and management environment. The subject will create behaviour and actions based on these assumptions. The characteristics of overt, covert and latent behaviour can be observed.

The orientation chosen for this research is realism, as there are formal structures within an organization, which are overlaid with informal structures, established overtly or covertly, which create the social phenomena that will be unique to that organization.

3.3 QUANTITATIVE METHODOLOGIES

Quantitative data can be collected from archival sources, process or system measurement, experiments, benchmarking, surveys, or from formal questionnaires where responses are aggregated. The data collection usually involves mathematical models based on measuring the relationship and variables of the system under research (Kast and Rosenzweig, 1985). The data does not have to be contextual and is likely

to be objective in nature. Quantitative data is philosophically closer to positivism and realism than to naturalism (Wass and Wells, 1994).

This type of research often takes the forms of surveys or structured questionnaires which are positivist in nature, preventing the respondent from articulating how they perceive the subject under investigation by means of the pro forma nature of the data collection (Gill and Johnson, 1997). They focus on generalizing across industry sectors or industries. The responses are then fed back to a database format where the data is aggregated and pre-established variables have been set for correlation. Other forms of statistical measurement may arise from process review, such as those seen within the organization relating to performance or occurrence. Experiments and simulation also fall within this group of methods.

3.3.1 Benchmarking

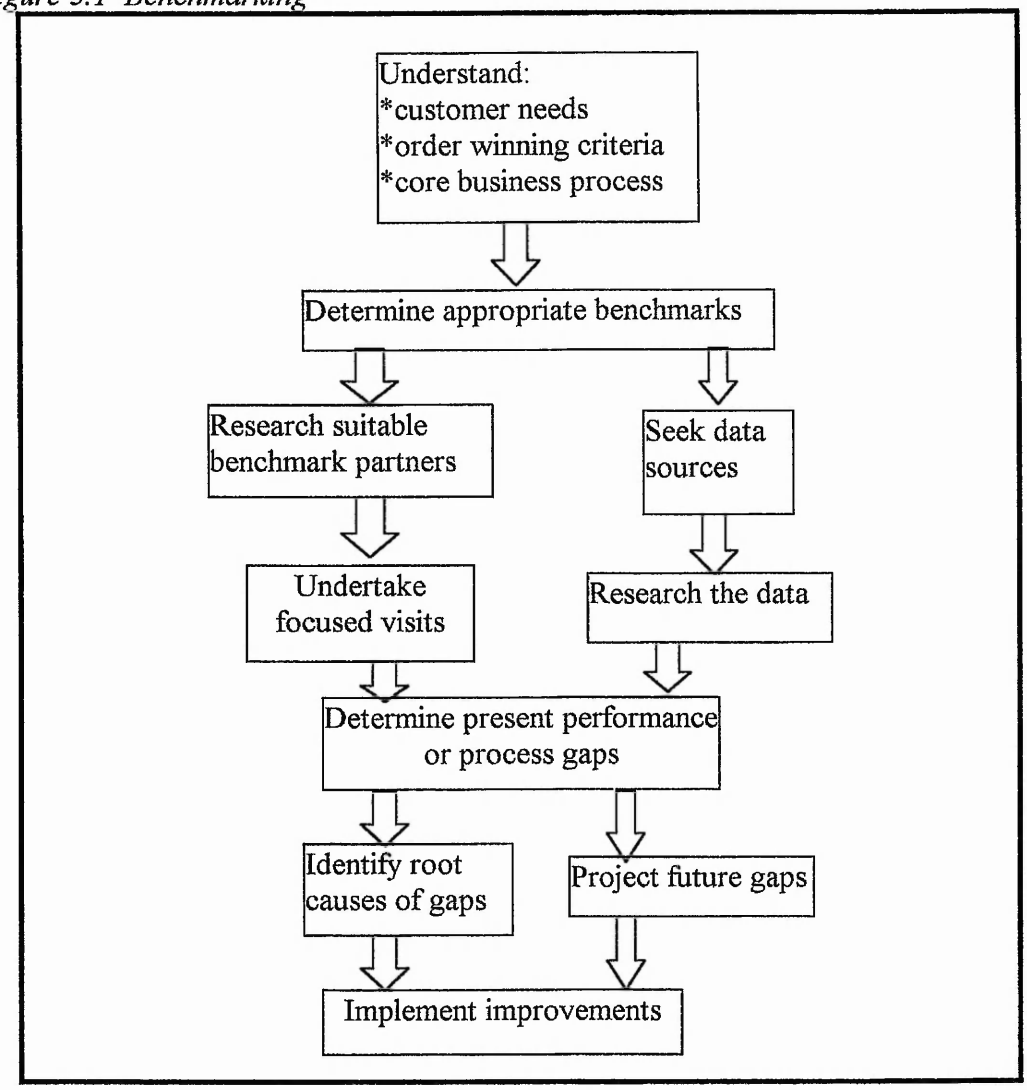
Benchmarking is a process of comparison, which can be internal or external to the organization (Codling, 1995). External comparison can be drawn with a company which the organization considers to be best at carrying out a particular practice (e.g. customer service, product innovation), whatever the organization considers to be a critical area for high achievement. The company may review other industry sectors in order to find an organization that they wish to benchmark against; it does not have to be industry-specific. The measures and access have to be agreed between the organizations, and data made available in order to measure the process and performance of the organizations.

Bogan and English (1994) describe three forms of benchmarking:

- process benchmarking, aimed at lowering the cost of productivity through operating and process improvement;
- performance benchmarking, focusing on issues of quality, time, reliability and price, facilitated by reverse engineering, operating procedure analysis and comparisons of own and competitors' products;
- strategic benchmarking, taking a long-term strategic view of the company, drawing comparisons with competitors' products and services.

The applications for benchmarking are setting and refining strategy, re-engineering work processes and business systems, continuous improvement, strategic planning and goal setting. Benchmarking can also assist in problem solving, learning, market performance comparisons and evaluations, and is a catalyst for change (Bogan and English 1994). The process of benchmarking is illustrated in figure 3.1

Figure 3.1 Benchmarking



(Source: Bicheno, 1998, p.61.)

Relevant points regarding the problems of selecting companies include the degree to which relationship variables within the environment of the organization may be one of constraint or not. The selection of these variables can alter the responses that the survey will receive. As a consequence of this the survey has to consider the required

balance between the strategic and tactical variables which it intends to measure. One of the perceived problems in benchmarking is the lack of exemplar companies (Hines and Rich, 1998). The result of this is that they are unable to learn from the experiences of 'the best' as they fall below the perceived requirements.

Conclusions

The benchmarking method in relation to networks and relationships allows for a large amount of data to be collected over a short period of time. However, there may be difficulty in finding and getting access to exemplar companies, and exemplar companies tend to filter the information. In relation to the environment and organizational aspect, benchmarking can give an overview of a specific area within set parameters. However, this method of research is of limited scope in analyzing the environment of the organization, usually only looking at the internal environment, and from the perspective of the interviewee or the employees made available at the benchmark company. When restricted access to people and parts of the organization occurs, the relevance of the data collection to the organization being benchmarked may be limited by the exclusion of other elements of the organization's structure, culture or environment. The usefulness of benchmarking is restricted by its relevance to a particular environment and period in time.

In relation to learning and systems, benchmarking can give an overview. The culture of the company plays an important role in the success or failure of learning and this cannot be observed using this method. Benchmarking can be used across the researched case studies to see how the organizations' approach to Supply Chain Management compares with the subsequent case studies and with promoted best practice in the automotive sector. However, the generalizability of the information is limited, due to conflicting information being received from different levels of the same supply chain.

3.4 QUALITATIVE METHODS

The qualitative research review includes case study, interview strategy, and participant observation. The research requirement is to collect data in a 'holistic' manner from the key players in the supply chain and attempt to gather information

which can then be integrated forming the entire process from the products conception to its launch. The context of the organization needs to be considered, requiring a view of the supply chain from the perspective of an insider observing the employees as individuals, a group, an organization, and a network. The internal and external environment of the organization forms an important part of understanding how organizations operate within supply chains. The need to interpret the process within the context leads to the consideration of a case study approach involving both qualitative and quantitative data collection.

The qualitative analysis focuses on the context of the employees and their behaviour and actions within their environment. Qualitative data collection is concerned with the inter-relatedness of the subjects and groups and their causality, and is more conscious of the relationships and processes which are involved. Qualitative data research relates to realism and naturalism (Wass and Wells, 1994).

3.4.1 Case studies

Case study methodology has been used for various studies in Supply Chain Management, by Womack *et al.* (1990), Stalk and Hout (1990), Pedler *et al.* (1997) and Hines (1994). This method can review the organization's internal and external interactions. The case study approach allows the researcher to link the processes together from one organization or department to another, following the flow of information and materials to build a complete picture of the supply chain.

> *In brief the case study allows an investigation to return the holistic and meaningful characteristics of real-life events - such as individual life cycles, organizational and managerial processes... and the maturation of industries.*
> (Yin, 1984, p.14.)

Case studies are an established method for assessing complicated organizational and management studies. Yin describes this method as an empirical inquiry, in that it examines a present day occurrence within its actual natural context. An organization's relationships across existing boundaries may initially be ill-defined, so a cross-sectional approach to data collection is used to create a holistic view and provide the required research evidence. The case study involves three main stages:

design planning and data collection; analysis of the field work; and the reporting of the findings in an appropriate format for the audience (Yin, 1994).

Conclusion

The beneficial aspects of the case study method in relation to networks and relationships are that both intra- and inter-company relationships can be observed, and the holistic network can be accessed for a period of time. The employee's subjective perspective can be explored, while reviewing the links across functions and organizations. The case study allows a review of a range of topics which are interrelated. The negative aspects of this method in relation to networks and relationships are that it may cause personnel to alter their natural actions, and that there is a risk of data overload.

In relation to the environment and organizational ecology unit of analysis a case study allows the observation of the internal and external environment of the organization from the employees' perspective. Changes can be observed over a period of time in the actual environment. However, a case study can only offer a snapshot of what is happening in an organization due to rapid change.

The learning and system aspect of the company can be observed with the case study method. The organization is organic in nature and is therefore changing the systems and methods of product development through the learning experiences of the employees involved. By using a case study the learning process can be observed over a period of time. The links in the system can be observed as a whole, and as the cross-functional process of product development takes at least six months, the longitudinal study allows a review over a time period of a year. However, the topic of learning is vast and with this method only a small amount of group learning can be observed.

There are difficulties in building theory and grounding theory within this area of research due to philosophies crossing over existing disciplines and the complexity of the inter relationships of the theories under review.

3.4.2 Types of case study

There are three forms of case study: explanatory, explorative and descriptive (Yin, 1994). Case studies will often have more than one of these elements as part of their different phases. Explanatory case studies ask the 'how and why' questions for data collection and involve tracking operational connections and occurrences, over a period of time, as a means of determining whether the process works or fails and why. The explanatory case study is concerned with direct observation and systematic interviewing of the key personnel, on site. Descriptive case studies look at the sequence of events, at the structure of an organization and at how the groups interact. Exploratory case studies require the use of the 'what' questions, which then form the hypotheses and related propositions for the later enquiry; the theory is then tested against what actually occurred. The researcher can use archival or survey data for exploratory studies, which leads to quantitative research, answering 'how many' questions. This research spans all three types of case study - explanatory, descriptive and exploratory.

3.4.3 Choice of cases

The careful choice of each of the case study organizations prior to starting the research ensured that they were representative of supply chains in the apparel and textile sector, and that they would allow a natural progression from a simple to complex supply chain form. Interviews were carried out with the key personnel in the organization before selection took place. The decision for inclusion was based on the reasons for the organization allowing access for the research activity, the product being produced, the extent of the supply chain to be researched and the geographic location of the other parts of their supply chain network. The location was important due to research practicalities of time and cost. The final study, lasting one year, was the most critical case study for selection purposes as it was to give depth to the research and involved long term access and on-site location.

3.5 CASE STUDY METHODS

Multiple sources of evidence were sought from interviews (based on an open-ended questionnaire) and participant observation. Documents and archival records were

consulted for the quantitative element of the case study research, which was then used in comparative analysis (chapter 5).

3.5.1 Interviews

Interviews take three main forms: structured, semi-structured and unstructured. The degree of structure for the interview is determined by the size of the sample being taken and the desire of the researcher to generalize about the responses (Wass and Wells, 1994). A clear identification of the format for the interview, the required questions, and the key interviewees should be made at the initial stages of the study. This research identified semi-structured interviews as the desired form of interviewing.

Semi- structured interviews

The use of semi-structured interviews and participant observation allow the subject to interpose with relevant and related views. The researcher's holistic view may not be shared by the subject. Semi-structured interviews are also useful when a cross-section of functions are to be interviewed regarding the relevant topics (Buchanan *et al.*, 1988). Interviews are often used in conjunction with participant observation to gain a greater understanding of the interrelationship and context of the research. The use of open questions helps to broaden the answers given by the interviewee (Yin, 1984). However, there are problems with issues of access, which include the researcher's independence in carrying out the interview:

> *Researchers must safeguard their own independence, by, for example, insisting that managerial staff do not sit in on interviews, or hand pick employees whom the researcher will interview.*
> (Bulmer, cited in Bryman, 1988, p.154.)

The access agreement with the organization should include the researcher's disclosure of draft material to the interviewee, to ensure accuracy; however this does not mean that the researcher wishes for censorship. The researcher may wish to tape record a semi-structured or unstructured interview in order to allow the free flow of dialogue, rather than the interviewer taking notes and only partially recording the responses (Mintzberg, cited in Bryman, 1988). The interviewer can then focus on the relevance and meaning of the views that the interviewee gives when responding to the questions (Easterby-Smith *et al.*, 1991). However, this is not to say that this method short-circuits the process, as the

length of interview may be two hours and the time to transcribe the interview could be eight hours. This research used an open-ended approach to form the outline for the semi-structured taped interview. A questionnaire was used in all three case studies and it was modified and improved to cover greater depth and apply to different levels of the organization as the case study moved from simple to complex supply chain forms. This allowed case study analysis to compare and contrast the responses from each of the three case studies.

Conclusions

In relation to networks and relationships, this method opens up opportunity for the interviewee to explain both inter- and intra-company relationships in their own words. The action of interviewing may prompt the interviewee to stop and question how the network operates. However, there is difficulty in discovering the covert and latent aspects of the relationships as the organization may limit the availability of data.

Where an overview of the organization, and interviewee perceptions of their environment, can be obtained semi-structured interviews have much to offer in researching the environment and organizational ecology. However, the interview will not address covert and latent behaviour. Regarding learning and systems, this approach allows a large amount of data to be collected in a short period of time and the interviewer may prompt the interviewee to question how the system actually operates. However, there is a risk that assumptions can be made by the interviewee which are difficult to verify.

3.5.2 Questionnaire

A questionnaire can either be completed by the recipient (survey format), or it can be used by a researcher to record responses, across an agreed scale, in a structured interview. The main aim is the aggregation of quantitative results (Easterby-Smith *et al.*, 1991). Previous benchmarking studies (see section 1.6) took the form of structured face-to-face interviews using a questionnaire. This format of interview has a more positivist approach, with limitations imposed through pre-selecting the questions which are considered of value prior to the actual research. The consistency of the question-and-answer format was helpful where the three case studies were compared and contrasted.

The questionnaire included sections on the structure of the company and its functions; the inputs and outputs; suppliers and customers; the reporting system; the process; technology, communication and information exchange; time scales; inventory; purchasing; replenishment; performance measures. Each of the key functions in the supply chain was explored with a section of similar questions, in order to cross-reference the responses at different levels and between functions. The questionnaire was refined by the inclusion of more open-ended questions about the interaction between functions and the interviewee's view of the future of the organization and of how improvements could be made. Once an interview had been carried out, the questionnaire could be amended to include areas of concern raised.

Conclusions

Surveys are limited in their depth of contextual investigation and are constrained by the number of questions, that a respondent will be prepared to take time to answer (Yin, 1984). Questionnaires usefully establish a basic structure for the network and relationship review. However, the data may be unreliable due to the interviewee's filtering of information. The interviewee's perception tends to be subjective and access to a broad range of personnel for data collection from all the links in the supply chain may prove problematic.

Questionnaires do not lend themselves to aspects of organizational ecology, and give a limited perspective - an overview - of the environment. The key personnel within an organization can change, which may limit the data that the interviewee can supply. Similarly, an overview of learning and systems can be obtained, though data may not be available in a format or time-scale which is required, and a limited time can be allocated to data collection.

3.5.3 Participant observation

This method gathers research data from within an organization, from the viewpoint of an insider. The method allows the observation of group dynamics and offers depth and insight into the experiences and perceptions of the subjects (Styles, 1994). Participant observation is defined from a sociologist's perspective as 'describ[ing] and analyz[ing] the culture and behaviour of humans and their groups from the point of

view of those being studied' (Bryman, cited in Wass and Wells, 1994, p.37.). From an anthropologist's perspective, participant observation is viewed as

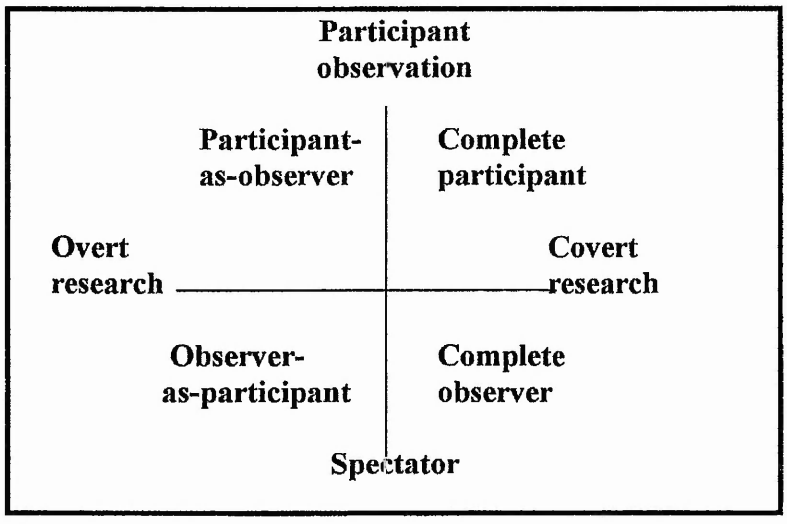
> *immersion in the research setting, with the objective of sharing in people's lives while attempting to learn their symbolic world... a concern with understanding the perspectives of social actors and a respect for the empirical world under study.*
> (Silverman, cited ibid., p.37.)

The cross-sectional analysis of functional viewpoints is important to the holistic aspect of observation, as it creates an overview perspective. The means of obtaining this cross-sectional view of the organization may be through interviews. The act of interviewing can be more or less successful depending on the 'tone':

> *'Tone' is difficult to define, but it is the important ability of the researcher to tune in to the environment being studied and pick up clues despite preconceptions that they may have.*
> (Bulmer, 1988, p.154)

The observer may unconsciously have formed a subjective viewpoint, prior to commencing the research, and has to try to avoid making assumptions while carrying out observations. Figure 3.2 shows a matrix for the different forms of participant observation.

Figure 3.2 Forms of participant observation



(Source: Gill and Johnson, 1997, p.117.)

Case study 3 - Sportsco - involved the use of participative observation and the review of structural information, and of process flow and communication channels within the

product development section and across related functions. Primary data could also have been collected through directly observing the supply chain development activities and the interaction of the people from different sections of the organization. Laterally the method of participant as observer was used in one of the development groups. This proactive approach is debated by Geertz (1984, cited in Gill and Johnson, 1997), who says that participation is reflexive in nature, but, an 'insider's view' is achieved. Pettigrew (1985, cited in Easterby-Smith *et al.*, 1991) describes the interaction which occurs when a researcher is located within the environment, and sees longitudinal studies as justified due to the incremental nature of the research development.

The chance to work as part of the development group, while carrying out the fieldwork, has been commented on thus:

> *the researcher should adopt an opportunistic approach to fieldwork in organizations. Fieldwork is permeated with the conflict between what is theoretically desirable on the one hand and what is practically possible on the other.*
> (Buchanan *et al.*, cited in Wass and Wells, 1994)

Complications can arise if the relationship with those being studied develops such that it may change the attributes of the group. There are drawbacks to this form of data collection as the observer's presence may affect the actions that are being observed: furthermore, the data collection is time-consuming and analysis is complex. Locating within the organization being studied and particularly sharing office space with the product development section of the company assists the researcher in understanding the employees contextual and historical viewpoint. The behaviour that results then has more meaning for the observer.

The organizational culture framework of Styles (1994), which was described earlier, gives consideration to the connections between the various subjects and people and their resulting actions, taken as a holistic perspective. An overt standpoint was taken regarding the observation and it was hoped that the daily presence within their working environment would limit the reactivity of the employees in the organization. However, group dynamics can be affected to a lesser or greater extent depending on the degree of interaction which occurred, as can be seen in case study 3 (see chapter

4). In the case of Sportsco, participation within the cross-functional team reviewing the product development process from concept to launch took place.

Conclusions

This participant observation form of research allows the researcher to discover what actually happens, as distinct from the documented version of interaction (Mintzberg, 1975). This separates the formal from the informal organization and the reality of the business can be observed, experiencing the social environment at first hand.

Problems relating to participant observation include: the desire to support the organizational team; the amount of time the observer can reasonably allocate to taking part in the activity; the effect of the observer's behaviour - this needs consideration in order to limit the bias which can result.

3.6 CONSTRAINTS OF THE CASE STUDY RESEARCH

3.6.1 Research access

Gaining access to people or information in an organization is one of the key tasks in carrying out management research; the 'project champion' within the selected company is relied on to define the depth and length of the research which can be undertaken. This element of the research process is outside of the researcher's control (Buchanan *et al.*, 1988).

The champion for the research is usually in a senior position within the organization and, if agreement is obtained to locate within the organization to carry out the research, the expectations of both the company and the researcher should be clearly stated. Personnel may appear wary, due to previous experience of the management's hidden agenda, or of process improvement involving delayering or downsizing.

> *One of the chief difficulties seems to be that, in spite of researchers protestations to the contrary, they are often seen as instruments of management who are there to evaluate or spy on their subjects and will report their findings back to senior officials....The researcher may also find his or her activities restricted once entry is achieved.*
> (Sinclair and Clarke, cited in Bryman, 1988, p.16.)

It is therefore important for the observer to be perceived as neutral and non-threatening to the employee's role within the company; this can partially be addressed by gaining approval from the interviewee on any comments or detail which they have disclosed (Buchanan *et al.*, 1988). However, censorship is not a course of action which should be considered.

The organization has to have a reason for allowing access and allocation of time (by key personnel) to the project, and as a result some form of incentive may be required to gain entry; this could be in the form of a feedback report. Bulmer (1988) also describes problems with access, and discusses the need to be 'open and honest' about the work the researchers wish to carry out in the organization. An explanation of the concept and strategy which they hope to follow, including the proposed outputs and benefits to those involved, helps to define the project boundaries and expectations. Organizations may require agreements on commercial confidentiality as part of the case study access arrangements to ensure sensitive data is not released to their competitors; this is especially the case in the area of new product development. The reviewer has a responsibility to generate the agreed outputs and to acknowledge the part that the organization and their personnel have played in the research project. Problems can occur when inadequate systems are in place to generate the required information or to review historical data. The final access issue is that of people, power and the politics in play, which can create barriers or distortion to the research data collection. This can result in interviewees responding in the way that they think the organization would want them to, or by creating misleading information to conceal what is really happening.

3.6.2 Generalizability of case studies

> *Bresnen and Dunkerley respectively refer to the work of Yin (1984) and Mitchell (1983) both whom sharply criticize the view that case studies are not capable of being generalized. Each of these authors argues that a case should not be thought of in statistical terms i.e. as a sample of one.*
> (Bryman, 1988, p.18.)

Problems arise from trying to generalize over the findings from only one case study:

> *The goal of a single case study is to expand and generate theories (analytical generalization) and not to enumerate frequencies (statistical generalization)*
> (Yin, 1984, p.21.)

Generalization of a case study can take two forms 'Statistical generalization', lends itself to survey research, where a sample is selected for data collection. 'Analytic generalization' is more applicable to case study research, where a predetermined theory is used for comparison with the new case study, to see if the results match (Yin, 1994). Yin says that greater analytic generalization can occur when an opposing theory is then tested against the results for conformity; if the results are in opposition then they are more likely to support the findings. This research takes the analytic generalization view and compares theory developed in the automotive sector supply chain with this research in apparel and textiles.

3.6.3 Triangulation

The triangulation rationale is based on the premise that case studies should seek several sources of data collection, which may take the form of interviews, observation, documents and historical reports, as evidence that the evaluations are accurate (Yin, 1994). The comparison of information from multiple sources should assist in corroborating the evidence for the inquiry. However, the term can also refer to the triangulation of evidence from different researchers and also from different theoretical perspectives (Patton, 1987).

It is argued that 'dialectical synthesis', which uses different methodological/ epistemological approaches on the research of a phenomenon, creates a more comprehensive overview (Reichardt and Cook, cited in Wass and Wells, 1994). However, different methodologies may not be compatible and therefore may not produce validation (Styles, 1994). This research triangulates different theories and different methods, and triangulates the evidence from different levels within the organization.

3.7 CONCLUSIONS

Qualitative and quantitative methodologies were analyzed to understand the data collection techniques and how they link to the theory under research, and to the core units of environment and organizational ecology, networks and relationships and learning and systems, while meeting the research needs for data. Field and desk research methods were reviewed to address the context of the theory, and the characteristics of the decision making, culture and values of the subjects.

The dominant epistemological perspective was that of realism; that knowledge is often bound up in a personal value system or the value system imposed by the organization. Causal relationships may result from the imposed values and these can generate characteristic behaviour that is overt, covert or latent. Included in the analysis of techniques were case studies, benchmarking, questionnaires, semi-structured face-to-face interviews, secondary data collection of archival and current documents and participant observation. A combination of research methods is based on the realist view of methodology and therefore a triangulation approach was appropriate. The method of recording the semi-structured interviews could take the form of 'open coding' the responses and a software package such as 'NUD.IST' was considered. This package assists in quantifying and collating the interviewees patterns of reference. However, it was considered that drawing conclusion from this could be misleading, and that this approach would not significantly contributed to the study. The grounded theory research method was considered but dismissed as creating too open an agenda, lacking focus and therefore comparability between organizations could prove problematic. The case study approach allows greater flexibility and opportunity for cross-comparison.

A review and refinement of research methods was carried out as the investigation progressed from initial pilot to the longitudinal case study. The methodology selection had to take into account the potential restrictions regarding access, resources and data availability, which act as a constraint on the research activity. The research environment was transient in nature and as a result a flexible methodology was a prerequisite. The methodology had to assist in building on existing knowledge and theories founded in other industrial sectors through their application in the apparel and textiles environment. It will be seen in the next chapter how effective the chosen methodologies have been in the three case studies of apparel and textile-related supply chains.

A mixture of qualitative and quantitative methods has been used. The theory that the case study refers to in this case has been triangulated by using learning, socio-technical system and contingency theories. Convergence of evidence has been sought through the use of the following techniques: observation, interviews, documentation (including archival

records) and participative research within the case study company; the approaches assist in triangulating the data and subsequent evaluation.

The selection of the type of processes which were studied was based on the research questions (see chapter 1 section 1.4), linked to the core units of environment and organizational ecology, networks and relationships, and learning and systems. These had to be observable within the case study organization and their supply chain partners. The measures for these processes have been confirmed from the collection of data from several sources (triangulation method): documents, interviews, direct observation, and participant-observation while carrying out the research study. Documents have been used from operational administrative processes and management information systems. Interviews were semi-structured, around a criteria framework, and information and opinions were sought from the respondent on the existing facts. Direct observation of the existing environment and behaviour included observations of the work place, of technology in action of both inter- and intra-company and functional interfaces. This helped to place the interviews in context. Participant-observation was used while carrying out a waste packaging project and also in the establishment of cross-functional teams. While participating in the team activities a support role was taken on, which assisted in understanding the culture of the company. Access to this group, which would not normally be available, allowed an inside viewpoint in a unique situation. Issues of impartiality were addressed in that no authority on decision making or for actioning any changes was given to the observer.

Changes occurred within Sportsco, both in personnel and in the internal and external environment, during the course of the research. These changes may have altered the findings, to a greater or lesser extent. However, change is part of the environment in which supply chain development is implemented.

A limited portion of the research data, dealing with the performance of suppliers is statistical in nature.

As the research was taking place in a social environment and the participants had a subjective approach based on their term of reference and experience, the research would not be valid according to the positivist perspective. A hypothesis would have hindered the subject being researched as it would have prejudged the nature of the problem. Therefore an inductive approach was taken where the fieldwork was based on a stimulus which was interpreted according to the participants' experience and their interpretation (subjectivity), and subsequent response or action. The empirical world encompasses the perceptions of and actual experience of participants (Glaser and Strauss 1967, Mintzberg 1980). This allowed for unforeseen responses and accommodating the desire to limit the influence over the subjects' behaviour and responses. Mintzberg (1980) describes this approach as 'detective work' as the researcher attempts to understand the order of things and then merge the various elements into patterns; the second phase requires a 'creative leap' which involves not just the data but the insights collected from the organization's personnel. This approach creates a less linear and ordered approach to the research methodology as it is not formally planned and may be fragmented in nature. Management research creates many conflicts with the traditional linear approach to research where the development of a prescriptive approach prior to commencing the primary research is the norm.

The use of face-to-face interviews and the collection of the personnel's account of how they perceived the process and culture formed a large part of the qualitative data collection, along with participative observation. The interviews were taped and transcribed, in an effort to see if a pattern of response emerged from the questions which were addressed to the employees. The questionnaire format had key themes for all the interviews. These themes allowed comparisons to be drawn and helped develop an overview of the organization's management approach. Latent issues are not usually verbalized by the employees and are therefore not able to be challenged. Attempts were made to address this by carrying out an open section of the interview which sought their view on past, present and future changes within the organization, and by questioning the personnel when latent behaviour was perceived but not verbalized.

3.7.1 Reasons why the case study method was selected

The case study method was selected to review and explain the links, which have been or are being established across the subject areas of the research topic, within a real active context, using a combination of exploratory and explanatory means. The case study can evaluate and illustrate where the interface occurs and who intervenes in the process and can explore the outcomes from the interface and the interventions. Observation can be carried out in a holistic manner - not in isolation from the rest of the company, its suppliers or customers.

Case studies are appropriate for dealing with a cross-section of evidence and the research was cross-functional and cross-disciplinary and therefore required more than one method of data collection. These included documents, interviews and observations.

3.7.2 Pre-case studies

As mentioned in chapter 1, section 1.6, research participation in two benchmarking studies in the field of SCM in the apparel and textile industry had already occurred. The questionnaire had already been established before the researcher joined the team of interviewers for the study. However, proofing of the questionnaire and comments were made before taking part in the interviews. The first study was initiated by Harvard University Centre for Textile and Apparel Research to explore '*Competitive Practices within Clothing Sectors*' and the second was initiated by Kurt Salmon Associates and was entitled '*Key Aspects of Supply Chain Operations*'. These studies brought out some of the core issues that a company has to establish as a starting point to measure supply chain development and levels of change in the industry sector. Although this research produced some quantitative outputs, it highlighted the need to obtain views from across the whole supply chain and to make no assumptions (given by top management), as to the understanding companies have of what supply chain development involves.

3.8 SELECTION

The selection of companies for the case study analysis out of the thousands of companies involved in the apparel and textiles supply chain was mainly based on access criteria: access to as much of the supply chain as possible, to key personnel and over a minimum period of time. Access problems were encountered due to the length of time it took from initial contact to first meeting, and then to the final agreement to the research proposal.

Several companies were approached and a dialogue was entered into which resulted in positive responses from six companies. From this start list, access was obtained to three companies, two for a limited period and one for a period of one year. The first case study was a pilot exploration to investigate the propositions, and to practise and refine research and data gathering and analysis techniques.

3.8.1 Case study 1: Pilot study - Mulberry

The first company researched was Mulberry, a leading branded leather goods and apparel manufacturer, whose main market was in Asia. A study was carried out in the area of point of sale packaging for their products, which were selling in their own retail outlets and their franchisees' (see chapter 1, figure 1.4). This limited scope supply chain study provided the opportunity of testing the use of semi-structured interviews and the devising of a questionnaire as a means of data collection. Interviews were carried out with internal personnel and with the two key suppliers of these products. Nine semi-structured interviews were carried out across manufacturing, sales and marketing, and finance and distribution. The questionnaire explored the structure of the division/ function, inputs received, outputs, and design process. The questionnaire for each division/ function had a similar structure of questions, with additions which related to its specific role. The questions were then refined and used subsequently for the Derbyshire Textiles and Sportsco case studies. Critical path analysis and value chain analysis tools and techniques (Hines and Rich, 1995) were used. The case study findings were evaluated in a report format rather than a full academic case study format. The study was then discussed with the company with regard to a possible action plan development.

3.8.2 Case study 2: Derbyshire Textiles

The criteria for the second case study were that it was a smaller company with a simplified supply chain structure and a convenient geographic location, and that the organization produced one basic product, which had many variations. The company, Derbyshire Textiles was a manufacturer of polo shirts. The whole supply chain from yarn to finished goods was reviewed (see chapter 1, figure 1.5) and interviews at all stages of the supply chain were carried out, with the exception of the final customer where access was not made available. The supply chain was local and the product was a single product type, allowing the further development of research techniques and a good overview of apparel and textile supply chain processes.

Access to the host company and its suppliers was easy to achieve and the 'project champion' in the organization, a director, was happy to take part in the case study on a short-term basis. The closeness and lack of complexity within the supply chain greatly assisted the collecting of data within a relatively short time span. The same data collection process was used to help refine both the questionnaire and the methods of interviewing.

One of the problems with the first two studies was the minimal contact with the general everyday environment of the business and also the short duration of the contact period with key personnel. This highlighted the need for being located on site over a longer period of time, to allow observation of the interface between personnel and the underlying influences that affected decision-making and application and implementation of the process.

3.8.3 Case study 3 - Sportsco

These two initial studies formed the framework for the major research, which was carried out in an international sports and leisure company. The company would like to remain anonymous and will therefore be described as Sportsco. Sportsco had their own manufacturing sites in the UK and they bought in finished product from around the world; they also operated with licensees. The focus of the research was in the area of product development as this is critical to their competitive advantage in the market-place. Sportsco was a complex company with five major product categories

which were marketed around the world (see chapter 1, figure 1.6). The research focused on one product category which form their core business and which they manufactured themselves, as well as buying in from sub-contractors on a 'cut-make-trim' (CMT) basis.

The study being carried out was current, not historical, and was an empirical enquiry and observation carried out in the existing environment, which was organic in nature. The questions were devised after carrying out a literature review, participating in two benchmarking studies and developing a network of industry and academic contacts (as previously described). The requirement was to carry out the study without prejudicing the environment and therefore the outcome. The link between the data collection and research questions can be problematic because of the sheer volume of data collected during a longitudinal case study leading to difficulties in analysis and interpretation.

Generalizability from one main case study was a concern. However, it was felt that valid findings could be achieved in an area where only limited research has been carried out. The use of the Derbyshire Textiles and Sportsco case studies would allow a comparison of two different supply chains with different organizational complexity and different product variety. A contrast of structure and geographic location would add breadth to the research, in addition to the depth possible in a case study.

A continuation of the research over a longer period of time in more depth and in more companies would have been advantageous, but was beyond the scope of this research programme.

Semi-structured interviews, supported by a questionnaire, were selected to provide a framework for the interviewer. Difficulties in data analysis can arise where non-standard data formats become included in data collection (Bulmer, cited in Bryman, 1988).

The innovation in to the research comes from the application of existing theory, method and knowledge from one industry sector, the automotive sector to another - that of apparel and textiles.

3.9 PROCESS - TOOLS AND TECHNIQUES

3.9.1 Introduction

The research methodology included the requirement of tools and techniques for value chain analysis (see chapter 3, section 3.8.1). The following section explains and illustrates the main tools and techniques which were used while carrying out this research.

3.9.2 Review of tools and techniques

Hines and Rich (1995) reviewed a cross section of tools, which have been applied in different sectors, and used to assess individual sections of operations across the supply chain. They then produced a matrix, which assists companies to select the most appropriate tools for assessing their value stream. The tools are: process activity mapping; supply chain response matrix; production variety mapping; Forrester effect mapping; physical structure mapping. The starting-point of the process is to interview the key company personnel to obtain their views on the seven wastes, from the Toyota Production System; the personnel are given a number of points to allocate to each of the wastes according to importance. From the results a correlation is drawn to determine the appropriateness of using the tools mentioned above.

Table 3.1 The seven value stream mapping tools

Mapping tool	1. Process activity mapping	2. Supply chain response matrix	3. Production variety funnel	4. Quality filter mapping	5. Forrester effect mapping	6. Decision point analysis	7. Physical structure a) volume b) value
Wastes/ Structure	L	M		L	M	M	
1. Overproduction	H	H	L		M	M	
2. Waiting	H						L
3. Transportation	H		M	L		L	
4. Inappropriate processing	H		M	L		L	
5. Unnecessary inventory	M	H	M		H	M	L
6. Unnecessary motion	H	L					
7. Defects	L			H			
8. Overall structure	L	L	M	L	L	M	H
Key H = High correlation and usefulness, M = medium correlation and usefulness L = Low correlation and usefulness							

(Source: Hines and Rich, 1995)

As described in chapter 2 there are several tools which have been associated with supply chain analysis (Hines and Rich, 1995) and some of these were selected for use in the case study research.

3.9.3 Supply chain mapping

The first tool is called process activity mapping. This technique originates from an industrial engineering source (Hines and Rich, 1997) (see figure 3.3). Process activity mapping allows a large volume of data to be collected and breaks down the tasks into a high level of detail. However, it is more difficult to use in an area where there is task uncertainty, such as in research and design. On completing the process activity mapping the waste in the process is reviewed by analyzing the columns containing operation, transport, inspect, store and delay. The operations column is the main section where value is added and the transport, inspect, store and delay columns are the focus for improvement or elimination. Carrying out process activity mapping makes people think about what they are doing and recording the tasks allows the complete section to link the whole process and question the areas of waste: transport, inspect, store and delay. Further, duplication or unnecessary processing is easy to detect.

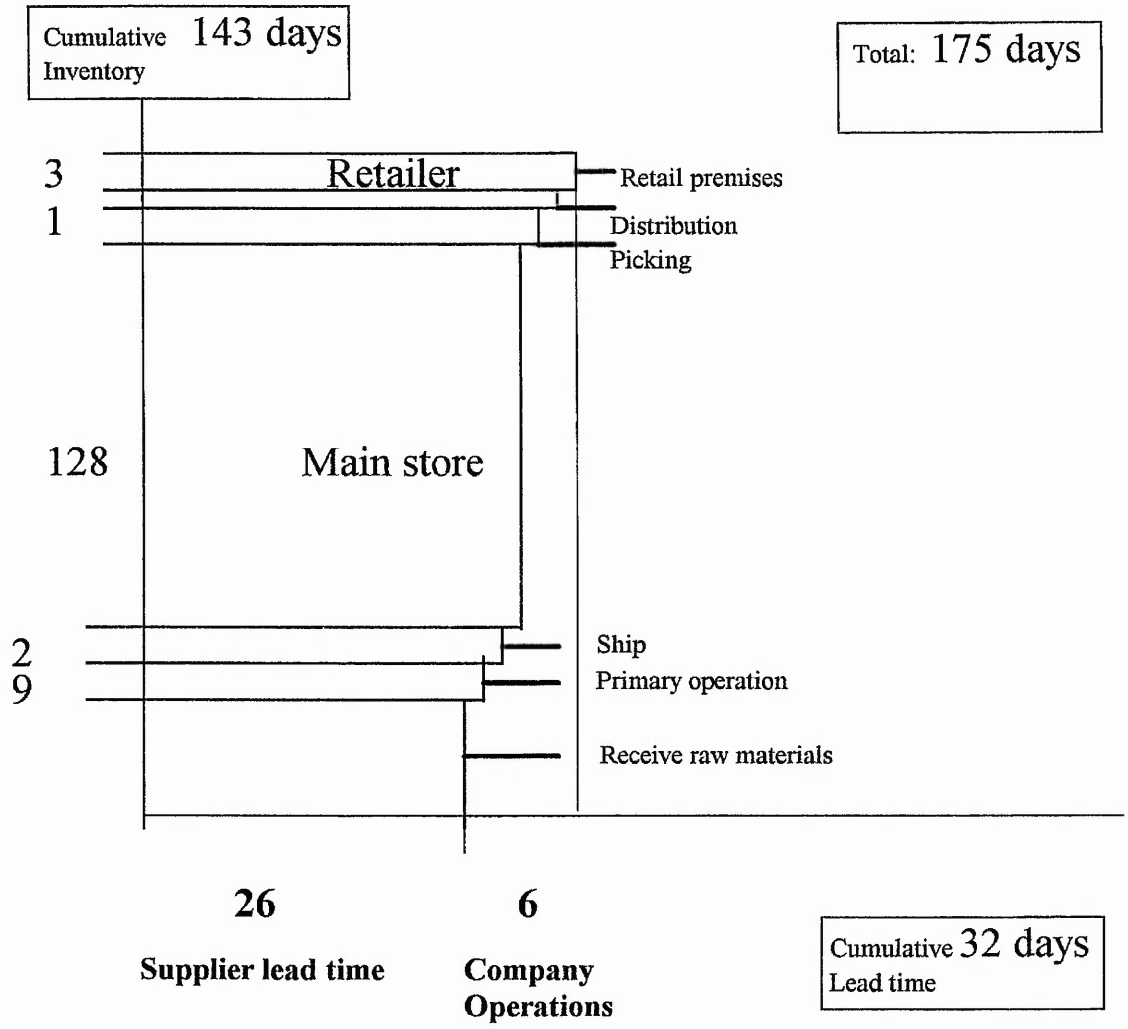
Figure 3.3 Process activity mapping

	Step	Flow	Machine	Dist(m)	Time(min)	People	OPERATIONS	TRANSPORT	INSPECT	STORE	DELAY	Comments
1	Request for raw material	O		0	0.1	1	0					
2	Check availability	O		0	0.1	1			I			
3	Walk to pump truck	T		15	1	1		T				
4	Drive pump truck to location in store	T	Pump truck	30	1.5	1		T				
5	Inspect raw material label	I		1	0.1	1			I			
6	Return to pump truck	T		1	0.1	1		T				
			Total	**350metres**	**234min**		**15**	**32**	**3**	**3**	**10**	

(Source: adapted from Hines and Rich, 1995.) The columns are totalled to give the number of times that the product is worked on to add value (operations), the number of times it is transported to different locations and the distance the product travels, the number of times it is inspected, the number of times it is stored or delayed waiting for information, or for previous operations to take place, or for raw materials to be available.

Figure 3.4 Supply chain response matrix

Based on time compression and logistics techniques of analyzing how responsive the supply chain is in each section



(Source: adapted from Hines and Rich, 1995.)

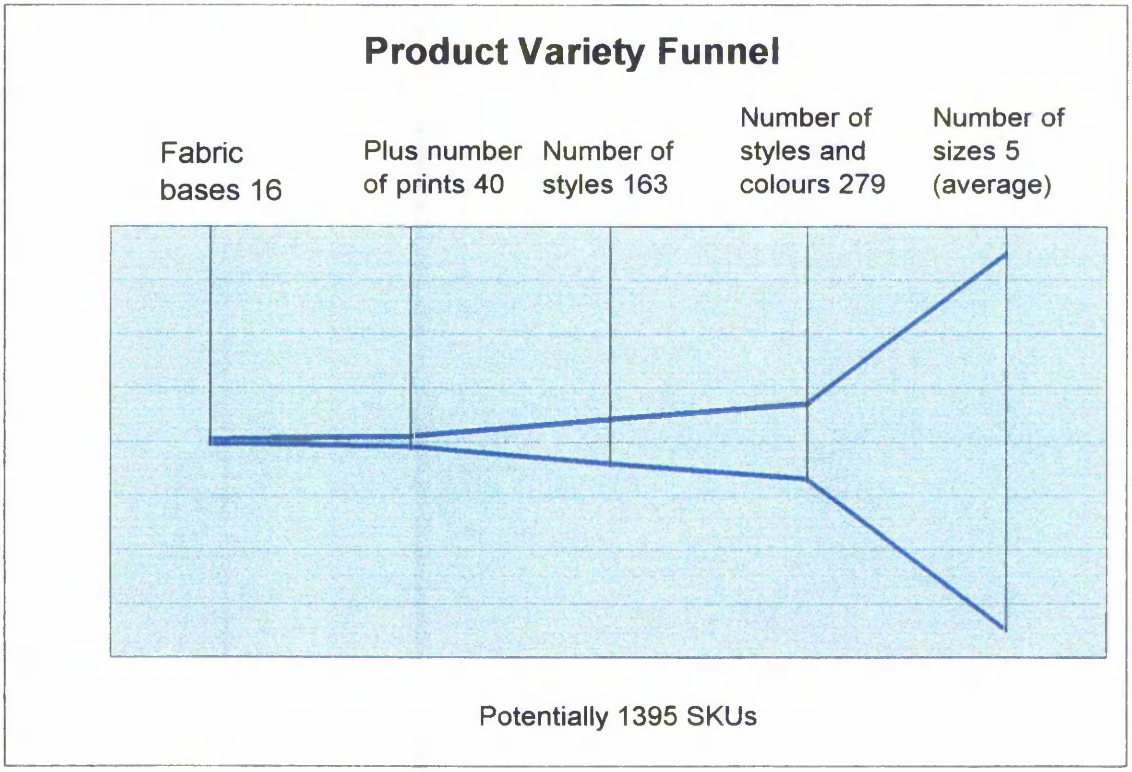
This diagramme illustrates the aggregate for the number of days of inventory held in the whole system and the number of days of lead time that it takes for a product to be pulled through the system to the end customer. This tool helps to analyze the number of days in each section of the supply chain, and creates a visual display of the area to focus on for improvement. The main store is holding stock which is equivalent to four times the cumulative lead time for placing and receiving an order. Unless there are limits on supplier capacity, perhaps due to seasonality, or if demand from the final customer fluctuates heavily, there seems little reason to hold such high levels of

finished stock within the supply chain as this can result in double handling, possible damage, and an increased area being required for storage which needs heating and lighting, generating waste in the chain.

3.9.4 Production variety funnel

This technique's origin is in operations management (Hines and Rich, 1997). It is an illustration of the variety which is created for one season at the different stages of the product supply chain. The product in this case is created from 16 base materials, then prints or finishes were applied to the fabric, which took the fabric variety to 40. The fabrics (plain and printed) were then made into 163 style variations and could be made in different colours which brought the total number of variations to 279. The apparel was then available in approximately five sizes in each style - in some cases more - which brought the stock keeping units (SKUs) to 1395. There was a possibility that further variety could be created if customized point of sale labelling or packaging is required for specific customers. The total variety for one season's products was 1395; of these styles, 106 SKUs are run-ons from previous seasons - around 7.5% of the range.

Figure 3.5 - Product variety funnel



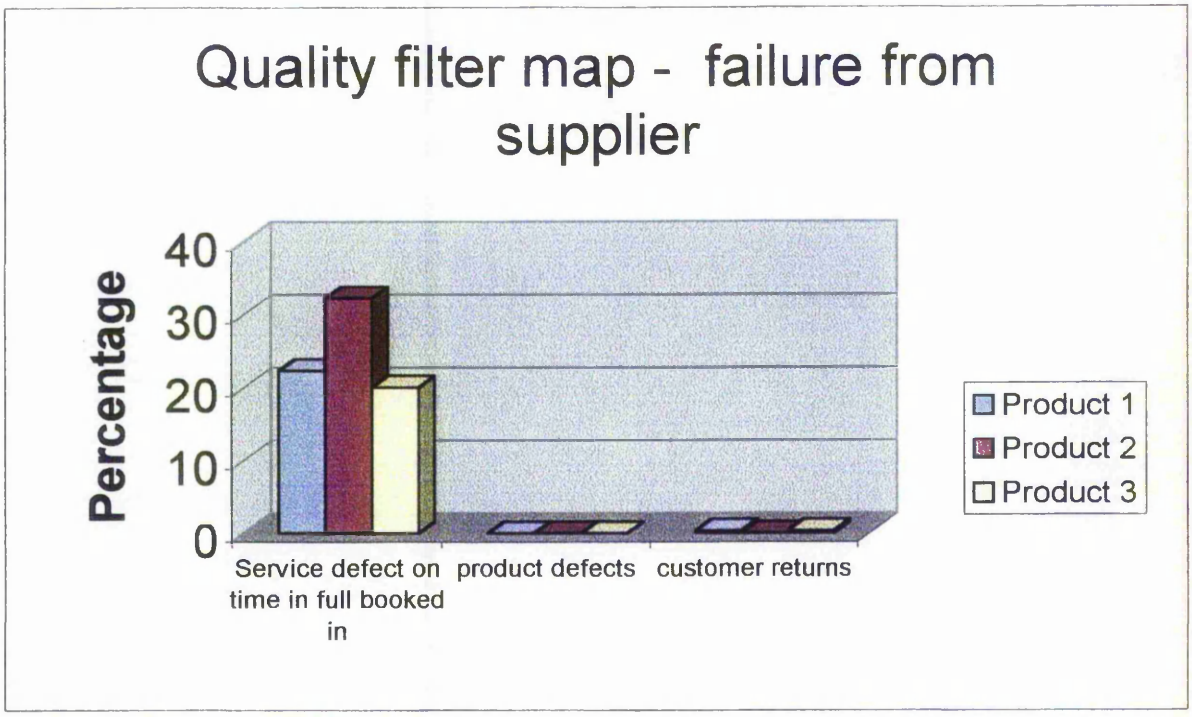
This tool helps to review the variety which was being generated from a product or from a range of products, and illustrates the number of stock keeping units (SKUs) which would have had to be held for each style, print, colourway and size to be available to the end customer. Range analysis could then have been targeted to break the product offer into manageable volumes. Although this tool illustrates the variety within the product offer, however, it does not demonstrate the complexity of supply chains which the variety of products required. The variety may have come from as few as one or two supply chains or from a whole network of supply chains. This was seen in comparing the Derbyshire Textiles supply chain and the Sportsco supply chain. The variety produced was similar but, the network of supply chains differed greatly. The Sportsco organization required a large number of supplier networks in order to give them flexibility for capacity, a high degree of innovation, flexible capabilities for manufacture, and the ability to leapfrog technology requirements. Derbyshire Textiles had a single product category to manufacture, product variety being achieved from the variation in colours, sizes, embroideries and tippings that could be manufactured using the same equipment and same set of skills which the supply chain already possessed. The derivative nature of the product design means that there was no need for leapfrog technology where suppliers were simultaneously researching and developing new products or raw materials.

3.9.5 Quality filter mapping

This tool was designed at the Lean Enterprise Research Centre to illustrate the quality issues in the supply chain. The quality filter is used to measure the product and the service from the supplier three forms: service defects, product defects and customer returns. Service defects include incorrect paperwork with delivery, incorrect quantity, delivery incomplete across the different items. These defects occur between the supplier and the customer. Product defects are those products which have been delivered by the supplier and are inspected by the customer and found to be defective. Customer returns refers to the customer sending out product which is faulty to the final customer, and then the final customer returning the product as defective. This tool illustrates where to focus the improvement activity; in the case of the above chart it would be the service defects between the supplier and customer.

Chart 3.1 below shows how most of the quality problems were focused in the service defect area. Further research and analysis was then required to define more exactly what was happening in this section of the supply chain. It may have been that the product was being presented incorrectly and therefore was set aside in a holding area for inspection at a later time, which caused delay and both transport and double handling waste. This could have resulted from incorrect information exchange or unclear agreed processing instructions.

Chart 3.1 Quality filter mapping



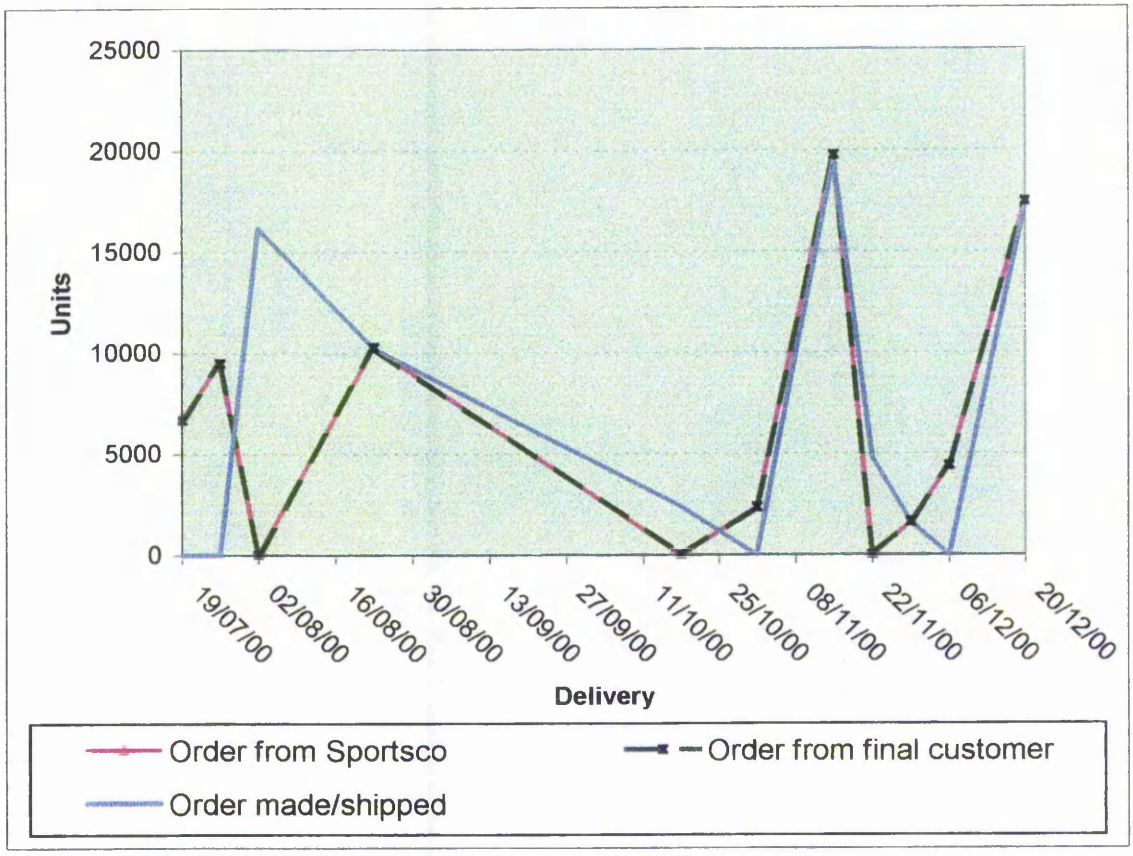
(Source: adapted from Hines and Rich, 1997.)

3.9.6 Demand amplification mapping

This tool can be used to illustrate the variations which are occurring within an organization's supply chain. The tool visualizes the actual demand quantities from the customer, the actual orders which the customer is placing and the deliveries they are receiving from the supplier. The chart illustrates the demand peaks and troughs in August and in November and in some cases the early delivery of product. The actual demand from final customer and the orders placed were superimposed onto each

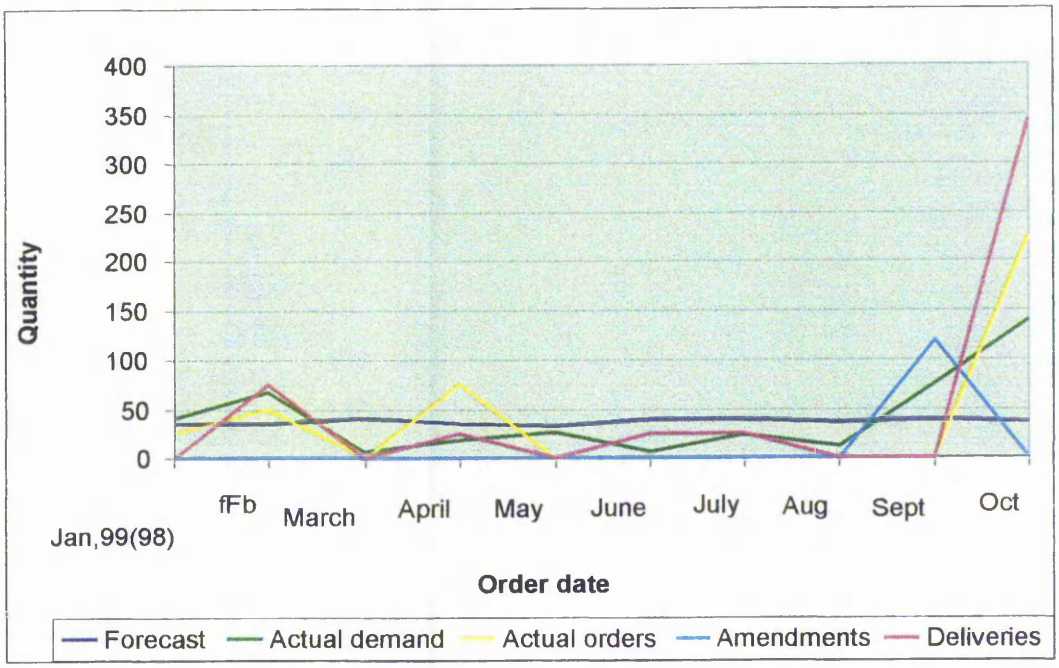
other because orders were only placed with the supplier where they had firm orders from the final customer.

Chart 3.2 Demand amplification



The full requirement for the demand amplification map should include the actual demand from the end consumer and any amendments or forecasts which had been carried out. The chart below illustrates what it could potentially look like.

Chart 3.3 Potential demand amplification



A combination of tools and techniques are used, according to their relevance to the process being analyzed (see table 3.1), the range of tools are selected for their appropriateness for the purpose of supply chain analysis. The tools will highlight areas on which to focus improvements and elimination of waste, while opening up opportunities for adding value to the final customer and improving the supply chain's efficiency.

CHAPTER 4 - CASE STUDIES

4.1 OVERVIEW

In the previous chapter, the rationale for a case study approach to the primary research was explained. The selection of companies has been covered in chapter 3, section 3.8. This had additional benefits in that the three organizations selected represent three different market sectors: luxury goods, customized core products, and middle-market high variety. The first case study was Mulberry, a designer and manufacturer of luxury leather goods, and designer of clothing and household products. Mulberry was the pilot study, carried out in late 1996, which was used to test out the research methods and to develop the tools and techniques for the subsequent studies. The second company was Derbyshire Textiles, a polo shirt manufacturer operating at a local level, data was obtained in 1997. The third company, here designated as 'Sportsco', operated at a global level; data was gathered from April 1997 to April 1998. The environment for the organizations was changing in all three cases - again this is not unusual in the apparel industry. The three companies can be contrasted in terms of the range of products offered and the type of product development undertaken. The size and structure of the three companies' supply chains was another variable considered. The case studies from these three organizations form the core of the primary research.

4.2 PILOT STUDY: MULBERRY

4.2.1 Background

Mulberry was a brand supplier of luxury leather goods and apparel and household products. The company had design, marketing, manufacturing and distribution functions. Mulberry was established in 1971 by Roger Saul and was incorporated as a private limited company in 1985. Employing 322 people in 1996/7, it had won the Queen's Award to Industry and the British Apparel Exporter of the Year Award two years running. In 1988, it was the largest manufacturer of designer leather accessories in Britain, with production based at their site in Somerset; it exported 80% of its products. In 1996 it had a retail turnover of £80 million. It had retail, mail order,

wholesale and duty free outlets and shops within shops. It sold into the Pacific Rim and Europe; at the time of the study its main growth was in the Pacific Rim.

The company describes itself as a family concern run by the founder and his family. The organization's environment had been created from a family philosophy and it employed local people in its Somerset factory to produce its crafted products, paying attention to the detail and quality of its luxury range of products.

In 1996 the company had expanded its range to include a made-to-order gentlemen's suit range and a watch range. However, the company was focused on exporting their products and the economic downturn in the Far East has meant a steep decline in sales. Therefore commercial and supply chain priorities were becoming more critical for the organization's survival.

The creative services department, which developed the artwork for the packaging products, was concerned with the corporate identity alignment across the company. They were also conscious of the brand image that was being promoted to the retail customer.

4.2.2 Project terms of reference

The project brief was to analyse a key element of the supply chain, taking into account the company strategies, structure, tactics and operation, and culture. The study was set to review the supply chain for point of sale carrier bags and was selected due to current problems. Availability disruptions, which were occurring in the business relating to stock outs, were affecting the customer service and advertising aspects of packaging.

The area for the study in packaging was a simple supply chain and represented the components that can be tracked through existing functional sections to the final retail point in the supply chain. This supply chain was therefore considered to be a good example for the pilot study. The project sponsor allowed access through the supply chain via a gatekeeper or project champion (Production Director), who opened the appropriate channels required for the study across all areas of the chain. The host

organization provided access through the buying department and across key players in the chain. The organization would consider the research to be of value if a report of the findings from the case study highlighted areas for improvement. The project term was for two weeks including interviews, data gathering and analysis, and was to be followed by the feedback to the organization.

The research aim was to pilot a supply chain case study and test the methods selected.

4.2.3 Project methods

The main focus for the study was to become familiar with the processes for supply chain analysis. This involved process mapping, a questionnaire, planning the sequence of interviews that were required, the interviews themselves, as well as the analysis of the procedures, lead times and the cross functional dependencies which existed. In order to achieve this aim it would be necessary to generate a questionnaire which would form the basis for the semi-structured interviews, and to develop a supply chain mapping process technique.

The research approach for the pilot study was to use semi-structured face-to-face interviews with the key personnel across the supply chain. Information was collected from the personnel in all the key areas of the supply chain to include the design concept through to the receipt of the product by the retail outlet. These interviews provided the necessary level of detail and illustrated the degree of supply chain awareness across the functions. The relationships, both internal and external, of the pilot organization were explored, and problems that arose in these relationships were identified. The information, materials and feedback exchanges could then be checked for flow, gaps and blocks.

A list of target interviewees was drawn up to ensure information requirements were from all relevant sources inside and outside the organization. In total, nine interviews took place with people performing the following functions: packaging buyer, packaging designer (creative services), customer services manager (wholesale sector), merchandiser (retail sector), warehouse supervisor and despatch manager, packaging schedule administrator, director at Supplier 1, and sales manager at Supplier 2. The

interviews were carried out over a period of two weeks in October 1996 in Mulberry's Somerset headquarters. A site visit was also made to Supplier 1's warehouse and distribution centre.

Reporting to the organization

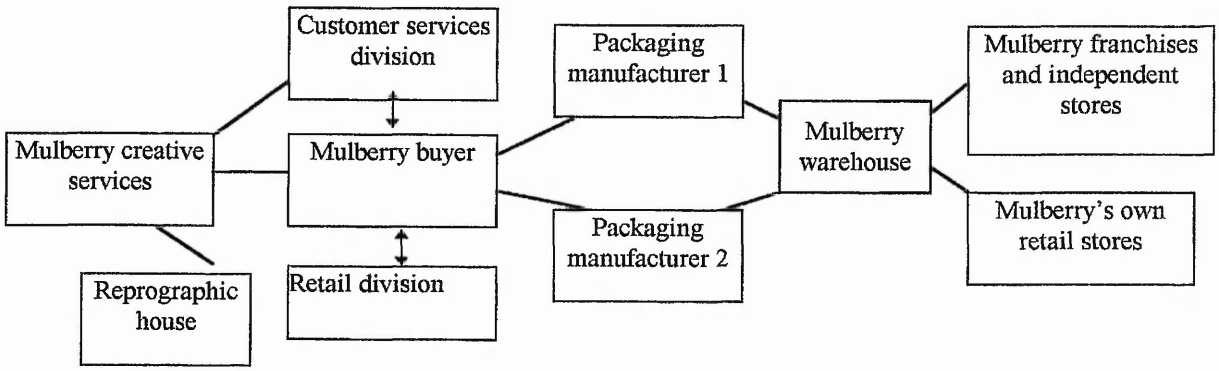
A report was produced for Mulberry with analysis of current operations (see appendix A). This included suppliers' and customers' strengths and weaknesses in the supply chain and highlighted areas for potential improvement. A process relationship map was produced in conjunction with a brief supplier audit. Each section of the process was reviewed and the form completed and fed back to the organization for confirmation and comment. The feedback form was used to confirm the accuracy of the data that had been collected. This assisted in raising awareness of the complete supply chain and it helped to review the process, which had not been examined as a total unit. The relationships in the supply chain had drifted into transactional behaviour which does not inform the key players of changes to the process or supplier capabilities.

4.2.4 Case study results

Supply Chain Review

Mulberry's supply chain for point of sale packaging has been represented below (see figure 4.1). Mulberry initiated the design of the carrier bag and they were also the customer for the end product. Retail outlets generated demand, while Head Office controlled the orders and supply.

Figure 4.1 Mulberry supply chain structure



There were two suppliers for the carrier bag which is produced in three sizes. Supplier 1 manufactured in the UK and in the Far East, however, Mulberry's product was made in the Far East due to the high labour content. Supplier 2 produced in Hong Kong and China (new territories) and operated from offices in North America, Hong Kong, Italy and the UK. Again, due to the high labour content of the product, they manufactured in the Far East. They were also making for other brands such as Gucci, Jigsaw and Selfridges.

New product design

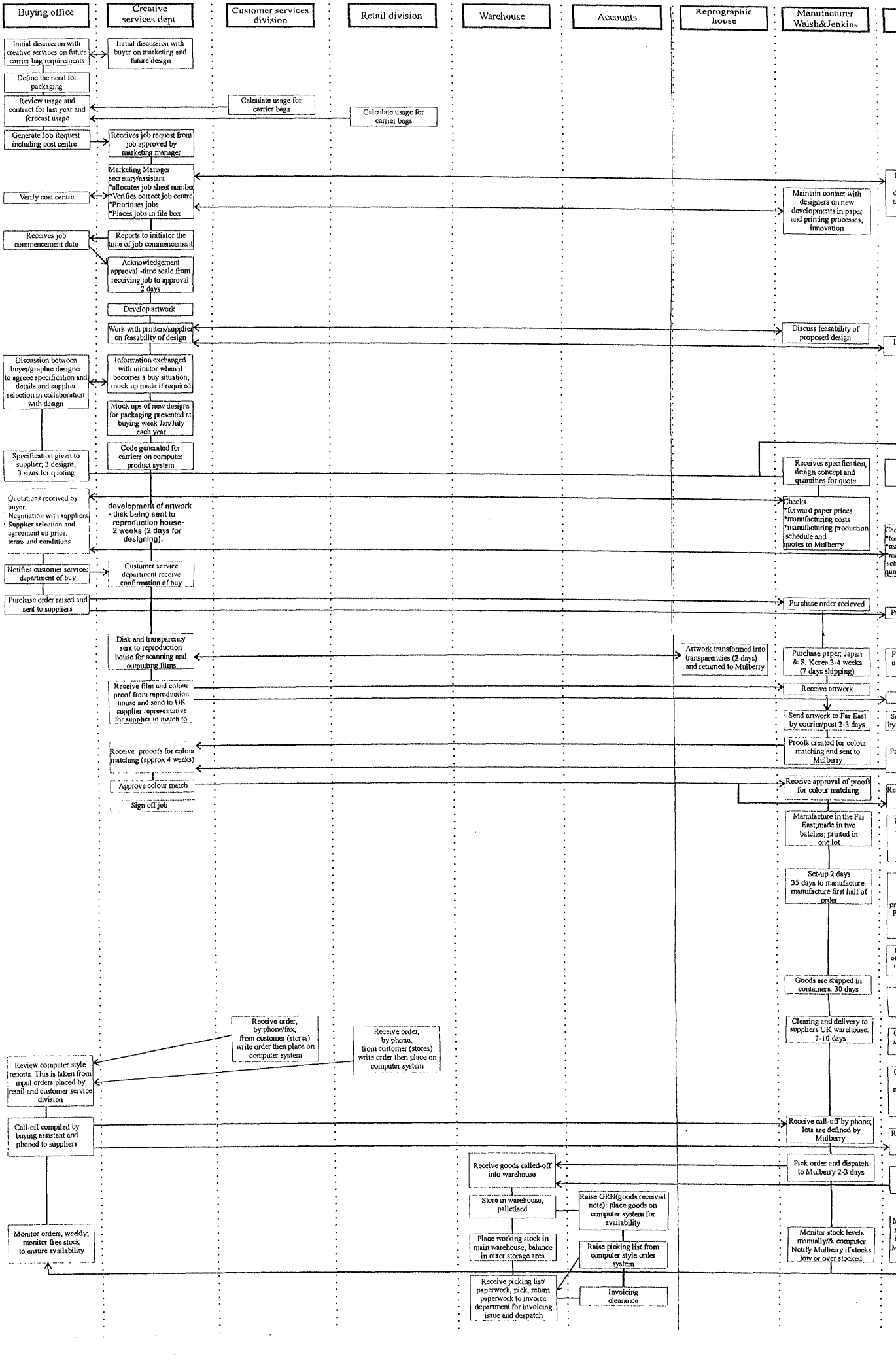
Mulberry's in-house creative services department, in collaboration with the buyer for these products, produced the design for the point of sale packaging. The creative services department generated the designs on computer and worked with a third party reprographic house to create the artwork and provide the approved colour separations for the printers and manufacturers.

New packaging products have to be planned to meet the requirement of retail's new product launch with links to the discontinuity of the previous products. Products may be generated for a specific season, which means new packaging is required every six months; the life cycle of the carrier is then six months. Some core carrier products may last for two or three years if they are not directly linked to the new ranges of leather or apparel products. Examples of this packaging would be "Sale" carrier bags or "Christmas" carriers. The old packaging has to be used within the system to reduce the risk of obsolescence. The value of the order for the three carrier bags in this case was around £45,000 per annum.

Dimensions of the product should be to industry norms (Sales Area Manager, Supplier 1, October 1996) so that no mistakes can occur. Mulberry's product specification was not formatted to the industry norm and required the intervention of the sales manager to ensure the product was correctly specified for their manufacturing operation.

Lead time

The process mapping (see figure 4.2) illustrates the tasks and the flow of materials and information across the functional areas and provides an overview of the interchanges which are occurring. The units under review were the supply chain network for the product including the structure, lead times and geographic location of the supply chain. Figure 4.2 illustrates the process mapping which occurred. The original map was A3 size and offered a higher level of detail, which was used to confirm all activities within each individual process. As the detail is difficult to portray in A4 format, all the data was transferred into the Microsoft Project computer programme application to illustrate the lead times and dependencies.


Buying office
Creative services dept.
Customer services division
Retail division
Warehouse
Accounts
Reprographic house
Manufacturer Walsh&Jenkins
Initial discussion with creative services on future carrier bag requirements
Initial discussion with buyer on marketing and future design
Define the need for packaging
Review usage and contract for last year and forecast usage
Calculate usage for carrier bags
Calculate usage for carrier bags
Generate Job Request including cost centre
Receives job request from job approved by marketing manager
Marketing Manager secretary/assistant *allocates job sheet number *Verifies correct job centre *Prioritises jobs *Places jobs in file box
Verify cost centre
Maintain contact with designers on new developments in paper and printing processes, innovation
Receives job commencement date
Reports to initiator the time of job commencement
Acknowledgement approval -time scale from receiving job to approval 2 days
Develop artwork
Work with printers/supplier on feasability of design
Discuss fesability of proposed design
Discussion between buyer/graphic designer to agreee specification and details and supplier selection in collaboration with design
Information exchanged with initiator when it becomes a buy situation; mock up made if required
Mock ups of new designs for packaging presented at buying week Jan/July each year
Code generated for carriers on computer product system
Specification given to supplier; 3 designs, 3 sizes for quoting
Receives specification, design concept and quantities for quote
Quotations received by buyer. Negotiation with suppliers. Supplier selection and agreement on price, terms and conditions
development of artwork - disk being sent to reproduction house- 2 weeks (2 days for designing).
Checks *forward paper prices *manufacturing costs *manufacturing production schedule and quotes to Mulberry
Notifies customer services department of buy
Customer service department receive confirmation of buy
Purchase order raised and sent to suppliers
Purchase order recieved
Disk and transparency sent to reproduction house for scanning and outputting films
Artwork transformed into transparencies (2 days) and returned to Mulberry
Purchase paper; Japan & S. Korea.3-4 weeks (7 days shipping)
Receive film and colour proof from reproduction house and send to UK supplier representative for supplier to match to
Receive artwork
Send artwork to Far East by courier/post 2-3 days
Receive proofs for colour matching (approx 4 weeks)
Proofs created for colour matching and sent to Mulberry
Approve colour match
Receive approval of proofs for colour matching
Sign off job
Manufacture in the Far East;made in two batches; printed in one lot
Set-up 2 days 35 days to manufacture: manufacture first half of order
Goods are shipped in containers: 30 days
Receive order, by phone/fax, from customer (steres) write order then place on computer system
Receive order, by phone, from customer (stores) write order then place on computer system
Clearing and delivery to suppliers UK warehouse: 7-10 days
Review computer style reports. This is taken from input orders placed by retail and customer service division
Call-off compiled by buying assistant and phoned to suppliers
Receive call-off by phone, lots are defined by Mulberry
Receive goods called-off into warehouse
Pick order and dispatch to Mulberry 2-3 days
Store in warehouse; palletised
Raise GRN(goods received note): place goods on computer system for availability
Monitor orders, weekly; monitor free stock to ensure availability
Place working stock in main warehouse; balance in outer storage area
Raise picking list from computer style order system
Monitor stock levels manually/& computer Notify Mulberry if stocks low or over stocked
Receive picking list/ paperwork, pick, return paperwork to invoice department for invoicing, issue and despatch
Invoicing clearance

From the data collected during the semi-structured interviews, the lead time was calculated (Microsoft Project software was used for this process - see figures 4.3 and figure 4.4). The process was calculated based on a five day week, except where the product is in transit from the Far East where a seven day week applies. The process for Supplier 1 is illustrated in figure 4.3. The duration of task 1 (ID.1) represents the cumulative lead time for the process, in this case 105 days. Supplier 2 (see figure 4.4, task 1 (ID.1)) had a cumulative lead time of 101 days. The two diagrams illustrate the input, output and timescale for each part of the process. The critical path was examined to optimize the process flow with the result that the possible cumulative lead time is 87.2 days (see figure 4.5, task.1).

FIGURE 43 SUPPLIER 1, POINT OF SALE PACKAGING

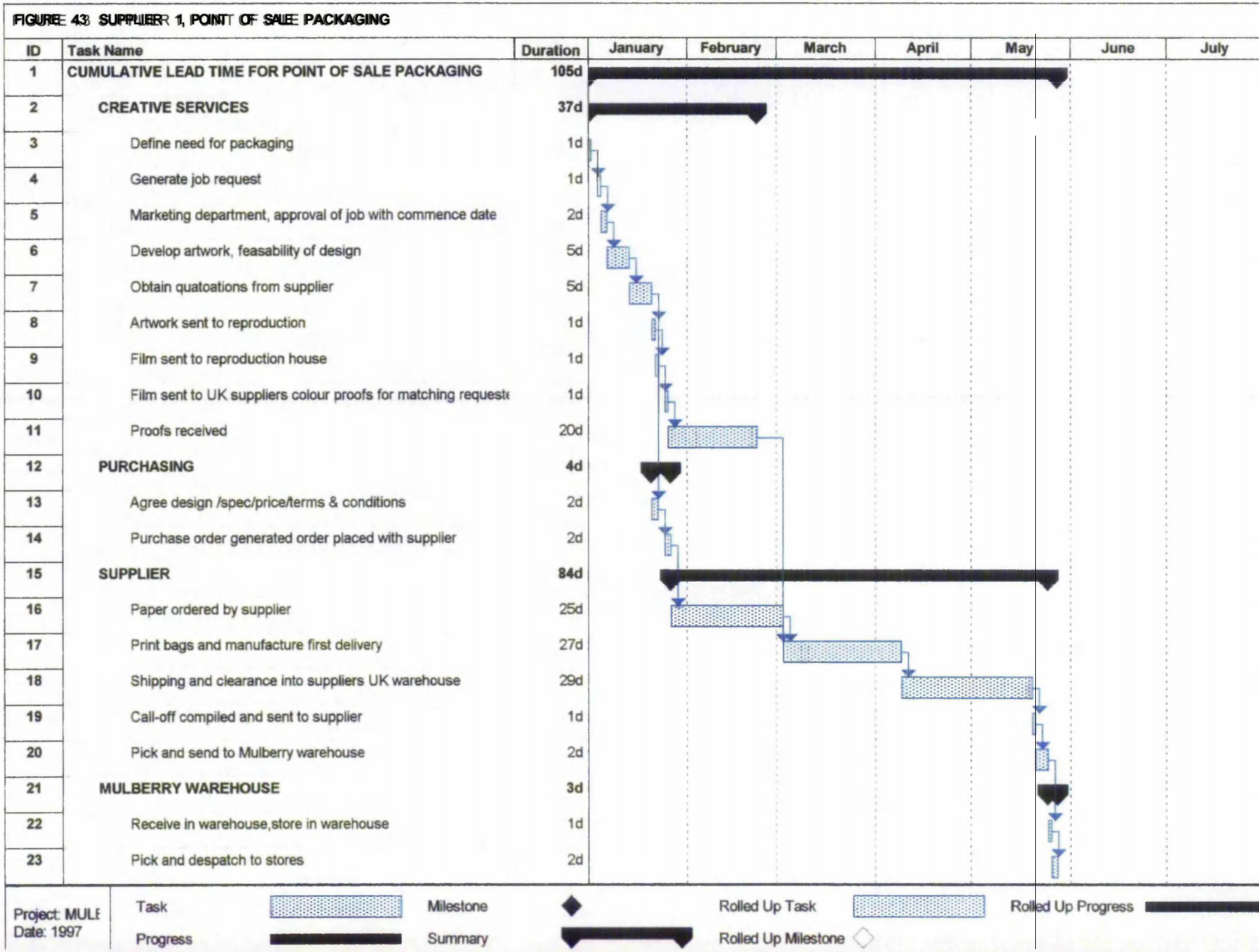
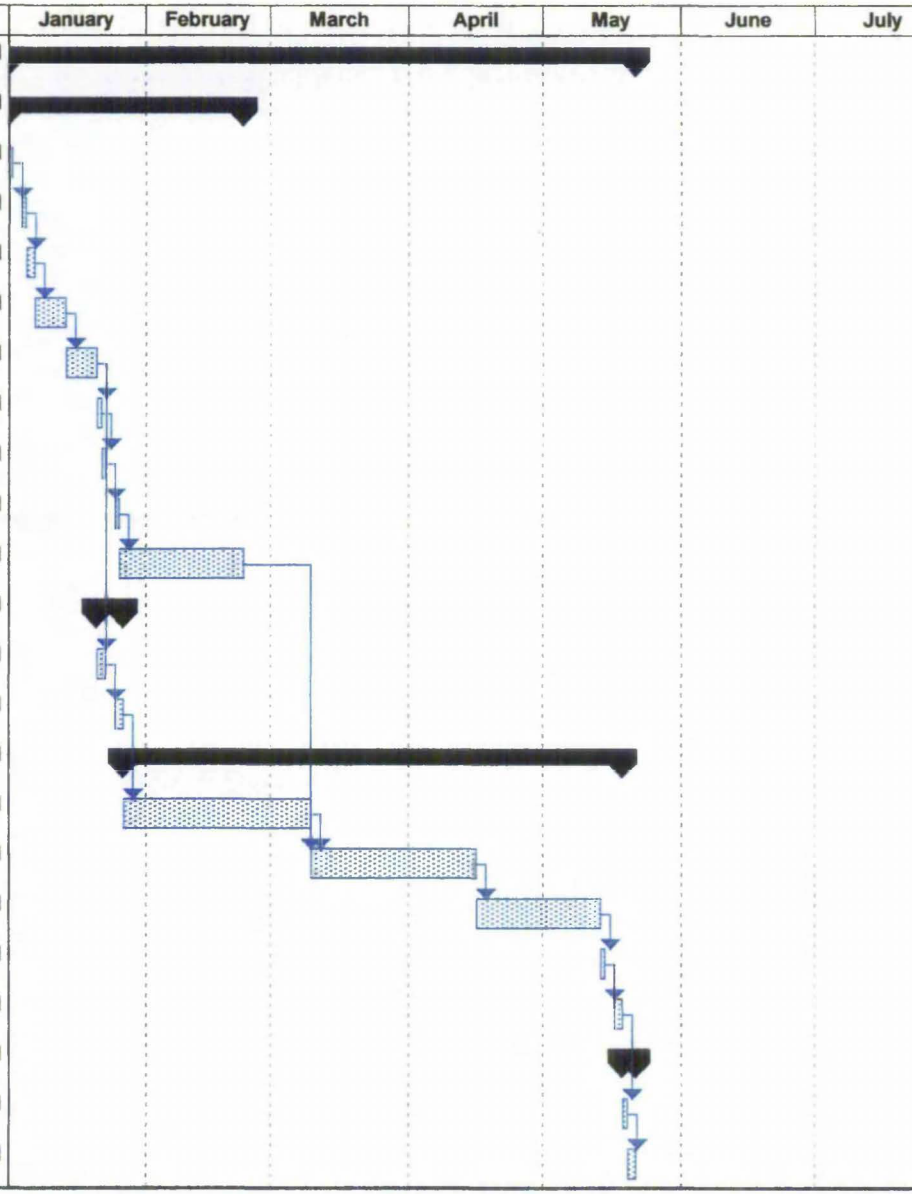


FIGURE 4.4 SUPPLIER 2 , POINT OF SALE PACKAGING

ID	Task Name	Duration
1	**CUMULATIVE LEAD TIME FOR POINT OF SALE PACKAGING**	**101d**
2	**CREATIVE SERVICES**	**37d**
3	Define need for packaging	1d
4	Generate job request	1d
5	Marketing department, approval of job with commence date	2d
6	Develop artwork, feasability of design	5d
7	Obtain quatoations from supplier	5d
8	Artwork sent to reproduction	1d
9	Film sent to reproduction house	1d
10	Film sent to UK suppliers colour proofs for matching requested	1d
11	Proofs received	20d
12	**PURCHASING**	**4d**
13	Agree design /spec/price/terms & conditions	2d
14	Purchase order generated order placed with supplier	2d
15	**SUPPLIER**	**80d**
16	Paper ordered by supplier	30d
17	Print bags and manufacture first delivery	27d
18	Shipping and clearance into suppliers UK warehouse	20d
19	Call-off compiled and sent to supplier	1d
20	Pick and send to Mulberry warehouse	2d
21	**MULBERRY WAREHOUSE**	**3d**
22	Receive in warehouse,store in warehouse	1d
23	Pick and despatch to stores	2d

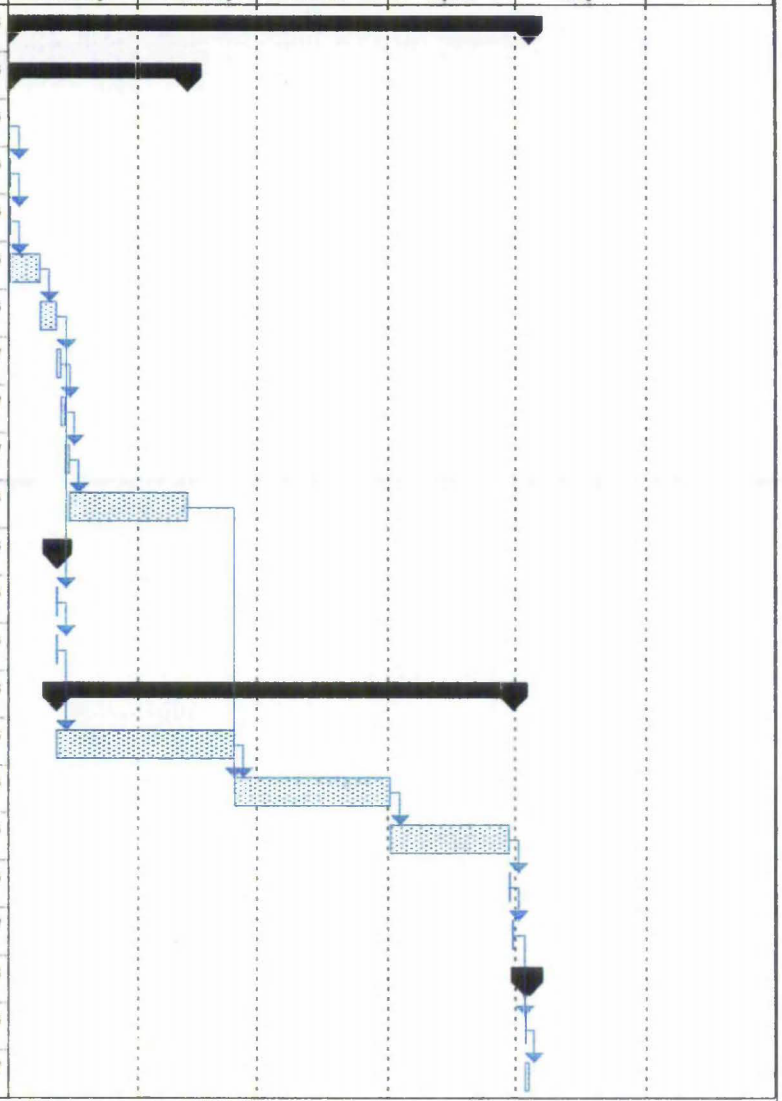


Project: MULE
Date: 1997

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

FIGURE 4.5 MULBERRY'S - POTENTIAL LEAD TIME WITH EXISTING PROCESS

ID	Task Name	Duration
1	**MULBERRY'S POTENTIAL LEAD TIME WITH THE EXISTING PROCESS**	87.2 days
2	**CREATIVE SERVICES**	30.7 days
3	Define need for packaging	0.5 days
4	Generate job request	0.1 days
5	Marketing department, approval of job with commence date	0.1 days
6	Develop artwork, feasability of design	5 days
7	Obtain quatoations from supplier	2 days
8	Artwork sent to reproduction	1 day
9	Film sent to reproduction house	1 day
10	Film sent to UK suppliers colour proofs for matching requested	1 day
11	Proofs received	20 days
12	**PURCHASING**	0.2 days
13	Agree design /spec/price/terms & conditions	0.1 days
14	Purchase order generated order placed with supplier	0.1 days
15	**SUPPLIER**	78.1 days
16	Paper ordered by supplier	30 days
17	Print bags and manufacture first delivery	27 days
18	Shipping and clearance into suppliers UK warehouse	20 days
19	Call-off compiled and sent to supplier	0.1 days
20	Pick and send to Mulberry warehouse	1 day
21	**MULBERRY WAREHOUSE**	1.2 days
22	Receive in warehouse,store in warehouse	0.2 days
23	Pick and despatch to stores	1 day



Project: M
Date: 199

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split

Purchasing procedures

The buyer placed a blanket order for packaging for the period of one year and stock was called off monthly. Supplier 1 manufactured the product once a year, Supplier 2 twice a year. The purchasing process was based on customer specification and purchasing schedule. The purchaser focused on two suppliers for competitive pricing. There was no asset specificity and exchanges were operational in nature, such as schedule and call-off data usually transferred by fax and phone.

The purchasing strategy for packaging products was that they were devolved to a product buyer and tended to be transferred between members of the buying team on a regular basis. This resulted in a lack of supply chain process knowledge for the product and poor relationships with the supplier. The supply chain positioning matrix (see figure 2.10) would class the relationship at stage two - 'quality competition' - with limited customer involvement mainly occurring around purchasing time. The carrier bags had a total order value of approximately £45,000 per annum, around 71,000 units (Buyer, October 1996). However, it appeared that they did not consider the order to be of any great monetary value and as a result little attention was being paid to the issues of stock outs, obsolescence and stockpiling within the organization.

The other area of uncertainty was the monitoring of the volume of packaging, which was actually being used. The retail outlets ordered the packaging whether they were own retail, franchise or wholesale, and as the product was not for sale but was given as part of the point of sale material, the EPoS system did not capture the information. The retail division had created a buffer of stock in the Mulberry warehouse. This was done by allocating packaging to the merchandise retail division without actually sending it out to the retail outlets. The internal allocation was made to ensure supply to the retail division stores (Merchandiser, October 1996). The warehouse/ distribution manager subsequently confirmed this during her interview - stock was allocated but remained stored in the warehouse and not distributed to the retail stores. This meant that stock outs were occurring each season even though product was available within the chain as allocated stock and held within the warehouse (Warehouse Supervisor, October 1996). At the time of interviewing, one in three of the product sizes were out of stock (print out from Mulberry's IT stock system). The

consequences were an added storage cost for the company, and increased distortion in demand at each interface in the supply chain (see section 2.3.4, Industrial Dynamics). However, the demand was not being measured. The product had a long lead time for replenishment because of the lead time for raw material order, caused by manufacturing in the Far East and shipping time to the UK. If a high demand was placed on the UK suppliers, the risk of stock out increased as it could take a maximum of 80 days (see figure 4.4, supplier processing section (ID 15)) for the carriers to be in stock again. The 80 days is the cumulative lead time from the supplier ordering the paper to the finished goods being picked and sent to Mulberry.

Both suppliers had been supplying Mulberry for around seven years. External trust with the supplier was formed mainly at the transaction level. Joint product development was limited at the initial stages. However, the relationship between the creative services department and the vendor was used to exchange information on new processing capabilities.

The buyer for the product was changed on a regular basis, leading to a lack of shared learning, both internally with the creative services section, and externally, with the vendor (see section 2.2.3). Supplier development was not a consideration as it was deemed of minimal importance to the core activity of the organization. Quality was given high importance along with competitive pricing. Both suppliers were able to offer the required quality for Mulberry although one of the suppliers was able to produce a higher quality than that specified. Co-operation by the vendor was high, although they were not being called on to provide any value added services for Mulberry. The current buyer was using dual sourcing to purchase the product. This was considered the preferred mode of business because it meant that they could maintain the power to source different quantities, match prices and maintain competitive pricing between the two sources. The two suppliers were offering stock holding for the company in their UK warehouses, usually three months stock.

The superior supplier was considered to be more efficient, but Mulberry's concern was to maintain a threat from an alternative source. The 'superior' supplier was a

major player in carrier bags in the UK, and therefore the buyer did not want to give away too much power to the supplier.

Mulberry's Systems - stock holding and performance measures

The organization operated a closed system and was mechanistic in structure (see figure 2.1). The system, within which the key players operate, was creating distortion of demand and this was compounded by the lack of trust, internally, in stock availability (Merchandiser, retail division, October 1996). This resulted in stockpiling (Warehouse supervisor, October 1996) which absorbed the variability in demand, causing fluctuations at each interface in the supply chain and greater uncertainty.

Performance measures were not in place for Mulberry regarding stock outs, inventory-holding at different locations, or patterns of demand from the retail customer. Mulberry had difficulty in monitoring true demand for carrier bags, as it was not part of its EPoS system. The carrier bags were not a priced item and were not sold to the customer but formed part of the service overhead. Traceability within the internal chain was problematic and their relationship with the customer was poor, resulting in lack of trust. This was partly due to packaging not having a barcode, as it is not a product that is actually sold to the end customer, only to the retail outlet. Also, retailers could not predict usage of each size of carrier as it was dependent on the number and type of products that the final customer purchased. There was a gap in the information system as it was unable to show stock-holding at the various internal points in Mulberry. One of the suppliers had performance measures for delivery with their third party carrier - this was 0.2% performance failure on delivery.

The packaging came in different sizes and pack quantities and this also distorted the demand. A pack of a hundred carriers may have been ordered but only gradually used over a long period. Inventory was held at the suppliers' manufacturing site. They maintained a level of around three months' stock in their UK warehouse. Supplier 1 made the complete order and held it in stock, ready for call-off. Supplier 2 printed all the paper, but made up the bags in two batches. On completing the first batch it was shipped to their UK warehouse. The balance of the order was made based on the monthly demand from Mulberry. Inventory was held at Mulberry's UK warehouse

(approximately two weeks, according to Mulberry's IT stock system) then at the retail outlet (stock levels unknown - data not captured). The order delivery quantity was around 3,000 units per month for each of the two suppliers. Inventory may have been in transit from the supplier's manufacturing site in the Far East. All this resulted in the accumulation of inventory costs throughout the chain, obscuring demand patterns, and restricting the flow of goods.

Analysis

The problems - barriers to improvement and waste in the process - were documented. The two suppliers worked on a 16 week lead time from the Far East: with Supplier 1 the lead time was 84 days (see figure 4.3, duration of task 15); with Supplier 2 it was 80 days (see figure 4.4, duration of task 15). This did not include the time for the buyer and creative services to define their requirement and agree design proofs. This took a further 37 days, bringing the total lead times to 105 and 101 days respectively. The shortest lead time which could have been achieved from the existing system, was 87.2 days (see figure 4.5 duration of task 1). This would be without any changes but with the buffer taken out between the sections of the supply chain. Reducing the supplier lead time focused on: the exchange of information for call-offs, reduction in the time for booking goods in, and the time for picking and despatching to stores from Mulberry's warehouse. Further reduction could be achieved if the suppliers were confident of a long term relationship with Mulberry. Around a third of the lead time is allocated to the waiting period for the paper to be ordered and received by the supplier (see figure 4.5, duration of task 16). This causes a long ramp up (time from initial enquiry until order is put into production) period for the suppliers' production. This could be reduced if they worked more closely with their suppliers. The buyer discontinuity was also hindering the relationship. Each time a new buyer was given the responsibility for purchasing point of sale packaging a period of learning was required, and there were no standard operating procedures. There were two elements which the buyer and supplier had to control: the development of new packaging and the replenishment of supply.

Both suppliers were holding a stock of carriers in their UK warehouse. This was to enable rapid replenishment once the initial delivery had been produced and received by the agent amounting to around a third or a half of the quantity of the total order.

The main areas of waste and therefore of analysis, were the delays of caused by waiting for the proofs to be processed, by waiting for the paper order to be scheduled from source and then shipped to Hong Kong, then by waiting for the transport and clearance of finished product into the UK warehouse. The two suppliers' lead times varied by approximately a week due to a longer shipping and clearance time, and the time from order to receipt of paper. The actual set-up and printing of the paper ready for manufacturing the carrier bags only takes around one day.

4.2.5 Pilot conclusion

The conclusions are split into two - the findings from the research and the findings from the methodology.

4.2.5.1 Research findings

The supply chain was well-integrated. However, the efficiency of the chain was sub-optimised by the retail division causing demand amplification, due to lack of trust of supply (see section 2.3.4).

The product packs should have been more closely linked to demand for the product. Large pack sizes encourage unnecessary stock holding along the chain. The carriers were sold in packs of 100 (small carrier) and 50 (medium and large carriers) even though the usage of the different sizes at the retail end was variable, with high usage in the smallest size. Sales were recorded at 39.84% (small), 34.71% (medium), 25.45% (large) (Merchandiser, Retail Division, October 1996).

One of the suppliers could have added further value to the supply chain by offering delivery direct from their warehouse to retail outlets and could have operated vendor-managed inventory for the company. However, neither of these capabilities was being used.

Method of reporting to the organization

A report was produced for Mulberry, with analysis of current operations including suppliers' and customer's strengths and weaknesses in the supply chain, and highlights for potential improvements. A process relationship map was produced, in conjunction with a brief supplier audit. The format for the process waste review is illustrated in appendix A.

Change and barriers to change

The organization did not consider packaging to be of importance and therefore few resources would be applied to resolve the problems that were occurring. There was a lack of awareness of the cost of stock, losses due to stock outs and missed opportunities with their suppliers. Although the value of the packaging was small in comparison with the product that the consumer was purchasing, the impact of stock outs was considerable at point of sale, and the benefits of reinforcing the brand image and of advertising were being lost.[1]

4.2.5.2 Research methodology/ case study experience

Prior to visiting the research organization, a background information search was carried out on the company, giving an insight into their development and structure. The study had a senior level champion in the organization which gave it a top-down approach. The semi-structured questionnaire/ interviews approach proved successful in understanding the product and information flow and formed the basis of the process mapping.

The factors observed while carrying out the interviews included the degree of supply chain integration and awareness of the product development process, the structure of the supply chain, the uncertainty of supply and distortion of demand, the inventory levels in the supply chain, and the relationship interface between the organizations in the supply chain.

[1] Since the pilot study was completed Mulbery has closed their Somerset factory; it is now outsourcing production from Italy, Spain and Turkey. Mulberry retains their design, commercial and distribution operation in-house.

The information on the pilot case study led to some preliminary findings for the further research. The triangulation of methods, described on page 98, assisted in building and checking the supply chain process. The main data sources for the study were: the mapping, questionnaire interviews and subsequent informal interviews. The development of the questionnaire was very helpful in focusing the face to face semi-structured interviews on the specific area under research: networks, systems, relationships and environment.

The relationships and environment of the supply chain were more difficult to review than the system that was in operation to control the supply chain process. Performance measures and demand data were anecdotal rather than hard data. However, given time and resources the company could have collected this in the future.

The pilot study had limited scope to observe the culture of the organization or the environment in which the personnel were operating. The organization was observed in snapshot, and only a short-term view of the supply chain processes was taken, which meant that changes were not part of the research. The report feedback was not commented on by the organization so it was unclear if any actions were to be taken to improve the supply chain and develop the supplier's capabilities. The perceived benefits would have been: greater supply chain visibility, reduced stock holding, improved stock control and reduced risk of stock outs.

The pilot study was used to generate a method for mapping and illustrating the supply chain structure and new product development, the product in this case being packaging. The study allowed the development and trial of the questionnaire, and analysis of the tools and techniques, including value analysis and waste review, while examining the supply chain process. The level of awareness and integration were assessed during the supply chain interviews. The pilot study demonstrated the value of the use of critical path analysis and project management techniques for the display of the supply chain process.

4.2.6 Issues for later case studies

For the second case study, the questionnaire required refining to incorporate a more free-flowing discussion, to bring out the interviewee's perceptions and assumptions towards the end of the interview. Skills in interviewing and the use of supply chain analysis tools and techniques, were being developed, to optimize the resource and the time given by the key personnel being researched.

Some of the issues that came out of the pilot study were the gaps in the research data collection process regarding the environment and the relationships of the organization. The pilot study was unable to view the filtering of the information by the key players or to understand the interviewee's assumptions or perceptions of the organization. Only the description of the process, not the task integration or the actual links across the functions could be observed. The complexity of the job could only partially be assessed in the limited time that was available for the study.

Future case studies would benefit from greater detail and on-site visits to suppliers would be made wherever possible. The research observations from the pilot study were the requirement for a long-term project, and that the research had to be undertaken from within the organization. The long-term approach would allow a greater understanding of the internal and external environment of the organization and both long- and short-term issues could be assessed. The backing of the project champion within the organization would be critical to the success of the research as they would form the link for access across the supply chain (see chapter 3, section 3.6.1). They would have the authority to open up the level of access along the support functions and to control the degree of involvement that could be expected.

The pilot study had a short data collection period. However, even in two weeks a large amount of data was collected and an overview of the current supply chain was created, including with the key problem areas for Mulberry's packaging supply chain. The people and system problems were examined; the research methodology was tested and improved. The requirements for future case studies were that they should be more comprehensive, of a longer duration and that contact with suppliers should be more detailed and more accessible (location).

The pilot study, even though short in duration, illustrated clear evidence of supply chain problems and inefficiencies within the chain. The review of the systems and the interviews with the people involved highlighted the problems that were occurring. These were mainly due to poor awareness and understanding of their process. The research methods were tested and improved on in preparation for the following case studies. The pilot study helped to define the requirements of the next study: that it should be more comprehensive, of longer duration and should include both local access and greater contact with suppliers.

4.3 DERBYSHIRE TEXTILES

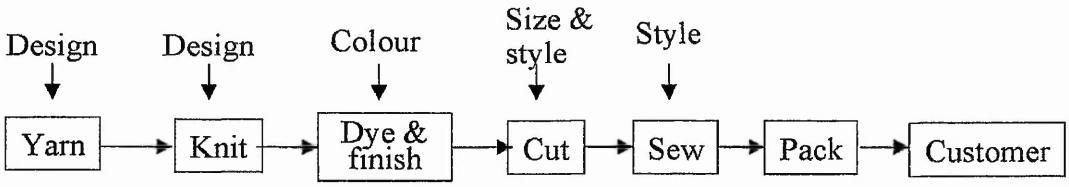
4.3.1 Introduction

The second case study was selected because the organization was manufacturing a typical mainstream apparel product. Apart from the yarn supplier, the supply chain was mainly within a fifty mile radius of the host company, making it easily accessible.

4.3.2 Background

Derbyshire Textiles is a polo shirt manufacturer supplying the sports, corporate wear and promotional market. This case study gave the opportunity to address the limitations of the pilot study and to analyse a typical fashion/ apparel supply chain (see figure 4.6).

Figure 4.6 Typical apparel supply chain



The company was established in 1985 by ex-Courtaulds employees who set up the organization as a single product type manufacturer. The company had around eighty employees - typical for a medium size company in this industry - and has a turnover of around £3 million. It had a supply chain which was established fourteen years ago and had recently had a fall in company sales. The company had since been going through growth and then rationalization. The customer base had been changing and there was pressure in the marketplace to reduce prices.

Derbyshire Textiles manufactured polo shirts and their customers were specialist department stores, corporate wear (direct and contractors), and clubs or promotional garment contractors. They were supplying around eight key customers.

The company had previously developed the promotional section of the business to offer individual customized embroidered polo shirts to clubs and for company

promotions. This area of the business had since been downscaled and they were concentrating on their core activity of bulk production. They had eleven key suppliers, two yarn suppliers, two contract knitters, a dyer and finisher and six trimming suppliers.

4.3.3 Project terms of reference

Because of the commercial pressures described above, there was a review and analysis of the key elements of the supply chain, the company strategies, structure, tactics and operation and the culture.

The project champion, a Director, welcomed outside research assistance. His aim was to review the process flow and lead times in order to improve their supply chain performance. The research aim was to review a mainstream apparel product supply chain from the purchase of the yarn to the finished product. A subsidiary aim was to improve and refine the methodology for the case study approach piloted with Mulberry by applying some of the tools and techniques.

4.3.4 Project methods

The method for the research was based on the pilot study, with improvements made to the questionnaire and mapping techniques. More access to the external key players in the supply chain was obtained for the second study. The interviews were to include eight internal and six external interviews from key players in the supply chain. This would improve the detail revealed of the degree of integration that was being achieved and would allow greater overall visibility of the supply chain. The mapping of the process would need to be refined, and a much more detailed process map with a broader scope generated. The project term was a two week period of access, followed by interviews with external suppliers, and a period of collation and analysis.

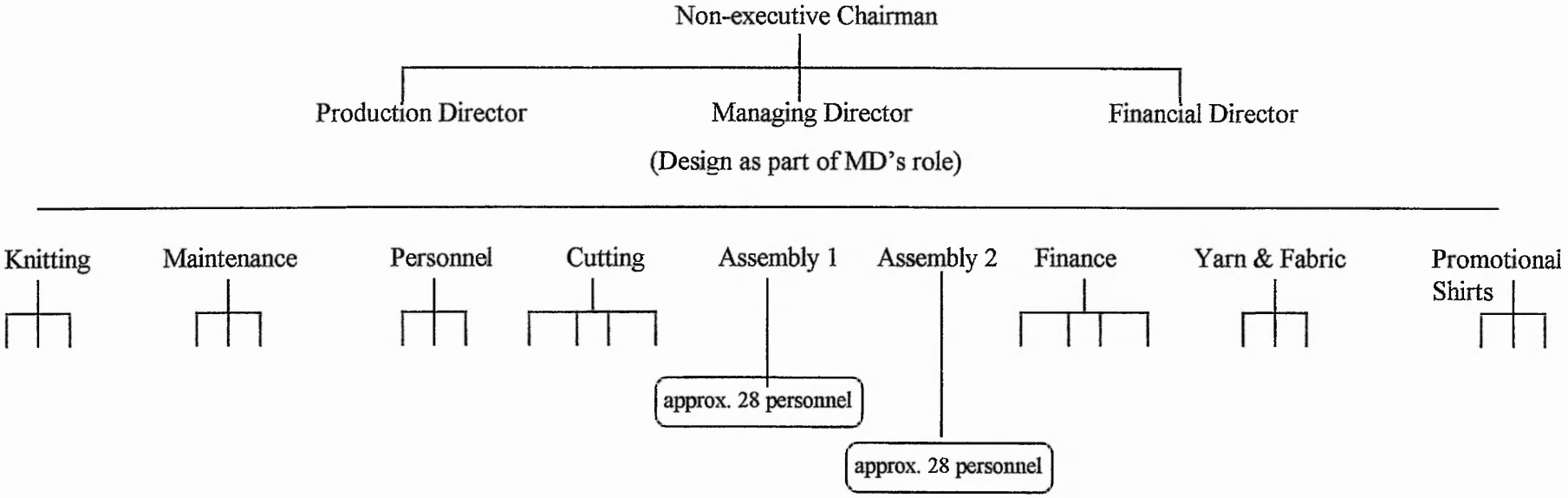
A full review of the supply chain was undertaken and sources including all stages of the process: yarn suppliers, contract knitters, dyeing and finishing, trimmings suppliers, sales, purchasing, Derbyshire Textiles' knitting division, production, sampling and cutting, warehouse goods-in and distribution, finance. A review of the timescales and the input and output requirements was carried out to illustrate the

overall supply chain layout. This was then represented in Microsoft Project format for the more detailed map.

4.3.5 Supply chain review - network structure

An overview of the polo shirt supply chain, and the processes within Derbyshire Textiles, was obtained from an interview with the Managing Director. The internal structure of the organization can be seen in figure 4.7. However, in the supply chain 'network' there was no real hierarchy - they came together to perform the network tasks of manufacturing polo shirts on short lead times (see figure 4.8). The process for Derbyshire Textiles started with the receipt of a contract. The yarn was then called-off from the bulk contract and the knitting capacity was planned. Fabric for the main body was sub-contracted; knitted trims such as the collars and cuffs were made in-house. The knitted body fabric and the collars and cuffs were then collected and taken for dyeing. The body fabric and collars and cuffs were then returned to be embroidered, assembled, labelled and packed ready for distribution to the customer.

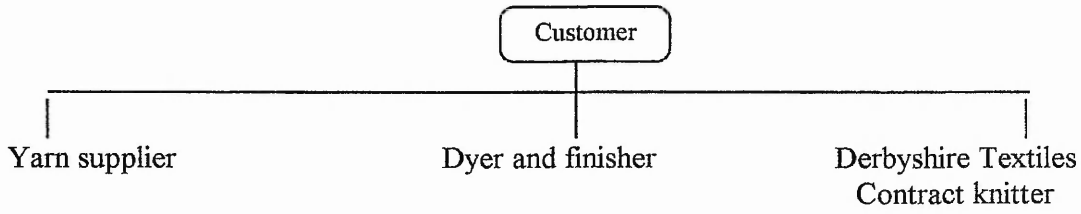
Figure 4.7 Structure of Derbyshire Textiles



(Source: Managing Director, 1997)

The directors operated across the different functions within Derbyshire Textiles when required. The Production Director focused on the cutting, maintenance, knitting and assembly areas, while the Managing Director focused on sales, design and marketing and personnel. The Finance Director was concerned with finance and the purchase of yarn and fabric, blanket contract negotiations and payment. He was also responsible for one of the production units.

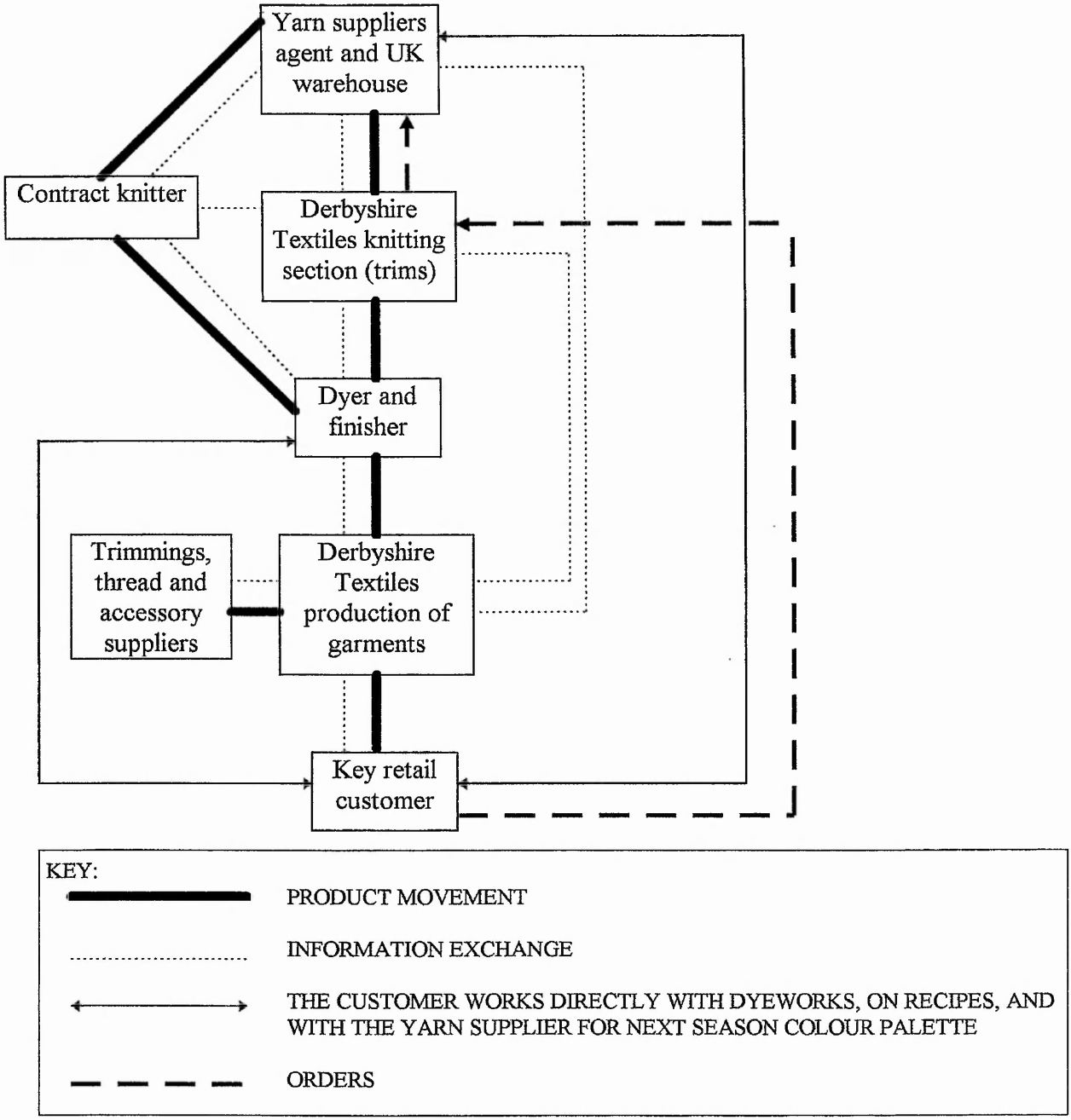
Figure 4. 8 Supply chain production network



(Source: Interviews)

The structure was flat as they had equal status within the network and worked to perform the task of manufacturing polo shirts. The contract knitter was positioned below Derbyshire Textiles because they did not directly work with the customer but worked closely with all the other members of the network. The convergence of practice and lack of complexity and variability of the process had resulted in a strong operational network. The processing had become standardized, based on each company's core task within the process (see figure 4.9). However, customization of the product was based around the embroidery and colour combinations available to the customer. The yarn supplier the dyer and finisher and the contract knitter operate within several supply chain networks independent of Derbyshire Textiles.

Figure 4.9 Supply chain structure - polo shirts, based on Derbyshire Textiles key retail customer.



(Source: Interviews)

The network shown in figure 4.9 illustrates the partnership sourcing strategy described by Macbeth and Ferguson (1994). The partners were carefully selected and the intra- and inter-company interfaces have been established with a long term view of their relationship.

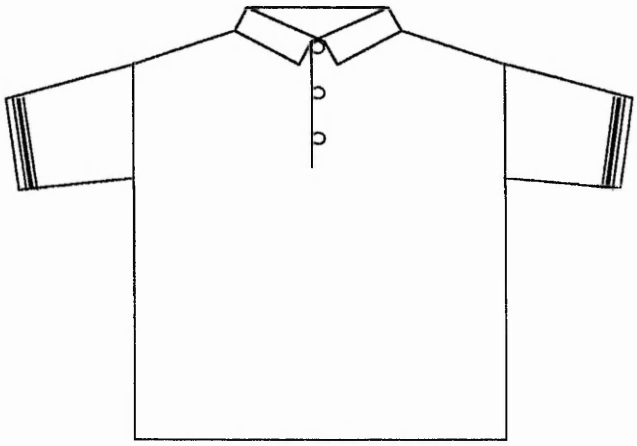
4.3.6 Product development

New product design - variety and customization

The company offered a customized quality product that was made to order. They were competing with imported standardized products which were then embroidered in the UK and sent to the customer. Derbyshire Textiles' product variety and added value derived from the type and quality of the yarns which came in different counts[1] and fibre types. The yarn was made into fabric that could be produced with variations to the wales[2] and courses[3], along with different stitch patterns and weights, to produce the end fabric. The fabric could then be dyed to a range of colours and finishes. The fabric was then cut to a specified style and size and sewn using an assortment of finishes, including types of seam and stitch preferences. Trims and accessories could be added to give further variability in the appearance of the end product, creating a new design for their customer. The imported products were often in a standard range of colours and are in pre-packed set ratio quantities. Derbyshire Textiles' market had comprised of customized colour palettes, size specifications, yarn specifications, fabric specifications, colour combinations, embroideries, tippings[4], buttons and garment silhouettes, and was based on smaller quantities (see figure 4.10 for generic product). Derbyshire Textiles' main customer had a range of 144 Stock Keeping Units (SKUs) based on the colour/ tippings/ sizing variations taken from their colour palette for one season. Maintaining their market share depended on whether the customer is prepared to pay for this service. Derbyshire Textiles did not want to compete in the low end of the product category where price is the main focus for buyers (interview, Managing Director).

[1] Counts - refers to the weight of the yarn
[2] Wale - intermeshed row of loops running from end to end of a weft knitted fabric
[3] Course - the loops of yarn which run from side to side of a weft knitted fabric
[4] Tippings - the coloured stripe inserted at the edge of the collar or cuff on the garment

Figure 4.10 Generic silhouette



The benefits of the Derbyshire Textiles' supply chain were that it could react to retail customers' EPoS data regarding customer preferences on size and colours, and that they were able to support the product offer with replenishment in the faster selling sizes and colours, which allowed their customer to maintain in-store availability to the consumer across all sizes and colours (see section 2.3.7, Schonberger, 1996). Rapid re-supply is not normally something which importers are able to offer, and stock outs or overstock in low-selling colourways means lost sales opportunities for the retailer. The retailer will have had to buy the full quantity of products, in large batches, in order to get a lower price from the importer. This either results in discounting or jobbing-off the slow-moving product to a merchant, thereby recovering some of their outlay. Stock outs and lack of the correct sizes for the product offer cause dissatisfaction for their customers, resulting in lost sales and possibly lost future custom.

Existing products

The product variety was limited to the styling of the polo shirt and is derivative in nature (see figure 2.16). At the time of the study, they had seven apparel silhouettes running and had fifteen that they had previously made (see figure 4.11, generic polo shirt silhouette).

The basic silhouette of the garment stayed the same and the variations occurred in the yarn type, the weight of the fabric, the colour of the body fabric, the number of wales and courses and the finished weight which were required for the finished fabric.

There were also variations in the size specification and machine finishes to garment, in the use of twin needle stitching instead of single row of stitching, in taped shoulder seam finishes, in design of the front placquet (button stand) and in the buttons. The main areas where customization occurred were on the collar and cuffs where an edge, or tipping, was used in different colourways to give different colour combinations, and in the application of customized embroidery (see table 4.1 for an example of the variations which occur in one order).

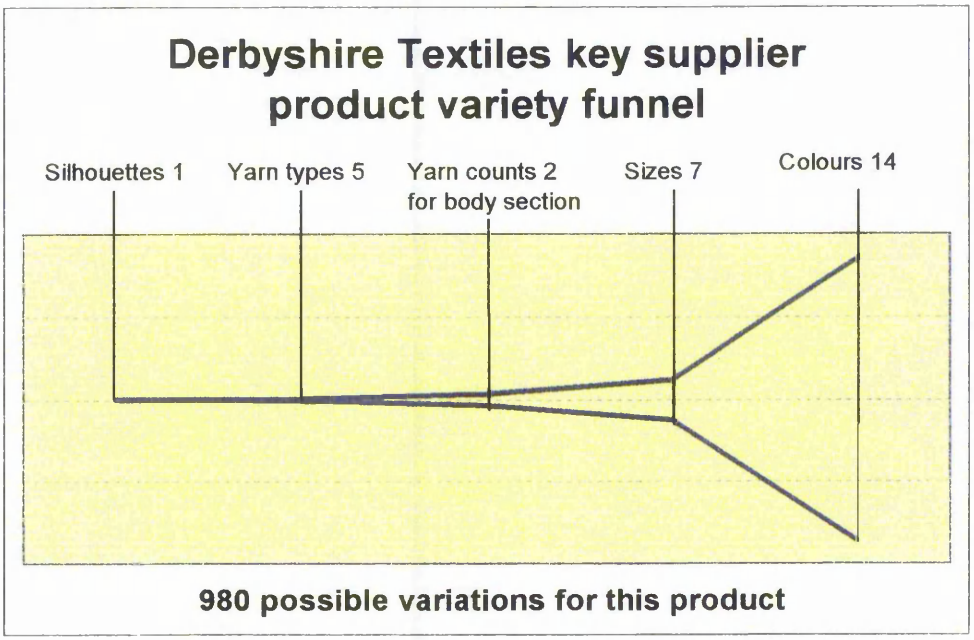
Table 4.1 Example of product variations for embroidery

Body colour	**Inner tip**	**Outer tip**	**Code**	**Embroidery colour**	**Shade number**
Black	White	Red	102	Red	1147
Red	Navy	Navy	109	Navy	1043
Royal	White	White	139	White	1002
Sage	Navy	Navy	140	Navy	1043
Yellow	Navy	Navy	147	Navy	1043
Navy	White	White	238	White	1002
White	Ice	Navy	300	Navy	1043
Black	Yellow	Yellow	506	Yellow	1064
Burgundy	White	Ice	609	Blue	1075
Ice	Navy	Red	794	Red	1147
Black	White	White	803	White	1002
Tan	Navy	Navy	980	Navy	1043

(Source: Derbyshire Textiles specification sheet, 1997)

Customized brand labels and packaging also added to the variety. This has not been indicated on the product variety funnel (see figure 4.11). Although the component parts could vary, the garment would be processed in the same way through the supply chain. The product variety funnel tool illustrates the possible variations that could occur even with only one product and one customer.

Figure 4.11 Derbyshire Textiles product variety funnel



The fabric structure and gauge are further variables that could be applied to the product variety funnel to give additional variety to the product offer.

However, the product variety funnel does not indicate the complexity of the supply chains that are required to supply this variety of products. In the case of Derbyshire Textiles there were two main supply chains. The supply chains differed in the area of yarn sourcing between marle and greige yarn. As previously indicated the marle yarn came from a range of small mills that supplied the main mill. The yarn was made in small batch sizes and in a wide variety of colour variations. Problems with delivery performance and quality often created variation in the supply chain performance. This was in contrast to the greige yarn supplier. Though a huge range of fibre and spinning processes were available, Derbyshire Textiles primarily used combed cotton of standard gauge in an undyed state.

New styles

Derbyshire Textiles were starting to look for new areas of opportunity for their product and were considering developing new product silhouettes. The organization had not previously looked to offer a selection of styles as they considered the variety should occur in the colours, tippings, embroideries and trims. Adverse market

conditions had led them to investigate alternative product styles. They were not considering alternative yarns, but would be prepared to buy in finished fabric.

Process

The process example given is for Derbyshire Textiles' key customer, slight variation could occur with other customers. The start of the process involved the customer selecting the yarns from the key supplier of combed cotton undyed yarn. The colour palette was then selected and the yarns were knitted and sent to the dyer who then submitted lab dyes for customer approval. The customer, manufacturer and yarn supplier calculated a schedule, and a blanket order was issued by the manufacturer to the yarn supplier. The customer placed an order with Derbyshire Textiles, who would then trigger the start of the manufacturing network operation. A call-off would then be issued to the yarn supplier. The yarn supplier held greige, combed cotton (undyed) stock in different yarn counts in their UK warehouse to await call-off by the manufacturer. The yarn was then sent either to Derbyshire Textiles or to the contract knitter where it was knitted into rolls of approximately 15 kg in weight (around 0.36kg per garment) and collected by the dyer and finisher. The knitted fabric was collected from the contract knitter, along with the knitted trim from Derbyshire Textiles, and they were then processed in dye batches. The dye batches (220 kg) were based on the machine capacity. After the dyeing process, the fabric was finished to the required specification and conditioned. The dyer and finisher then returned the trim and the fabric to Derbyshire Textiles where the fabric was cut into the size range of seven sizes and cut in a ratio which was given by the customer. The ratio was calculated as indicated in table 4.2 for a typical order of 620 garments.

Table 4.2 Cutting ratio

Size	Extra extra small	Extra small	Small	Medium	Large	Extra large	Extra extra large
Quantity	20	60	120	160	140	100	20
Ratio for cutting	1	3	6	8	7	5	1

The knitted trims were then allocated to the bundles and sent for embroidery and garment manufacture. The garments were packed and despatched to the key customer. The customer had a logistics operation, which distributed the product throughout their retail outlets.

Lead time

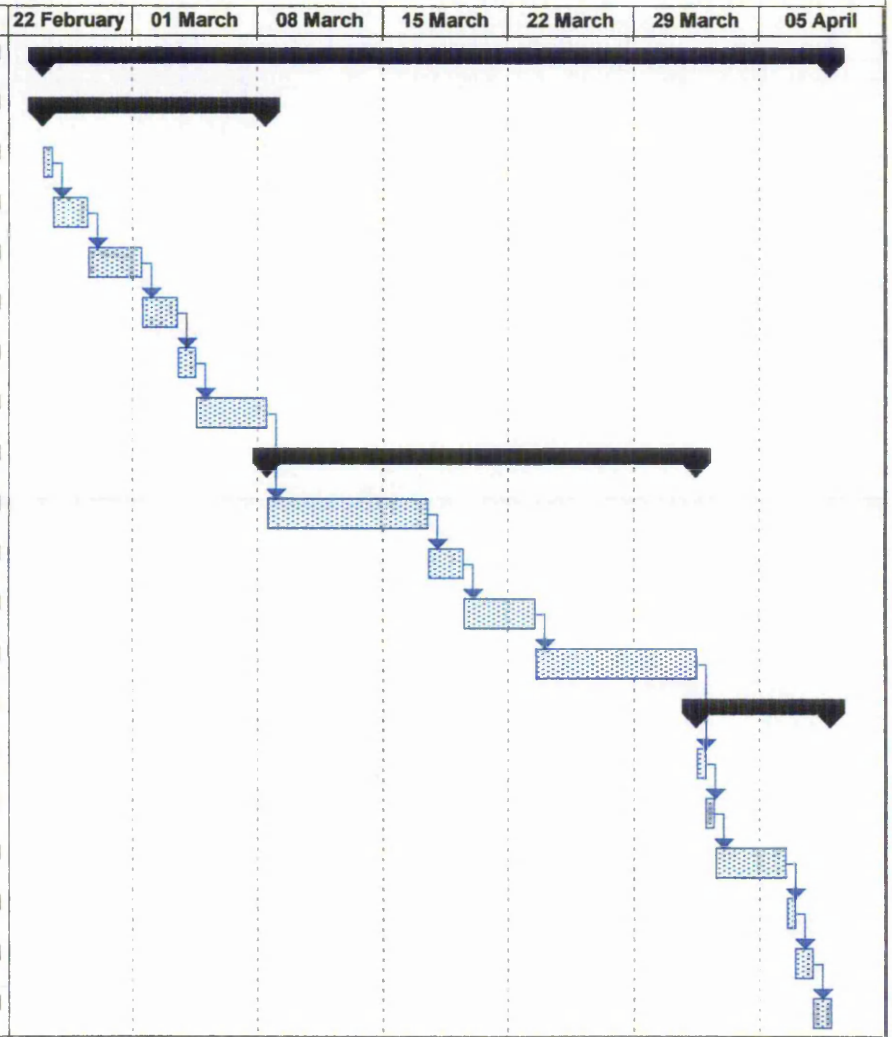
The supply chain relationship map (figure 4.12) illustrates the links across the tasks that the key players in the supply chain performed. The map could then be used to obtain an overview of the whole supply chain and not just one section of it. The degree of integration could be reviewed and the effectiveness of the supply chain assessed. The process maps give details of the task performed (see figure 4.12 and 4.13).

The lead time was calculated as 32 days (see task 1, figure 4.12, Microsoft Project) and was based on the current supply chain operation, from the receipt of the customer's order to the delivery of the finished product. The data was collected from the interviews along the whole supply chain and the documents that were made available. The interviewees included the sales and yarn buyer, yarn suppliers, contract knitter, knitting trims manager, production manager, production director, trimmings purchaser, cutting room manager, dyer and finisher, and the warehouse and distribution manager. The second Microsoft Project diagram (see task 1, figure 4.13) illustrates that a lead time of 13.6 days could be achieved without any changes to the process. The time has been calculated after removing the buffer that was set between each of the links in the network and by confirming the processing times (interviews).

The product lead time, illustrated in figure 4.13, shows the lead time for the complete process from customer to end product. However, this does not include the early involvement at the beginning of each season where colour palettes and lab dyes were agreed. The yarn lead time has been calculated based on the inventory of greige yarn, which was held at the yarn manufacturer's UK warehouse.

FIGURE 4.12 DERBYSHIRE TEXTILES CURRENT SUPPLY CHAIN LEAD TIME

ID	Task Name	Duration
1	**CUMULATIVE LEAD TIME FOR POLO SHIRT MANUFACTURE**	**32d**
2	**SALES AND PURCHASING**	**8.5d**
3	Define buying needs for customer	0.5d
4	Receive confirmation for yarn suppliers of earliest order delivery dates	2d
5	Generate appropriate adminstrative paperwork	1d
6	Obtain quotes from accessory suppliers price and dates	2d
7	Agree design /specification/prices/terms and conditions	1d
8	Purchase order generated order placed with supplier	2d
9	**FABRIC KNITTING, DYEING, AND FINISHING**	**18d**
10	Yarn sent to knitters and knitted	7d
11	Fabric collected and delivered to dye house	2d
12	Fabric and knit trims grouped in dye lot ready for dyeing	2d
13	Fabric dyed and finishe and delivered Derbyshire Textiles	7d
14	**GOODS IN AND MANUFACTURE**	**5.5d**
15	Goods booked in and tested	0.5d
16	Lay plans calculated layed up and order cut	0.5d
17	Garments manufactured	2d
18	Receive in warehouse, store in warehouse	0.5d
19	Pick and despatch to Customer	1d
20	Customers logistics receive	1d



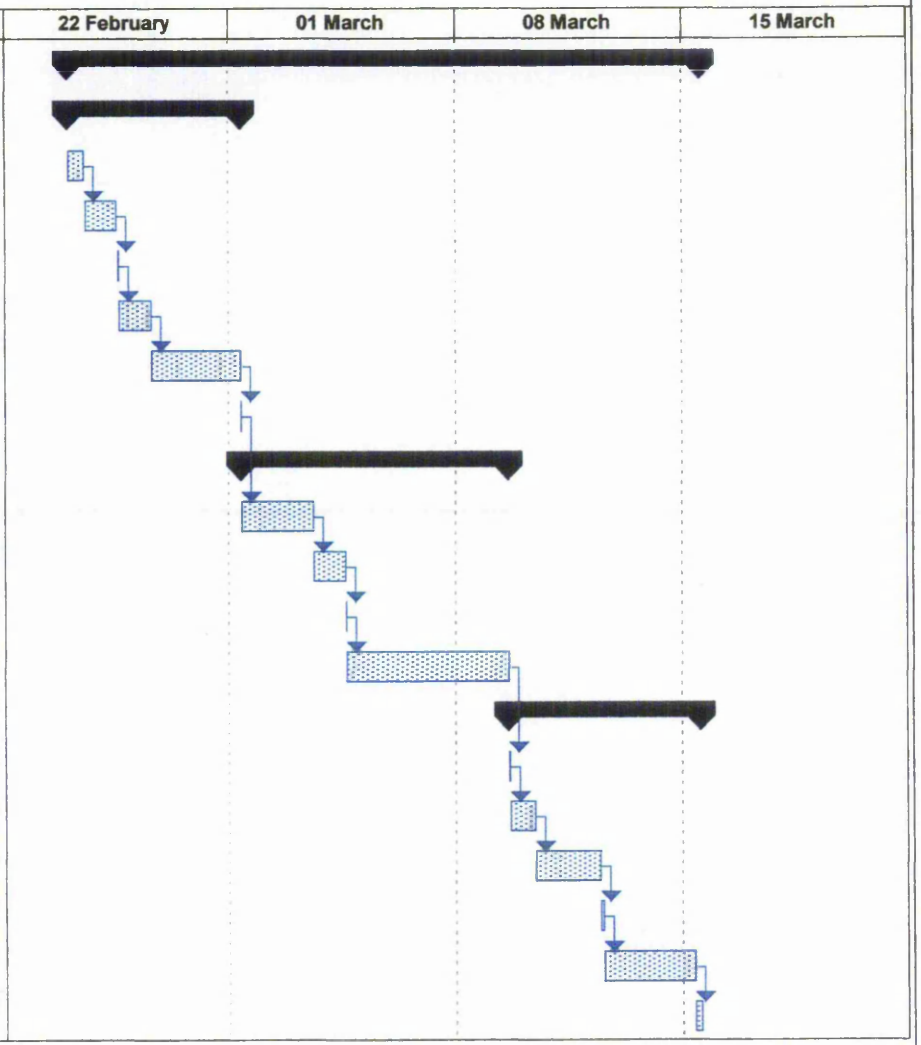
Project: Derby CASE STUD' Date:1997

Task Milestone Rolled Up Task Rolled Up Progress

Progress Summary Rolled Up Milestone

FIGURE 4.13 DERBYSHIRE TEXTILES POSSIBLE LEAD TIME

ID	Task Name	Duration
1	**CUMULATIVE LEAD TIME FOR POLO SHIRT MANUFACTURE**	**13.6d**
2	**SALES AND PURCHASING**	**3.2d**
3	Define buying needs for customer	0.5d
4	Receive confirmation for yarn suppliers of earliest order delivery dates	1d
5	Generate appropriate adminstrative paperwork	0.1d
6	Obtain quotes from accessory suppliers price and dates	1d
7	Agree design /specification/prices/terms and conditions	0.5d
8	Purchase order generated order placed with supplier	0.1d
9	**FABRIC KNITTING, DYEING, AND FINISHING**	**6.6d**
10	Yarn sent to knitters and knitted	2.5d
11	Fabric collected and delivered to dye house	1d
12	Fabric and knit trims grouped in dye lot ready for dyeing	0.1d
13	Fabric dyed and finishe and delivered Derbyshire Textiles	3d
14	**GOODS IN AND MANUFACTURE**	**3.8d**
15	Goods booked in and tested	0.1d
16	Lay plans calculated layed up and order cut	0.5d
17	Garments manufactured	2d
18	Receive in warehouse, store in warehouse	0.2d
19	Pick and despatch to Customer	0.5d
20	Customers logistics receive	0.5d



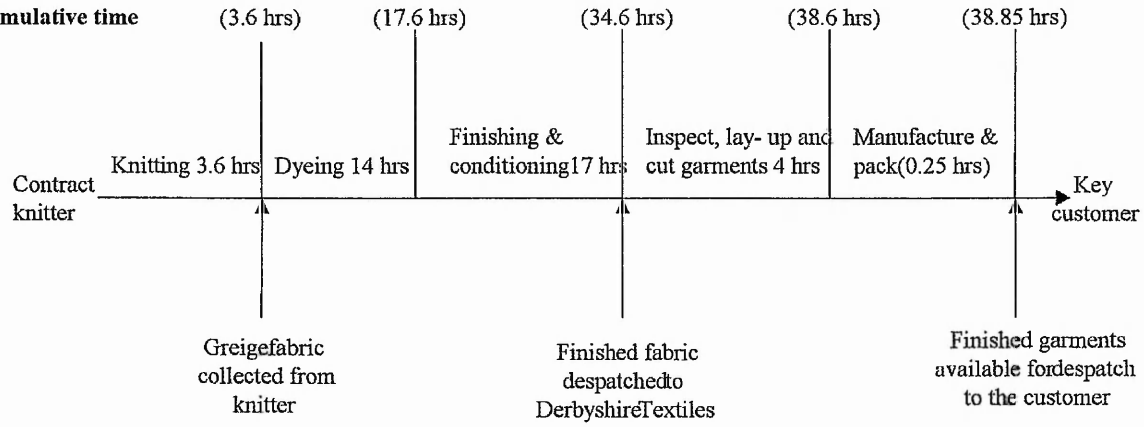
Project: Derby
CASE STUD
Date: 1997

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

DERBYSHIRE TEXTILES POLO SHIRT LEAD TIME

However, with further analysis and waste removal from the supply chain process, the lead time should be nearer to 47.6 hours (4.6 days process time and 1 day transport time), based on an 8.5 hour day (see figure 4.14). The calculation is based on one dye batch quantity of 220 kg and assumes that a buffer stock of yarn was available at the contract knitter. If stock had had to come from the yarn warehouse it would have added a further 17 hours to the process lead time. The target lead time is based on Just In Time principles, with delivery of materials Just In Time for conversion at the next part of the process. Figure 4.14 shows the possible future state for the supply chain to work towards. The partners in the chain could decide if additional buffers are to be placed at key points in the chain.

Figure 4.14 Target lead time of 5.6 days



The figures for figure 4.14 have been calculated on the basis of an 8.5 hour working day

Purchasing

The two suppliers of yarn formed two supply chains and for the purpose of analysis the main supplier was selected; this supplier supplied greige (undyed) yarn. The supply chain formed a loop, as can be seen from the diagram (see figure 4.9).

Derbyshire Textiles had arranged their greige yarn supply chain network for mutual benefit, working closely and forming a long-term relationship over several years. They had customer-supplier involvement in the selection of colour palettes, dye

recipes and schedules for pseudo-JIT delivery. The market environment for the product and service was stable, but uncertainty had been created by the change of customer ownership. The network exchanged information on a daily or weekly basis as required and carried out problem solving along the supply chain. They had four key suppliers of raw materials and a further 11 main components suppliers; they had a stable product requirement.

The dyer and finisher collected and delivered product to Derbyshire Textiles and the contract knitter. This used the 'milk round' concept - collecting raw materials for processing when returning product which is ready for the next part of the process; the loop closes when the finished product is sent to the customer.

The undyed combed carded cotton yarn (greige) supplier was given a schedule of usage for a period and a blanket order of three to six months to cover the different counts of yarn. The yarn was in greige (undyed) state and would be shipped in monthly consignments from Portugal, which took six days, to the UK, where it was stored awaiting call-off and distribution. The consignments had to be allocated a number which identified the spinning batch, in order to ensure the batches were not mixed when the yarn was shipped to the knitter. The reason for having separate batches of yarn was to ensure that when the garment was dyed there was no variation in dye take up. This was because each spinning batch of a natural fibre would behave slightly differently in the dyeing process and product variation would occur if the yarns were mixed during knitting. Shading or colour variation would be visible to the eye and unacceptable to the customer. Derbyshire Textiles used call-offs to notify the supplier of their yarn requirements, and the delivery took approximately two to three days (yarn Supplier 1, 1997) from call-off to receipt.

The second supplier's performance differed from that given above in that the marle yarn[1] was bought for specific orders and required batch size ordering. The marle yarn was ordered from the agent who then sent it from the main mills inventory holding. If the yarn was not in stock, the order had to be placed with the mill. This increased the lead time and introduced an element of uncertainty as the supplier's delivery

[1] Marle yarn - two or more colours or yarns twisted together to give a textured effect.

performance was poor. The marle yarn, when received, was sent to the contract knitter and then sent to the dyer and finisher where it was finished only. The marle yarn was already coloured so did not need dyeing. The finished fabric was then sent back to Derbyshire Textiles where it underwent the same processing as the greige fabric. The marle yarn created problems with flexibility as batch sizes of yarn had to be ordered and the quantity delivered could be over or under that requested. This caused problems with the volume of garments which were then required to be made for the customer resulting in over - or under-delivery of the product, and poor order fill for the customer. Therefore Derbyshire Textiles were trying to persuade the customer away from the selection of marle yarns. The marle yarn could also cause raw material holding by Derbyshire Textiles, as they were required to order a batch size that could be in excess of their requirement. The customer might not have re-ordered this colour, resulting in raw material obsolescence.

Marled yarns had already been dyed but would require finishing in preparation for cutting and then garment manufacture. Finishing involved a cleaning and stentering[1] process, followed by drying and conditioning. The marle yarns were sourced from Italy, where a network of small mills manufactured the yarn and sent them to a central depot for distribution to the customer. Some colours of marle yarn were held in stock, but often colours had to be made to order. The minimum order quantity (batch size) for spinning the yarn is approximately 350 kg. This represented around 970 finished garments. The average lead time for the yarn was four to seven weeks (yarn Supplier 2, 1997), depending on existing production schedules for the mills.

Once the customer and yarn manufacturer had agreed the palette that they were working to, yarn would be produced and held in stock, either at source or in a UK warehouse, ready for the network to become operational. When Derbyshire Textiles received an order from the customer the supply chain process would start. Derbyshire Textiles exchanges information with the other members in the chain (see figure 4.9) to let them know the volume and timing for the product. They then formed an informal network to agree exchange and pick up times along the chain. They had achieved

[1] Stentering - this process stretches the fabric between lines of pins. The fabric passes through a heat-controlled oven which sets the fabric at particular dimensions of length and width

strategic and operational integration within their network (see section 2.3.5). The systems they operate with had been agreed and the tasks they are required to perform were understood.

Contract knitter

The contract knitter held around two to two and a half tonnes (2540 kg; approximately 11.5 dye lots) of yarn on site as a buffer for the scheduling of production. This represented around 42.3 hours knitting capacity, on one machine, for the contract knitter, or 7,000 finished garments for Derbyshire Textiles. Key Supply Chain Management outcomes for the process were that a standing agreement were established for a knitting program, and Derbyshire Textiles called-off their yarn from the yarn supplier and had it sent direct to the knitter. Derbyshire Textiles faxed the order quantities and the required knitting specifications, along with a copy of the yarn call-off, so that they were notified in advance of the delivery. Yarns were issued to knitting for spinning batch lots to ensure continuity of colour within a fabric length. The finished fabric was then collected by the dyer and finisher. The knitter then sent a delivery note of the lengths/ weights of the fabric rolls and the number of pieces which the dyer had received along with an invoice to Derbyshire Textiles. Fabric was made to order and no stock of knitted fabric was held.

The contract knitter could produce rolls of fabric which were 20 kg in weight. However, the dyer was unable to process rolls that were over 15 kg in weight due to the handling operation of lifting the fabric. Trims such as collars and cuffs were knitted on separate machines in-house but from the same batch of yarn. All this must be co-ordinated throughout the manufacturing process.

Dyeing and finishing

The dyer and finisher used their transport to collect the fabric from the contract knitter, at the same time they would return the previous dye order of finished fabric to Derbyshire Textiles and collect the knitted trims for the next order. This was then matched up with the current batch they received from the contract knitter. The trims and the greige fabric were then dyed together to obtain continuity of colour. Each dye lot of 220 kg represented around 610 garments (allowing for process waste). The

process involved scouring the fabric to remove lubricants used in the spinning and knitting process, dyeing to a standard recipe, and drying and finishing to specification for width, weight, wales and courses. Quality control also checked colour against a standard shade, and failure to match colour required the dyeing process to be repeated. The fabric was then tested for colour fastness and shrinkage.

No formal processing plan existed between the dyeworks and Derbyshire Textiles. However, they remained in weekly contact with each other and at the time were working on the basis of reserved production space. The dyer and finisher were also in close contact with the contract knitter to schedule collection of knitted fabric. The quantity from week to week could vary but the overall quantity should balance out. Prices were negotiated and agreed for a set period of time and for the agreed range of colours. The range for their key customer was 14 colour variations for the main body (Derbyshire Textiles, specification sheet).

Garment production

The production was divided into units: in-house knitting of collar and cuffs, garment cutting, two machining (sewing) units, inspection and packing. The garment production was supported by the purchasing of yarn and accessories, finance, sales, maintenance, and personnel (see figure 4.7). The actual sewing assembly operated on bundle (typically batches of 12 typically) line production methods and piecework. Sewing typically involved 15 separate operations on a polo shirt, using a variety of machine types (overlock, lockstitch, coverstitch, bartack, etc.). Short cycle repetition resulted in very high levels of specialised skills, involving both materials handling and machine control. Standard time per garment was typically less than 11 minutes (Production Director, 1997), though the bundle throughput time and work in progress level averaged 3.8 days (see figure 4.13 task 15).

Derbyshire Textiles had multi-skilled operators, and they could produce any of the variations previously described. If the product changed to one other than polo shirts then problems could arise as they had become focused on one specific type of product. The situation at the time, of uneven demand from their main customer was causing peaks and troughs in work for the operatives, and this could mean Derbyshire

Textiles having to lay off workers at some stage. Even if employees were laid off temporarily this could result in operatives looking for alternative jobs and if successful, they might not return to Derbyshire Textiles. This uneven demand caused a drop in profit for the business, as they would be operating below capacity.

Analysis

The company sat at the centre of a well-established and integrated collaborative supply chain network which could be described as achieving stage 3 of the supply chain positioning matrix (see figure 2.10) 'close-co-operation' - a proactive relationship. At the outset of operations, Derbyshire Textiles selected a knitter and a dyer and finisher as key suppliers who were located within 50 miles of the main site.

The purchasing strategy of Derbyshire Textiles was also at the 'close co-operation' stage of the supply chain positioning matrix (see figure 2.10). They operate on preferred supplier selection criteria with shared strategy and trust. The purchasing and order scheduling method was based on a six month rolling contract, which was then shipped from the yarn supplier's UK warehouse using a call-off system. The tactics of the inter- intra-company network were that the contract knitter and the dyer and finisher had an agreement for booked production space with Derbyshire Textiles. In many cases, Derbyshire Textiles single-sourced from their suppliers. The supplier development was carried out at the early stages of establishing the supply chain network and had to some degree lapsed at the time of the research. A high degree of trust existed regarding the forward purchasing of raw materials and between the key manufacturing processes.

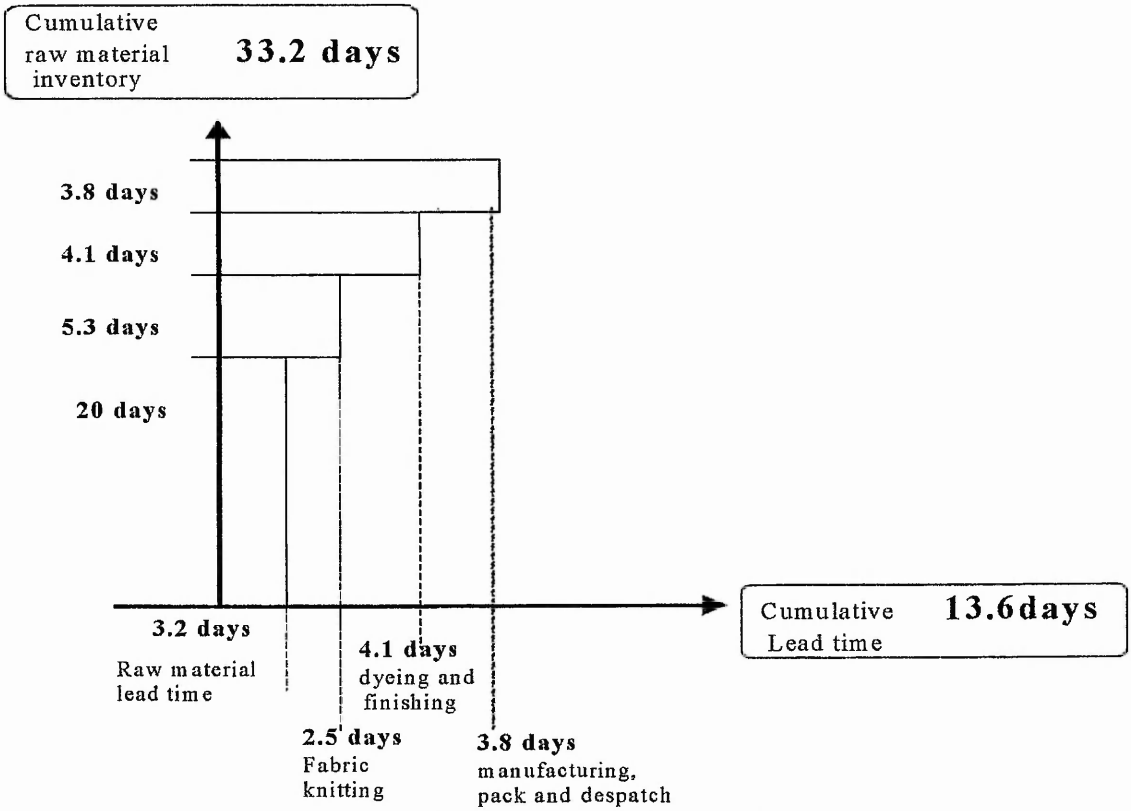
The environment had recently changed for Derbyshire Textiles and the relationship between customer and manufacturer had moved to somewhere between stage 1 and 2; this was since the change of ownership of their key customer.

Lead time and inventory

There were two aspects to this. The first was the flow of product for existing product including replenishment of this product. The second was the introduction of new product variations. For existing products, the supply chain cumulative lead time and

the cumulative inventory holding within the supply chain (see figure 4.15 supply chain response matrix); this matrix is described in more detail in chapter 3 (see figure 3.4). The lead time has been based on the data from figure 4.13, as this is the possible lead time from the existing process. The cumulative raw material holding was 33.2 days of stock and 20 days of this was held at the Yarn warehouse in the UK, which formed the main inventory holding within the chain.

Figure 4.15 Derbyshire Textiles supply chain response matrix



(Source: Interviews, Derbyshire Textiles and supplier site visits)

This information was gathered while carrying out the supply chain interviewing and during on-site visits, including discussions while walking through the process with the interviewee. When the actual time for processing was measured, an amount of time had been added to the actual process time as a buffer. The lead time for new product introduction started around six months prior to product launch with discussion on colour palettes and lab dye approval.

The revised version of the lead time analysis would indicate that the process could be reduced from 32 days (see fig.4.13, task 1, cumulative lead time) to around 5.6 days

(figure 4.15, target lead time), reducing the lead time to around a 20% of the original lead time. The areas of waste (see section 2.3.5) were in production time and the built in waste on fabric dyeing, fabric usage and knitted trim production and downsizing[1] or double cutting. Administrative waste was occurring in reconciling paperwork and duplication in the supply chain. Administrative processes could be greatly improved if there was an agreement for the format and content.

4.3.7 Conclusions of Case Study

The conclusions are split into two, the findings from the research and the findings from the methodology.

4.3.7.1 Research findings

Environment and organizational ecology

The environment for Derbyshire Textiles had changed, their key customer was now owned by the Japanese and the strong relationship, which they had had, had altered to one of uncertainty. The smooth process flow had gone and pressure to respond more quickly with less information flow was creating disruption in demand throughout the chain. The yarn suppliers' and manufacturer's commitment to raw materials and their commitment to production capacity had been well-established but this had recently suffered a blow. The peaks and troughs that the supply chain had experienced had disrupted the smooth supply chain flow (Director, Derbyshire Textiles, 1997). This raised issues of working more closely to improve the existing operation in an effort to reduce time and cost within the chain.

Change and barriers to change

Derbyshire Textiles had a form of partnership with their suppliers and they trusted each other to carry out the required process and to problem solve when required. The supply chain operated within a stable network that had only recently become more volatile, due to the change in ownership of their key customer. Their relationship with the customer would have to be built again or an alternative customer sought in order to stabilize the supply chain. The task contingency element of the research

[1] Downsizing - this involves cutting the garment as a large size within the original lay plan and then cutting it down to a smaller size after the bulk has been cut.

theory (see section 2.2.4) would indicate that the tasks were predictable in nature and would lean towards a centralised and formalised structure. However, this did not appear to be the case with the Derbyshire Textile supply chain. They had a more organic structure with a view of a shared process to produce an end-product. They communicated at different levels of the organizations but had perhaps lapsed into not questioning and improving their supply chain.

The uncertain market environment had caused Derbyshire Textiles to review what had been a very efficient supply chain network. The network had had strong links that had created a flow of product to the customer. Both the informal and the formal systems had operated well, although perhaps some of the informal communication had lapsed into more operational transactions. The review of the network did highlight some issues, which had not been addressed when times were good.

Changes that were ongoing

Derbyshire Textiles was reviewing their customer profile and searching for alternative core business which could replace their main customer if required. The structure of the business was altering to focus on their core skills and a review of their supply chain network involved re-opening a more strategic dialogue with their existing network partners.

Networks and relationships

The culture of the company was task orientated and was built on the relationships within their supply chain, which were open and informal in nature and showed a high degree of trust between those participating in the chain. An open, hands-on approach by management was adopted within the factory, as some of the directors were also managers of sections of the production. Training and support was given to the workforce and a high degree of loyalty was apparent with family members working together within the factory.

The network that they had established, over several years, had retained a group of key suppliers who operated together as part of a supply network. Each member understood and had agreed the process. Supplier performance monitoring did take

place in the form of measurement against specifications on receipt of goods. Each link in the chain would problem-solve any discrepancies from the specified requirements with the previous processor. However, in general quality was high and it was not formally recorded as the supplier was expected to maintain quality levels as a pre-requisite for being part of the network.

The supply chain process was well established and had been operational for several years. The key players had established a long-term relationship and had organized integration of each process in the chain well. Problem solving and support was given along the supply chain with alternative solutions being sought which worked well in a 'manual' environment; however, they had not been prepared for major market turbulence.

The supply chain was well integrated and operated successfully in a stable environment. The involvement of the key members of the supply chain at the early stages assisted the network; the external yarn suppliers and customer, and Derbyshire Textiles were involved in joint discussion every six months on the next season's colour palette, design and future schedule quantities. These meetings set the network in operation with exchange of lab dyes, yarn counts, and operational planning, linking together ready for the start of the seasons production. The flexibility of the supply chain was maintained when the demand for polo shirts was stable, and the trust with the customer could be observed through the exchange of information, and the fact that future plans were openly discussed. Flexibility had become eroded due to demand uncertainty and communication problems with the customer.

Derbyshire Textiles' supply chain operated within a system which had a good working relationship. The boundaries of the organizations in the chain were blurred to allow a supply chain structure that formed almost a continuous flow. The use of information technology systems within the supply chain was low, but the long-term relationship of the key players, and the establishment of information exchange which were both formalized, and informal and day-to-day, ensured the transfer of data.

Operational elements of review were to be the batch sizes, and the buffer stocks held at each stage of the chain. The actual time within the process was 4.6 days (see figure 4.14) therefore this was the target. The target time plus the time for transport between the sites represented the minimum time which could theoretically have been achieved. Derbyshire Textiles only made to order, so the issue of the volume of SKUs was of less importance than the inventory of raw materials.

The product variety funnel illustrated the volume of variations that were achieved from what at first glance would appear to be a small range of seven basic silhouettes for the product. These seven silhouettes could form different products by using the variables of colour, yarn type, fabric weights, size, customization of embroideries and the use of coloured tipping for the edge of collars and sleeve cuffs providing huge variety to the product offer.

Learning and systems

This system was a 'closed system' as described in the theory review (see section 2.2.1), and would develop difficulties accordingly when it had to operate in a changing environment. Previously the environment for Derbyshire Textiles had been commercially stable with little change to the product offer. The supply chain was originally organic in nature (see section 2.2.2, structure) but had moved towards mechanistic transactional communication due to the instability of the network. The network was able to operate within the normal variables of the established range: silhouette, colour, yarn type, embroidery, dyeing and finishing, and gauge of knitting machines. Difficulties arose when their key customer created uncertainty in the system.

Unlike the automotive industry supply chain tiered structure (see figure 2.12), the retail customer in this case study would deal with more than just the first-tier supplier. The customer would be involved with the yarn supplier as they developed new colour palettes for each season. These were then used to co-ordinate the complete offer across product ranges in their retail outlets. They would also work with the dyeworks to agree dyeing recipes for the season.

Decision making at Derbyshire Textiles was centralised with the directors holding the power to change and deploy resources. Most of the directors also held other roles within the organization, as unit managers, and they made themselves aware of the employees' viewpoints.

Information exchange along the supply chain was mainly through verbal communication and fax confirmation; this was separate from the financial invoicing and payment information that was in place. Because the network was stable and the product variety low the information was mainly to verify quantity, colours and date required. The information exchange was transactional in nature. The main use of information technology was for the financial and purchasing side of the business.

The Derbyshire Textiles supply chain network attempted to operate a system which was as simple and easy as possible, benefiting each of the organizations as the product flows on a pull system through the chain.

4.3.7.2 Research methodology / case study experience

Planned research

A major step forward from the pilot case study at Mulberry's (see section 4.2) was the increased access to key players, which improved the overview of the supply chain map and linked the flow of goods and information. The case study champion allowed access to all sections with the exception of their key customer.

Data gathering

This was achieved using interviews and the review of production records. Although this supply chain was for an apparently simple product, there was complexity from the variety of options that the product could achieve. The analysis of the value chain described by Womack and Jones (1996) and Hines and Rich (1995) was used to generate a map of the whole supply chain, which included the external suppliers and customers. The semi-structured interviews were used to obtain an understanding of the tasks that were involved in developing the product from concept brief to final customer. These interviews, which used a questionnaire format, formed a critical part of the study. The site visits to the key players locations allowed observation of the

actual process and access to data documentation - the data collection process was assisted by the close location of the other key players in the supply chain. This contrasted with the international location of Mulberry's suppliers in the first study, which resulted in a verbal description of the process, reducing the level and accuracy of the data collection.

The data was used to illustrate the lead time for the supply chain, which then allowed visual notification of the waste elements which were to be removed from the system, and the potential improvement and setting of targets for improved lead times.

Greater depth of research could have been achieved despite the 'whole chain' overview, through gathering more details of the dyeing, knitting and machinery options, and having the opportunity to obtain the customers' views. However, there was limited potential due to the scope of the product range, and to the access being to the localized part of the supply chain only.

4.4 PRIMARY CASE STUDY: SPORTSCO.

4.4.1 Introduction

After the research at Derbyshire Textiles, which had a relatively simple and stable supply chain structure, a comparison was needed with an organization which had multiple supply chains, a high degree of innovation and multiple distribution channels (see figure 1.6). The research focuses heavily on the product development aspects of the supply chain as indicated in the rationale for the research (see chapter 1, section 1.5).

A study was sought that would fit these criteria and which would allow long term access and location on-site; and observation of the supply chain in operation, seeing the changes which were occurring in the organization, structurally and procedurally. The study had to be close to the intra- and inter-company interaction of the employees and their environment. This determined the need for the researcher to be located within the environment for a period of time, in this case one year, this would allow for a more detailed data capture. and for the observation of the group dynamics. Participant observation was carried out within the product development concept-to-launch team project. The uncertain environment of the current market-place for apparel and textiles created a problem in obtaining long-term access to an organization. However, access was obtained.

The major case study was selected because the organization both manufactured and sourced branded product for sale internationally. The company wishes to remain anonymous and will be referred to as Sportsco for the case study. Sportsco had an in-house product development department which generated two ranges of products per annum, over five product categories, so they had a high degree of innovation. Their UK manufacturing was located within easy reach of the main site. The host organization's project champion was at Director level and was able to provide access to a large section of the supply chain.

4.4.2 Background

Sportscohad been started in 1935 and had grown to become a leading international brand, with subsidiaries in UK, Germany, France, Australia and New Zealand, and distributors who covered 24 European countries. They also had Licensees who managed a further ninety- six countries including the Far East, Africa, Western Europe, North and South America and the Middle East. This in total represented distribution channels, covering 125 countries and they had a turnover of around £36million (Sportsco's induction pack to new employees). Customers were categorized into six main types, distributor, licensee, independent retailer, sports promotion customer, internal customer and the final end consumer for the product. Sportsco sat at the centre of the supply chain as the innovator, manufacturer and marketeer of a leading brand; and an outsourcer of finished product. The development of the global brand was on-going. The out-sourced manufacturing took advantage of low wages in Third World countries while maintaining the required capacity flexibility. Approximately 4,351,000 garments were manufactured in the researched product category in 1997 (Data from Management Information System) around 19% of that was outsourced manufacturing. In 1997 they had 1319 products across the five product categories, which must be multiplied by the number of sizes and colourways to get the total stock keeping units (SKUs). The organization was holding 22,000 SKUs, and were operating at a 70% availability rate across the product offer (interview, Distribution Manager).

The company was trying to develop a clear brand strategy for the organization with five key product categories within their field of expertise, focusing on performance sports. Competition from new entrants into their market had centred their activities on being the brand leader in their field: they were investing heavily in research and development and working with suppliers of raw materials to develop new concept fabrics which cannot be copied easily. They prided themselves on successful scientific fabric development; working with key fibre and fabric manufacturers to create revolutionary 'leading edge' products for the sports industry. They were constantly challenging the existing performance capabilities to produce unique and innovative fabrics and apparel for the brand. This strategy for competitive advantage was described in section 2.3.12.

Changes were occurring in Sportsco's UK customer base, with a shift in market segmentation (see table 4.3).

Table 4.3 Percentage of UK sales by market sector for 1995-1997

	1995 %	1996 %	1997 %	Change %
1. Field sales	39.5	35.4	34.0	- 5.5
2. High street	16.4	20.9	20.8	+ 4.4
3. Multiple	23.8	25.5	27.4	+ 3.6
4. Sports specialist	9.0	7.5	8.4	- 0.6
5. Mail order	9.8	9.2	8.2	- 1.6
6. Other	1.5	1.5	1.2	- 0.3

(Source: Interview, Financial Accountant)

The market for Sportsco was moving away from field sales and mail order and towards multiples and high street retailers. This was in some respects beneficial in that sales resources could be optimized in the key retail companies. However, more risk was attached if one of the larger customers made a decision to purchase the product from another source.

The UK market represents 46.5% of Sportsco's sales, with a steady growth of their distributors sales from 27.3% in 1995 to 31% in 1997.

4.4.3 Project terms of reference

The organization's project champion played a key role in the success of the case study. Her project brief was to review the supply chain from product concept of raw materials through product development, testing and marketing, to launch. Key elements of the supply chain, company structure, tactics and operations, and culture were to be examined. The research aim was to examine and analyse the supply chain in depth giving the organization supply chain visibility of the process, and determining where value could be added and waste removed for supply chain development and improvement. The project term was for one year with access across the supply chain internally and to part of the external supply chain. The study was initiated to raise

awareness of the process and to focus on the importance of improving and reducing the time from concept to launch. Pressure from competition and the international growth of the company were driving them to improve their process performance. Facilities and a base for the research were provided in the product development department, but access was made available to all parts of the organization at all levels, from directors to machinists.

4.4.4 Case study method

Following the initial pilot case study and the Derbyshire Textiles study, a review of the research questions and methods was performed to see if the core areas of the research were being addressed. The core areas were product development, networks, collaboration and developing relationships. The first two case studies were able to address the product development and network issues of supply chain development but the degree of collaboration and relationship development was more difficult to analyse due to the short-term nature and more limited scope of the studies. The third case study at Sportsco was able to address these limitations as direct contact was maintained over a period of a year.

The review included data collection from product manager, design manager, research and development, garment engineering, purchasing manager (raw materials), purchasing (sourced product), supply chain manager, production manager, cutting room, quality, finance, warehouse and distribution marketing, sales UK and international and customer service. This gave both horizontal and vertical perspectives from within the organization. The external sources were fabric manufacturers, accessory suppliers and a retail customer. Secondary data was collected from historical data based on the product development process and the project plans for each range launch. These included milestones and cross-functional activities, which were carried out as part of the 'whole' process of creating a new range of products every six months.

Twenty-nine face-to-face semi-structured interviews, using a questionnaire format, were carried out with key personnel across the organization. Interviews were carried out across the functions of product development, sales, marketing, finance, production,

purchasing, planning, research and development, garment technology, distribution, suppliers and customer sections.

This method allowed a large amount of data to be collected in a short time and it was useful in forming an overview of the process and creating a foundation for further data collection. The other positive aspect of the semi-structured interviews was the opportunity to talk with key personnel uninterrupted for a period of up to two hours; this formal approach to data collection forces the interviewee to allocate time away from the pressures of normal day to day operations of the organization.

Changes to the method of research were made to include shadowing of key personnel. This was done to assist the review of task integration and multi-tasking, and to take into account the complexity of the product manager's job and the fragmented nature of his/ her working day. The research approach of participant observation was used during work with one of the supply chain development teams in the area of product development from concept to launch.

This adaptation of the research approach during the study was made to take advantage of the opportunity to obtain a view as an insider observing the group dynamics, culture and behaviour of the personnel within the organizational setting (see section 3.4.1).

4.4.5 Case study results

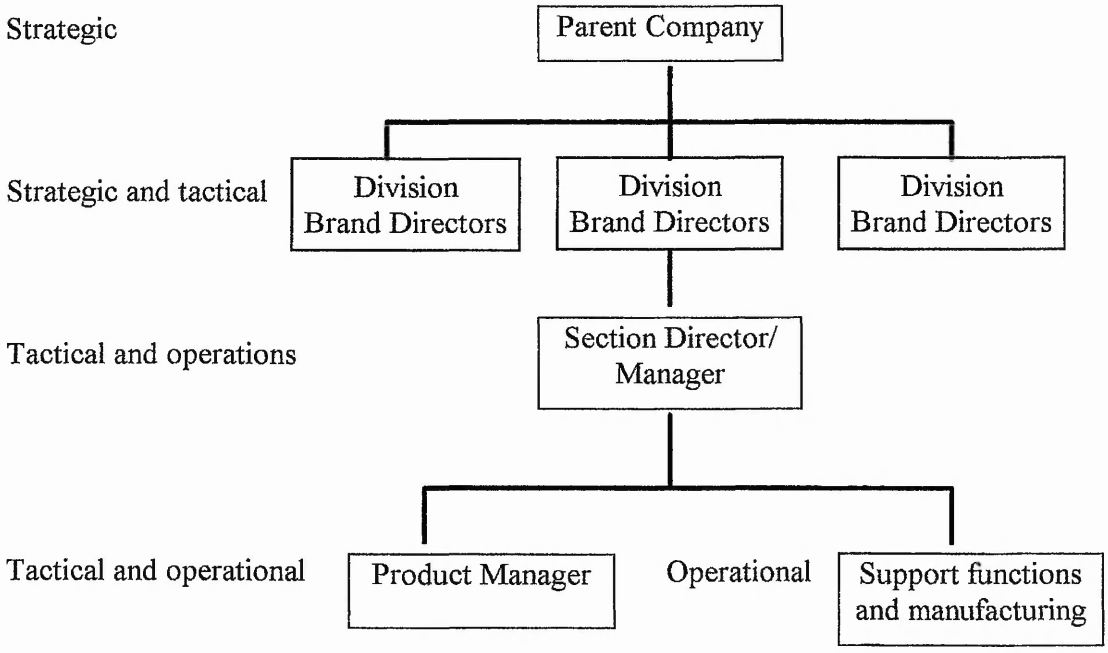
Supply Chain Review - network structure

Sportsco employed around 250 people in manufacturing with further employees in finance, product development, quality, engineering, sales and marketing and information technology support.

The organization had three forms of structure. The main structure was hierarchical in nature based around the more stable areas of the process, including sales, marketing and manufacturing, while the key area of product innovation operated under conditions of 'task uncertainty' (see section 2.2.2, task contingency). As a consequence, they operated in a matrix structure internally with garment technology,

quality, research and development and manufacturing. They formed a network framework for their interface with external suppliers. Product managers had a decentralized decision-making process. There were five levels of authority within the organization (see figure 4.16).

Figure 4.16 Sportsco structure: level of authority



Sportsco had been restructuring and continued to do so as it developed new areas of its market, and as its competitors entered its existing market; the structure was therefore organic in nature in order to adapt to the uncertainty of the market environment and the situational variances. These variances or uncertainties within the system have focused the company's efforts on this 'task uncertainty' in an effort to minimize the change with the elements of the supply chain.

The organization was using step changes to bring about the re-structuring including several changes in middle management personnel. The re-organization involved examining the role and function of any vacancy and re-categorizing the job requirements and moving away from functional employment towards process, to encourage cross-functional supply chain thinking (see section 2.2.2, figure 2.1).

The change with director level personnel had also brought different directions for the company and as a consequence personnel described their feelings of going 'on to the next battle' and issues of 'continuity' were voiced. The personnel were operating in an uncertain environment.

A complicating factor during the research was that the organization had experienced a turnover of middle managers, this may be for several reasons (interviews, with key personnel; observation). The organization had recruited people who had shown their knowledge and ability to change the existing operations to a leaner profile. However, the organization had operated in a fire-fighting environment for some time and had difficulty in allowing the new personnel to change anything too drastically (see section 2.2.3). Some of the comments from employees were that roles became 'obscured by add-on jobs' and that as a consequence they left after a few years as they described 'a feeling of not being able to accomplish things' and becoming less satisfied with their role in the organization. The second reason had been the high degree of commitment by personnel and the lack of recognition or reward. As the organization was brand-led, the control was with the marketing and sales areas. This had to some extent led to a biased approach with regard to their strategy and as a consequence to problems when attempting to integrate the supply chain (see section 2.2.2, structure).

Sportsco had developed a personnel strategy including the process of Investors in People to help them to generate learning: this included an induction programme, individual training plans and the communication of the organization's strategy goals and targets.

The requirement to develop a strong supply base focused the use of resources on the critical suppliers and the organizations that were open to developing a long-term strategy for efficient supply to Sportsco. The fabric supply chain lead time was approximately three-four months from initial selection to receipt for apparel production. However early research and development for specific leading-edge fabrics would be longer term, with a 12-18 month lead time.

Network systems

The systems for the organization were constantly under review and were being updated throughout the year. The teams were reactive within each section, and were responsible for raising mismatches or suggesting improvements that would then be checked and agreed with other sections of the supply chain. The system was being reviewed as a whole taking into consideration the dependencies on the different parts or sub-systems (see section 2.2.1).

The socio-technical aspect of the Sportsco system had been addressed with the integrated management information system, where information could be accessed vertically and horizontally across the organization. A complex computer system was in place. However, some of the information technology systems were later additions to the original system and they were found to generate conflicting reports depending on the programme that was used to access the data. The system was linked across different site locations which assisted in integrating the process irrespective of geographic location. Barcoding and scanners were being introduced in the warehouse and distribution area in an effort to improve inventory accuracy and visibility (interview, Warehouse Manager). Discussions on the use of Electronic Data Interchange (EDI) were also ongoing. CAD/ CAM was being used and in some cases CAD data was transferred by Integrated Services Digital Network (ISDN), a wide area network; however, compatibility of systems was proving problematic (interview, Design Manager). The integration of these technologies was proving highly beneficial when working across organizational and geographical boundaries (see figure 4.22).

4.4.6 Product Development

New product development

Sportsco had reduced the number of SKUs by 24% for 1998 which, it was hoped would help to focus the product offer and improve their rate of order fill. The designing of prints for products was closely linked to the colour palette, silhouettes and themes for each collection. Consideration for international colour and silhouette preferences had been made when developing the branded range that sold into several countries. Prints were developed outside of Sportsco's operation. On Sportsco's main product category, eight different base fabrics could be selected for printing.

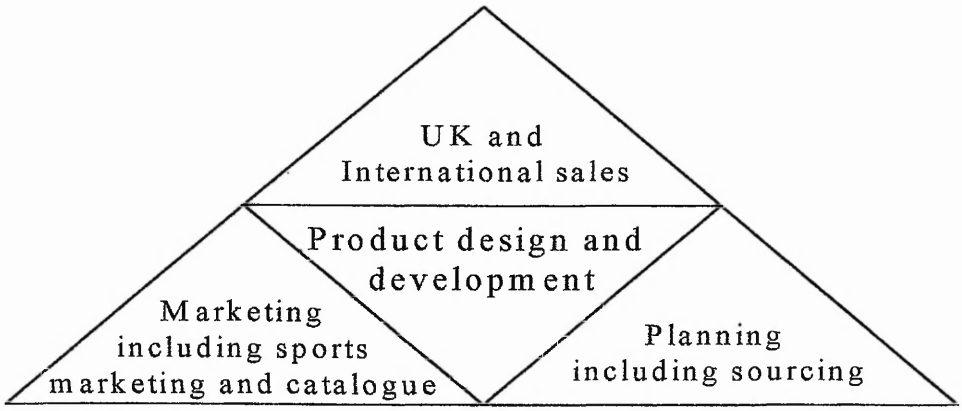
Around 50 prints were developed each season and around 20 were withdrawn, leaving a core of 30 prints which were used across the ranges. The actual time involved in manufacturing the garment was, on average, seven minutes (interview, Product Engineer Manager) which means a large proportion of the time was spent in development, preparation and waiting for raw materials: 194 days (see figure 4.25, Task I.D.1).

The marketing focus on sports sponsorship meant that technical textile performance was as important as fashion aspects in product development. A high degree of trust was placed in their suppliers to participate in product development and, by working closely with their key supplier's development team, they ensured that allocated resource would generate benefits for both organizations (interview, Research and Development).

As Sportsco developed a new range of products every six months, and had to maintain its position in the market, it was required to develop materials with several suppliers. Suppliers would have core capabilities and, in order to keep product flexibility, Sportsco would continue to develop relationships with all the key suppliers even if they might not have purchased from them for that particular season's range of products (interview, Research and Development).

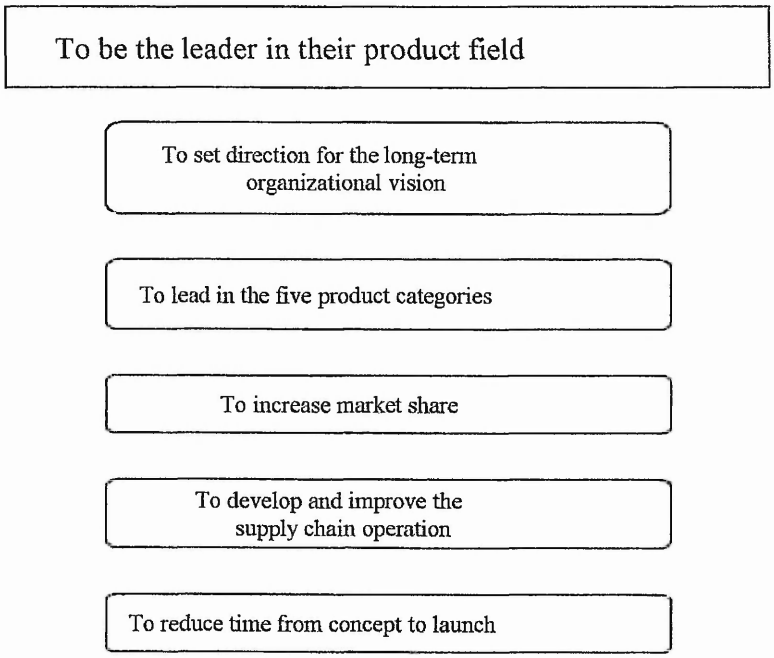
The key elements of product development illustrated in figure 4.17 required to be integrated as a whole process rather than developed in functional sections.

Figure 4.17 Elements of product development



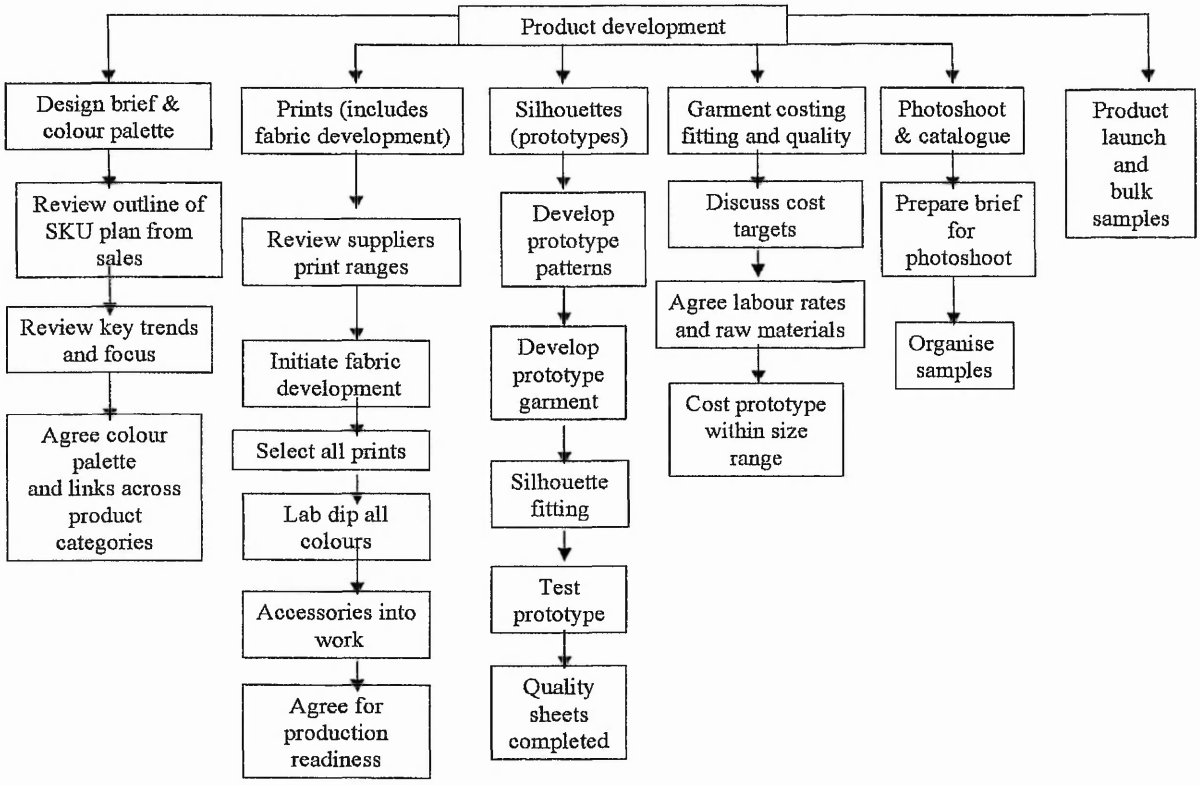
The product development strategy was divided into two levels. Level 1 took the long term view of product development and was concerned with brand continuity, integration across the product category and the organization's goal for the future (see figure 4.18)

Figure 4.18 Sportsco product development level 1 - long-term



Level 2 was concerned with the more process-orientated aspects. The process required to be integrated and to be rigorous to ensure successful completion (see figure 4.19)

Figure 4.19 Sportsco product development level 2 -(duration 9 months)



By agreeing on the two levels of product development across the functions of the whole organization they hoped to achieve a process that all functions were aware of and which could then form a starting point for continuous improvement both internally, and then externally with their suppliers and customers.

The diagram of Sportsco's product development process (see figure 4.20) has been adapted from the Cusumano and Nobeoka multi-project product development model (see section 2.3.10, concurrent engineering). Their model was used to describe the product development process within the automotive industry. Sportsco's product development process form is also multi-project-based with inter-product line relationships and generational relationships. However, figure 4.20 shows that the role of research and development crosses all the projects as a multi-functional unit. This ensures shared knowledge at the concept stage of the multiple projects, not transferred knowledge as can be seen in the automotive industry. The product team were involved to a greater or lesser extent throughout the development launch and manufacture of the product, as is illustrated in figure 4.33 - product development resource allocation chart.

Figure 4.20 Sportsco's seasonal product range development process

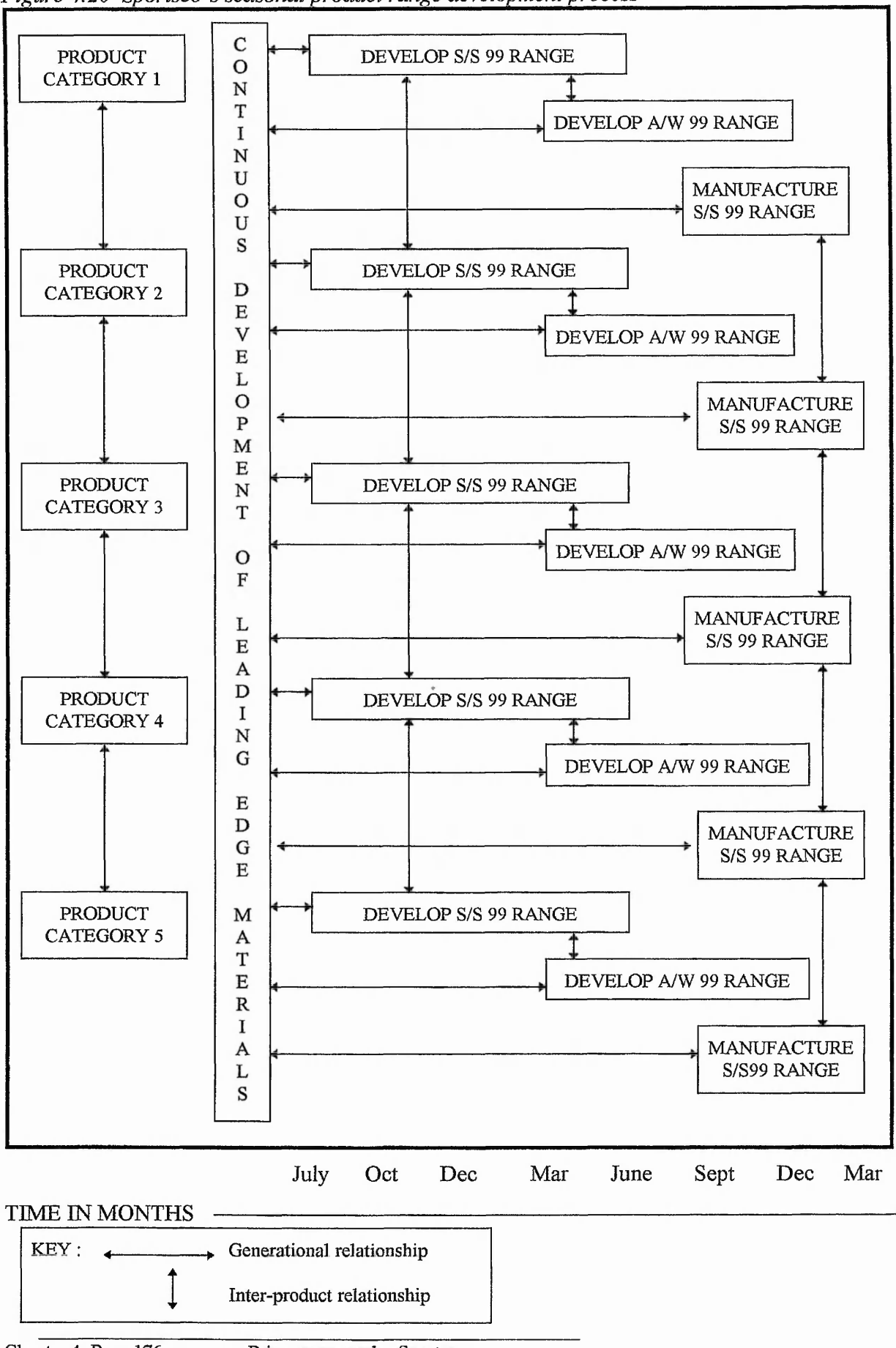
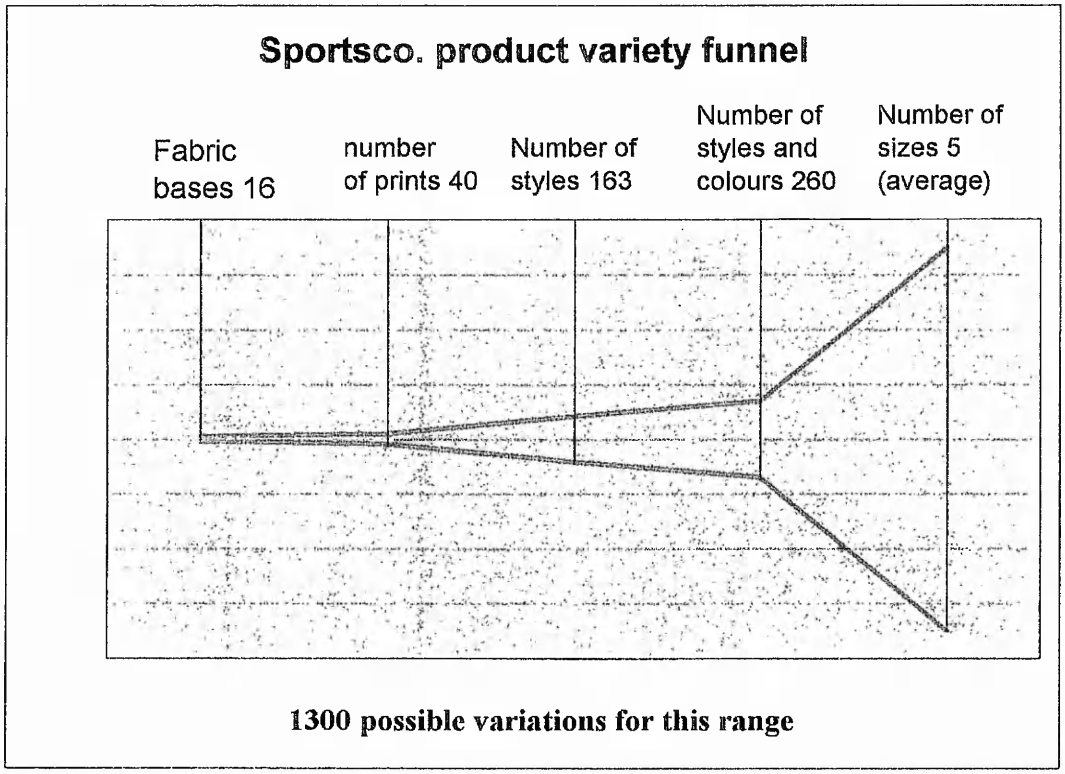


Figure 4.20 illustrates two seasons of product development, the Autumn/ Winter range overlapping with the Spring/ Summer range, this would involve the early stage fabric research and development; the research and development was a semi-continuous process. The colour palette and concepts development was carried out in preparation for the new range (interview, Design Manager). Integration across the product categories was required to produce a consistent brand image for the organization. While the generation of new product occurred within each category, there was a degree of information-sharing between product managers, with complementary development in other categories. The continuous materials development had both an inter-product line relationship and a generational relationship for the process.

The product variety for one season and one category has been illustrated below (see Figure 4.21) and shows that from the sixteen base fabrics a range of styles, prints, colourways and size variety was created which resulted in a potential of 1300 variations. Sportsco's marketing department had limited the combinations in which the product was available - otherwise, the variations could have amounted to 135,618,000 SKUs. Therefore the total figure is not accumulative along the whole of the funnel but calculated by multiplying the number of styles and colours by the number of sizes. 106 of these products had been run in a previous season's range.

Figure 4.21 Sportsco. product variety funnel



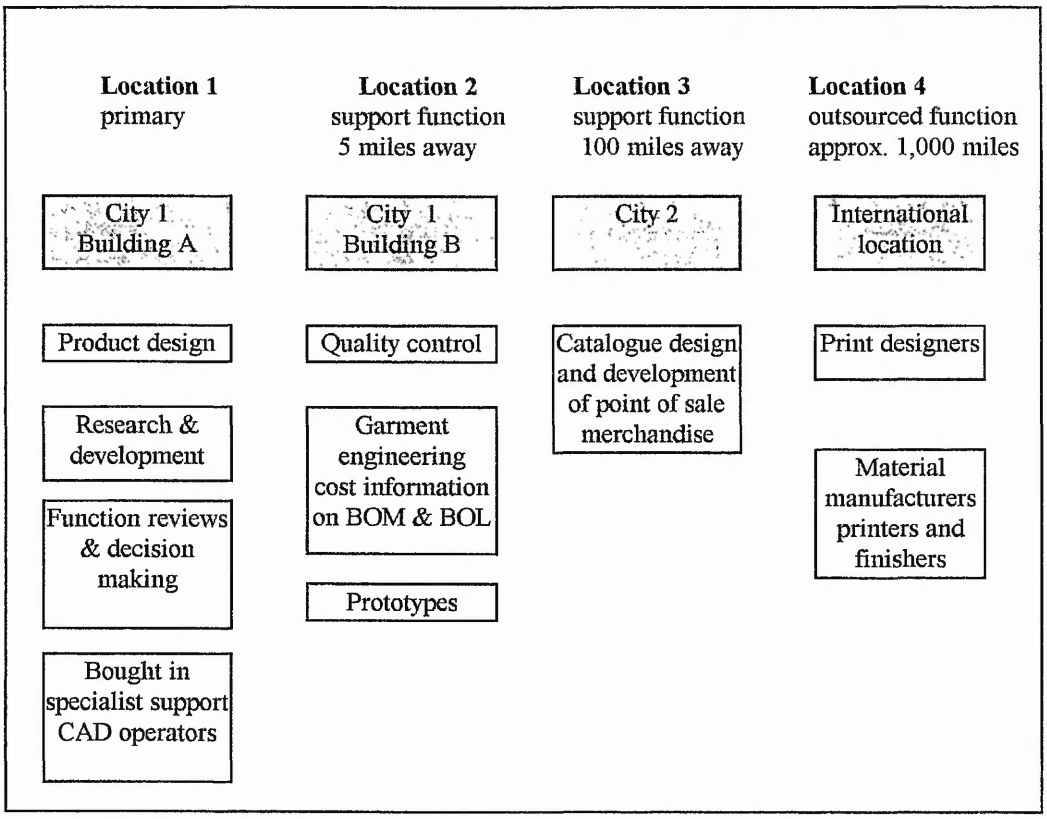
(Tool source: Hines and Rich, 1997; data source, range list document. 106 of the styles and colours section are run-on lines, which means that they have been in a previous seasons range list.)

However, what the product variety funnel does not indicate is the number of supply chain networks that were involved in developing and producing this range, starting with, for example, ten different raw material suppliers.

Design locations

The design process functions were on two sites, with a third site providing a support function and the fourth site offering out-sourcing of textile design.

Figure 4.22 Sportsco's design location



The product development process was carried out on two main sites and a third support function site that was shared across the parent company group. The sites A and B carried out the design, garment pattern construction, garment engineering, costing and prototyping. Sportsco hoped to bring these two areas together in one site to improve information exchange and logistics processes. The support functions of quality control and garment engineering were shared across other product development categories; they were also shared with the bought-in finished goods department, which allocates production to off-shore manufacturers. The goal for the product development process at the time of the research was to compress the time for concept to launch of the product range (interview, Product Director). Further

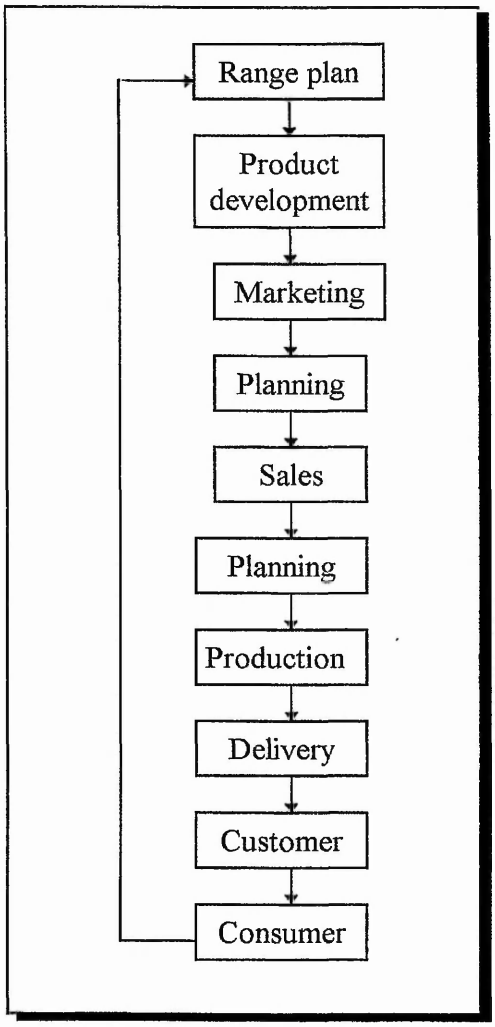
performance measures included the volume of products sold and the listing of best sellers in category (interview, Product Manager).

The functional boundaries had become blurred and this had resulted in unclear sharing of information, handover and responsibility for the product from concept to launch. Because of the demands placed on the organization from the different market sectors, who had different lead times and power, there were decisions which were made which impacted across the customer base. The value stream for each of the sub sections within the organization had not been identified, which caused an imbalance in priorities and resources.

There were the added costs of reworking prototypes, partly due to non-availability of actual production materials of the correct performance/ quality (substitute fabrics were sometimes used due to time restrictions). The initial trial product run would have included sewability tests. However, at the high sewing speeds which were experienced in volume production, the materials caused unforeseen problems that caused delay and rework (Production Manager).

A cross-functional team was established, consisting of sales, marketing, product development, planning, sports promotion, customer service, supply chain manager (bought in finished goods, purchasing and scheduling) and production, to review the time from concept to launch. The first step was to bring the key people together to agree to collaborate. The key members were all asked to list the tasks that they carried out. Their product development and launch process model has been schematically represented (see figure 4.23).

Figure 4.23 Framework for the process



The co-ordination of all these functions and operations was required. Each function was well aware of their operations and partially aware of operations prior to and after their tasks. The tasks were reviewed two or three times before final approval (more tasks were added and lead time increased). Product development worked throughout the overall process while the other functions participated in a limited capacity until their function area became the key role in the process. The tasks were reviewed to ensure they were in the correct sequence and the appropriate task duration time had been allocated. Once each function agreed on their version of the supply chain map, they were brought together to review how the process did or did not integrate across the functions.

When the map was presented to the team, it started raising an awareness of the lack of integration. They started to recognise what the other functions' part in the chain were.

They had to apply supply chain management methods to try and reduce lead times and remove waste. The team recognised that a proportion of their time was taken up at the end of the process carrying out fire fighting.

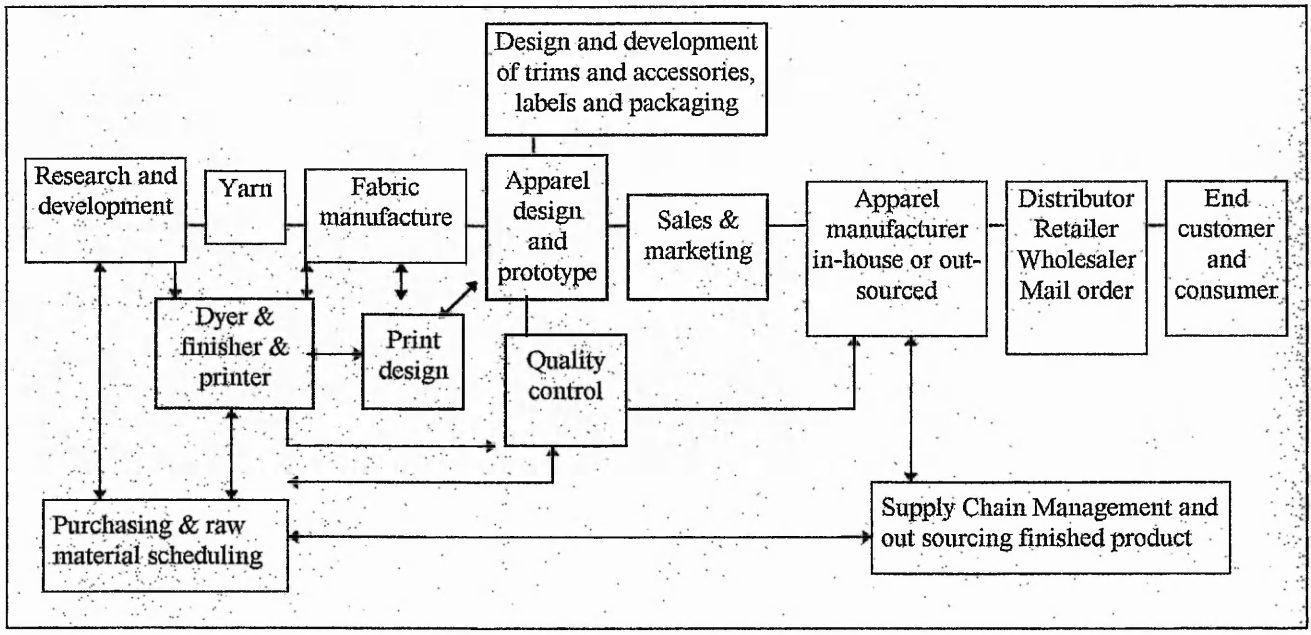
Sportsco needed to innovate and bring new products to market which involved new processes and new technology - to be first to market and to be able to sell the product at a high margin prior to imitations becoming available in the market. As time costs, salaries, overheads, and opportunity, reducing time spent should have resulted in cost savings. By improving the process and improving design for manufacture, the quality should have improved and the cost of poor delivery and incomplete order fill and returns should also have decreased. With the team approach they should have had more control over the process. The removal of time and, as a result, wasted cost, from product development had to be reflected in the whole supply chain from concept to delivery and the final consumer.

The team focused on defining the process so they could then review the opportunities for reducing the lead time (see figure 4.25). The issues of completeness and dependencies were important, as was awareness of the obstacles to achieving their objective. Mapping of the process was carried out by the researcher with the assistance of the team members, and then used by the team as a reference during the review process.

As previously described, the supply chain was in the form of a network of suppliers, but, this network was changing regularly, with a high degree of task uncertainty placed on the product managers. Each new product development season was bringing changes in the variables including type of fabric required, print design requirements, special fabric finishes or technology, or apparel manufacturing capabilities, ergonomic compatibility and testing. The network had to adapt to the requirements of the market and therefore a switch in the suppliers who form this network might have been

required. The flexibility of the supply base was critical to the level of innovation achieved and to the organization's survival. In the case of the supplier, flexibility with their network of customers was critical to their survival. The formation of the network was like an amoeba, changing in shape to form a new network. The process illustrated in figure 4.24 shows the main features of the supply network.

Figure 4.24 The main flow process for Sportsco



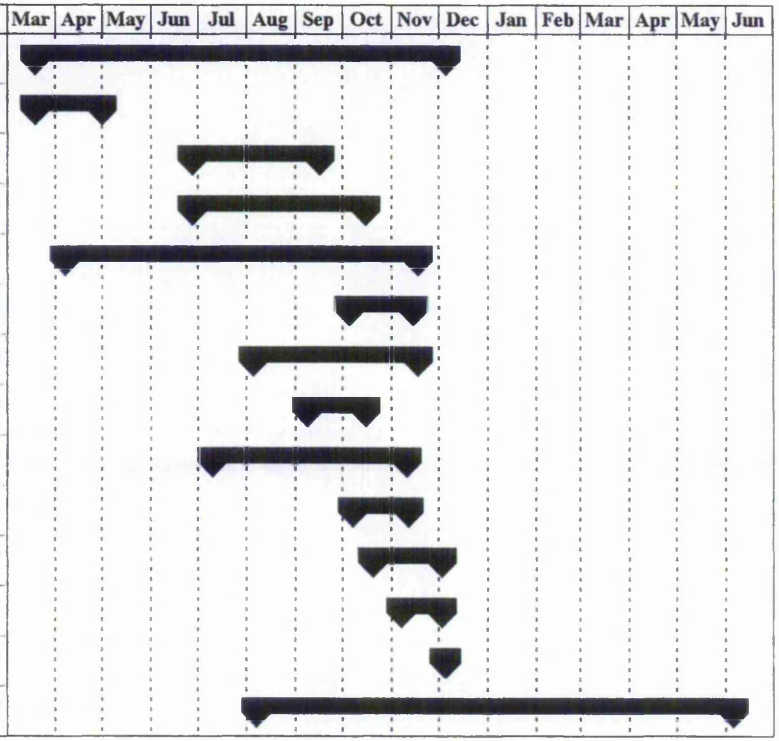
Process

The mapping of the process (Microsoft project format), seen in figures 4.25-4.32, illustrates the fact that the lead time for new product development was calculated at 194 days (see task I.D 1, figure 4.25) based on the existing process data. These days included around eight weekend days when the team would work during presentations and during preparation for product presentations and product launch. Figures 4.25-4.32 show the lead time and the links between the tasks for each of the sub-categories. Figure 4.33 illustrates Sportsco's resource allocation at the time of the study for the product development team - it consisted of three key personnel. The over-allocation of time is also illustrated and during the month of November, during the build up to the product launch it can be seen that in theory there should have been five people to cover the amount of work against the resource time available. This confirms the problems which the team had prior to the main product launch at the

European conference (Source: observation) - see figure 4.32, Task ID.87-92. The team were working weekends, and long hours during the week, just to try and keep up with the demands for their time. The second set of diagrams, figures 4.34-4.41 illustrate the revised version of the existing process which has a cumulative lead time of 176 days (see figure 4.34, task ID.1). This was calculated by removing the delay between the processes. The delay was mainly caused by having to wait for information, or for a decision to be made, before proceeding to the next part of the process. The implications for these product development changes were that the product development time was reduced. The practice at the time required the resource staff to operate overtime and excess hours in order to complete the process within the current lead time.

FIGURE 4.25 SPORTSCO SUPPLY CHAIN LEAD TIME

ID	Task Name	Duration
1	Product development for Autumn /Winter development	193 days
2	Design brief and colour palette	32 days
10	Garment costing, fitting and quality	58 days
15	Silhouettes	80 days
24	Prints	164 days
44	External presentations	32 days
53	Trade shows	77 days
58	Photo shoot & catalogue	29 days
63	Catalogue	90 days
72	Internal product launch	27 days
75	Bulk samples	33 days
84	European conference	19 days
90	Forecast & production orders	2 days
93	Spring Summer developments - Prints and silhouettes	220 days



Project: Sportsco - CASE STUDY
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Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split

FIGURE 4.26 SPORTSCO SUPPLY CHAIN LEAD TIME - design brief and colour palette, garment costing/ fitting/ quality

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
3	Look at first colour palette	2 days
4	Initiate swingers	1 day
5	Agree key trends and focus	2 days
6	Look at first colour palette	2 days
7	Agree ties across range	2 days
8	Finalize colour palette	3 days
9	SKU plans received from sales	1 day
10	**Garment costing, fitting and quality**	58 days
11	Discuss rough costs	1 day
12	Silhouette fitting	12 days
13	Labour rates and raw materials prices confirmed	1 day
14	Quality sheets on prints & accessories	7 days
15	**Silhouettes**	80 days
24	**Prints**	164 days
44	**External presentations**	32 days
53	**Trade shows**	77 days
58	**Photo shoot & catalogue**	29 days
63	**Catalogue**	90 days
72	**Internal product launch**	27 days
75	**Bulk samples**	33 days
84	**European conference**	19 days

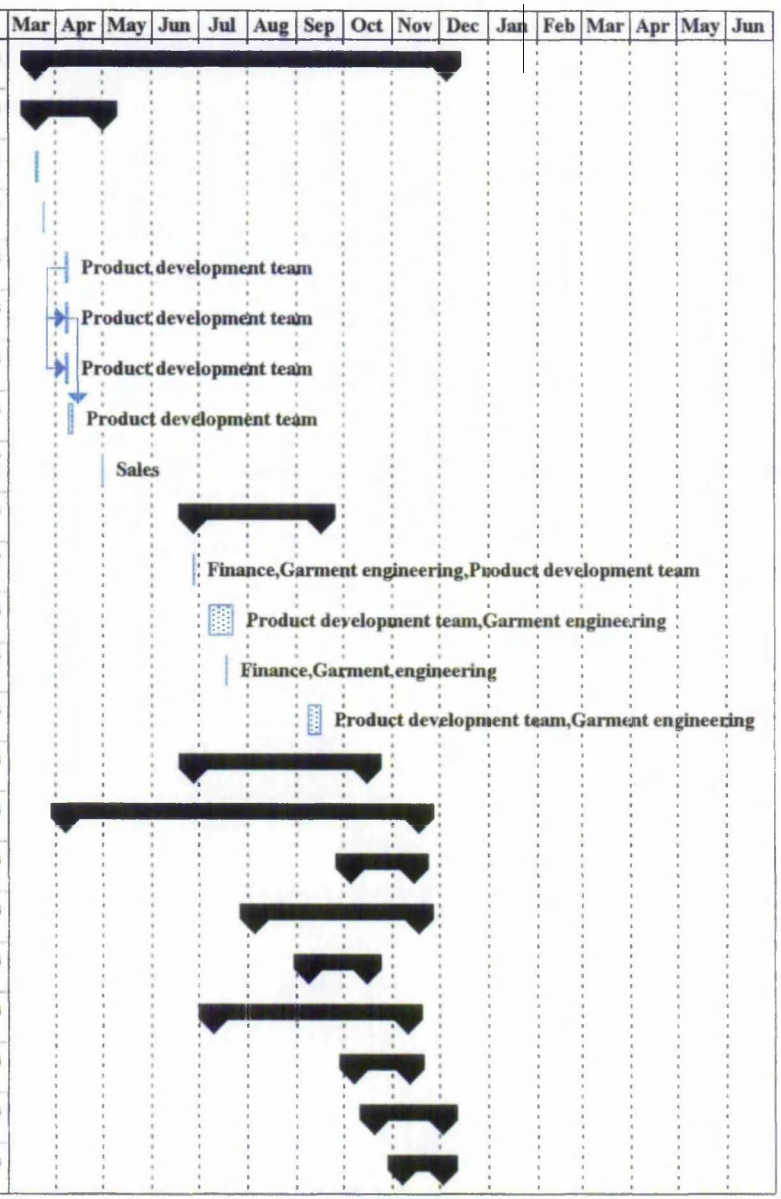


FIGURE 4.27 SPORTSCO SUPPLY CHAIN LEAD TIME - Silhouettes

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
10	**Garment costing, fitting and quality**	58 days
15	**Silhouettes**	80 days
16	Issue all silhouettes to garment engineering	4 days
17	Preview product preparation	7 days
18	Speak to key markets	3 days
19	Approve product silhouettes	4 days
20	A/W silhouettes to Far East for costing	3 days
21	Finalise silhouette work A/W,emb. transtats & swing tags	8.5 days
22	Chasing sample -2s of everything	4 days
23	Review range and make amendments, reduce if necessary	4 days
24	**Prints**	164 days
44	**External presentations**	32 days
53	**Trade shows**	77 days
58	**Photo shoot & catalogue**	29 days
63	**Catalogue**	90 days
72	**Internal product launch**	27 days
75	**Bulk samples**	33 days
84	**European conference**	19 days
90	**Forecast & production orders**	2 days
93	**Spring Summer developments - Prints and silhouettes**	220 days

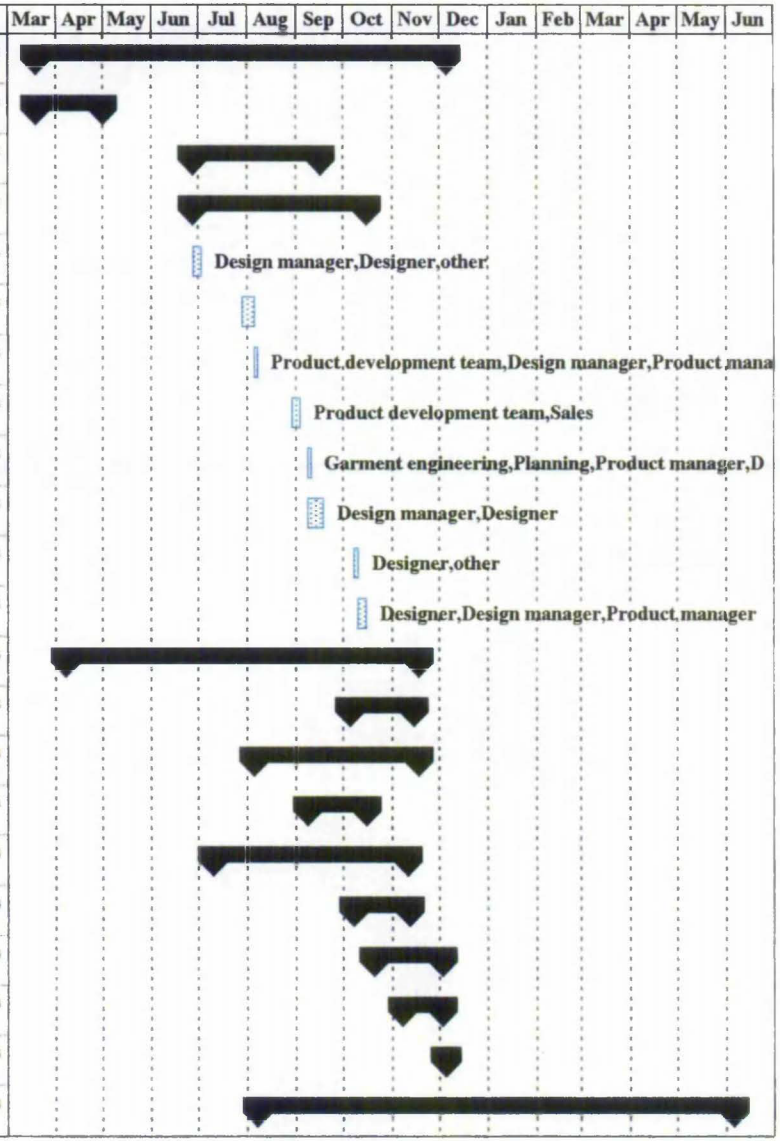


FIGURE 4.28 SPORTSCO SUPPLY CHAIN LEAD TIME - Prints

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
10	**Garment costing, fitting and quality**	58 days
15	**Silhouettes**	80 days
24	**Prints**	164 days
25	Work in from freelancers	1 day
26	Fabric supplier produces strike offs	22 days
27	Approval of strike offs	3 days
28	Recolouring of print strike offs	10 days
29	Approval strike offs sample fabrics	5 days
30	Obtaining first sample metreage	1 day
31	All product prints into work+ accessories	5 days
32	Reconfirm product bulk sample capacity	0.5 days
33	Checking the range	1 day
34	Finalise SSM again, check with SKU	7 days
35	Style sheet maintenance complete	3 days
36	Product costs complete	2 days
37	Finalise range, modules	4 days
38	Italy to sort out prints	3 days
39	Information forum - preparation	3 days
40	Forum- sales information previous 2 seasons start SKU plan	5 days
41	Finish SKU plan	7 days
42	Check catalogue SKUs and DPS	7 days
43	Fabric books-specify order layout;chase fabrics;prices info	7 days
44	**External presentations**	32 days

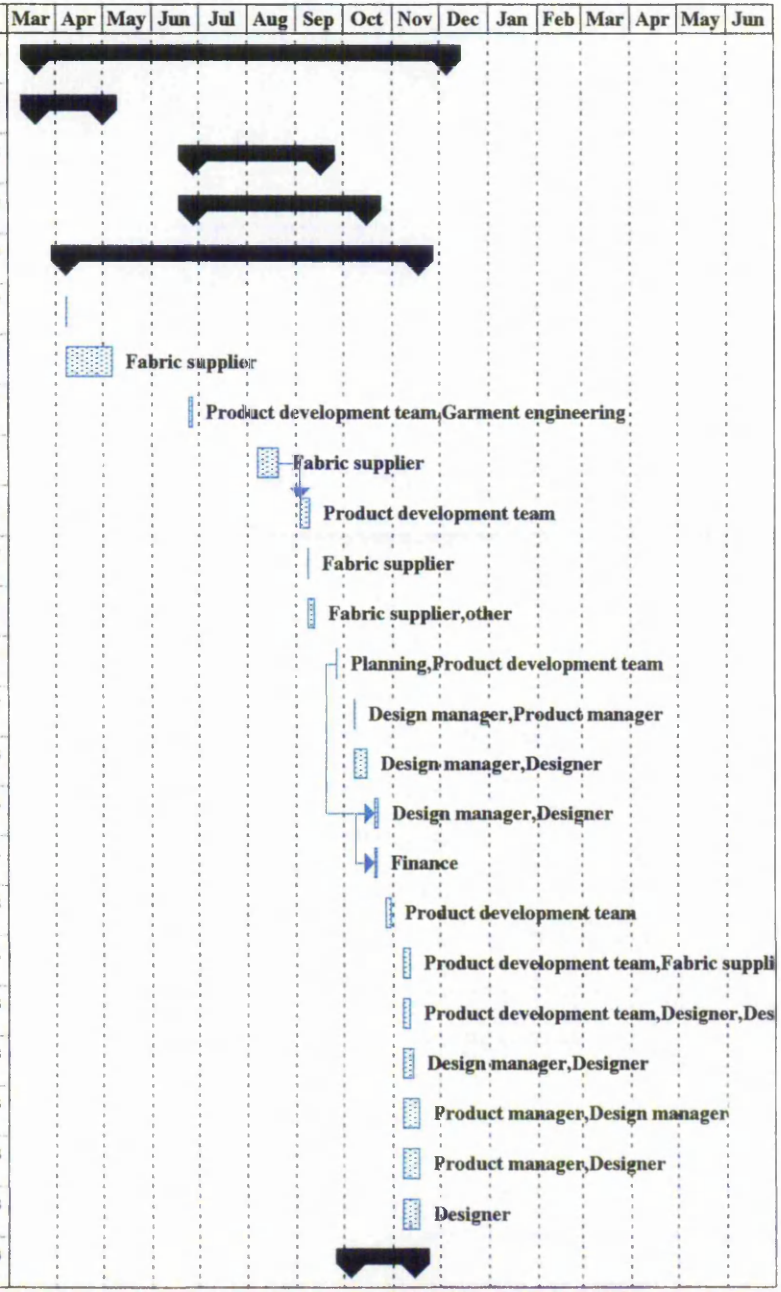


FIGURE 4.29 SPORTSCO SUPPLY CHAIN LEAD TIME - External presentations trade shows

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	**193 days**
2	**Design brief and colour palette**	**32 days**
10	**Garment costing, fitting and quality**	**58 days**
15	**Silhouettes**	**80 days**
24	**Prints**	**164 days**
44	**External presentations**	**32 days**
45	Preparation for Intersport	3 days
46	Key accounts	4 days
47	Intersport presentations Swiss	2 days
48	Intersport UK	1 day
49	Latin America -licensees design forum Miami	7 days
50	Practise presentations	1 day
51	Mail order presentation	6 days
52	Licensee visits	3 days
53	**Trade shows**	**77 days**
54	ISPO	2 days
55	Premier vision	3 days
56	Research trip to L.A. & N.Y.	7 days
57	40 degrees show	1 day
58	**Photo shoot & catalogue**	**29 days**
63	**Catalogue**	**90 days**
72	**Internal product launch**	**27 days**
75	**Bulk samples**	**33 days**
84	**European conference**	**19 days**

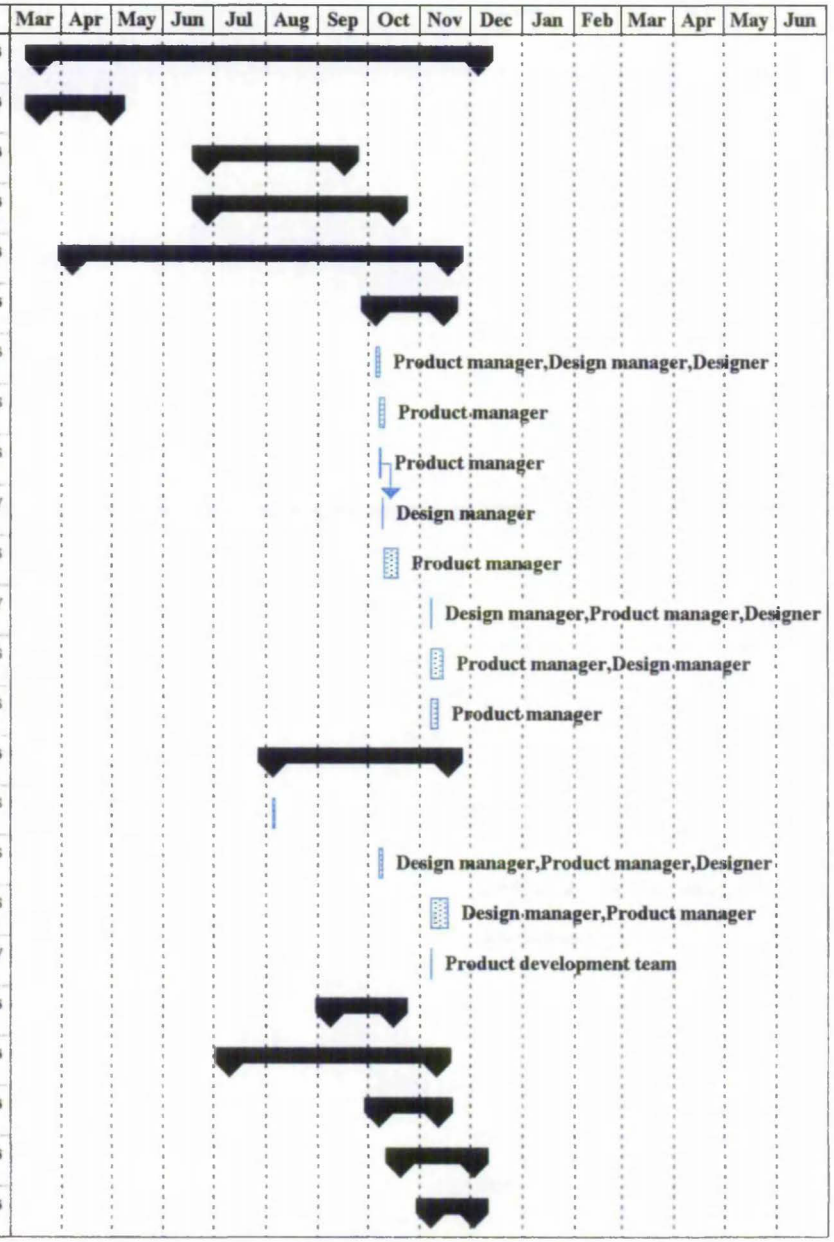


FIGURE 4.30 SPORTSCO SUPPLY CHAIN LEAD TIME - Photoshoot and catalogue/ catalogue

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
10	**Garment costing, fitting and quality**	58 days
15	**Silhouettes**	80 days
24	**Prints**	164 days
44	**External presentations**	32 days
53	**Trade shows**	77 days
58	**Photo shoot & catalogue**	29 days
59	Paper brief for photoshoot	1.5 days
60	Final photoshoot brief	1 day
61	Organize photo samples and carnet	2 days
62	Photoshoot	8 days
63	**Catalogue**	90 days
64	Advise P.O.S stories	1 day
65	Silhouettes to reprograhics for drawing + grids	2 days
66	Scan prints for catalogue	6 days
67	Catalogue process meeting	1 day
68	Sign off catalogue	1 day
69	Silhouettes to be drawn up for catalogue final	1 day
70	Pass the catalogue to reprographics	0.5 days
71	PR releases	2 days
72	**Internal product launch**	27 days
75	**Bulk samples**	33 days
84	**European conference**	19 days

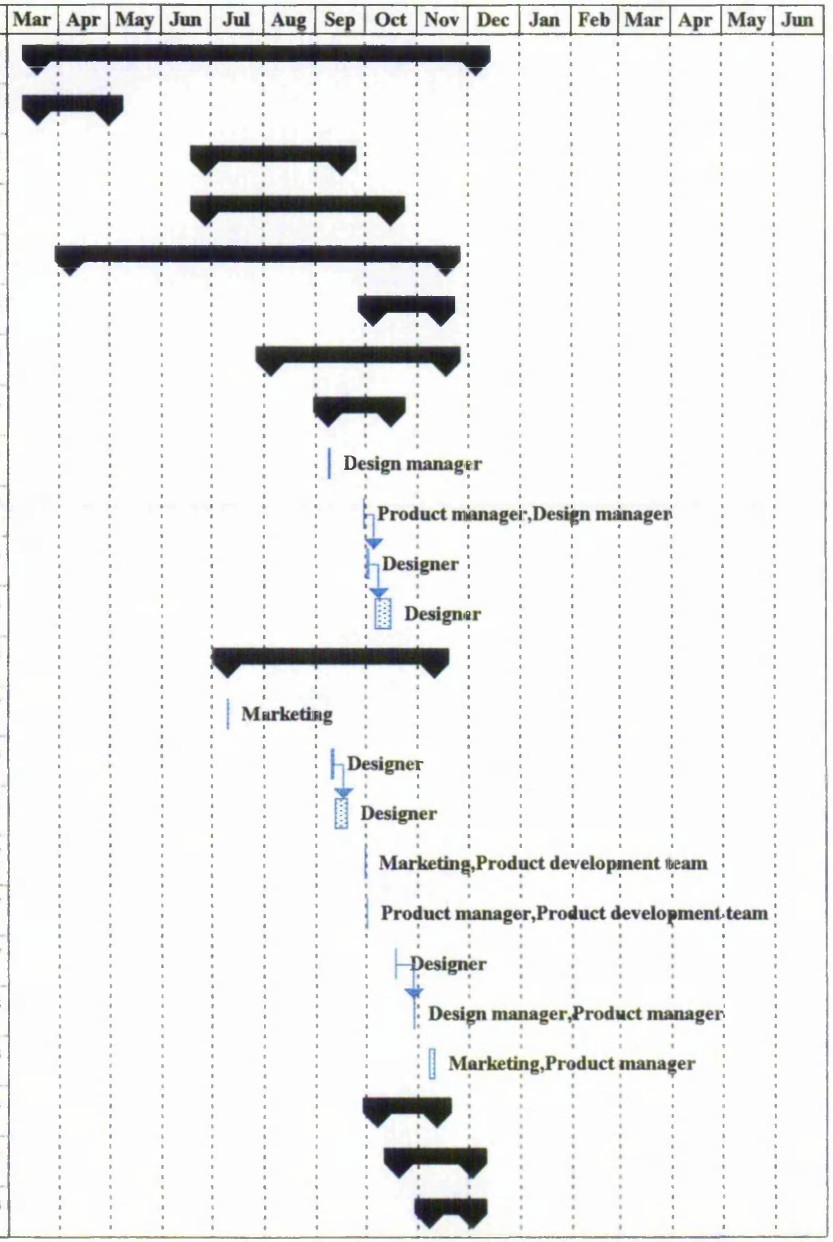


FIGURE 4.31 SPORTSCO SUPPLY CHAIN LEAD TIME - Internal product launch/ bulk samples

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
10	**Garment costing, fitting and quality**	58 days
15	**Silhouettes**	80 days
24	**Prints**	164 days
44	**External presentations**	32 days
53	**Trade shows**	77 days
58	**Photo shoot & catalogue**	29 days
63	**Catalogue**	90 days
72	**Internal product launch**	27 days
73	Organize models and presentations for launch	1.5 days
74	Casting models	3 days
75	**Bulk samples**	33 days
76	Handover to Manufacturing pre-production meeting	1 day
77	Bulk sample order for product to manufacturing	1 day
78	Order product for conference-Garment eng.	1 day
79	Order product for conference-given to manuf.(15sets)	1 day
80	Product bulk sample order passed to manufacturing	1 day
81	Bulk sample order with UK and International sales	1 day
82	Product, cut fabric, bulk swatches	1 day
83	Product fabric bulk swatches to agency	1 day
84	**European conference**	19 days
90	**Forecast & production orders**	2 days
93	**Spring Summer developments - Prints and silhouettes**	220 days

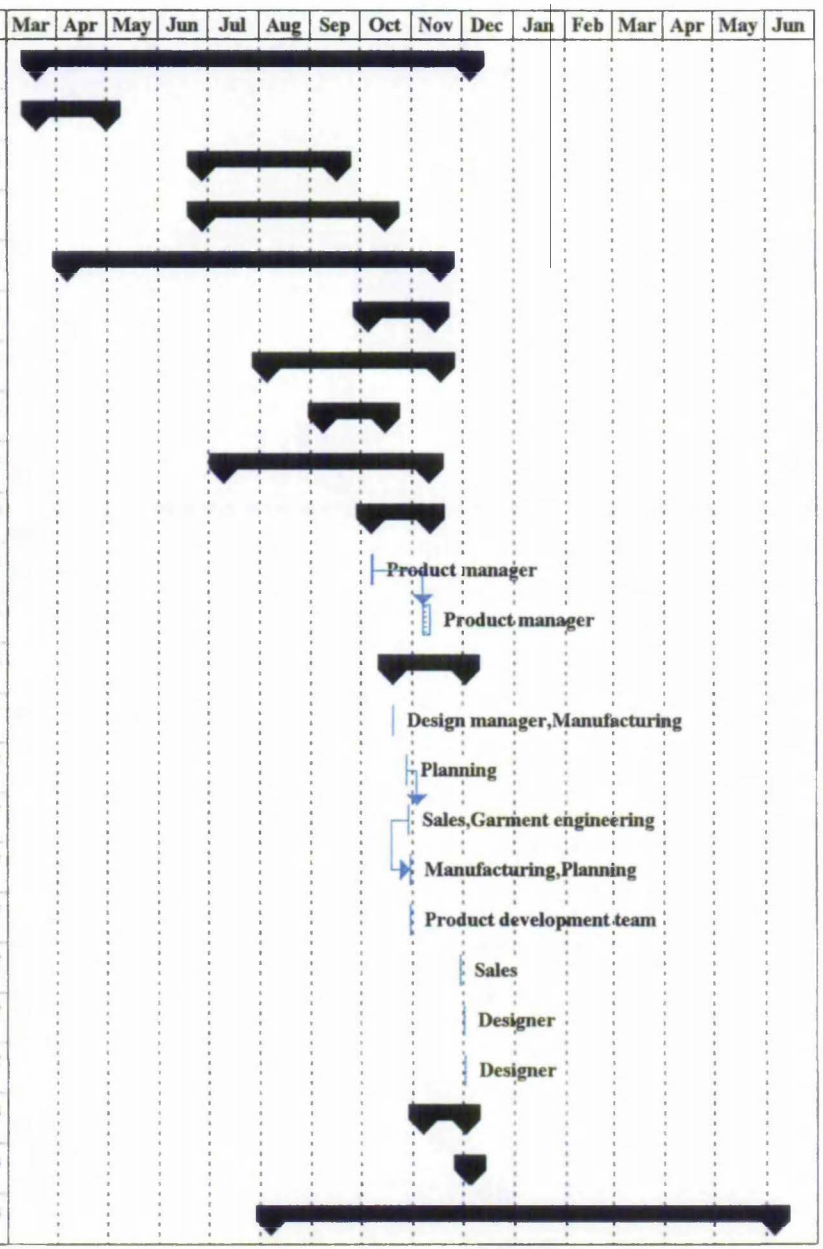


FIGURE 4.32 SPORTSCO SUPPLY CHAIN LEAD TIME - European conference/forecast and production

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	193 days
2	**Design brief and colour palette**	32 days
10	**Garment costing, fitting and quality**	58 days
15	**Silhouettes**	80 days
24	**Prints**	164 days
44	**External presentations**	32 days
53	**Trade shows**	77 days
58	**Photo shoot & catalogue**	29 days
63	**Catalogue**	90 days
72	**Internal product launch**	27 days
75	**Bulk samples**	33 days
84	**European conference**	19 days
85	Conference meeting /planning	7 days
86	UK conference preparation	3 days
87	Information for folders	1.5 days
88	Casting models	1.5 days
89	Conference 3 days	6 days
90	**Forecast & production orders**	2 days
91	Complete forecast due to planning	1 day
92	Forecast in bulk capacity for production	1 day
93	**Spring Summer developments - Prints and silhouettes**	220 days

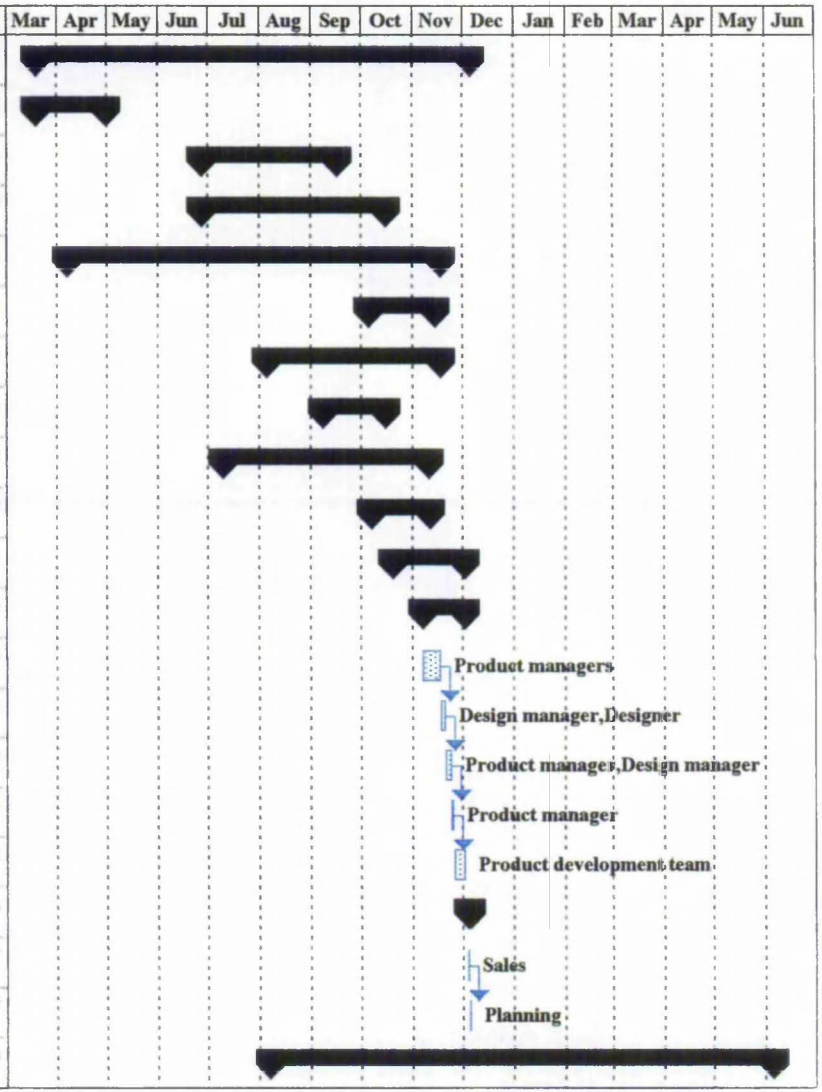


Figure 4.33 SPORTSCO - CORE PRODUCT DEVELOPMENT TEAM (3 PEOPLE) RESOURCE ALLOCATION

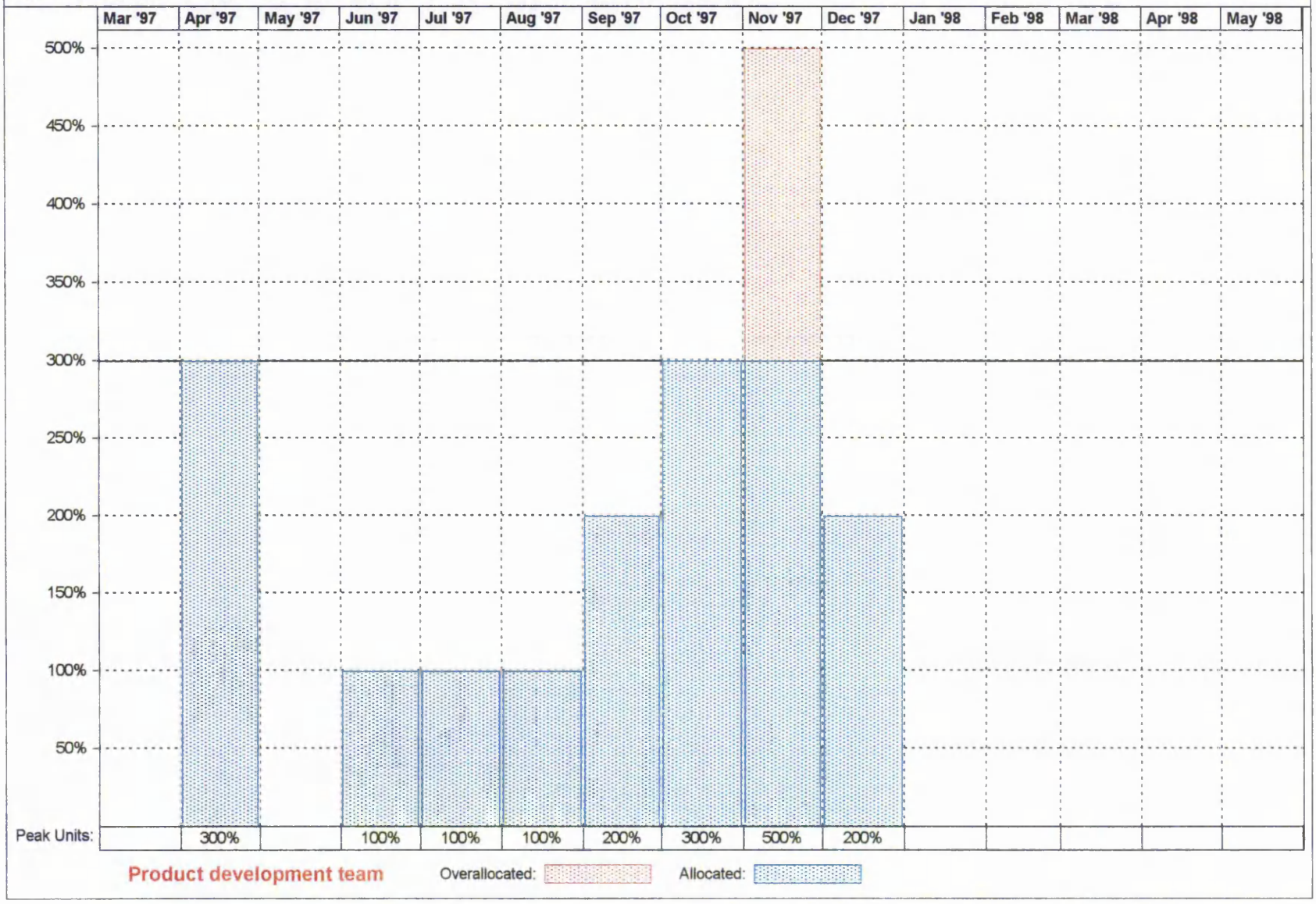
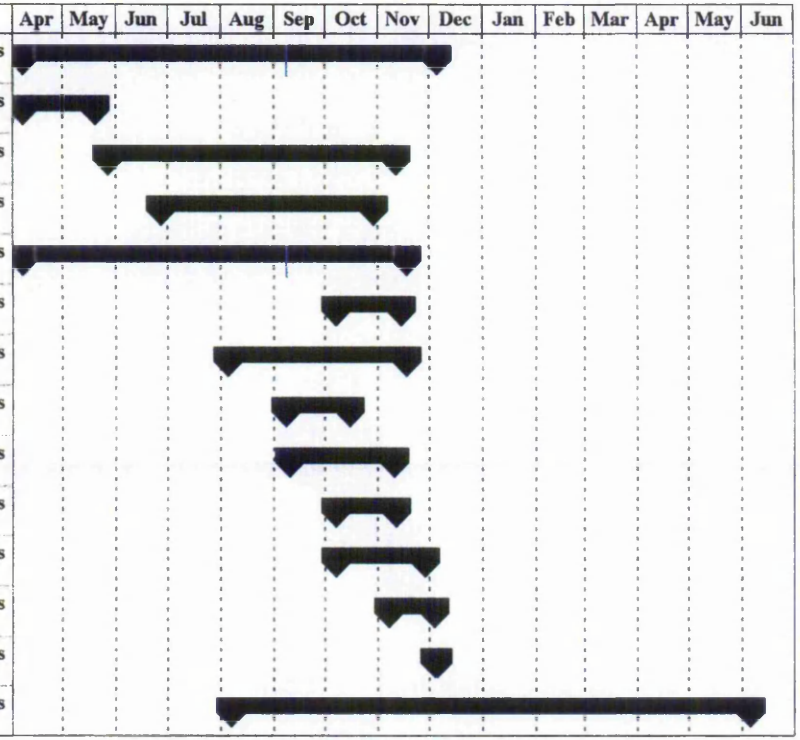


FIGURE 4.34 SPORTSCO POSSIBLE LEAD TIME

ID	Task Name	Duration
1	Product development for Autumn /Winter development	176 days
2	Design brief and colour palette	32 days
8	Garment costing, fitting and quality	121 days
18	Silhouettes	89 days
27	Prints	162 days
46	External presentations	29 days
55	Trade shows	75 days
60	Photo shoot & catalogue	28 days
65	Catalogue	44 days
74	Internal product launch	26 days
77	Bulk samples	38.5 days
86	European conference	19 days
92	Forecast & production orders	2 days
95	Spring Summer developments - Prints and silhouettes	217 days



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Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split

FIGURE 4.35 SPORTSCO POSSIBLE LEAD TIME - Design brief and colour palette, garment costing, fitting and quality

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
3	Agree key trends and focus	2 days
4	Look at first colour palette	2 days
5	Agree ties across range	2 days
6	Finalize colour palette	30 days
7	SKU plans received from sales	1 day
8	**Garment costing, fitting and quality**	121 days
9	Discuss costs	1 day
10	Labour rates and raw materials prices confirmed	1 day
11	Silhouette fitting	12 days
12	Quality sheets on prints & accessories	7 days
13	Approve product strike offs	3 days
14	Recolouring of print strike offs	10 days
15	Obtaining 1st sample metreage 10m A/W	1 day
16	All product prints into work + A/W accessories	5 days
17	Italy to sort out prints	3 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
46	**External presentations**	29 days
55	**Trade shows**	75 days
60	**Photo shoot & catalogue**	28 days
65	**Catalogue**	44 days

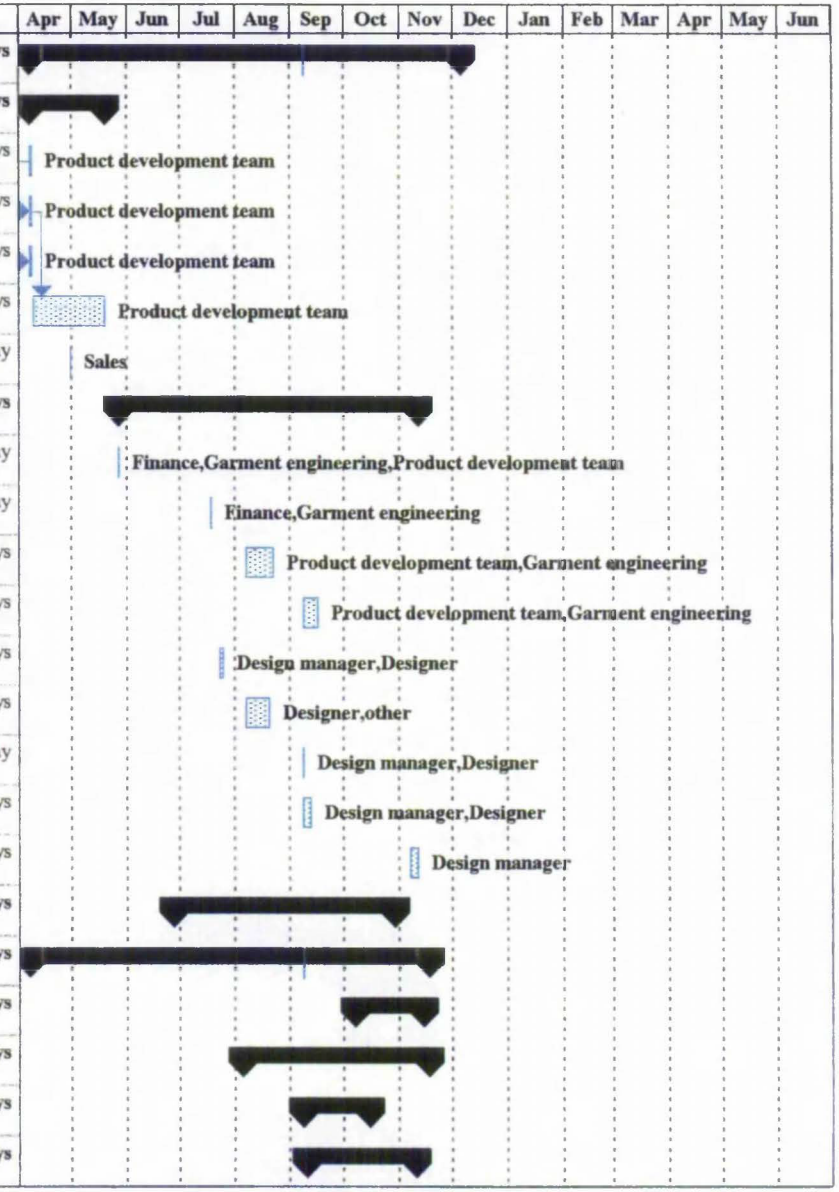


FIGURE 4.36 SPORTSCO POSSIBLE LEAD TIME - Silhouettes

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
19	Issue all silhouettes to garment engineering	4 days
20	Preview product	10 days
21	Approve product silhouettes	4 days
22	A/W silhouettes to Far East for costing	3 days
23	Finalise silhouette work A/W,emb. transtats & swing ta	8.5 days
24	Chasing sample -2s of everything	4 days
25	Review range and make amendments, reduce if neces:	10 days
26	Speak to key markets	3 days
27	**Prints**	162 days
46	**External presentations**	29 days
55	**Trade shows**	75 days
60	**Photo shoot & catalogue**	28 days
65	**Catalogue**	44 days
74	**Internal product launch**	26 days
77	**Bulk samples**	38.5 days
86	**European conference**	19 days
92	**Forecast & production orders**	2 days
95	**Spring Summer developments - Prints and silhouettes**	217 days

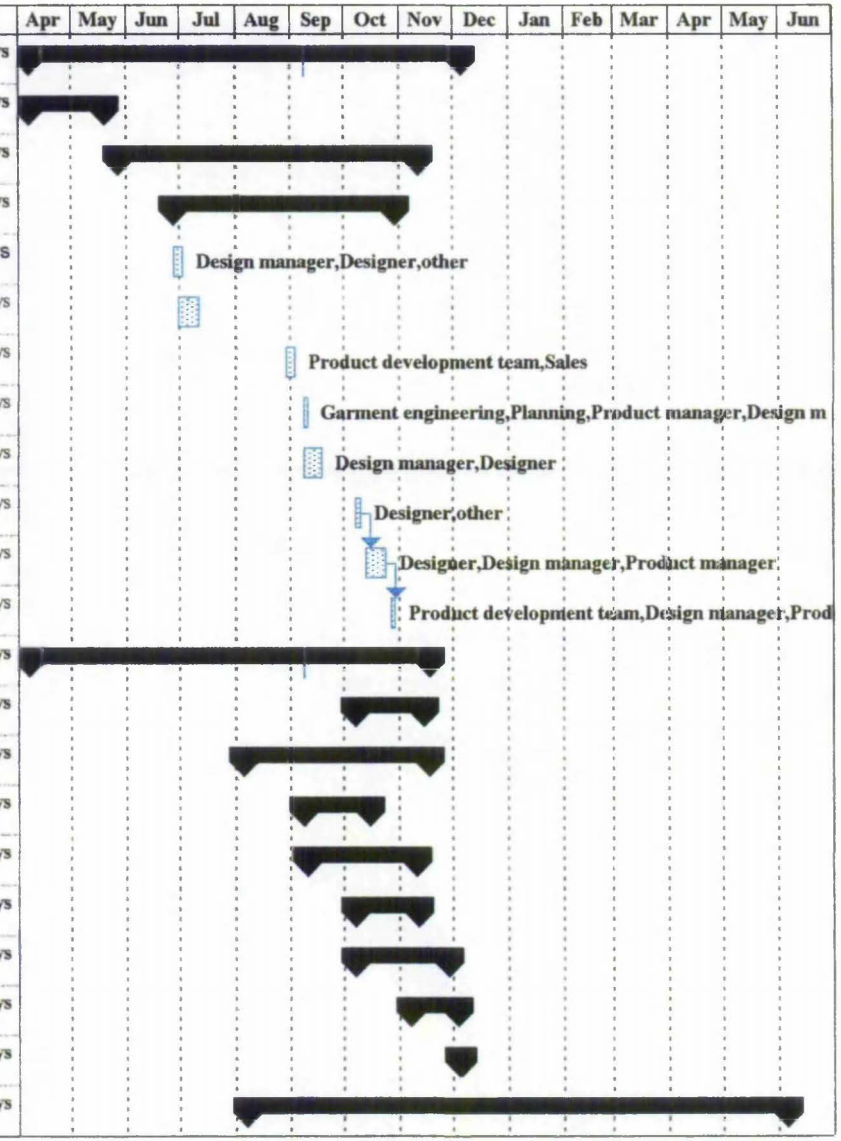


FIGURE 4.37 SPORTSCO POSSIBLE LEAD TIME - Prints

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
28	Work in from freelancers	1 day
29	Fabric supplier produces strike offs	22 days
30	Place and approval final strike offs bulk sample fabrics	3 days
31	Recolouring of print strike offs	10 days
32	Obtaining first sample metreage	1 day
33	All product prints into work+ accessories	5 days
34	Reconfirm product bulk sample capacity	0.5 days
35	Style sheet maintenance complete	10 days
36	Product costs complete	2 days
37	Checking the range	1 day
38	Finalise range, modules	2 days
39	Finalise SSM again, check with SKU	7 days
40	Itlay to sort out prints	3 days
41	Information forum - preparation	3 days
42	Forum- sales information previous 2 seasons start SKU	5 days
43	Finish SKU plan	7 days
44	Check catalogue SKUs and DPS	7 days
45	Fabric books-specify order layout;chase fabrics;prices	7 days
46	**External presentations**	29 days

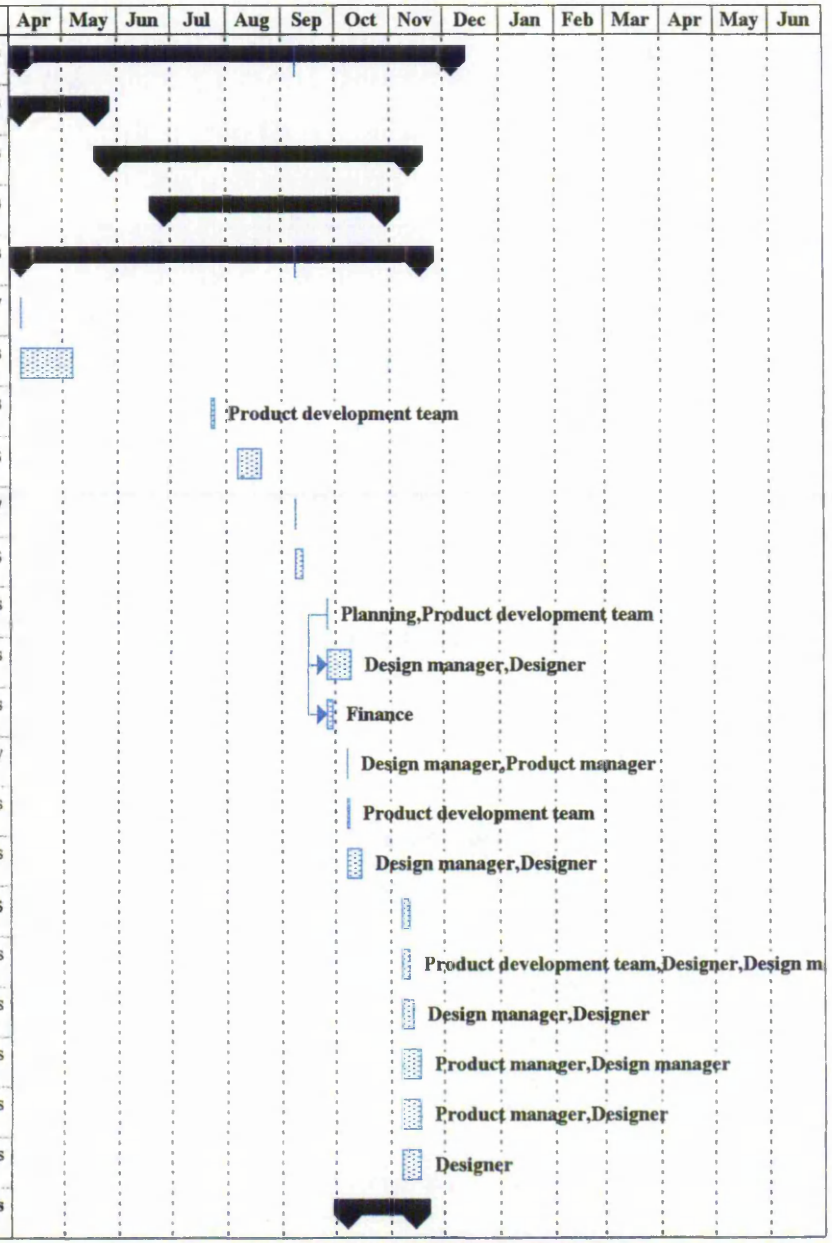


FIGURE 4.38 SPORTSCO POSSIBLE LEAD TIME - External presentations trade shows

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
46	**External presentations**	29 days
47	Key accounts	4 days
48	Preparation for Intersport	2 days
49	Intersport presentations Swiss	2 days
50	Intersport UK	1 day
51	Latin America -licensees design forum Miami	8 days
52	Mail order presentation	6 days
53	Licensee visits	3 days
54	Practise presentations	1 day
55	**Trade shows**	75 days
56	ISPO	2 days
57	Premier vision	3 days
58	Research trip to L.A. & N.Y.	7 days
59	40 degrees show	1 day
60	**Photo shoot & catalogue**	28 days
65	**Catalogue**	44 days
74	**Internal product launch**	26 days
77	**Bulk samples**	38.5 days

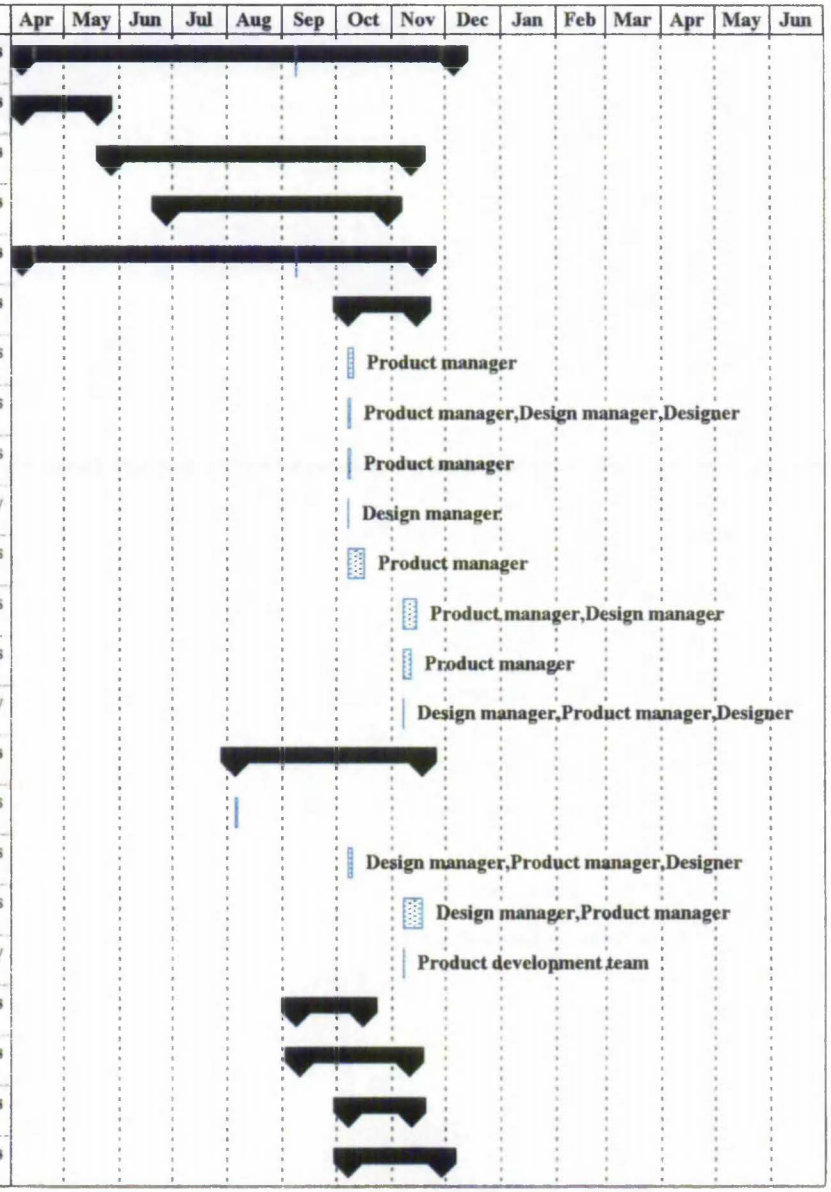


FIGURE 4.39 SPORTSCO POSSIBLE LEAD TIME - Photoshoot and catalogue/ catalogue

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
46	**External presentations**	29 days
55	**Trade shows**	75 days
60	**Photo shoot & catalogue**	28 days
61	Paper brief for photoshoot	1.5 days
62	Final photoshoot brief	1 day
63	Photoshoot	8 days
64	Organise photo samples and carnet	2 days
65	**Catalogue**	44 days
66	Silhouettes to sentry box for drawing + grids	2 days
67	Scan prints for catalogue	6 days
68	Pass the catalogue to reprographics	0.5 days
69	Silhouettes to be drawn up for catalogue final	0.5 days
70	Advise P.O.S stories	1 day
71	Catalogue process meeting	1 day
72	Sign off catalogue	0.5 days
73	PR releases	2 days
74	**Internal product launch**	26 days
77	**Bulk samples**	38.5 days

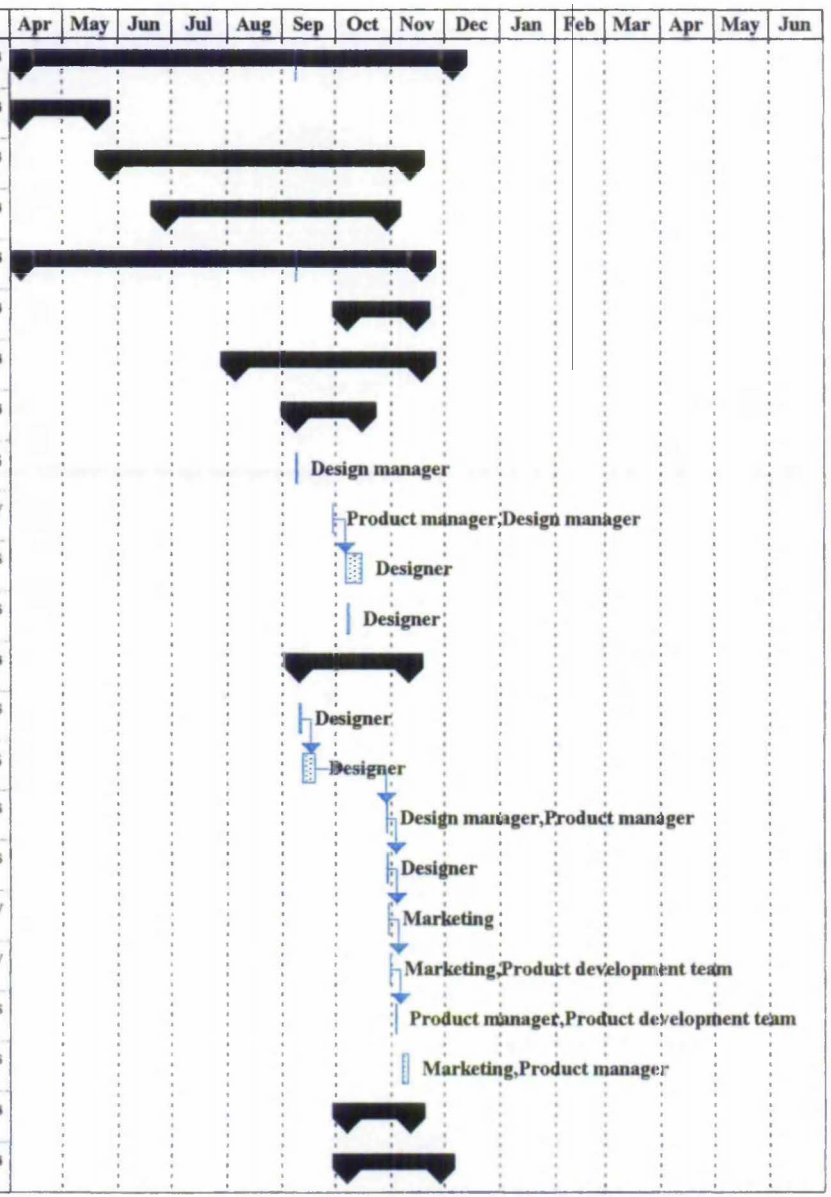


FIGURE 4.40 SPORTSCO POSSIBLE LEAD TIME - Internal product launch/ bulk samples

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
46	**External presentations**	29 days
55	**Trade shows**	75 days
60	**Photo shoot & catalogue**	28 days
65	**Catalogue**	44 days
74	**Internal product launch**	26 days
75	Organise models and presentations for launch	1.5 days
76	Casting models	3 days
77	**Bulk samples**	38.5 days
78	Handover to Manufacturing pre-production meeting	0.5 days
79	Bulk sample order for product to manufacturing	1 day
80	Order product for conference-Garment eng.	1 day
81	Order product for conference-given to manuf.(15sets)	0.5 days
82	Product bulk sample order passed to manufacturing	0.5 days
83	Bulk sample order with UK and Internatioanl sales	2 days
84	Product, cut fabric, bulk swatches	1 day
85	Product fabric bulk swatches to agency	0.5 days
86	**European conference**	19 days
92	**Forecast & production orders**	2 days

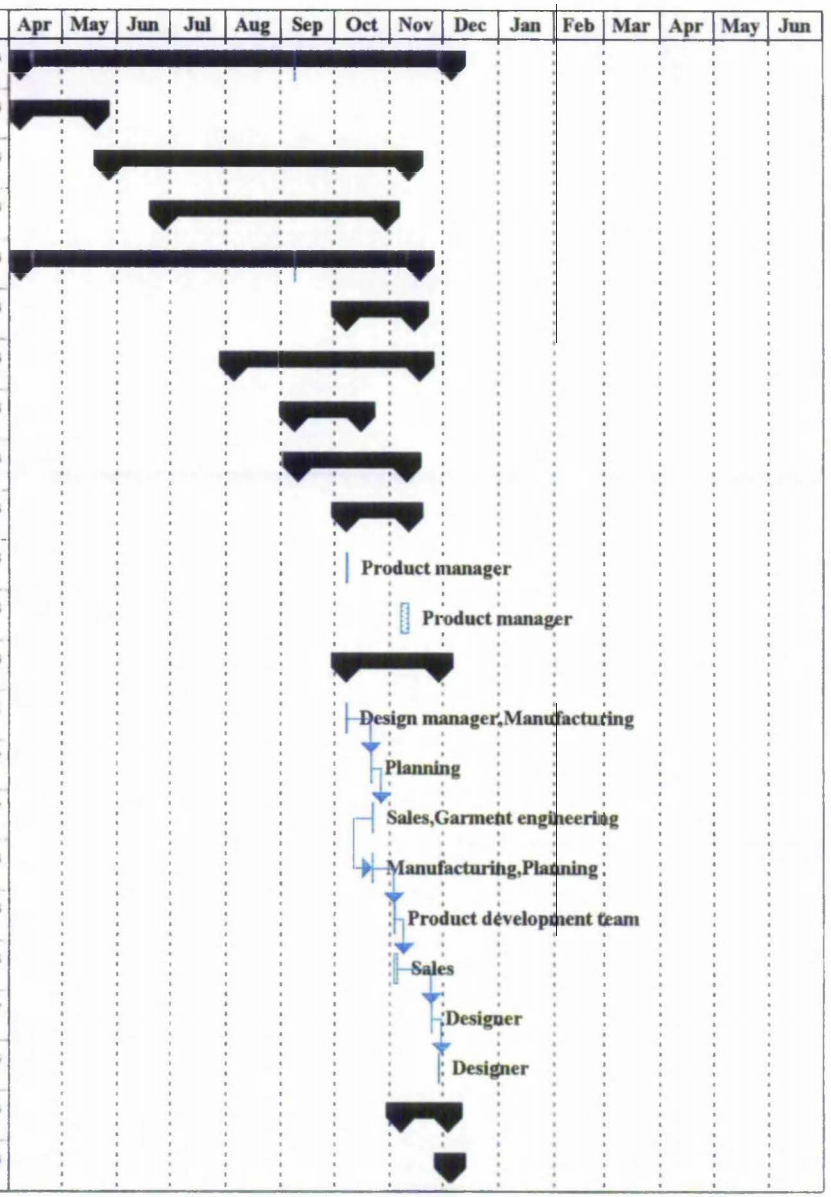
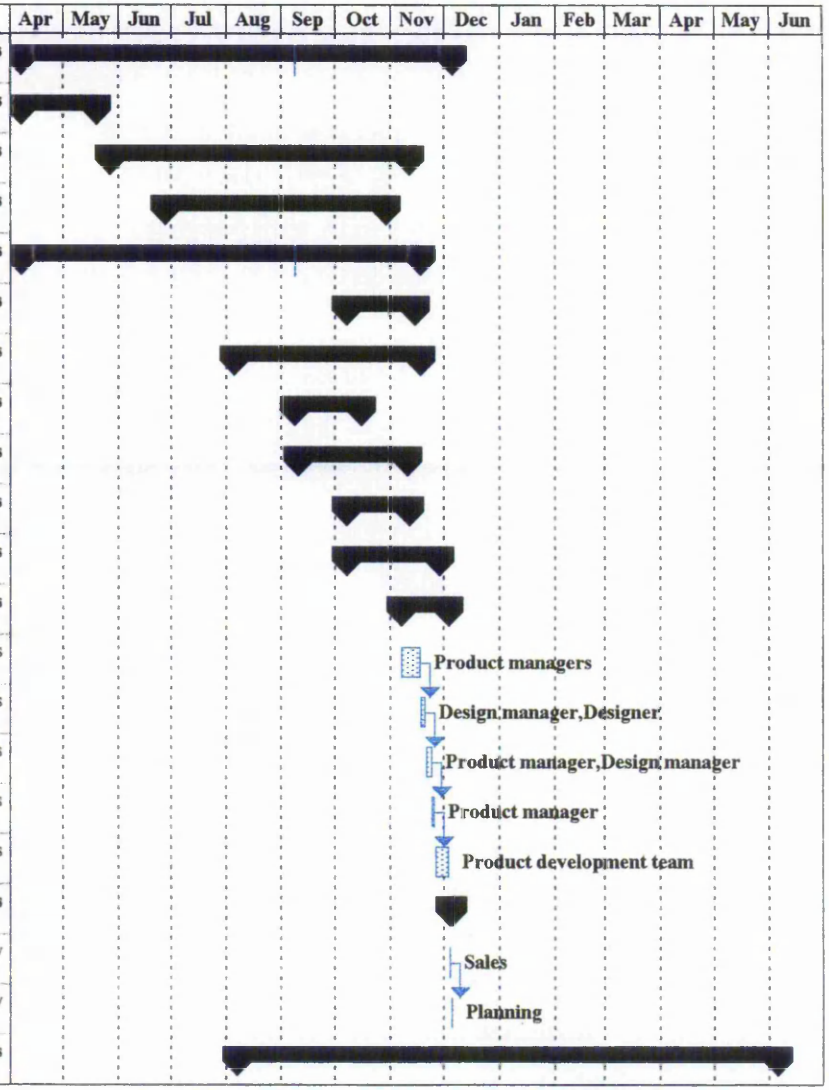


FIGURE 4.41 SPORTSCO POSSIBLE LEAD TIME - European conference/ forecast and production orders

ID	Task Name	Duration
1	**Product development for Autumn /Winter development**	176 days
2	**Design brief and colour palette**	32 days
8	**Garment costing, fitting and quality**	121 days
18	**Silhouettes**	89 days
27	**Prints**	162 days
46	**External presentations**	29 days
55	**Trade shows**	75 days
60	**Photo shoot & catalogue**	28 days
65	**Catalogue**	44 days
74	**Internal product launch**	26 days
77	**Bulk samples**	38.5 days
86	**European conference**	19 days
87	Conference meeting /planning	7 days
88	UK conference preparation	3 days
89	Information for folders	1.5 days
90	Casting models	1.5 days
91	Conference 3 days	6 days
92	**Forecast & production orders**	2 days
93	Complete forecast due to planning	1 day
94	Forecast in bulk capacity for production	1 day
95	**Spring Summer developments - Prints and silhouettes**	217 days



The desire to supply to the customer had led to a policy of overproduction either in the form of producing it too early, or of manufacturing looking for long runs that created stock and required warehousing, resulting in double handling and transportation waste. As the products were often sold as part of a package of goods which went to form a complete order of ranges of products, this could also have created customer delivery failure issues of part consignments, duplication of effort and transport, along with potential loss of the customer. Bulk production runs could have resulted in the manufacture of products that were not directly required and in not making products that could have been sold prior to them. This was in conflict with the stock-out situation where there was a lost opportunity to sell when there was high product demand in the marketplace.

Purchasing strategy - raw materials

The strategy for the purchase of raw materials changed quite dramatically over the period of time that the study was taking place. There was restructuring of the functional boundaries between the purchasing of raw materials and the raw materials store section as they were amalgamated under one manager.

The new purchasing section carried out a Pareto analysis of suppliers, vendor analysis, discussion and negotiation of alternative process. They were moving them to a strategy of building long-term relationships and the development of a strong supply base. The purchasing roles of expediting and market analysis were created to support the move to strategic purchasing. This was a change in policy from reactive to proactive purchasing. This would be classed as stage 3 of Hines's (1994) model, (see figure 2.10). Early involvement of purchasing during the product development stage could assist the information and product flow at the product launch and manufacturing stages of the process (interview, Purchasing Manager).

The raw materials for the product represented up to 70% of the product cost and as a result were a key part of the supply chain strategy. The purchasing manager had reduced the inventory holding for raw materials by 40%, which assisted in creating supply chain visibility, but this was a one-off and further initiatives were required to continue this downward trend in inventory holding. The selection of suppliers was

based on the review that was carried out by the new purchasing manager. To some degree it was based on the response that the organization received for information regarding the supplier's strategic plan for the next five years.

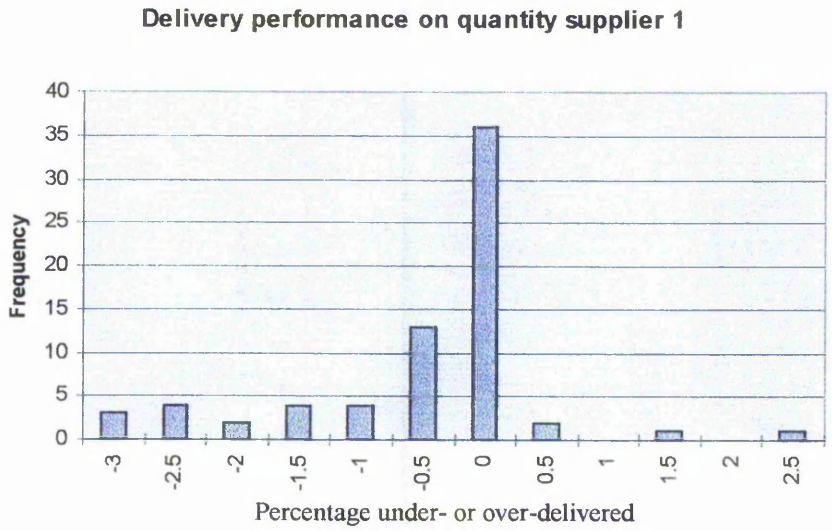
Outsourced finished product

The main season for Sportsco was the summer range that was sold in the retail stores from around the end of January onwards. Problems were occurring in the supply chain with the outsourced products and research was carried out to measure their performance. Previous interviews with the UK production manager had also indicated that there had been a need for rework on bought-in products, which the UK production facility had carried out, bringing into question the suppliers' manufacturing capability.

The charts below indicate the delivery performance of three of the out-source finished product suppliers, which varied considerably. As can be seen, there are discrepancies on delivery on time. The data was taken from historical documents where various variables appeared to be operating. These could have been due to the intervention of expediting measures, delay in manufacturing to requested lead time, delay during shipping or clearance and transshipment, or mismatched paperwork. Service discrepancies were not differentiated or measured, so the raw data was all that could be assessed for the purpose of delivery performance measurement from the three suppliers. The deliveries have been measured on weeks over- or under-delivered to Sportsco.

Chart 4.1 indicates the delivery performance on quantity received against the order. Only supplier 1 has been illustrated as the historical data on the other two key suppliers regarding quantities received were very difficult to reconcile and therefore the reliability of the data could not be verified and so has not been included in this section.

Chart 4.1 Deliveries complete quantity



The under delivery of product would have resulted in reduced order fill to the customer. The product shortfall would normally have been due to the batch size of the raw material being below that ordered, resulting in a reduced number of garments being cut and therefore a shortfall to Sportsco and to their customer. The under-delivery of raw material can also have affected a whole range of products if it formed part of the overall raw material requirement. This would have been the case where a range of products is designed using two or three different body fabrics or even two or three different coloured sections within the garment (interview, cutting room Supervisor).

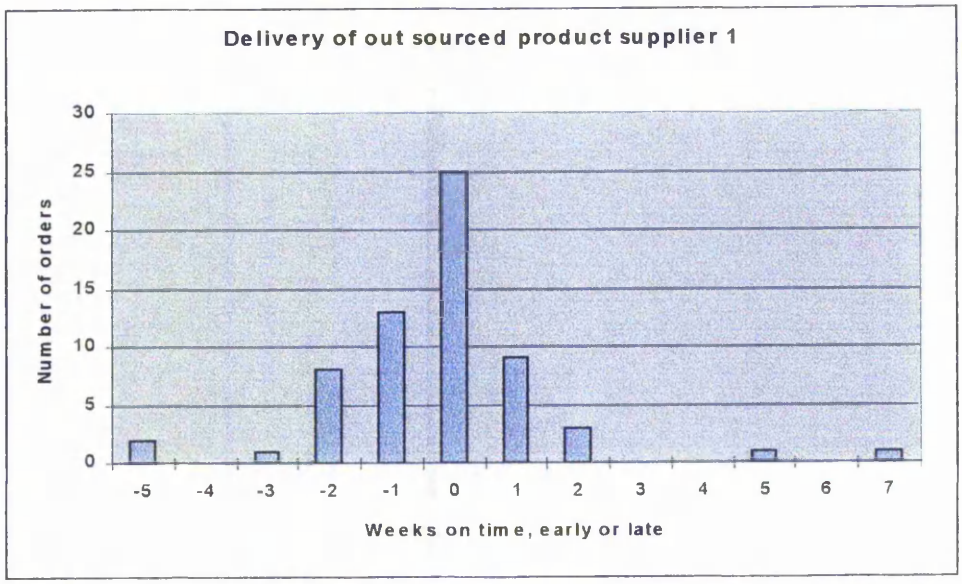
Delivery on time to Sportsco has also been measured from three of their main suppliers of sourced product, and the chart 4.2 below shows the degree of accuracy of supply on time. Supplier 1's deliveries were mainly spread from two weeks early to two weeks late. Supplier 2's spread from six weeks early to six weeks late. Supplier 3's average delivery was four weeks late but varied from on time to eight weeks late (see chart 4.2). This could have led to partial order fill for the retailers - as previously mentioned, only 70% order fill was being achieved.

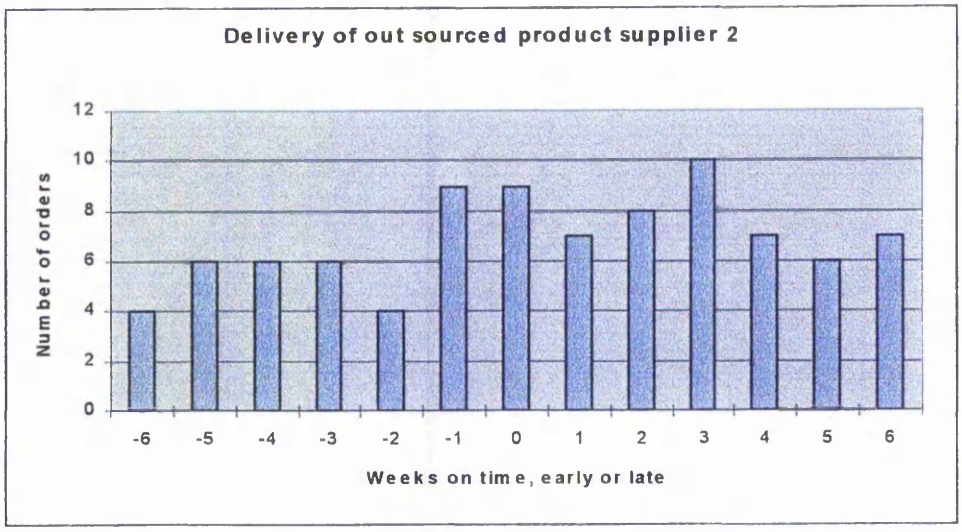
When reviewing the historical data the lead time variance from order to receipt was also found to have fluctuated, which may indicate that raw materials were already available for product manufacturing, causing the lead time reduction of the first part

of the supply chain - order and receipt of raw materials. It may also have been that out-source manufacturing accepted orders even though they were aware that their capacity was already full, which would then have resulted in late deliveries. Until performance measures were in place it would be difficult for Sportsco to make the supplier more accountable.

The supplier's commitment to Sportsco was dependent at the time of the study on the power of their other customers. Decisions could have been made on the value that the customer represented to the supplier if they were to lose their business. That was why the long-term supplier customer planning described in the purchase of raw materials played an integral part in establishing a strong supply chain. The source supplier would have to be flexible to accommodate rapid style change and smaller quantities per style.

Chart 4.2 Deliveries on time





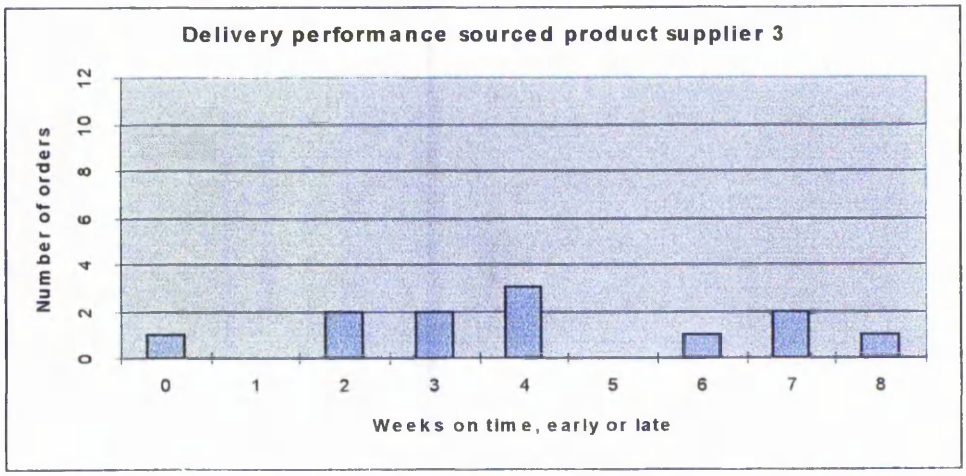
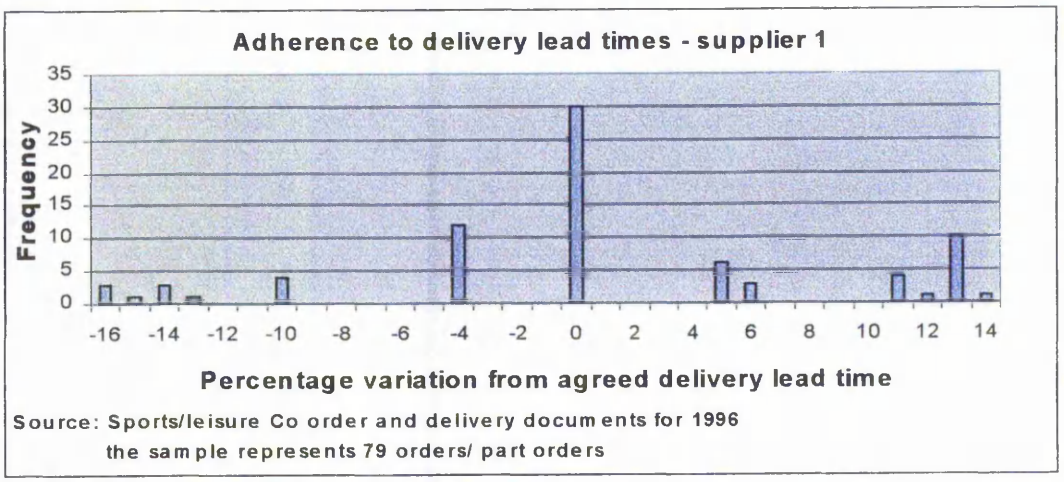
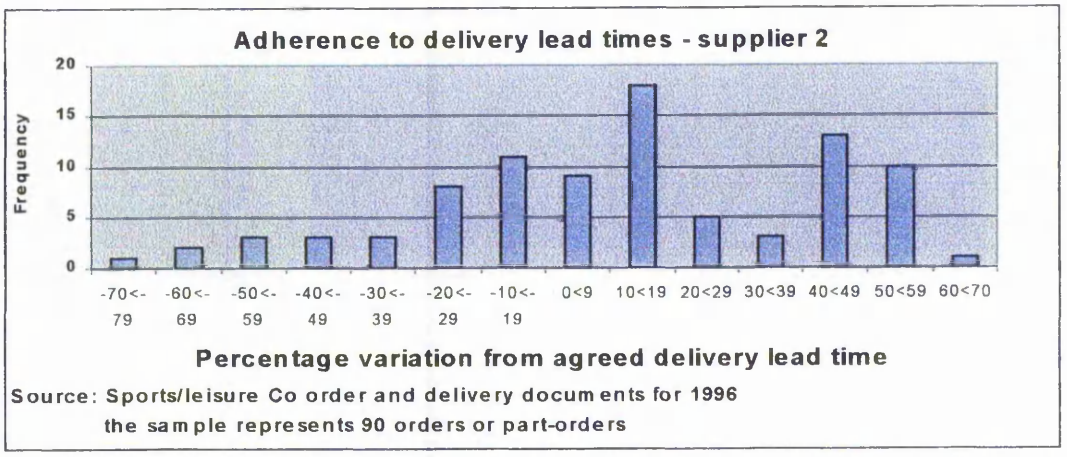


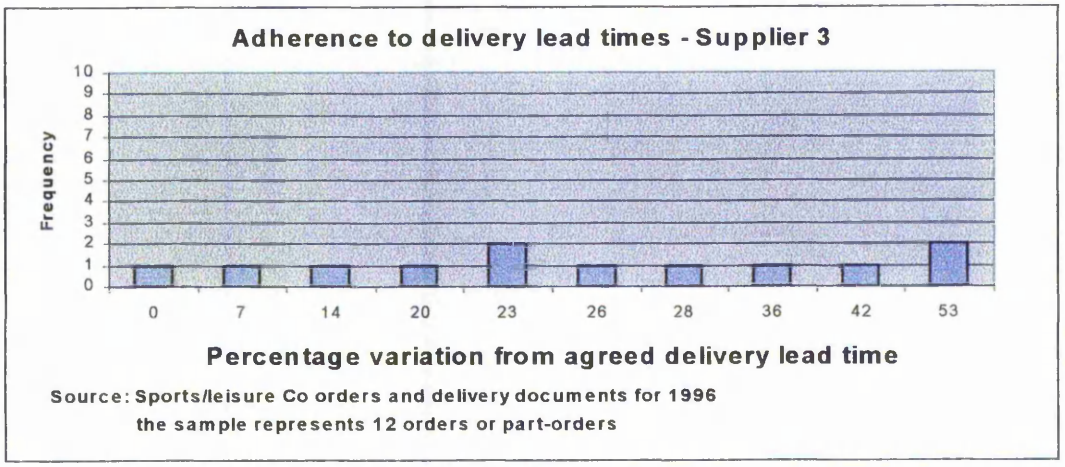
Chart 4.3 Delivery lead times



Source: Sports/leisure Co order and delivery documents for 1996
the sample represents 79 orders/ part orders



Source: Sports/leisure Co order and delivery documents for 1996
the sample represents 90 orders or part-orders

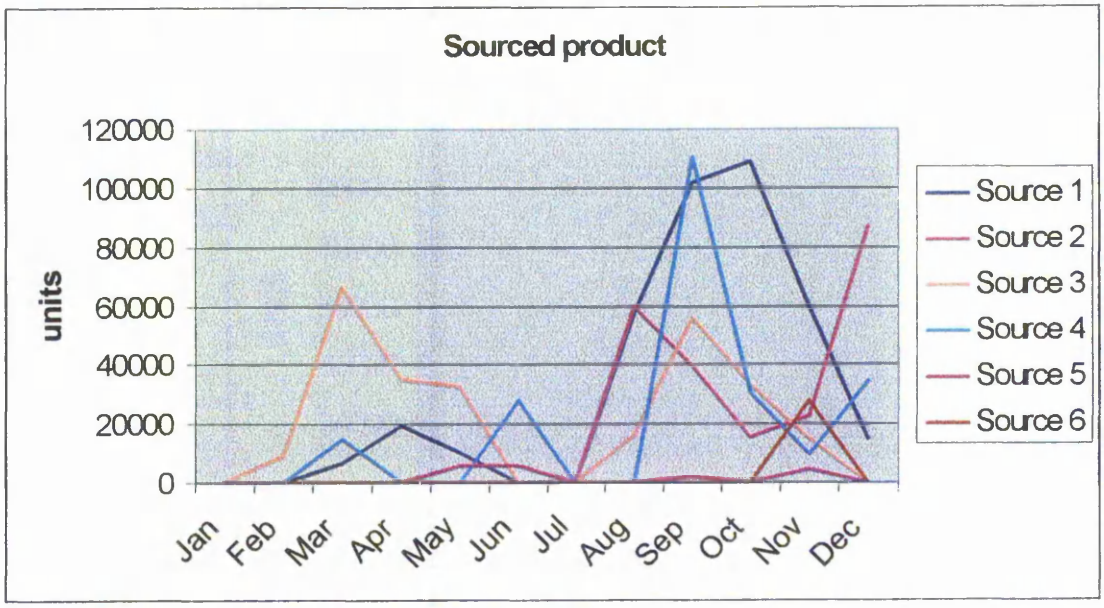


Source: Sports/leisure Co orders and delivery documents for 1996
the sample represents 12 orders or part-orders

The supply chain performance results in the previous charts may also have been due to the effects of batching and seasonality in apparel and textiles sourcing, Chart number 4.4 illustrates the problems which were created through the batch order process which occurred through the seasonality of the product. The sourcing

therefore occurred from August until October, which allowed the manufacturer to produce the product and deliver in January.

Chart 4.4 Sportsco orders for sourced product



(Source : Sportsco historical records.)

However, as can be seen from chart 4.4, the orders for the sourced product were not spread evenly across the suppliers and as a result, high levels of peaks and troughs for the manufacturer occurred over the months. The peaks for placing orders were due to the set cut-off dates placed on the Sportsco salesforce for final dates for receipt of orders from their customers.

4.4.7 Analysis

The lead time analysis indicates that the process could have been further reduced from 194 days to 137.5 days. The areas of waste were rework, delay time between functional elements, waiting and changes to decisions. Their product development process was suffering from information overload and lacked concise information for the required purpose. The lead time increased due to the distance travelled between sites and information flow and backflow between sites. Poor visibility occurred as a result of high levels of inventory in the supply chain. There was also inventory building because of large batch sizes and long production runs which created long periods of storage and tied investment up for several months. In addition, processing

was being done in advance of requirement, creating waste through double handling and the increased need for storage.

Sportsco had a high level of complexity within the organization and a holistic approach to any changes was required as the results could have impacted across the supply chain. The boundaries across the functions had started to be eroded, creating an 'open system'; a more cross-functional system approach applied. The co-ordination internally and externally and the building of relationships within the supply chain was critical to performance in time for product launch. The reorganization was necessary but "the agony of change could be justified simply by the avoidance of the tremendous risks involved in being a slow innovator" (Stalk and Hout 1990, p.133).

Their method of operating focused on the short-term and they had high levels of pressure at the peak times, usually prior to internal launch and again at the external product launch. Further, added cost of production occurred due to problems when bulk production commenced - this happened when volume production highlighted problems of material handling occurring when two or more materials were sewn together at high speeds.

The product required a high degree of flexibility in supply, manufacturing and processing capabilities. As previously mentioned approximately 22,000 stock keeping units (SKUs) were held, which illustrates the diversity of their product offer across the five product categories.

A collaboration was essential as both parties had a wealth of knowledge, which could be brought to the development process. This competence trust and goodwill trust (Sako 1992) played a part in the strength of the supply chain. Macbeth and Ferguson (1994) state that 'partners in the chain are vulnerable to each other's action or inaction' which was definitely the case with Sportsco's supply chain. Sportsco was dependent on its core suppliers to deliver this level of innovation and were dependant on new process methods and technology to maintain their position in the market. Therefore building a strong supply relationships and a strong supply network were critical factors for their success (interview, Product Director). This is confirmed by

Macbeth and Ferguson's (1994) description of the switching of suppliers for the uniqueness of new technologically-advanced products.

Power of buyer and supplier

There were some very powerful raw material suppliers who held the control over who they wanted to supply and the volume which they were prepared to produce as minimum quantities. Hard negotiation was required to establish a contract that allowed both organizations to benefit from the relationship (interview, Purchasing Manager). The variables of overall fabric type usage, pricing for the range of colours in the palette, delivery schedule and timescales for commitment to colour quantities were all used to create greater flexibility of the supply chain. The variables had to be discussed to obtain a clear picture that allowed the manufacturer to cost the final product effectively. Information was being used to replace the requirement for inventory and to reduce the risk of misaligned production within the supply chain.

Supplier performance measurement - bought in products

Performance measurement was only starting to be evaluated and discussions on key performance indicators were ongoing. Sportsco wanted to agree across the functions and suppliers what the key measures should be, and then focus on improvement programmes. (This is also discussed later in the chapter in relation to out-sourced manufactured products.) Performance measures tended to be functionally based as opposed to relating to cross-functional measures that would have represented more clearly the real effect on the total cost of the product for the organization.

There was a lack of measurement on the quality of out sourced product in relation to the cost of rework and potential lost orders. The financial accounting for this discrepancy was based on allocating an overhead for these exceptions of 0.75% (interview, Commercial Finance Manager). This meant that the UK in-house production and the out sourced products were not being measured by the same set of standards; an unfair advantage was placed on the out-sourced product as neither the cost of doing business with off-shore suppliers, nor the cost of quality, delivery, payment terms or travel were part of the equation for the 'Total acquisition cost of the product' - they were accounted for as a group overhead for the organization.

Issues of reliability, flexibility and inter company communication and partnerships arose when selecting and resourcing the selection of out source suppliers. There were also issues of the ease of doing business with the supplier and exchanges of paperwork, quality checks, shipment/ distribution, sampling and volume expectations. The integration of the suppliers with Sportsco would have affected the overall performance issues of lead time, completeness, on time delivery, cost and ease of doing business.

The use of group consignments to reduce cost of transporting raw materials was costing the company in wasted time, as the goods were collated and stored awaiting a full load. The same applied to production (waiting for the total order to be shipped). If part lots could have been shipped, it would have increased the paperwork, but if the system had been reviewed and simplified this problem could have been overcome. The grouping of consignments also contributed to low inventory turns resulting in money being tied up for longer periods of time at a greater cost to the organization.

The number of stock turns per annum had reduced from 2.8 in 1995 to 2.5 in 1997. This may have been attributable to the expansion of the range which was offered, which diluted the product offer and resulted in an increase in finished goods stock and an increase in markdown provisions.

During the data collection process it was found that stock was not being measured in its different forms, which included raw materials, work in progress and finished goods, and as a result it was difficult to determine the inventory holding pattern for the organization. However, the raw material holding had declined since the new purchaser had worked more closely with the supplier, reducing bulk production of product and moving to schedules which more closely followed the demand from the next link in the supply chain which was the apparel manufacturer.

The development and production of two ranges a year (see section 4.4.5) created peaks and troughs and it was therefore more beneficial to move towards four or six ranges. However, this organization would have had to change dramatically the structure of the product development, sales and marketing operations in order to

accommodate the increase in ranges per year and stronger supply chains would have to have been in place, increasing the information exchange and leaving decision-making to be in line with demand from the customer. The issues of quality and delivery reliability would have to have been a prerequisite.

Information control

The purchasing operation had started to establish a process of sharing information along the supply chain in an effort to replace inventory with information exchange. Purchasing had established the variables that they wanted to operate with and how they proposed to carry out business in the future. Decision-making on fabric types, colourways, finishes and quantities was left to the last appropriate moment in order to reduce the holding of inventory throughout the supply chain and reduce the risk of overproduction or production of stock which was not required until a later date. The supply chain should have been optimized in this way, rather than through segmented optimization within the chain.

The effectiveness of chain

The effectiveness of the supply chain revolved around their suppliers' ability to integrate with Sportsco. The flexibility to align their operation with the system of the host and other members of the network along with the ability to be able to switch from one network to another and to maintain the flow of information and goods, depended very much on the relationship which they had established. Sportsco was trying to build these strong relationships which would allow them to switch their network while maintaining the performance criteria of quality, delivery and cost and innovation (Relationship positioning tool, Macbeth, 1994, p.173). Being able to maintain these performance criteria when switching network members illustrated their ability to compete against rival supply chains. This was described earlier (see section 2.2.2, contingency theory) as a means of organizational survival in a turbulent environment. A high level of co-operation was required across the links in the supply chain.

4.4.8 Conclusions of primary case study

As with the previous case study, the conclusions are split into two: the findings from the research, and the findings from the methodology

4.4.8.1 Research findings

Environment and organizational ecology

The organization had previously experienced a piecemeal approach to strategy, but a more cohesive procedure was being developed to bring about incremental change to the organization. However, this was not always apparent to the personnel within the organization as dissemination of part of the strategy had not always reached the different levels within the company. This may have led to mistrust of or confusion about the strategic direction promoted by Sportsco's Directors.

The approach of top-down strategy and bottom-up policy deployment had not necessarily been the approach that had been used. Levels of trust varied across the hierarchy of the company. However, the morale of the company and degree of company loyalty was extremely high (semi-structured interviews).

Sportsco had actioned cross-functional teams that were formed from internal personnel mainly middle management. External supply chain members were not included at this stage. The cross-functional group that reviewed the process were taken from sales, marketing, design, product management and planning. The supply chain development team meetings were used to address the communal aspect of the group's perception of the processes and culture of the organization, as well as how they saw change occurring; this used an approach put forward by Glaser and Strauss (1967) and reiterated by Styles (1994). The team presented the findings at a higher management level for open discussion, prior to agreeing a plan of action for further detailed data collection.

Sportsco were supporting the change process with a recruitment policy that was to generate job specifications where experience was required across functional boundaries. However, reward structures were not visible in the organization. The measures were not in place to encourage and measure supply chain benefits rather

than functional benefits such as increased productivity, or total acquisition cost. Sportsco was focusing on reduced lead time to market and increased innovation. 'Compatible structures' included the use of IT in the area of warehousing and distribution, which may since have been linked to EDI systems for real time inventory management. Devolved decision making authority already existed with the product managers regarding off-shore products. However, the area of cost and pricing of their own manufactured products was not integrated with the product managers and real total acquisition costing was not carried out. Relationships were being developed up and down the supply chain. This involved the key suppliers early on in the process in working closely on innovative new products. One of Sportsco's customers was entering into negotiation on a proposed category management role for Sportsco.

Change and barriers to change

Changes were occurring in Sportsco's structure. They were moving towards cross-functional teams to carry out a review of the process and culture of the organization. This was with a view to reduce the time from concept to market and to remove any wasteful activity or unnecessary processing. Supply chain development would require Sportsco to adopt a system to improve communication and documentation. This would attempt to remove the informal system that was being used at the time of the study to override the formal system. The product selection process was out of sequence with the photoshoot. They hoped to address this subsequently by linking the commercial costing area more closely with garment engineering and the product managers. The costing process had been an undefined 'grey area' within the supply chain process (cross-functional team meeting, reviewing supply chain process). With greater understanding of the costing process the cross-functional product team would have been able to assess the criteria for the product costing prior to the internal selection process and to eliminate the product(s) that did not meet the criteria.

There were problems in the way that the products were manufactured as they were sold in stories or families of products. These groups of products would sit together in the retail store in one display area. The various products which made up these families might have been manufactured at more than one location and might have been a combination of in-house and out-sourced manufacture, which have resulted in

different lead times and therefore they ran the risk of only part of that family of products being available for sale to the customer at any one time. Uneven delivery performance from the out-source manufacturers led to only part of the product family being available resulting in disruption in supply to the customer and therefore poor performance from Sportsco to their customers. This could have resulted in the loss of sales of a whole product family not just the out-of-stock product or in fragmentation of ranges and markdowns.

Barriers to change

Sportsco needed to focus on quality and delivery, both from their suppliers and to their customers. They had to achieve flow through the whole supply chain and remove the barriers that were causing poor performance. Charts 4.1, 4.2 and 4.3 illustrate the performance on quantity and more noticeably delivery performance that varied dramatically across their supply base. Until the suppliers became proficient at delivering on time in full, to the required specifications, they would experience difficulties with supply to their customers.

Networks and relationships

The combination of reviewing and integrating the process that was aligned with the environment and organizational ecology, networks and relationships, and learning and systems formed the critical elements when considering and planning change. Each area was subdivided to focus on the main elements that required co-ordinating as a unit not as piecemeal actions.

Sportsco were operating out of three main sites at the time (see figure 4.22), which caused logistics problems for movement of products, resulting in double handling, and problems with the exchange of information, causing duplication or missing information, adding unnecessary time to the process.

A schematic representation of the product development process was used to depict the cross-functional involvement, including the tasks and goals, which had to be achieved in order for the process to succeed. This was again fed back to the development team and the accuracy of its assessment of present practice was agreed.

A review of the data using the concepts used in supply chain development for removing waste was used and then regenerated to represent the possible forecast process for future product development. This future state for product development was a trigger for the organization to formulate their plan for achieving these changes.

The establishment of cross-functional teams was encouraging involvement from site locations 1, 2 and 3. The purchasing manager now developed the raw material supply base and was improving internal company relationships between the raw materials store and the purchasing department. The external relationship improvement with suppliers had been based on supplier selection, strategic purchasing and devolving expediting to a separate role. It was hoped this would reduce the fire-fighting which was previously carried out, and encourage the different functions to have a greater understanding of the process across their functions and with external members of the supply chain. A positive attitude to understanding and developing their raw material suppliers existed; due in part to their dependency on the raw material supplier's ability to innovate (see section 2.3.10 product development - apparel innovation). Sportsco understood the value that a strong supply base could offer; achieving this was one of their goals.

The sharing of information between product development and purchasing had been limited to functional transactions although they were attempting to improve this with more cross-functional involvement. There were issues of functional boundary responsibilities and infringement into the area of development resulted in conflicts of interest between the desire to work closely with a few suppliers and the desire to be open to any opportunity for innovation. Introducing technical development in a leapfrog fashion, rather than taking a long-term, incremental approach that may be seen in other industries, could have been in opposition to the theory of long-term relationships.

Issues arose with out-sourced finished product suppliers, this could have been for several reasons that are partially illustrated in the Sportsco ordering pattern (see chart 4.5). Fluctuating lead times and volumes were creating peaks and troughs in demand and generating poor supplier performance. Traceability with multi-sourced products

was creating problems for the improvement strategy. The improvement of information flow in this area could have addressed some of problems that arose. Joint process engineering was not occurring with suppliers and a lack of a quality control improvement strategy was not helped by the geographic location of the supplier of finished products. Further, problems in information exchange and language barriers in technical interpretation were observed.

Cross-functional performance measures were required which measured the entire process and overall performance of the supply chain; these measures had to be agreed for the process under review. The team co-operated fully in reviewing and analysing the existing process, group learning was achieved when each function explained and illustrated their tasks to the team; interaction across the boundaries was enthusiastic. The out sourced product suppliers listed quality control issues caused by mismatched specifications as one of the problem areas when dealing with Sportsco. They described delivery failure mainly caused by fabric problems (questionnaire given to supplier during visit by Sportsco's Quality Manager).

Finance were switching their stock-holding accounting to specific areas of the business in order to make them more accountable, but until they could create greater visibility in the supply chain they would struggle to allocate the stock realistically. The inventory measures required changing to create three types of inventory in the system: raw materials, work in progress and finished goods. The other area was the allocation of overheads to the product at the time were allocated as a fixed overhead (interview, Finance Manager), irrespective of the source of the product, the delivery or quality performance from the supplier. 'They were unable to apportion overhead to different products...the cost of rework on imported garments was "a grey area"... they didn't usually recover the cost of rework from the supplier...there was no recourse for non- conformance' (interview, Finance Manager) which gave no incentive for the supplier to conform.

External relationships - customers

Trust in external relationships may have been damaged because of late and incomplete delivery of merchandise. The timing varied for the different market segments which

the organization was trying to supply: e.g., mail-order was required earlier than high street retail orders. The main areas of supply chain dissatisfaction could be categorized as delay, quality and inventory holding.

External relationships - suppliers

The purchasing department for raw material suppliers had formed long term relationships with their key suppliers for materials and for trims and accessories. Sportsco's available supply chain development resource could now focus on building the relationship and trust required for a strong supply chain.

The outsource finished product suppliers still had a long way to go before supply chain effectiveness could be achieved. The geographic location, language difficulties in interpreting information and limited resource for supply chain development had created difficulties in managing this part of the process. However, as previously mentioned standardisation of the process, would help to remove some of the obstacles.

Learning and systems

Sportsco's planning time was insufficient and mistakes were made which resulted in later rework (interviews, Garment Engineer and Sample Supervisor), where drawings, artwork or information was found to be incomplete. All the product categories were being forced into the same time-scale, although there were different lead times for each product category. Late delivery and incorrect samples cause delay in the process. The supplier may not have delivered in full on time, causing part order availability, and part order fill with the customer. The issues with quality were previously commented on as being difficult to trace, unless caught at the goods-in inspection. Quality issues then become the responsibility of Sportsco's own manufacturing section, as repairs or rework was required before the product could be sold on to the customer. This caused delay, and a requirement for space for rework to be carried out. Lack of timely marketing information meant the photoshoot for the publicity in store marketing took place too early as the decision of retail product selection was not to be until a much later date. There was a lack of time for feedback on the range from the retailer and sales force. The sales operation was under pressure

to reduce prices due to the high value of the pound and there were differences between the sales force and design as to the agreed calculation of gross margin issues. This was because they were unclear how margins were being attributed to different products.

A clear understanding of the process was required for all the team involved. The members then knew the variables and process that they were working with and could make informed decisions that would reflect the purpose and required outcomes of the team.

Sportsco had high stock levels, which were partly due to the seasonal delivery periods set by their customers, and partly to the supply chain batch and queuing of orders and deliveries. This created peaks and troughs in purchasing (raw materials and out-sourced finished product), in manufacturing and in the warehouse and delivery operations. This was then reflected in the long response time (194 days - see figure 4.25, Task I.D.1) which they achieved with their current process. High levels of stock had been required because of the uncertainty of tasks and difficulty with the reliability of suppliers of raw materials and finished stock.

The purchasing department for raw materials had to a great extent resolved stock holding, by forward-booking production with the fabric mills and making decisions on what they would produce on a Just In Time basis, linked to Sportsco's manufacturing schedules. The selection of key suppliers to work on supply chain development had improved their lead time and reduced raw material stock levels. However, on the out-sourced finished product the delivery performance had been poor (see chart 4.2), and there had been quality problems and rework on the product when it arrived at Sportsco (interview, Factory Manager). This, along with long lead times from the Far East, and problems with the exchange and understanding of information between Sportsco and their suppliers, had resulted in increased lead time. This same problem of information exchange internally in Sportsco affected their own manufacturing capability. Therefore if they could have standardised the process of product development to ensure information accuracy and completeness, then - hopefully - delays to their own and to out-sourced manufactured products should have been

removed or at least reduced to a manageable level. Sportsco was at the early stages of working more closely with their out-source suppliers and an ongoing programme of quality improvement was being applied. Traceability of defects was a problem and this was a key area to focus the resource on future quality improvements.

Sportsco's customer delivery problems

Some of Sportsco's customers contract on a call-off agreement for specified delivery dates. When the products were available for the customer Sportsco had to confirm the delivery with them and the customer should then have accepted the product into their retail outlets. However, some of the customers would respond by asking for the product to be held by Sportsco for call-off at a later date from their original instruction. This delay in despatch is termed as 'cherry picking' where the retailer selects only certain products for call-off even though their order is to be made available from a specified date (interview, Sales Director). The products were confined to that customer and therefore could not be sent out to other customers who were waiting for product; this was to ensure that when the customer's range of products was picked for despatch, all the products were available, ensuring complete order fill.

Sportco's sales force had created a hierarchy for their customers and the more powerful the customer, the more latitude was given to the customer altering the terms of the contract regarding the delivery of the products. Customer tactics of delaying despatch, reducing the quantities they wished to accept or, less occasionally, asking for the cancellation of an order, were common occurrences (interview, Sales Director).

4.4.8.2 Research methodology/ case study experience

Planned research

The access to the key players was achieved over the agreed time scale, one year, and analysis of a wide section of the internal and external supply chain was covered. The product supply chain was reviewed from concept to launch in one of the product categories. A supply map was generated to include fabric research and development,

product development and testing, marketing and sales and manufacturing, through to the customer.

Interviews were achieved across the structure of the organization at top, middle and lower points in the hierarchy. These included internal interviews, as previously described and external interviews with fabric manufacturers, accessory manufacturers, and a retailer for the product.

The use of participant observation allowed cross-sectional analysis from a functional viewpoint (see section 3.2.1, Gill and Johnson, (1997)). The integration across functions and the degree of interaction or lack of interaction could be directly observed from the perspective of the key players.

When semi-structured interviews were used in conjunction with participant observation, an overview was obtained of the supply chain, providing greater visibility of the degree of integration which was being achieved across the functions.

Data gathering

The semi-structured interviews formed the basis for understanding the product concept to launch process. The interviews gave insight into the problems that were occurring between functional boundaries within the organization. Those interviewed were able to voice their concerns regarding the organization's change and development plans for the future.

Secondary data was sought from the historical documents generated by the sourcing/ planning department who purchased finished goods off-shore. The historical data from 1996 was used to measure the ordering periods and delivery lead times, and the supplier's performance in delivering on time and in full to Sportsco. The secondary data was not easy to reconcile in two of the supplier's cases, due to the format of data presentation. Secondary data on the product development process was also examined to review the changes that had taken place over the last two years.

An improved overview of the organization was achieved when participating in the cross-functional group which was reviewing the product concept to launch process. The group was able to learn how the other functions within the organization perceived their role in the process and how they defined their boundaries. The culture of the organization was further explored during this period. First hand experience of group learning, and of overt and covert behaviour within the group, occurred.

Primary data from Sportsco's suppliers and a retail customer expanded the understanding of the whole supply chain process. This was done through face-to-face interviews. Sportsco felt confident to allow access to the retailer as they had established a strong relationship with them and were working towards category management with them. This was critical in closing the loop for the review of the 'whole' supply chain process, rather than the partial supply chain review that occurred while carrying out the Derbyshire Textiles case study.

CHAPTER 5 - RESEARCH RESULTS AND ANALYSIS

5.1 INTRODUCTION

The theoretical framework (see section 2.2) was formed from the theories of systems and socio-technical theory, contingency theory and learning theory. These theories led to the development of the core units for consideration - networks and relationships, learning, systems and product development, and environment and organizational ecology, bringing together the concepts and the theory. The verification of the supply chain development activities and the underlying issues were triangulated using different methods. Interviewing was carried out at various levels within each organization in an effort to give validity to the research in the three case studies.

This chapter analyses the findings from the three case studies and their supply chains. The reason for using three different case studies from the apparel and textiles sector is that they differ in size, structure and product innovation (see chapter 1, p.16-17). This cross-case approach to the study was considered more appropriate in that it raised the widest possible variety of issues, and allowed the comparison and contrast of the findings. The multiple case study approach allowed for the synthesis of the concept application of Supply Chain Management in different organizations. The case study protocol was the same in the three studies, with the exception of the use of participative observation and the increase in time for data collection for the longitudinal study at Sportsco. The Mulberry case study had limited scope with a partial supply chain in the area of packaging. This provided a good mix of case studies to enable understanding of apparel supply chain characteristics.

The first key areas for analysis are Supply Chain Management concepts, including general Supply Chain Management techniques, partnerships and supply chain development and learning organizations. Further key areas are: supply chain tactics, value chain analysis, cross-functional teams, and organizational approaches to product development. Further sub-sections include application, technology, communication and relationships. Additional analysis of the three case studies looks at practices relating to inventory and replenishment, purchasing, lead times, change and barriers to

change, and structure. Each of the case studies helps to answer the main research questions from a different perspective as they represent a span from low to high levels of innovation and product variety. The supply chain complexity across the cases also ranged from single/ dual supply chains to a portfolio of supply chains. Each supply chain was unique in that it could not be directly replicated, as the socio-technical system interface would have differed even when the core elements were the same. This means that the internal environment for each supply chain would have differed even if the external environment had remained the same. The combination of the people and the organizational culture formed a unique component of the supply chain relationship development and maintenance. Therefore even if the organization agreed on a best practice approach to SCM they generated different results, due to the variables described above.

The theory developed in chapter 2 was used in conjunction with the tools and techniques (see section 3.9) as a framework for the comparison of the empirical findings of the case studies. A parallel was drawn between the original findings in the automotive sector and those observed in the case studies, in particular the longitudinal study at Sportsco. Similarities and differences between sectors, and between case studies, and between their concepts for supply chain development, are analysed.

The case study research encompassed the three organizations' internal and external environments and the intra- and inter-company interaction process in relation to the product development process. The model developed by Hakansson (1982) (see figure 1.3), assisted in reviewing the organization's supply chain, and the differences and connections of buyer-supplier interaction, as illustrated in the model. This helped to focus consideration on the core units of the research (see figure 2.3): the environment and organizational ecology, network and relationships, learning, systems and product development; similarly, it helped in reviewing the variables of an organization's world. Hakansson's model includes both long- and short-term processes which are given direction and influenced by the key people at different levels. The internal and external environments are composed of the process structures and the social behaviour of the staff, including their degree and scope of power within the process.

Organizations may promote varying degrees of co-operation within their supply base based on past experience and conflicts in the interactions.

The product development strategy was reviewed based on the product categories described in Stevens, Wheelwright and Clark (1992): breakthrough projects, platform projects and derivative projects (see figure 2.16). The strategies for developing the different types of product innovation were analyzed, giving consideration to the competitive advantage concepts presented by Porter (1980, 1990) (see section 2.3.12), and the analysis of time based concepts (product innovation, first to market, rapid presence of new technology in the marketplace) described by Stalk and Hout (1990). The learning review for the organization used the models adapted from Pedler *et al.* (1991) (see figure 2.2), and Child (1984) (see chapter 2, p.28), and the project management methods developed for multi-project management by Cusumano and Nobeoka (1998) (see figure 2.14).

5.2 THE APPLICATION OF SUPPLY CHAIN MANAGEMENT CONCEPTS

5.2.1 General Supply Chain Management techniques

The prevalence of UK manufacturing practices (previously described by Waterson *et al.* (1996)) (see chapter 2, p.40), forms a framework when reviewing the application of SCM practices in the three case studies. These practices include team-based working, JIT, TQM, concurrent engineering, promoting a learning culture, outsourcing, supply chain partnering and business process reengineering (see figure 5.1).

Figure 5.1 Application of supply chain concepts

	Mulberry	Derbyshire Textiles	Sportsco
Team based working			☑
JIT		☑	
TQM		☑	☑
Concurrent engineering			
Learning culture			☑
Outsourcing	☑	☑	☑
Supply chain partnering		☑	
Business process reengineering		☑	☑

Source: Primary research - three case studies

Mulberry outsourced the manufacture of their packaging products and perhaps as a consequence had not applied their resources to developing other supply chain concepts. The design was carried out in-house. Mulberry could have improved their packaging supply chain by applying a strategy that focused on improvement in all the other areas.

Derbyshire Textiles had applied several of the supply chain concepts, including JIT and TQM. They had also formed partnerships with their outsource fabric knitting and dyeing and finishing organizations. Derbyshire Textiles was at the early stages of carrying out business process reengineering. Team-based working was not applied in the manufacturing area due to a bad experience of team cells in Courtaulds (where the directors had previously worked). However, key partners were operating as a team to create flow in the supply chain. They had omitted the learning culture which would have helped them to regenerate the business and sustain continuous improvement. Little design was carried out and concurrent engineering was not a consideration.

Sportsco operated team-based working in the area of design and apparel engineering. They also operated teams in part of their manufacturing section where a high degree of product variety and complexity occurs. Kaizen activities were operational in areas

such as time from product concept to launch and sampling. Elements of TQM were being used, but the traceability of statistics was poor and activity often focused on reactive activities caused by failure or defects. Sportsco had the CAD technology but were not using this concurrently with their suppliers. They used the CAD system mainly as a means of transmitting the design across geographic boundaries. Sportsco had established an Investors In People programme and had a recruitment policy to achieve the restructuring of the desired organization. This involved re-evaluating job descriptions and redefining functional boundaries prior to advertising any replacement or additional posts. Sportsco outsourced finished products, raw materials and some areas of the production process. The finished products may have been from off-shore sources requiring formalised systems and measurement. Business process re-engineering was a continuous process at Sportsco. This may have been a reflection of the complexity of the organization and the external environmental pressure for changes to the processes or organizational structure. They are attempting to be proactive in their reengineering by aligning the organization and operations to achieve their vision.

None of the case organizations applied all of the concepts, which indicated a lack of overall strategy for SCM. Davis (1995) describes a Commitment Agreement to be set by top management and disseminated 'by them', which requires a long-term SCM commitment and the development of a culture that shares knowledge across functional boundaries. Management has to own the supply chain and take responsibility. The SCM message has to be delivered with enthusiasm (for the project) by senior management, and this was not apparent in any of the three case studies.

5.2.2 Partnerships and supply chain development

Partnerships are established to manage issues of flexibility of demand and manufacturing capacity, to reduce time from concept to product launch, to generate innovation and reduce waste in the supply chain through greater visibility. In apparel and textiles the life cycle of the product is short, so it is critical to optimize the efficiency of all members of the chain. Partnerships require resource deployment and it is therefore essential that a formal commitment is recognized when dealing with the

key partners. This is often implied by the partners to the agreement but no evidence was found in the case study partnerships, causing friction in their relationship. The partners needed to develop trust internally and externally before the barriers to change could be removed. It was observed that hidden agendas and high turnover of personnel (see section 4.4.7) hindered the aims and objectives which the partnership was targeting.

Figure 5.2 compares the elements that were highlighted as the criteria for an effective partnership (see section 2.3.5). The primary research carried out in each of the three case study organizations has been compared to the criteria set by Moss-Kanter (see figure 2.8), to see how they fit. Each criterion is graded as of high, medium, or low importance based on the interviews and observations made during the primary case study research.

Figure 5.2 Partnership analysis with suppliers, based on figure 2.8 (see chapter 2, p.48).

	Mulberry		Derbyshire Textiles		Sportsco	
	Internal	External	Internal	External	Internal	External
	Mulberry	Supplier	Derbyshire	Textile Supplier	Sportsco	Supplier
Importance: is the business 'strategically significant' to the customer or supplier	L	L	H	H	H	M
Investment: 'willing to invest'	L	M	M	M	H	M
Information: 'exchange of information	L	H	H	H	M	M
Integration: 'connect at all levels'	L	M	H	H	L	L
Interdependence: 'cannot exist without each other'	L	L	M	M	H	M
Institutionalisation 'formal mechanisms, structure'	L	H	H	H	M	M
Integrity: 'respect, mutuality, trust'	L	L	H	H	M	M

Key: Low L
Medium M
High H

(Source: adapted from Moss-Kanter (1996) using primary research - assessments based on case study interviews and participant observation.)

Figure 5.2 reviews how each case study organization viewed the criteria in relation to the suppliers and how the supplier viewed the criteria in relation to their customer (the case study organization).

Mulberry considered their supplier not to be strategically significant. They appeared unwilling to invest resources in them; they had a low information exchange

dependency and low formal mechanisms and structure. There was a lack of trust of the supplier and minimal sharing was observed.

The main supplier to Mulberry considered them of low strategic significance in that they had a well-established customer base and they had invested in integrating their supply chain and developing the supply chain with other customers. They were willing to invest in their supply chain and had offered Mulberry value adding services that had not been considered. The supplier's internal supply chain was integrated, but the external integration across the organizations in the supply chain did not occur, partially because of the lack of information exchange. The supplier could exist without Mulberry and they did have formal mechanism and structure internally, but not externally with Mulberry. The supplier was unable to trust Mulberry because of the adversarial nature of the relationship, and the lack of information exchange. Overall the two organizations failed to meet the criteria for an effective partnership, but had the potential to do so if they wished to change.

In the case of Derbyshire Textiles and their suppliers, the perceptions matched across the set criteria - this was thus described as having a good fit (see chapter 2, p.29). They had established a network where they had become strategically significant to each other. They did have respect, mutuality and trust for each other and had developed formal mechanisms and structure to operate the supply chain network. This was a good example of successful partnering. They were willing to invest as long as they would still have a fit with the rest of their customer base. They had a high level of integration that connected at all levels. They did have a portfolio of customers and therefore they could exist without each other.

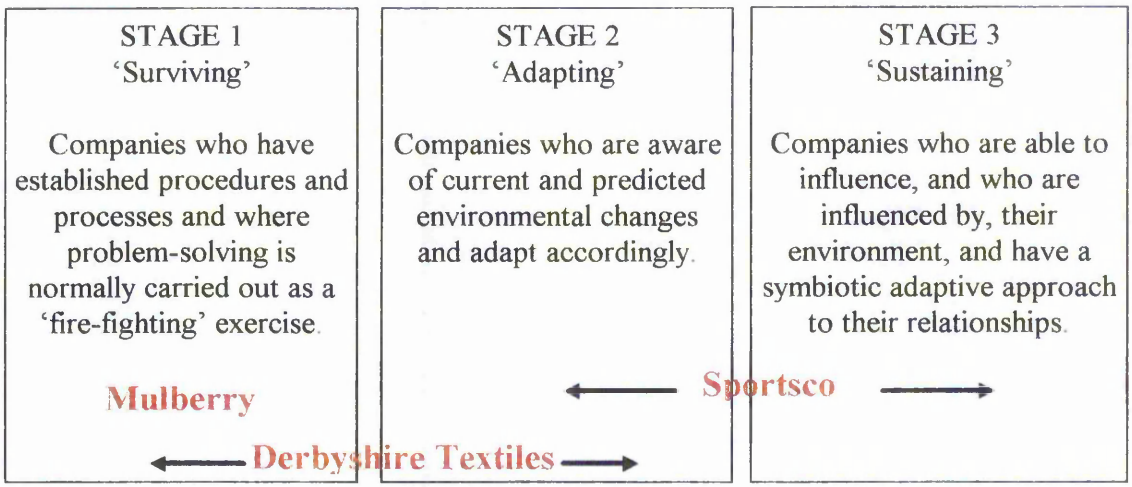
Sportsco considered their suppliers to be strategically significant and they were willing to invest resources for their development. The information exchange between Sportsco and their suppliers was improving but not connecting at all levels of the organizations. Sportsco had a higher dependency on their raw material suppliers than the supplier had on them. The structure and formal mechanisms were beginning to be established between the organizations but continual improvement was the main focus along with the development of trust and respect between the participating partners.

Sportsco's key raw material suppliers operated from a strong power base. So Sportsco were less strategically significant to them. However, the supplier did invest resources as they wanted to be associated with leading-edge innovations. Sportsco had a highly visible brand image and was well-recognized in the market-place. The suppliers respected Sportsco's innovative abilities and integrity and trusted that product development would be of mutual interest.

5.2.3 Learning organizations

The product development process requires a great effort across a large group of multi-skilled practitioners. The creation of a learning organization (see section 2.2.3), can help to maintain the balance with the internal and external environment and meet the changing needs of the organization. In figure 5.3, figure 2.2 has been adapted to measure each case study organization's stage of learning development:

Figure 5.3 Learning companies



(Source : primary data from three case studies.)

Mulberry was at stage 1 as a learning organization regarding their packaging supply chain operation. They had procedures and processes that required reviewing as they focused their efforts on fire-fighting in this supply chain. Derbyshire Textiles fell between stages 1 and 2 where they were surviving, but were following an approach which led into adapting to their current and future environment needs. They established partnerships with their key suppliers but they had not been carrying out

activities to sustain their relationships. Sportsco was the most progressive in developing a learning organization, having slightly more influence over their market than Derbyshire Textiles because they were a brand leader within their market. Sportsco had a high level of innovation and required a symbiotic adaptive approach to their inter- and intra-organizational relationships. Their Investors in People programme recognized the need for continuous personnel development, acknowledging Sportsco's commitment to developing as an adaptive learning company. This learning approach will hopefully sustain their continuous improvement.

5.3 SUPPLY CHAIN TACTICS ANALYSIS

At the end of chapter 2, the common key features of all the tactics used in the supply chain concepts were identified as value chain identification, continuous improvement, cross-functional problem-solving, proactive collaboration, removing waste and operating to a pull system. The tactics have been identified as present or missing for the three case studies and illustrated in figure 5.4. The diagram shows that none of the case studies had applied all of the tactics, but had taken a piecemeal approach (see section 2.3.3).

Figure 5.4 application of SCM tactics

	Mulberry	Derbyshire Textiles	Sportsco
Value chain identification		☑	☑
Continuous improvement			☑
Cross-functional problem-solving		☑	☑
Proactive collaboration		☑	☑
Removing waste			
Operating to a pull system		☑	

(Source: primary research - case study interviews and participant observation.)

The tactic of removing waste (see Lean, section 2.3.6) was not in evidence at Mulberry or at Derbyshire Textiles, but Sportsco were reviewing the waste relating to time delays in taking the product from concept to launch.

Mulberry had not applied any of the tactics to the area of packaging. This could be explained by their lack of interest in the purchase, due to the small budget which it represented. This resulted in a lack of traceability or review of the order fulfilment process, and therefore no improvement in their supply chain.

Derbyshire Textiles were operating a pull system and had identified the value chain. However, they had omitted the concept of continuous improvement and as a result their value chain had not been reviewed for several years. They operated cross-functional problem-solving and inter- and intra-company proactive collaborative techniques. Derbyshire Textiles had lagged behind in the application of waste removal tactics, although consideration had been given to this when the supply chain was originally established.

Sportsco had started to implement value chain analysis, but they were still at the early stages and had recently introduced cross-functional teams for problem-solving. However, some problems had arisen where a conflict of roles occurred:

> *Roles should be more focused and less cross-functional; with the cross-functional team they can't concentrate their efforts in set areas for the required time, as the pressures from the other areas are too great.*
> (Interview, Product Manager.)

This statement reflects the additional resources that are required to allow the team members to carry out proactive participation that results in action. At the time of the study they were expected to take on additional cross-functional team activities that then impacted on the time available to carry out their core function.

Sportsco were changing to a proactive collaboration with their suppliers and this was starting to be seen in the area of raw material purchasing (see chapter 4, p.201). They were looking at the time element of waste and they had projects to reduce the time from concept to launch. However, the other areas of waste (see chapter 2, p.49-50

and chapter 4, Sportsco case study), had not been addressed and they suffered from overproduction, waiting, unnecessary transportation (double handling), inappropriate processing, unnecessary inventory, unnecessary motion (due to the layout of the manufacturing), defects (mainly from the out-sourced products) and the untapped potential of highly skilled and very dedicated personnel. Sportsco had an issue with their systems which were in place and they were trying to address this problem. However, it involved a major task of integration due to the complexity and uncertainty of their environment. Sportsco also wasted energy on double handling and having manufacturing and warehouse sites in several different locations. They were reviewing the possibility of having everything on one site.

5.3.1 Value chain analysis

Value chain analysis is carried out to review the effectiveness of the chain, the flexibility of the supply chain, skills requirement, links in the chain, and to raise awareness of the chain within chains and of the networks that have been established between organizations.

Value chain mapping was carried out in all three case study organizations, and in all cases it was found that the flow of products was interrupted and waste could be removed from the chain. The focus was on time from concept to launch. In the case of Mulberry this could have been reduced from 105 days to 87.2 days (see figures 4.4 and 4.5), for Derbyshire Textiles could have dropped from 32 days to 13.6 days (see figure 4.12 and 4.13), and a targeted possible 5.6 days (see figure 4.14). Sportsco could have reduced their time from 194 days to 176 days (see figure 4.25 and 4.34). The value stream mapping was a starting point for awareness-raising and it was then used to focus on areas for improvement. This involved mapping the baseline and tracking improvement, while displaying the results visually for all to see. The data was recorded by team members and not by external representatives - they owned their data. This approach reinforces teams' efforts through peer recognition. Problems are controllable and the team approach brings about remedial action to the problem, not defensive blaming.

The process flow diagram illustrates the flow of goods and information and indicates the tasks and exchanges that take place from the start to the end of the process. By representing the whole of the process each task can be reviewed to check efficient flow and opportunities for improvement. When this diagram is completed, all the team personnel can understand where they fit into the overall process and can assist in actions for continuous improvement (see figure 4.24, Sportsco case study).

5.3.2 Cross-functional teams

Cross-functional teams should be comprised of representatives who form the links in the chain for the work flow (see section 4.4.6, Sportsco case study). The team members become responsible for their process. To be part of the team there should be a 'willingness to share knowledge egalitarian communication talents, common sense, consideration, empathy and kindness', (Schonberger, 1996, p.181).

Teams must be committed to operating together and have a consensus approach regarding their roles and responsibilities and how the tasks are performed. The team method is in conflict with today's workforce mobility in that it creates unrest when new team players are brought in at top or middle management level. This is often described as being brought in 'for a rescue operation', (Deming, 1982). The existing team members then lose the original consensus and the ground rules have to be re-established. This happened several times at Sportsco with key players leaving to take up jobs with other organizations or to transfer within the parent company.

5.3.3 Product development analysis

The product development activity in the three case studies has been schematically represented in figure 5.6, to show variables in the types of product development that is taking place, the supply chain environment for the task, the nature of the product complexity and the turbulence relating to the market sector for each supply chain.

The three case studies showed differences in the degree of task certainty or uncertainty in relation to product development. Task certainty or uncertainty characteristics are illustrated in figure 5.5 and show that task certainty requires the following conditions: a static environment, high volume, centralised decision-making

within a formal structure and products which have a long life cycle. For task uncertainty the criteria are a turbulent environment, a high degree of product variety, decentralised decision-making, an informal structure to the supply chain and products with a short life cycle. The degree of task certainty or uncertainty in product development was compared with the theory of chapter 2, and forms part of the analysis in figure 5.6.

Figure 5. 5 Task certainty vs. Task uncertainty

Task certainty	Task uncertainty
Static	Turbulent
Volume	Variety
Centralized	Decentralized
Formal structure of supply chain	Informal structure of supply chain
Long life cycle	Short life cycle

The criteria determining the complexity of the market used in figure 5.6 were defined earlier (see chapter 2, p.24).

Figure 5.6 Product development in the three case studies.

		Mulberry	Derbyshire Textiles	Sportsco
Type of product development	Derivative	✓	✓	✓
	Platform	✓		✓
	Breakthrough			✓
Supply chain environment	Task certainty	✓	✓	
	Task uncertainty			✓
Product	Complex			✓
	Simple	✓	✓	
Market	Static	✓	✓	
	Rapid change			✓

(Source : primary research - case study interviews and participant observation.)

Mulberry's product development of packaging operated in the derivative or platform area with a high level of task certainty and was a simple product that was being offered in a static market. Derbyshire Textiles product development was based on derivative products which had a high degree of task certainty and were simple. The market they operated in was static and this had created problems for them in that they needed to be innovative in order to differentiate themselves from the rest of the suppliers to this market. Otherwise they would have competed only on the commodity price element (see section 2.3.12). It was recommended that they employ a designer to make improvements through product innovation and diversification. Sportsco's product development operated in all three areas (derivative, platform and breakthrough) and had a high level of task uncertainty. This was emphasised by a focus on breakthrough unique products that would maintain the company's brand position in the market. Their products were complex in nature as they not only had to fit quality requirements but had to be ergonomically robust to meet sporting demands. As the product often had to fit the human body closely the demands placed on the materials and manufacture meant they had to be of a high quality. Sportsco operated under the greatest variability in the market-place with a high level of change and fluctuation.

Sportsco was attempting to compete on time, innovation and quality. Brand promotion included the sponsorship of sporting personalities to enhance the product value perception. Sportsco were trying to change by diversifying product categories, changing the structure of the organization and increasing innovation of new products through the use of new technology. There were several areas of range development that could be described as portfolio management. The range comprised of highly innovative sports/ leisurewear, capsule product ranges, core products and carry-forward products, as part of their product offer covering the full range of their market-place (see figure 5.7).

Figure 5.7 Sportsco range strategies

Range composition	Purpose	Competition	Pricing	Volume
Highly innovative performance sports/ leisurewear	Maintain brand leadership	Medium	Medium sensitivity - price set to target	Low
Capsule product range	Maintain brand image for fashion and performance	Medium	Medium sensitivity - market set the price	Medium to High
Core products	Maintain brand image for good basics	High	Highly sensitive commodity pricing by retailer and final customer	High
Carry forwards	Maintain brand and continuity with previous seasons' range	High	Highly sensitive competitive pricing	Medium - High

(Source: Sportsco - interviews and historical data.)

The range comprised of a mixture of product types. The highly innovative breakthrough products helped to maintain brand leadership; these tended to be less price-sensitive, lower in volume and represented the area of highest investment risk. As they were low volume the research and development cost was difficult to recover. However, these developments would create the next generation of platform products, which formed part of the capsule product ranges. The capsule range was aimed at the fashion and performance sector and had average intensity of competition and sensitivity to pricing. The capsule range was target-costed. These products would be competing more on design content and performance. Core products were basic products which had reduced design input and were more subject to commodity pricing, this was considered to be the high volume category and return on research and development should have been achieved. Carry-forwards would be the same styling and fabric but perhaps with different labelling or slight variation to the fabric specification; they were in a highly competitive price environment. Rapid innovation did, however, create obsolescence of design and any outstanding inventory became difficult to sell at even a cost value.

5.3.4 Innovation in apparel and textiles

Apparel can be said to have similar life cycle to the electronics industry, and to an extent apparel companies build in obsolescence when introducing new products. The need to switch sources due to technology advances is done by leap-frogging.

The Sportsco case study has been used to illustrate how apparel organizations operate. The way that they were operating at the time of the study was short-term and in fire-fighting mode, and they had high levels of pressure at peak times, usually prior to internal launches and official product launches. This can be illustrated by the map of time allocation, (see figure 4.33). There were the additional costs of reworking prototypes (partly due to non-availability of production materials of the correct performance/ quality) and there were also production problems when bulk production commenced.

Manufacturing met with problems of redesigning manufacturing processes necessitated by restriction on machine availability and compounded by the lack of sufficient correct materials for machineability testing prior to bulk production. Machine tests were carried out, but fabric combinations within one garment created problems during bulk production due to slippage, or poor machineability of one fabric with another. Last minute production modifications or missing accessories such as sew in labels or swing tags effected the end of the process and created bottlenecks for order fulfilment and poor performance. The manufacturing focus was on reduced cost, such as maximum size lays (cutting batch) for low material wastage and associated large batch production. Costings were based on operator machine time, irrespective of the time work was 'work in progress' within the factory, and the time then spent in stock as finished inventory.

A lot of effort was going into designing quality into the product but there was limited opportunity to design manufacturability into the manufacturing process. This was often left until the last minute, slightly before or during bulk production of the samples:

> *We don't have enough input into the actual manufacturing variations that are possible, we don't have enough time to experiment with new machines.*
> (Interview, Production Manager.)

The collaboration was limited in some cases and manufacturing was unclear what it would be making six months later. This was partly due to the long time allowed for the selling process and partly to the delay in recognizing production requirements for new machine processes, such as attachments/ folders to improve the process.

Examples of textiles innovation were the development of fabrics which absorbed or dissipated moisture or which allowed a sportsperson to challenge existing product performance for aerodynamic or ergonomic qualities. The customer did not always appreciate the benefits of the innovation. Conversely, innovation opened up the possibility of creating obsolescence in the company's existing own products.

Most apparel sold in retail outlets has a short life cycle relative to engineering/ automotive products. In response to this, manufacturers and retailers have developed a process of trialling products in their key stores. They measure customer demand using EPoS data, then decide whether to open the offer to selected stores or discontinue the product offer. The method of Quick Response is used to satisfy this demand within a short period of time. The retail data will also measure the demand by colour and by size to optimize the ratio offer of the product. With apparel it can be difficult to profile the customer that will actually purchase the product, and even more difficult to determine the physical size of those customers or their colour preferences.

Many apparel and textile companies create their own ranges, usually to a rough brief of trends/ mood, colour palettes and, in some cases, silhouettes. The retailer is already dependent on the supplier's ability to innovate, in some cases using new technology. An open protocol exists for review of new concepts, advances in raw materials and processing (interview, Sales Director). Joint collaboration may take place but often the main activity lies with the seller (manufacturer or importer). The brand manufacturer has autonomy of design and in many cases can dictate to the

retailer on ranges, colour palettes, delivery schedules and point of sale merchandising, as was the case with Sportsco.

There is a level of risk in product development in that it may go to launch and then not sell to the market. The variables of material weights, colour palettes, print combinations or silhouettes create problems when trying to satisfy the preferences of the customers in an international market-place (interview, Design Manager and International Sales Director). The resulting need for damage limitation is met by producing as wide a product offer as possible. This creates a risk of reduced order size and uneconomic production quantities for materials. Although a product may sell to the market-place, in this case the retailer, it may not then sell to the customer or end user. If this happens, it results in stagnant stock in retail and slow call-off of any back-up inventory held at the manufacturer, awaiting call-off. The options are then to sell that inventory to another market (another country) where the product is selling, allowing the retailer whose stock is not selling to replace it with another product. However, as orders are normally placed six months prior to delivery it may not be possible to replace slow moving products. Occasionally fluctuating international markets may create a situation where countries fall into short-term recession/ decline over a limited period of time, and withdraw their orders, making stock available.

5.3.5 Product development in automotive and apparel and textiles industries compared

Product development in the apparel and textiles industry tends to have a more holistic approach than in comparison with the automotive industry with less specialization. According to Womack *et al.* (1990), automotive industry mass-production was highly focused on specific areas, such as door lock design but not manufacture. A comparison between product prototypes in the automotive industry (see table 2.1) and the Sportsco case study (see section 4.4) shows that the apparel development time was 20% that of a car, with 2% of the number of employees. They generated 6.5 times more body types with around the same number of shared body parts. They had 63% more input from suppliers' engineers and had the same time from production start to first sale (see table 5.1).

Table 5.1 Apparel prototypes

Comparison between the automotive and clothing sectors:

	Apparel	Automotive
Average development time in months	9.7	46.2
Number of employees in project team	10	485
Number of body types	15	2.3
Average ratio of shared body parts (%)	20	18
Supplier share of parts engineering (%)*	70	51
Prototype Lead time (months)	1	6.2
Supplier share of total engineering effort (%)*	10	30
Time from production start to first sale (months)	1	1

(Source: Sportsco case study.)[* estimated]

Womack *et al.* (1990) describe how Ohno & Toyoda focused on product and process engineering using a team of multi-disciplined players. This already occurs with apparel and textiles, as where design and process engineering are closely linked and close team-work is a requirement. However, where new technology is involved this can lead to problems, caused by the difference between prototyping and small batch production, and on-line full production. Quality issues and new equipment may pose manufacturing problems. A decisions to accept a design after a trial/ batch has been produced (using existing processing techniques) may necessitate new processing techniques when bulk production is agreed. Investment in new equipment is only made once confirmation of order (sufficient volume) is confirmed, making it viable to manufacture. This late commitment to actual production methods may result in delay, defects or rework as there is insufficient time available to test the product again prior to bulk production.

Figure 5.8 compares the product development of an automotive organization with that of an apparel organization, and shows the range of differences between the two forms. The automotive industry example is taken from Toyota and the research of Cusumano and Nobeoka (1998) (see figure 2.14). The comparison has been made with the primary case study research into Sportsco.

Figure 5.8 Product development in automotive sector compared to apparel and textiles sector

Toyota *	Sportsco
Autonomy of engineering	Autonomy of product development
1.5 - 2 years sole project	12 months period - 2 project at 3 stages e.g. research and development, product development, and manufacture
Independence of projects - some lateral integration	Research and development linked to all product management
Narrow specialisation	Broad specialization
Move towards multi-project managers	Same manager controls several projects
Increased focus on cost	Increased focus on cost
Increase in product offer	Reduction in the product offer
Restructuring taking place	Restructuring taking place
Increased product segmentation	Increased product segmentation
Portfolio management	Portfolio management
Engineering develops platforms and technical product specifications	Transfer of technology across product categories more apparent
Develop the use of target costing	Develop the use of target costing
Average 5 platforms - 36 models	15 silhouettes 260 SKUs
Component sharing	Component sharing
Product life cycle 4 years	Product life cycle 6 months
5,000 people in core product development	20 people in core product development
5,000-6,000 parts per product	20 - 40
Average lead time 60 months	Average lead time 9 months

* Nobeoka and Cusumano (1995)
(Source: Toyota information from Nobeoka and Cusumano (1995) used to compare with primary resource data from Sportsco case study data.)

The autonomy of the designers or the engineers was the same in the automotive and the apparel organization. The time for product development projects was one and a half to two years for a sole project in the automotive sector while the apparel sector would produce two projects in a twelve month period and would oversee three stages. These stages are research and development, product development and manufacture for bulk. In automotives there is independence of projects with some lateral integration, although in the case of Toyota they were moving towards

horizontal integration. The apparel and textile example of product development (see Figure 4.21) shows that research and development is linked to all the projects (in this case five product categories) and horizontal and virtual integration occurred. This helped to transfer technology and knowledge simultaneously to all product categories as it occurs. Toyota engineers had previously been very specialised but this was changing, according to Nobeoka and Cusumano (1995). Sportsco had a broad specialisation as it needed to assimilate new skills rapidly due to the short life cycle and rapid change of products and technology. Toyota were moving to multi-project managers while Sportsco already operated in this way. Toyota and Sportsco both had an increased focus on cost due to the pressures in their market environment, including increased competition. Toyota were increasing their product offer while Sportsco had tried this approach and found that the more products they offered, the higher the likelihood of dilution and diminishing returns for each product. This caused problems with cost structures, purchasing of raw materials and scheduling of manufacture. They were reducing their product offer at the time of the study. Both organizations were restructuring their product development operation and were increasing their product segmentation in an effort to increase their overall market share.

Toyota and Sportsco both operated portfolio management to ensure that all product categories and market sectors fitted with their existing and proposed markets. New products were introduced to complement the core products and to replace those which were coming to the end of their product life cycle or which had proved a mismatch with their customer.

The Sportsco case study shows the rapid transfer of technology to all product projects. This appears have been slower to transfer in Toyota's case. Both organizations used target costing to price their products to fit with customer retail price points. Toyota worked with five platforms to design their product offer while Sportsco worked with 15 silhouettes. Both companies shared components across products. The product life cycle for a car is four years at Toyota while at Sportsco it is six months due to seasonality and changes in fashion. One of the most noticeable differences was the number of engineers who were used in Toyota - 5,000 core product developers - , compared to Sportsco, where there was a core of 20 people

producing the products. The ratio of developers to the number of parts was the same. However, Toyota produced 36 models while Sportsco produced 260. The lead time for Toyota's car design was 60 months; in Sportsco time from the design concept to the product launch was nine months.

There are cost implications arising from the research and development needed to sustain innovation, and the recognition of requirements for shared benefits levels have to be addressed. The innovation of products may be characterised in two ways - incremental or leading-edge and have lower or higher investment accordingly. The research and development costs for leading edge innovation are usually much higher and the work is carried out over a longer period of time. This is in contrast with incremental developments, which could involve reverse engineering of a competitor's existing product. Any innovation involves risk and the level of collaboration will be dependent on the commitment of both parties to the relationship and the benefits returned by the investment. In the apparel sector research and development may prototype a garment, which may require several further prototypes. However, the retailer may decide not to buy the product from your company. The prototype could be given to a competitor who perhaps does not have research and development facilities and therefore could offer the product at a lower cost due to lower overhead costs (benchmarking interview, Centre for Work and Technology.) The power of the retailer (see section 1.1) means that the manufacturer/ designer has difficulty in controlling the ownership of the design once the prototype is with the retailer. Because the product's life is normally not more than six months, the window of opportunity for sales, and for the recovery of investment in research and development is limited by time. The manufacturer of the prototype needs to maintain business with the customer and as a consequence remains silent, hoping to receive other business in compensation.

This is unlike the automotive industry where suppliers are involved at the initial stages and have a target price to meet. The supplier will get the production business as long as they meet the requirements. The aftermarket sales could last for ten years or more, allowing them time to recover their research and development costs. The developments are often incremental in nature, in contrast with those of organizations

like Sportsco who are looking for a higher level of innovation on a breakthrough project level.

In the automotive industry, suppliers can deliver major sub-assemblies of the car on a JIT basis, direct to the production line. A comparable area in apparel and textiles is perhaps the manufacture of the garment, by a sub-contractor in a low cost country, to a stage where the garment is ready for dyeing and finishing (LATC, 1997). This is termed greige (prepared for dyeing and finishing) production. The garment is imported in partly finished state and sent for dyeing and finishing on a pull system of orders for a predetermined range of colourways. This allows for the fluctuation of demand by the retailer for specific colours on a Quick Response basis.

The apparel retailer places a contract with the manufacturer to have inventory of finished goods available for call-off at specific periods in time throughout the selling period. The manufacturer produces the product as per contract delivery date and notifies the retailer of availability, as required, via their EDI system. The production then awaits call-off, which may take days, weeks or, in some cases, months. This may be due to the lack of trust from the retailer, who may consider it necessary for inventory to be ready ahead of time (a buffer). This could be in case of unseasonal weather or the requirement of early product introduction. Alternatively it could be caused by a lack of awareness along the supply chain or lack of system integration:

> *It is not the individual abilities of strategies of buyers or sellers that are important: it is the mutual relationship between the two that is the key to their joint strategy*
> (Hines, 1995, p.135)

If the relationship between buyer and seller were more open to an agreed strategy, collaboration could be achieved and less waste generated.

5.4 THE APPLICATION OF TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

Figure 5.9 reviews the application of technology within the three case organizations. Mulberry had the capability of CAD/CAM, barcode and EPoS systems. Their packaging product was out sourced and they did not actually use their systems to

drive the process. The use of the Barcode and EPoS system would have been advantageous in their packaging supply chain (see chapter 4, p.130). They did have CAD capability but it was not used concurrently with the supplier.

Derbyshire Textiles had none of the listed technologies. However, the product was simple and derivative in nature so the frequency of use of CAD/CAM capabilities would have been low. Derbyshire Textiles investment in technology had not been a prerequisite for trading with their customers. They relied on the long-term relationships that they had developed over the previous 14 years, and the systems were dependent on minimal technology requirement.

In contrast to this Sportsco was a multi-site, multiple distribution organization which required technology to control the design, manufacture, sales, marketing and distribution of their product. Some of their end customers, usually the large mixed retail stores, required Sportsco to operate EDI as a pre-requisite for trading. However, it was not being used to its full advantage in that supply chain visibility into customers' systems had not been achieved and relied on the filtering of information between organizations. The multi-site nature of Sportsco internal supply chain (figure 4.23) demanded that information was available vertically and horizontally within the organization and accessible across functional boundaries. Product development was linked into the CAD/CAM system for design, lay planning, cutting and manufacture. Sportsco was trying to improve the links in CAD systems with external suppliers (see chapter 4, p.172). The use of barcodes was mainly for the inventory management, sales and distribution/ warehousing part of the organization. The high variety of products and the complexity of the portfolio of products lent itself to the technological transfer of information to ensure accuracy of data and to speed the transfer of information to all parts of the internal supply chain.

Figure 5.9 The application of technology - three case studies

	Types of technology used			
	EDI	CAD / CAM	Barcode	EPoS
Mulberry		✓	✓	✓
Derbyshire Textiles				
Sportsco	✓	✓	✓	

(Source: primary research - case study interviews.)

In the knitwear industry, technology such as CAD/CAM and ISDN can assist organizations to produce a prototype garment from concept to sample. Coats Viyella use this technology to support their product development and rapid prototyping, achieving concept to prototype in 48hours (LATC 1997).

A further area of technology applied in manufacturing is the use of robotic operations within the process. This has been successful in areas of the automotive industry like spot welding. Apparel and textiles has tried to automate with robotics but fabric manipulation - handling during machining operations - has proved too difficult due to the variety of fabrics being used and the flexibility of production required (Knox, Courtaulds FAGA project, 1992).

5.5 COMMUNICATION AND RELATIONSHIPS

The focus for communication is often transaction-orientated, and IT solutions are sought for the transfer of data. However, as previously mentioned, this data may not be informative as it may not be in a reliable format. At Sportsco, information was conflicting where IT systems such as Material Requirements Planning and Enterprise Resource Planning had been introduced - they had generated different reports depending on the source of data.

For a relationship to develop it should encourage face-to-face interaction across functions and organizations and rely as little as possible on e-mails and transaction documentation. The creation of cross-functional teams encourages this face-to-face communication and develops the relationships across functional silos; it was

commented that the possible downside is that 'too many people have so much say' (cross-functional team meeting).

The change in buyer/ supplier business interface is a key area of research, according to Carlisle and Parker (1989), Lamming (1993), Macbeth and Ferguson (1994) and Hines (1994). They all refer to this process as a two-way exchange, with shared responsibility for managing the supply chain 'as a requirement', moving away from an adversarial to a collaborative relationship. The main feature of an adversarial relationship is decisions being based mainly on price factors, ignoring other critical aspects such as quality, innovation, cost, delivery and ease of doing business, which add up to the total cost of acquisition. This is still a prime concern in apparel and textiles (interviews, Design Director and Commercial Finance Manager).

5.5.1 Relationship improvement process

The Supply Chain Management Group at Glasgow University Business School have been researching supply chain best practice for several years. Some of the elements of best practice they define are: support in sharing learning in areas of technology operations where internal customer training is already in place, which helps to develop and build on the relationships between companies as they become aware of the larger picture (five year business plans were exchanged between Sportsco and their key suppliers); extending and sharing the learning from one manufacturer to another within the customer's supply base; exchanging experienced personnel (fabric and garment engineering technicians were exchanged to assist Sportsco suppliers); inter-company exchange between customer and supplier. They argue that relationships development should be ongoing not only, in times of crisis.

People have become adept at protecting themselves from learning (Pedler *et al.*, 1991), so that, when faced with required change, they have already created a defence system in their working environment. This may have been the result of previous management initiatives which they have participated in, which, on successful completion, resulted in organizational change and job losses. If this happens, the

personnel, faced with the new initiative, appear to join in, while in reality participating non-actively as a method of maintaining the status quo.

Teams have to be committed to operating together and have a consensus approach to their roles and responsibilities and how tasks are performed (Schonberger, 1996). The team method is in conflict with today's workforce mobility in that it means that unrest is created when new team players are brought in at top or middle management level (this occurred during the Sportsco case study.) The existing team members then lose the original consensus and the ground rules have to be re-established (Deming, 1982).

The supplier has to understand the customer's operational needs. A mapping or flow chart of their part of the chain will illustrate the time-scale and information needs. The problem has been that when an economy is strong the companies within it are not under pressure to improve and change (Lamming, 1993). The Derbyshire Textiles case study illustrated this point: they became concerned about reviewing their supply chain as a means of improvement and change when there was a downturn in their business.

Resistance to change can take several forms: social, attitudinal, structural, organizational/ managerial and procedural (Macbeth and Ferguson, 1994). The holistic approach to change is therefore critical to success. Goldratt and Cox (1989) argue that an organization's hardest task is to bring about change. Resistance to change was observed at Mulberry and Sportsco (see 'change and barrier to change') (see sections 4.2.6 and 4.4.7).

Systems have to include the interaction of personnel in order to build trust and relationships which can use the body of cross-functional knowledge across the companies to best advantage. The reliability of the system both inter- and intra-company, will reduce cost in the supply chain.

> *If greater responsiveness to customers is the goal, then systems to eliminate unpredictable elements in processes and thereby support part and product flows should probably head the agenda.*
> (Haas, 1991, p.13.)

Information comes at a cost because the need for personnel to collect, process and maintain the system to ensure that the information is up to date. Therefore the data that is processed has to be of value to the people who make decisions based on the information (see 'network systems' section 4.4.5).

Systems may be technically driven or people driven, formal or informal. However agreement on a form of system approach is required for supply chain integration to be effective (see 'learning and systems' sections, 4.3.7, 4.4.7).

5.6 COMPANY CHANGES

The employees within an organization are the stakeholders in the process of supply chain development. It is therefore important that they are involved as 'human action arises from the sense that people make of different situations, rather than as a direct response from external stimuli' (Easterby-Smith *et al.*, 1991, p.24). Peters (1989) is concerned that changes occur more readily where the employees assist in formulating the strategies. This happens as a result of the organization focusing on inter-relationships and internal culture and power within the company. The frame of reference for culture was "values and assumptions that lend meaning to the outward aspect of the culture" (Styles, cited in Wass and Wells 1994).

The value described above is formalised to refer to performance goals and measures set both by the organization, and the personnel concerned. This also includes the preferences for achieving these goals (Rokeach, cited in Wass *et al.*, 1994). The cross-functional team approach to the supply chain development is an effort to aggregate the values, goals and methods used across the process of product development.

In the case of Sportsco, the framework for improving the progress of the product from concept to launch consisted of: the removal of intermediary links in the distribution channels; each division taking ownership for their inventory; orders for manufacture being given only on receipt of customer orders; the development of cross-functional teams; the restructuring of the company, changes in job specifications moving towards a cross-functional specification and restructuring of departments; the outsourcing of specialists to carry out part of the marketing package - the catalogue - which required experienced CAD operatives. Sportsco increased the personnel in the procurement department in order to focus efforts on reducing the 70% of product cost represented by materials acquisition and supplier development. This led to the reduction of the supply base and initiation of new contracting and procurement processes to allow for greater flexibility and the development of key core materials suppliers.

The approach for developing partnership sourcing involves: encouraging inter- and intra-organizational relationships; a long-term strategy; working closely as a team, while operating together as one supply chain which supplies the end customer. This approach to a long-term strategy with suppliers was in evidence at Derbyshire Textiles and at Sportsco. The principle that 'mutual obligation... means a long-term commitment for mutual survival' (Macbeth and Ferguson, 1994, p.2) was used to define the commitment needed for successful Supply Chain Management. The motivation for many companies is to survive in an uncertain environment. The key is the desire of each company in the chain to survive - not just the survival of the main company driving the improvement.

The faster and more accurate transfer of information can lead to improvements in the overall supply chain's efficiency in providing the right product, of the right quality, in the right place at the right time (interview, cross-functional team at Sportsco). Technological systems, however, are only one aspect of supply chain improvement and are dependent on the collaborative relationship which exists between the supply chain partners. An example of a non-collaborative relationship could be when a retailer 'cherry-picks orders' (see section 4.4.7, Sportsco's customer delivery problems).

5.6.1 Customer service

Sportsco were reviewing the key indicators that illustrated good customer practice. The markets were segmented as they had specific needs relating to their customers. They were generating a strategy to meet the requirements of the developing organization. Control mechanisms had to be put in place to measure, monitor and control. The result was an integrated management reporting system which could be used to measure performance against organizational targets. A proactive interface with the supplier and the customer had to be established. This was formulated on the 'who, when and how' of operations and good practice.

As a proportion of the manufacturer's goods were imported, further measures were used to calculate the operational costs. These measures included: stock minus sales divided by average inventories (this was measured because of the high holding cost

for imported goods); the cost of financing the import payment terms, shipping and handling costs and importation documentation, the greater risk associated with long lead times for Far East imports and the necessity for earlier decisions to be made. The cost of importing had to include negotiation via an agency, documentation including organizing an import licence, warehousing, holding inventory, quality checks and re-processing (example, ticketing for the retail requirement for floor-ready merchandise). The total cost of product acquisition had to be calculated taking into account all these areas and only then could the comparison be made with the cost of the company's own manufactured product. Sportsco did not have a total cost of acquisition measurement system and were therefore unable to draw a true parallel between bought-in products and their own manufacture.

Many apparel companies have garments made off-shore. This may take the form of a sub-contracting operation, a joint venture, licensing or another agreement. The nature of off-shore buying is in opposition to the Quick Response concept, because of the long lead time for shipment - four or five weeks, depending on location. The garments are bulky and the cheapest method of transport is by sea, but when shipping by sea the garments are packed in plastic bags and boxed in cartons. Then rework is required as garments have to be un-bagged, pressed and either re-packaged or presented hanging ready for distribution to the retail outlet. This requires further on-cost in the UK and often a third party contractor is used. Warehousing facilities are required as the total order is usually imported in one drop. The product is then stored until it is gradually called off by the retailer.

Some companies - Coats Viyella for example - bring in unfinished, undyed products which are then dyed in response to the PoS information that is supplied via the retail organization (LATC, 1997). This allows the retailer to delay decision-making until the last possible moment and select the colour of the garment only as demand requires, resulting in a pull-system in the later stages of the supply chain. There is considerable risk in early decision-making, which has been a requirement for off-shore buying of finished goods and this final finishing on a local basis has proved a successful operation. However, not all garments can be treated in this way, and it is more suited to knitted apparel. This is really pseudo-Quick Response, as there are

still long lead times required from the manufacture of the unfinished products to their receipt. Although a decision on the colour of the garment can be made at the last minute the size of the garment and ratio of sizes has already been determined many months ahead. The manufacturer who is importing these products is also carrying a high cost for unfinished goods inventory. In the apparel and textile industry, first-tier suppliers have moved much of their production off-shore while reducing their presence in the UK to one of customer service, warehousing and reprocessing. They offer support in finished goods or raw material inventory, which is held near to the customer.

5.7 INVENTORY

Sportsco's inventory lacked visibility. Goods were spreading throughout different warehouses and inventory was not measured in its different forms (raw materials, Work-In-Process, finished goods). These should have been balanced and measured at predetermined intervals. The stock turn for Sportsco was 2.5 per annum, reduced from 2.8 three years previously. Although they offered six capsule ranges a season, they sold those products twice a year. This perpetuated the low stock turns, as products were manufactured in bulk and stored ahead of time to await order consolidation. Sportsco only manufactured to order and were unable to replenish if the retailer sold out, except in a few cases where raw materials were readily available or when another customer had cancelled an order.

Visibility along the supply chain is usually affected by the manufacturing aspect of the process, and takes the form of Work-In-Progress. However, the finished goods inventory has recently been the focus for visibility as companies realise the waste that is contained in stockpiling finished goods. The size of the batch that is being sent along the supply chain is critical in creating visibility. Small batch sizes reduce the amount of inventory in the process, described as Work-In-Progress (Goldratt, 1990).

Inventory is a 'liability' (Macbeth and Ferguson, 1994), unless it can be sold. The annual report of a large apparel and textile company in 1994/5 illustrated how inventory was becoming a liability.

> *Major customers are increasingly calling off orders on a Just-In-Time Quick Response basis. As a result, a significant volume of previously ordered goods were not called off during the winter months.*
> (Annual report 1994/5, Duofold Performance Apparel USA, part of Dawson International plc)

As mentioned in the Sportsco case study, inventory was not being measured in its different forms but only in finished stock, making it hard to create visibility and therefore action any improvement. Products were only being made to orders. However, the large retailers selected their order by product or story and 'cherry-picked' the items they wanted first, then drip fed call-offs for the balance of the orders. Some products which were not called off were offered to the smaller independent retailers for immediate delivery, perhaps discounted.

Derbyshire Textiles only made to order and the goods were shipped on due date. The main inventory was in the raw materials which were held at different points in the supply chain (see figure 4.15). Mulberry had some problems with measuring inventory at the different parts of the internal supply chain; inventory allocated without being despatched disappeared from the inventory measure.

5.8 PURCHASING

Mulberry's packaging product was outsourced and had an annual negotiation which would fall under stage 2 of the supply chain positioning matrix, quality competition (see chapter 2, p.52). This classification indicates that little information was exchanged and no relationship development took place. Therefore figure 5.1 shows that only one Supply Chain Management tactic had been applied in this case.

Derbyshire Textiles took a strategic approach to purchasing when they established their network and had continued to operate in this manner. They were between close-collaboration (stage 3) and strategic partnership (stage 4) of the supply chain positioning matrix. The company had strong links with their supply base and had developed a high level of trust and dependency which had given them an ability to respond quickly to customer demand, while maintaining a pull system and minimising

inventory. Inventory took the form of raw material and Work-In-Progress along the supply chain.

Sportsco had a strategic approach to purchasing of raw materials. They had carried out a significant amount of supply chain development in this area (see section 4.4.6, purchasing strategy - raw materials). They had a programme to continue this development and hoped to integrate the internal functions of design, warehousing and production further in order to improve the process further. They needed to expand this to their bought-in finished products. They had reached a point between stages 2 and 3 of the supply chain positioning matrix - quality competition, and close co-operation.

5.9 LEAD TIMES

Lead times could have been reduced in all the case organizations (see chapter 4), ranging from 9% (Sportsco), to 17% (Mulberry) to 67% (Derbyshire Textiles), based on the removal of buffer time between the existing processes. Further time could have been removed with greater integration and by replacing inventory with information. In addition, the alignment of the systems and the development of awareness, relationships and trust between the supply chain members could have further improved the lead time.

> *Relationships need time to be built and need time to be maintained. They thus become central in strategic planning, both at the corporate and marketing level.*
> (Gummesson, 1987.)

In Sportsco the cross-functional teams could have reviewed the process to look for waste (see chapter 2, p.49-50) and have used the tools and techniques (see, section 3.9) to focus their continuous improvement activities in the key areas. The waste may have taken the form of errors due to inaccurate and untimely information, delay in producing prototypes or manufacturing the product resulting in missed opportunities, duplication of effort or rework on prototypes.

5.10 REPLENISHMENT

Mulberry's suppliers held stock of finished products in their UK warehouse to await call-off. Their supplier would make half the order and hold it in stock in the UK, as

stock depleted they would make the second part of the order and ship it to their warehouse in preparation for call-offs. However, this continuity of supply could be disrupted between the end of one contract and the next time the order was renegotiated - which happened annually (see chapter 4, p.128). Derbyshire Textiles could offer replenishment of stock within a month of placing the order. Sportsco were unable to replenish stock, except in a few cases where excess raw materials and capacity were available, or a customer had cancelled. The lead time for ordering raw materials and manufacture was in many cases too great and the window of opportunity was missed.

5.10.1 Vendor-managed inventory

Another option for the retailer is to assign the task of controlling the product offer within their retail outlet to the supplier. It then becomes the priority of the manufacturer-supplier to maintain a flow of products which matches the consumer demand, matching the sales of specific styles and replenishing with back up stock. The flow of sales information to the manufacturer-supplier will also allow them to review the product life cycle, replace flagging sales and control the introduction of new product. This will ensure maximum sales within the allocated area in the retail store (interview, retail customer of Sportsco). A further step would be to give the manufacturer-supplier the whole category of merchandise to manage, including the co-ordination of other manufacturers or suppliers within the retail sales area. This shift of responsibility for sales is a new venture and requires a great deal of trust on behalf of the retailer. The manufacturer-supplier will, however, gain valuable first-hand knowledge of the customer preferences, including modes of display.

5.11 STRUCTURAL DIFFERENCES AUTOMOTIVE AND APPAREL AND TEXTILES

There are similarities between the two sectors - the first-tier supplier collaborates with low-cost manufacturers overseas while offering a local service to its customer. This is in an effort to reduce cost to the customer. This collaboration may extend to overseas joint ventures. However, Lamming (1995) believes that, through Lean production methods, the return on low-cost overseas manufacturing will diminish.

In the apparel and textiles sector, the retail purchase price for products has fallen or remained unchanged, while the supplier has had to take on more of the role traditionally carried out by the retailer. The supplier now acts as a warehouse for the retailer, as the inventory is held by the supplier, rather than at a retailer's regional distribution centre or store room within the retail outlet (interview, Sales Director Sportsco). The retailer's key suppliers were encouraged to manufacture off-shore and to set up joint ventures taking over more and more of the role of the retailer. This requires greater investment by the supplier and, to a degree, greater risk.

Child (1984) describes methods which organizations use to operate in a variable market. These are used to increase the support staff for information collection and collation, and in some cases to extend the 'vertical integration' of the organization in order to try and obtain greater control. Specialists will be brought in to maintain the knowledge base required so that they can continue an interface with a rapidly changing external environment. The deformalization of existing roles and processes is required to allow for flexibility, though this does require more informal, face-to-face communication at the middle and top management level of the organization, in order to control the decision-making process.

The early success of pilot projects can prove rewarding and can motivate the personnel to continue the changes, but companies have to have a long-term view of this as a roll-out process for improvement, not a one-off 'quick fix'. Change has often been associated with redundancy, as previously mentioned, and in order to motivate personnel a policy that there would be no redundancy for the period of change was used by one UK car seat manufacturer. This allowed experimentation and change in a more secure environment, acknowledging that mistakes may be made during the development (site visit, Johnson Controls).

Nissan in Sunderland trust their suppliers to deliver products which are of the required quantity and quality and as a result they have no goods-inward inspection and they pay the supplier for the volume of cars which are completed. The car, if complete, will contain a given number of the supplier's parts and they will therefore receive

payment for them; any unused parts, faulty or incorrect, will therefore not be included (site visit, Nissan).

Schonberger (1987) discusses how the organization is perceived from various internal and external standpoints. If a company has more than one location or functional division, friction can be caused by communication black holes, the 'them and us 'syndrome': and the formation of sub-groups. These perceptions may be based on: performance measures (including pricing), the company representatives - the external face of the company, on design capability or on the buildings that the organization operates from.

5.12 SUPPORT STRUCTURES

One of the critical issues with Supply Chain Management implementation is whether the culture of the organization allows change to take place. The prevailing culture may have been dictated by the structure of the company, specifically, whether it is hierarchical and operates a centralized decision-making (closed), or is flat and operates decentralized decision-making (open). Functional silos create poor communication and a blame culture. IT system-driven processing formalizes the processes without allowing for environmental change. This prevents the system from being organic, and therefore flexible (see chapter 2, p.30; Sportsco case study, section 4.4.8.1). The culture of an organization must be compatible to change and include learning (see section 2.2.3, Sportsco case study, section 4.4.8.1).

The culture of the organization is the values, beliefs and the assumptions which people within it adhere to. Bringing about change, in this case the development of the supply chain, involves an awareness of all the characteristic layers which form the organization, alongside addressing assumptions about roles and boundaries. Change involves interlinking the processing of product with the exchange and processing of information. The process of digging deeper and reviewing the assumptions and the perceived values brings understanding of the opportunities for change. The attitudes and behaviour of employees can change how they perceive their role and the company that they work for. The company's investment in raising awareness and training shows a commitment to their workforce and that they are considered to be a valuable

asset (seminar session, Unipart, Centre for Research in Strategic Purchasing and Supply).

5.13 ANALYSIS OF THE CORE UNITS

This dissertation illustrates how organizations cope with developments and how they operate within their environment and the resulting implications for the people involved. Figure 5.10 illustrates the three primary research case studies in relation to the core units of analysis, networks and relationships, learning and systems, and environment and organizational ecology (see chapter 2, p.35).

Figure 5.10 Primary research - case studies and core units of analysis

	Mulberry	Motive	Derbyshire Textiles	Motive	Sportsco	Motive
Networks and relationships	- minimal resource and development - no contingency planning - no continuous improvement - no cross-functional team - value chain not identified prior to case study research	- to promote competition in the network - to keep supplier in a defensive mode	- single established network well-integrated - relationships based on mutuality and trust - continuous improvement had been neglected - cross-functional team established	- to achieve flow - competitive advantage - ease of doing business	- networks established - contingency planning was considered - continuous improvement was lacking - value chain was being identified and reviewed - cross-functional teams established	- to develop a strong supply base with focused resource allocation - to understand the value chain
Learning and systems	- regular switching of buyer causes new learning each time, knowledge is not shared or cross functional - no socio-technical alignment through the supply chain - value chain not identified prior to case study research - measures for target setting are not in place	- low product spend therefore low priority	- socio-technical alignment - established infrastructure -value chain identified (but in need of updating) - cross functional learning not apparent - target setting and improvement required reviewing	- to achieve flow and ease of doing business	- cross-functional learning was starting to occur - socio-technical alignment was initiated and ongoing - infrastructure was being established - cross functional teams were in place - value chain was under review - improvement targets were being established	- to share knowledge - ease of doing business - to remove waste (mainly time) - holistic problem solving - to align structure, system and culture alignment
Environment and organization ecology	- environment has not established organizational policies - organizational ecology with this supplier is unlikely	- supplier not considered of importance to Mulberry's present or future	- organizational policies were in place - contingency planning had been overlooked due to stability in customer base	- to create a stable environment	- organizational policies were recently established - contingency planning was considered	- to create a proactive environment which allows change and flexibility

As previously mentioned, Mulberry was using minimal resources in the development of packaging networks and relationships both internally and with their supplier. They were not carrying out contingency planning, continuous improvement or value chain analysis. They wished to promote an environment of competition that could have result in the supplier taking a defensive operational mode. Mulberry's systems were not aligned with their supplier and value could not to be identified or generated. They had no target measures in place but they focused on price and quality. Packaging represented a low spend for Mulberry and therefore had a low priority in relation to their supplier management. Mulberry's environment was static in this area and therefore organizational ecology was unlikely.

Derbyshire Textiles had a well-established network and strong relationships with their suppliers based on trust and mutuality. They carried out cross-functional activities and had achieved a good flow of product through the processing which gave them competitive advantage and had created ease of doing business. The competitive advantage had been eroded, and perhaps a refocusing of product development would have strengthened their position. Derbyshire Textiles' systems were aligned and they had established a strong infrastructure and a well defined value chain. They needed to regenerate their learning and set targets for improvement. Their external environment had altered, causing instability in their market and they lacked a contingency plan. They needed to create a more stable environment by focusing on their product offer and market and the benefits of their strong supply chain network.

Sportsco's networks were well established and they had considered contingency planning as part of their Supply Chain Management. They carried out value chain analysis, which needed to be linked to continuous improvement activities and their development of cross-functional teams. They recognised the need to develop a strong supply base that focused their resources and optimised value creation. They operated cross functional learning strategies and were aligning their socio-technical systems. The infrastructure was being established with cross-functional teams, sharing of knowledge and holistic problem solving. Their organizational policies were recently established and progress was being made on implementing them, taking into consideration the need for contingency planning due to the high level of task

uncertainty that occurs. They were creating an environment which was proactive and which could change and be flexible to their market demands.

The progressive case studies from Mulberry through to Sportco have shown an increased understanding of the core units which form a strong Supply Chain Management strategy. Where imbalance occurred it can be explained by the omission represented in figure 5.10. The strength of the supply chain is dependent on the inclusion of a policy to cover all the core units that form the holistic approach to developing successful Supply Chain Management. The delays in the process can be attributed to the people, learning, a flaw in the system, or poor intra- and inter-organizational network and relationships.

The issues of flexible networks within the product development area involves picking up and dropping specific network partners in order to compete and differentiate the market offer. This may not be an attractive proposition if you are the one being dropped. However, it is a cornerstone of a 'competitive free market' where organizations compete against each others' current performance.

> *Where in the plant do we need redundancy? Where should we place the burden of adjustments? What costs should we incur in place to minimize delay, risk, and vulnerability in another?* (Drucker, 1991, p.8)

Drucker's article, written in 1991, focuses on how he foresees the change from the early 90s to 1999. The language that he uses in the above statement already sets the scene for negative aspects of change, redundancy and burden of adjustment - not exactly encouraging words for participation.

5.14 CHANGE AND BARRIERS TO CHANGE

The degree of change that was occurring in the three case organization went from low at Mulberry through medium at Derbyshire Textiles to a high degree of change at Sportsco. This was in line with change that was occurring in the external market environment of the relevant supply chains and the complexity of the network for product development in each case.

Barriers to change include the discontinuity of senior management when they change every two years, which leads to changes to the goals, objectives and initiatives for change which are driven by the Chief Executive Officer. The promotion of functional learning creates barriers both within the organization and externally within educational programmes. The knowledge base needs to be cross-functional, which would put it in conflict with the existing structures and functional boundaries in many organizations. The structure of an organization has to fit the value stream requirements, not the existing functional boundaries. The culture within organizations plays a critical role in acting as either a conduit or barrier to change. Organizations who set targets or reward on a functional or individual basis will continue to sub-optimize the holistic supply chain performance; targets have to be set for the whole supply chain as it needs to form one continuous process with seamless boundaries. Lack of awareness of the whole supply chain also causes barriers as each part of the chain believes that they are performing efficiently without considering the total value stream of all the partner organizations. Consideration must also be given to the requirements of the end customer, not just each internal customer (see section 4.4.7, change and barriers to change).

5.15 CONCLUSIONS

The components of the supply chain concepts (see figure 5.1) are interrelated and should be addressed collectively, using a co-ordinated approach for changing the supply chain. The people aspects of SCM are bound up with the organization's structure and the power and status which the functions or organizations have obtained. The equilibrium of the company is being challenged with new structures and the erosion of functional boundaries. People in the lower tiers of the organization are being included in the supply chain strategy and charged with the role of building inter- and intra-company relationships. The threats from the organization's environment are linked with the development of trust across the supply chain in an effort to improve overall supply chain effectiveness. This requires the collaboration of all the members of the supply chain. The perceived outcomes are reduced waste, improved communication and relationships which contribute to overall supply chain efficiency. Without the willing involvement of the people, proactive interface in the chain will not improve.

The term 'supply chain' and 'value chain' are often used in conjunction, with the belief that they are used to achieve the same strategic goals. This brings in to question who is driving the supply chain, as well as issues of value and the question of who benefits from the change - is there 'shared mutual benefit'? Lamming describes the Japanese as establishing mutual benefits; however, this was due to the post-war desire to rebuild their economy.

There is a need for a strategy that encompasses all the elements of the supply chain, creating a framework for achieving supply chain development. Long-term commitment to the process is required, as is a culture which allows mistakes to be made as part of the learning experience. Management have to be involved at all levels in the dissemination of knowledge throughout the various levels of the organization. Addressing the SCM framework in a piecemeal fashion will sub-optimize the benefits and will not create supply chain development.

We have described these changes to the market-place as a move to Quick Response even though the cost of this improved service is not reflected in the manufacturing retailer price. The price structure has remained the same with risk moving upstream, and the cost of increased inventory being borne by the manufacturer. This movement of the risk further up the supply chain means the commitment by the retailer is made as late as possible.

There appears to be a decline in UK manufacturing operations and a move towards becoming warehouse operators and or distributors, precipitating a restructuring of the apparel and textiles industry. 'Courtaulds, Coats Viyella and Dewhirst will have 70%, of production overseas within 2 years' (Minton, 1999). The manufacturers' move to off-shore manufacturing in the 60s and 70s is the converse of the automotive sector, where the desire for flexibility makes it advantageous for suppliers to be close to their customers.

This chapter has brought together the analysis of the research findings; chapter 6 draws conclusions from the investigation into apparel and textile supply chain development.

5.16 REVIEW OF RESEARCH

The methods were repeated across the three case studies and the informants were at different levels in the supply chain - not just managerial levels. Each supply chain involved several organizations outside the host organization. The sampling was the same in all three cases - following the flow from concept to launch. The element of continual presence was addressed in the final longitudinal study, which was not merely a snapshot of a supply chain, but a study over a period of a year. Even though the Sportsco study was longer than the first two case studies, the observation of change occurring was limited to that time-scale. Organizational ecology could be better reviewed over several years, as the system and relationships change and the supply chain develops to match the changing environment. The research has drawn in the main from the people and their operational systems. However, time was given between the case studies to review the research methods and their application and to review the data emerging from each case study. Methods were critiqued and refined for subsequent studies. The sampling of representative informants was increased from the first study through to the third, as greater access was achieved via the project champion in each case organization. Where possible, the information was fed back to ensure validity and triangulation of documentation, historical data, interviews at different levels and the actual review of the process to check for misrepresentation or gaps in the data.

Participant observation in the Sportsco case study allowed observation of the evolving cross-functional teams as an insider to the team. However, no responsibility or power was given as a participant in the team. Participation only occurred six months into the study when the team members were familiar with the researcher's presence in the organization. Many of the team members had participated in interviews for the case study and they were well aware of the reason for the researcher's presence in the organization.

The dynamics of the case studies varied, but common elements came out of the research. Each supply chain is unique because of the people element in the socio-technical exchange along the supply chain. This means that it cannot be directly replicated.

CHAPTER 6 - DISCUSSION AND CONCLUSIONS

6.1 INTRODUCTION

The final chapter in this thesis brings together the main findings of the research in to Supply Chain Management and its application in the field of apparel and textiles. The focus has been on product development and the research covered a cross-section of apparel and textiles companies. This has been a gap in the research literature, and a successful methodology was developed for carrying out Supply Chain Management research in the apparel and textiles industry. The results have been critically analysed, compared and contrasted, and in this chapter the main research questions defined in chapter 1 are reviewed. The variables within the three case studies have assisted in focusing on the different dimensions and the resulting implications of Supply Chain Management development for both practitioners and academia. The core units for consideration are networks and relationships, learning and systems, and environment and organizational ecology; these were used to generate a framework that illustrates the key features of supply chain development. This is used to establish a model for Supply Chain Management development. The results and conclusions lead on to a consideration of the requirements for future research.

6.2 APPAREL SUPPLY CHAIN MANAGEMENT RESEARCH

Three case studies, using a cross-section of apparel and textiles companies, were successfully completed. One of the key lessons has been that researching in this area is far from easy. The scope of the change that is involved for organizations or supply chains is considerable and requires a strong strategy and driving force for it to succeed. Long-term commitment is essential when embarking on the quest for a flexible, efficient, effective and reliable supply chain. The organizations within the chain have to refine their relationship issues, not just devolving responsibility but sharing benefits. Risk has to be understood and risk management apportioned across the chain. In apparel and textiles the risk is disproportionately weighted on the manufacturer. The inventory that is held in the supply chain has to optimize the flexibility of the end product and maximize service to the customer. This was achieved in the Derbyshire Textiles supply chain (see section 4.3). The preferred inventory was in the form of raw materials, which were only processed when a

decision from the customer initiated a demand for finished product. The raw materials stockholding cost was with the supplier, but it had several customers who could potentially have taken the stock if Derbyshire Textiles defaulted.

A commitment to employee involvement, learning and development is required to generate an environment for devolved decision-making and therefore responsibility. The development of an 'Investing in People' strategy is thrown out of balance when personnel leave the organization within a short period of acquiring skills relating to the organization's core competencies, because the skills are not transferred to other members of the organization. With this change of personnel, especially at middle and top management levels, the dynamics change. This means that systems have to be in place so that replacing key people does not impact heavily on the group's performance. The organization has to encourage their employees to remain with the company, growing and developing their own and other personnel's skills, in the pursuit of a learning culture for the company, supporting the organization's need for continuous improvement of the supply chain.

6.2.1 Strategic Time-scales

Vital to the teams who are implementing Supply Chain Management change is the time-scale from Supply Chain Management application to observed improvements. This is around six months. However, a longer-term view of two years will see definite improvement to operations, process, delivery and quality. This involves a continuous process of improvement and therefore, as with Forrester's information feedback system (see chapter 2, figure 2.7), changes to the environment or the organization will cause a regeneration of the system. It was observed during the research and while carrying out early benchmarking studies (see chapter 1, section, 1.6) that organizations often change their chief executives officers on a two yearly cycle. This may be contributing to the problems of the Supply Chain Management strategies and policies by causing discontinuity for the supply chain partners. The automotive industry has an investment and strategy horizon of five to ten years or more, whereas in the apparel and textiles industry this would appear to be six months to two years. The short-term strategy horizon limits what the apparel and textiles Supply Chain Management development team is able to achieve and has led to short-term

improvements rather than the creation of a process for long-term continuous improvement.

6.2.2 Maintaining focus

The scope of a holistic review of an operational supply chain presents a major challenge: maintaining focus. Piecemeal research of sections of the supply chain would not create an understanding of the entire system from raw materials to the end customer. Also, as previously described, the review has to encompass the different elements of purpose, process, and people, within a framework of an internal environment (the organization), and an external environment (market forces). The area of physical production/ engineering in relation to Supply Chain Management has been well-documented by previous researchers. The decision was made to focus on product development for the primary research, reviewing the other key elements within the supply chain: environment and organizational ecology, structures, networks and relationships, systems, learning and the process of product development. The primary case study used the review of the product development process, from concept to launch, to form an understanding of the key elements listed above and to examine the exchange of information and product throughout the interacting organizations.

6.2.3 Research sample: size access and methods of review

A methodology was developed for apparel and textiles industry Supply Chain Management research. The use of several methods of research to triangulate the findings helped to balance the strengths and weaknesses of each of approaches and to validate the findings across the supply chain. The opportunity to carry out participative observation was an added bonus, giving a unique insight into cross-functional teams. The tools and techniques that were applied were refined and expanded during the case studies. The modelling of the process tasks and interaction across the functions and organizations still proves problematic and results in a more segmented representation. The segmented approach feels fragmented in form, whereas the wider overview model creates a large-scale schematic format which becomes difficult to understand except for those directly involved in the review process.

The size of the sample of case studies examined was purposely restricted due to the requirement of evaluating whole supply chains that in each case involved several organizations. The degree of complexity increased from the simplified example in the pilot study, the stable network with low innovation requirements in the second case study, through to the longitudinal case study that was both complex and unstable in nature with a very high level of innovation involved. The variables that were present in the case organizations gave an opportunity to observe different approaches to developing Supply Chain Management. These case studies provided a contrasts between the findings and illustrated the degree of successful interaction that can be, or is desired to be, achieved within supply chains.

6.3 RESPONSE TO THE MAIN RESEARCH QUESTIONS

Three key objectives of the research were set out in section 1.3 as questions relating to Supply Chain Management, or networks in other industry sectors. It is now possible to address these in the light of the research findings.

6.3.1 Question 1 *Can the apparel and textiles companies adopt the SCM methodology used by the automotive sector to develop and manage their supply chain?*

It has been shown in the case studies that the Supply Chain Management methodology can be applied in apparel and textiles if the approach taken is formalised and not introduced in a piecemeal manner. The organization of the supply chain has to have strategic validity and it has to have recognizable resources to carry the strategy out. When the Supply Chain Management mechanisms are developed and integration is achieved, a form of dependency will be generated between the supply chain organizations. This centralizes the control of inputs and outputs for the supply chain as a whole, as apposed to individual parts of the chain. The members of the supply chain will have to agree the terms of their participation, with a trade-off of responsiveness for instability occurring. The apparel and textiles sector operates in an unstable and rapidly changing environment that relies on establishing trust with each member of the supply chain, and on each member balancing the level of risk that they will bear as a participant in the chain. The balance is necessary to minimize the risk

for the whole supply chain through the recognition of the consequences if trust is lost between members. In order to mitigate risk in the unstable environment of apparel and textiles, they must decide where the risk is situated in the chain and where investment and resource is required to manage the supply chain most effectively.

In apparel and textiles, the nature of the product raises the issue of how to manage the rapid change in processing and the need for a portfolio of supply chains. Companies have to manage both the flexibility of demand and the rapid changes in the type of products that are being offered to the customer. The need for continuous innovation and the short life cycle of the product requires a portfolio of contingencies for their supply chains to cope with the variables of the market and environment. This short time-scale environment is a major difference between automotive sector and apparel sector supply chains.

The key focus for automotive supply chain development had been in the following areas: Just-In-Time; Total Quality Management; team working; supplier selection and development; network development; waste removal; joint product development and/ or concurrent engineering; partnerships; personal development; group learning. All these methods have been used in the development of supply chain strategy in apparel and textiles. However, as with other industries, they are often adopted in a piecemeal fashion without an overview strategy of improvement. The supply chain concepts of networks and joint or concurrent engineering are of prime concern for rapid product development and Quick Response.

6.3.2 Question 2 *Are the benefits of developing collaboration and Quick Response to the market of mutual competitive advantage?*

The longitudinal Sportsco case study in particular indicated that in that instance the benefits were increased interaction cross-functionally, joint product development resulting in a decrease in the quantity of prototypes, and reduced time from product concept to launch (see sections 4.4.7.1 and 5.6). The information flow improved between the manufacturer and raw material suppliers and this allowed decisions to be made at the last possible moment, reducing the risk of commitment to unsold finished

inventory or the unnecessary manufacture of raw materials. The ability to share direct sales information is available from the EPoS system that is used by most retailers and global links can also share the information. Supply Chain Management initiatives have improved the interaction between suppliers and customers.

In the UK apparel and textiles sectors, the driver for improvement in the supply chain has often been the retailer, and in many cases the retailer has benefited from the competitive advantage achieved from improvements. The inventory in the supply chain has been pushed back up it, along with investment and risk. The retailer has benefited through the reduction of on-site inventory stock holding, allowing more floor selling space within their prime sites in the high street. This has allowed the retailer to reduce central warehousing facilities, due to direct supply from the manufacturers who then carry out this wholesaling function on the retailer's behalf. The increase in the number of selling seasons from two to six has increased the investment in new product research and development, most of the cost being borne by the manufacturer. However, the recovery of this cost is not always met when the retailer then dual-sources or sources the product off-shore at a lower cost.

The retailer and manufacturer have in some cases been confronted with issues relating to the ownership or copyright of new product design. When a supplier is locked into a reduced customer base, the manufacturer has a high risk factor due to buy-outs, mergers or acquisitions causing dramatic downturns to their business and market (section 4.3.2, Derbyshire Textiles).

It would appear that companies are failing to put in place the appropriate measures for accurately comparing supply chain with supply chain. The Sportsco case study (see section 4.4.6) illustrated that the same criteria to measure imports with home sourcing were not being applied. These measures for supplying their customers included quality, cost and delivery should be used as a starting-point for their outsourced finished product suppliers. The cost of non-conformity should be allocated to the total cost of acquisition.

The idea of supplier development seems to flounder when there is a high degree of volatility in the environment within which they operate. Financial measures are not in step with the concept of overall supply chain efficiency measures. These should include: supplier development and relationships management; costs; payment terms; logistics costs; the cost of research and development; all products for a customer's order being delivered on time and in full and of the correct quality; the level of service and ease of doing business; the need for increasing stock turns and return on investment. Until organizations measure the total cost of acquisition there will be little understanding of how supply chain efficiency affects the profitability of an organization.

Some manufacturers have been developing off-shore bases and use the resulting low economy imports to compete, as previously described in chapter 5, section 5.15. These manufacturers can then compete on quality, delivery and cost, while maintaining high levels of innovation. They retain design, warehousing and some production in the UK so as to maintain their presence near the customer, to manage the retailer relationship and increase the customer interface e.g. Sportsco. Suppliers who have set up to manufacture off-shore often have higher levels of technology, due to the distances involved and the requirement for rapid transfer of technical information. The use of CAD/ CAM and EDI have become more common as prerequisites for carrying out business. The Quick Response concept developed in this sector has improved the product offer to the end customer and reduced the waste for the retailer of unsold inventory and mark-downs.

The implications of this are that there is a need for capacity to be retained in the domestic market, while also developing off-shore capabilities in an effort to benefit from the low cost manufacturing base. However, this causes a conflict between the concept of Quick Response, and the costs involved and delivery/ logistics issues of operating in this way. In many cases, apparel and textiles organizations have established either joint venture or partnerships as sister sites for their operations (Minton, 1999). The other alternative is to develop licensees with off-shore organizations who either operate independently by creating branded products sold under the recognised brand, or who sell products from the original brand and products

that they have developed (Sportsco utilised the latter method). The implication for Supply Chain Management is that they still have to be strategically managed but the benefits are that they will have intelligence relating to their domestic market, and that they will be closer to the local market and the end customer.

Another area of change in the supply chain structure was highlighted during the research namely category management (see section 5.10.1). This involves a retailer selecting a key brand supplier to manage all the brands that form the product offer within a given category for all their retail outlets. This form of category management was in its infancy at Sportsco and its merit at that stage was unproven. The reasoning behind the idea is that the brand leader has the knowledge and skill within their market to be best positioned to understand their customer. With this comes a trust between the brand leader the retailer and the other brands. It requires them to operate for the benefit of the customer, and therefore to improve the variety and availability of the products that the end customer is faced with. The consequence is increased throughput within the retail store of the right selection of products at the right time. This subordination of the other brands to the brand leader in respect of product selection is a new departure in the field of apparel and textiles, and may improve relationships and collaboration, discouraging the prevalent promotion of adversarial practices. The brand leader should get closer to the system. Control is being devolved to a different section of the supply chain. They seek to control the inputs of the system, which should improve their ability to manage and optimize the supply chain. This devolving of responsibility, by the retailer, could lead to a loss of the retailer's core competencies. This could result in an opportunity for power to revert to the manufacturer. New issues of integration, control and changes to the structure of existing supply chains will be raised. Structure, control and power could move upstream in the supply chain as the manufacturer/ brand leader gets closer to the end customer. Benefits will be achieved through the flow of market demand and sector information.

This contrasts with 'own label' retailers who focus on their own brand such as Marks and Spencer and British Home Stores. Their brands run through all their product

categories and category management is controlled internally by a team of buyers and inventory controllers.

6.3.3 Question 3 *Can the network methodology, used in the automotive industry, be employed in the apparel and textile sector?*

The network methodology that operates in the automotive industry is connected with the ability to control the bill of materials which are required within a tiered structure. In the apparel and textiles industry, there is a high degree of instability and fluidity in the structure of the supply base for the bill of materials; this causes problems when trying to formalize a tiered structure. The apparel and textiles supply chain structure is more evolutionary, in that the requirements change according to the dictates of fashion and because the products are fast-moving consumer goods. The desire for control is motivated by a desire for mutual benefit. The relationship has to be built on trust and the knowledge that there is an intermittent, if not continuous, dependency. This allows them to 'leap-frog' with their suppliers in order to meet the requirements of the product's bill of material in relation to performance and the fashion needs for that season or product life cycle.

The automotive industry supply chain has been described as a tiered system, which structures the levels of interaction between customer and supplier. In the case of Toyota, they would only deal with first tier suppliers and considered that the first-tier supplier's role was to deal with and develop tiers two and three (Hines, 1994).

If applied in apparel and textiles, this would mean that the first tier suppliers to the retailer would have the information processing capability to be able to operate a portfolio of supply chains in a strategic manner, in order to supply to the end customer. The apparel and textiles customer needs to work closely with several tiers of suppliers in order to create a fluid structure and manage the instability of the market. If they do not operate at several levels, it will be detrimental to their potential future requirements. Their Supply Chain Management strategy must focus on the mutual benefits that can be achieved for their partners in the supply chain. The mutual

benefits gained in the network structure will enhance the customer's ability to survive in the long-term as their partners will be encouraged to continue working with them.

The comparability of an apparel and textiles supply chain with an automotive industry equivalent will vary with the market which the apparel and textiles organization is supplying. Where it has a stable product with a long life cycle, which is derivative in nature, and which has a certain market, then a strong network can operate (section 4.3, Derbyshire Textiles). Such a network will be more autonomous, with shared tasks and risk, and equally shared problem-solving requirements. However, in an uncertain environment this network becomes unstable and the supply chain becomes more of a risk. An uncertain environment, linked to a high degree of task uncertainty and a high level of innovation, does not lend itself to a formalized structure. The network structure is formed from the need for flexibility and rapid transfer of technology, referred to as leap-frog technology (section 4.4, Sportsco). This means that the short life cycle of the product requires the retailer or brand manufacturer to be highly innovative and to have a network of suppliers who can be drawn in to their network to develop, in many cases jointly, a new product for their market. This is where brands and retailers are competing supply chain against supply chain. These products will hopefully be unique in the market-place and, for a short period of time, there will not be copycat products competing with them for the end customer.

The time from concept to launch is critical, and maximum flexibility of capacity of manufacture is required in order to benefit from the unique product offer to their final customer. In the case of apparel and textiles there is the element of uncertainty about the product's acceptability, and personal preferences for colour and size may be difficult to forecast. The supply chain network has to be flexible enough to ramp up the production rate if the sales are high or to reduce the rate, or even replace the product, if it is proving unsuccessful.

The equivalent of this in the automotive industry is that they are committed to a certain period of manufacture and have signed agreements of supply for the life of the product, which can be several years. In apparel and textiles, the network is built on trust and interdependency of their organizations. This amoeba-like network formation

means that each cell or organization merges with and withdraws from the network in order to maintain the flexibility of the supply chain. Suppliers and customers have a core group of organizations that they work closely with to develop long-term and short-term projects. They have to switch the network formation to optimize the skills which each of the organizations can bring to the supply chain. This encourages suppliers to be innovative but creates an unstable environment dependent on the relationships, systems and knowledge base which have been established on previous projects/ season ranges. Due to the short life cycle of the product, these networks will form and disband dependencies according to the type of innovation required by the market-place.

Some of the elements of network development whose application to the automotive industry has been described are also relevant to apparel and textiles. Process review, removal of waste, sharing information, development of cross-functional teams, supplier selection and development and joint product development are all instances of this. However, the formalized structure and long-term agreements are not compatible with the uncertainty of the tasks and of the market environment, in apparel and textiles (case study, Sportsco).

Another outcome from the research has been the review of good practice in the automotive industry compared with apparel and textiles. The development of strategic partnerships is one of the key elements for supply chain development in both sectors. Product research and development appeared more integrated in apparel and textiles and more cross-functional. Cross-functional teams were well-established in the manufacturing automotive industry, but were less evident in their research and development of new products.

The role of strategic purchasing is established in the automotive industry; it was observed in Derbyshire Textiles and was being created in Sportsco. The network for automotives is global, with a local presence in order to service their customer. However, the current over capacity in production has led them to consolidate their sites (Society for Motor Manufacturers and Traders, 1999). The network was mainly local for Derbyshire Textiles, as they are close to their suppliers and their customers.

However, their supply of raw materials was global. Sportsco's global presence allowed them to service their customers while their off-shore manufacturing in low labour cost countries such as China assisted them in maintaining competitive pricing for their market. Their global network also fulfilled their need for rapid product innovation; this reflects the unstable environment and high product variety and task uncertainty that they are required to manage.

6.4 CONTRIBUTION TO SUPPLY CHAIN MANAGEMENT - understanding the theory

The evolving concept of Supply Chain Management has often focused on the slower moving and mature industries - as in the research into the automotive industry of Womack *et al.*(1990), Lamming (1993), Hines (1995), and Cusumano and Nobeoka (1998). This research has critically analysed, compared and contrasted its three case studies over a cross-section of apparel and textile supply chains that were operating in a turbulent and mature market; the application of the theory is in the area of fast-moving consumer goods. The product life cycle is short in apparel and textiles - six months on average - in comparison with the four years or more in the automotive sector. The system is organic in nature and confirms the organizational theory promoted by Burns and Stalker (1994), which argues the need for a holistic approach to knowledge transfer, tasks and structure which are required to encourage open communication and cross-functional expertise. The research confirms the contingency theory approach described by Lawrence and Lorsch (1967) and Burns and Stalker (1994), which shows how the situation variances determine the structure of the organization in an effort to control the variables of the environment that the supply chain is operating in. These include task uncertainty, strategy, size and the environment of the system, including its external relationships. Burns and Stalker's approach is intended to create 'fit' with the environment, and control the input and output requirements of the supply chain. The problem that Supply Chain Management has in the apparel and textiles sector is that it requires an evolving and changing structure.

The methods applied in the research have extended the existing knowledge by using a longitudinal study (the research is carried out over a period of time, rather than just

taking a snapshot in time). This allowed the expansion of the SCM initiatives to be perceived over a period of time including the interrelationships that were evolving and developing as the research matured. The study highlights the significance of the software (personnel) aspects of Supply Chain Management and the issues of power and dependency that emerge between functions and vertically through the different levels of the supply chain organizations. Previous methods of interviewing, often being focused at a managerial level, have not been able to see the effects of Supply Chain Management both cross-functionally and horizontally in these structures. The methodology used in this research included both these aspects. The methods allowed for an inductive process of research, which is not always the case in earlier Supply Chain Management research.

6.5 DEVELOPING A FRAMEWORK FOR SUPPLY CHAIN MANAGEMENT

The core units of analysis as defined in chapter 2, networks and relationships, learning and systems, and environment and organizational ecology, have been used as a preliminary framework to understand the components and procedures, characteristics and motives for supply chain development. This is summarized in figure 6.1. The core units are listed in the first column and are then broken down into components and procedure characteristics, and motives in the second, third and fourth. The timescale for the implementing the core units is indicated in the final column. The first core unit is networks and relationships. Under the components and procedures heading this involves selection of the people who will form the cross-functional team. The cross-functional team will then identify the value chain and select the suppliers who will form the desired network, and form contingency plans for future requirements.

Figure 6.1. Integration of the core units of supply chain development

	Components and procedures	Characteristics	Motives	Time scale
Networks and relationships	Cross-functional teams Identification of Value chain Network/ supplier selection Continuous improvement Contingency planning	Proactive collaboration Stable supply chain environment Minimize uncertainty Contingency planning Establish dependency	Focus resource for maximum benefit Understand the value chain(s) Create seamless supply chain Create flow	Long-term ongoing
Learning and systems	Cross functional learning Socio-technical alignment vertically and horizontally Infrastructure Identification of Value chain Measure for target setting and improvement	Interaction between (inter-) and within (intra-) the organization Integration between (inter-)and within (intra-) the organization Awareness raising between and within the organization.	Share knowledge and learning Create ease of doing business Remove waste in the system Solve problems holistically not just functionally Align structure, system and culture aligned Achieve awareness of supply chain Measure for improvement	Long term on-going
Environment and organizational ecology	Organizational policies on: - structure - culture: open, learning - strategy for development and survival - employment review Top-down - bottom-up policy deployment Contingency planning	Proactive innovation Competitive advantage product/ service Collaboration Fudging of functional boundaries Contingency planning Supply chain portfolio innovation	Create an environment which does not restrict, but assists improvement Plan for possible changes to the environment and therefore to the growth of the supply chain(s)	Long-term ongoing

The process will require continuous improvement as part of the procedure. This approach encourages proactive collaboration across functions, and attempts to stabilize the supply chain environment and to minimize the task uncertainty. However, contingency planning is a requirement for a shared desire to establish a form of dependency and to encourage collaboration. The motives for this are to focus the resources for maximum benefit throughout the whole supply chain, to understand the internal and external value chain, and to create a seamless supply chain that produces flow.

The second core unit, learning and systems, consists of cross-functional learning, both internally and externally, and the alignment of the supply chain's socio-technical systems, both vertically and horizontally. The system requires an infrastructure that will support the value chain process and an agreement to measure the targets and desired improvements. This should promote interaction and integration between and within organizations while raising awareness of the supply chain as a 'whole' rather than as independent sections. The motive for this is to share the knowledge and learning across organizational and functional boundaries, and create 'ease of doing business' within the supply chain. This approach helps to remove waste in the system and approaches problems in a holistic manner with structure, system and culture aligns to optimize effectiveness and efficiency. Agreed measurement will hopefully lead to improvement of the 'whole' supply chain.

The third core unit, environment and organizational ecology, consists of organizational policies on structure, culture, development strategy and employment review. The policies will be directed from the top management but deployed from the bottom of the organization upwards. Contingency planning for future environmental needs will be required to maintain and balance the future needs of the supply chain. This should promote proactive innovation in the supply chain and competitive advantage in the market place for the supply chain's product or service. The functional boundaries will become less defined - becoming 'fudged' - and a portfolio of supply chains will be promoted as a contingency plan for the organizations future survival. The motive for this is to create an environment which assists rather than

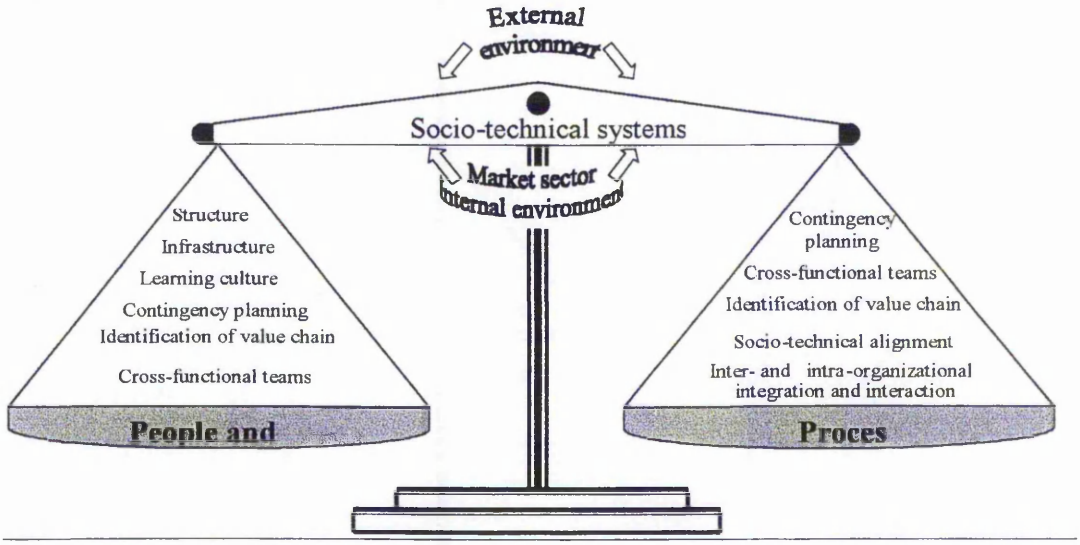
restricts supply chain improvement. There is also a need to plan for possible changes to the environment and therefore to the potential growth of the supply chain(s).

The time scale for the supply chain development framework is long-term and on going - it is not considered a quick fix or a process which when carried out remains static. The process for development has to be regenerative and to continue to question how the supply chain can improve. The development of relationships is time consuming, but without this development the supply chain will experience difficulties when operating in a volatile market.

6.6 MODEL FOR THE DEVELOPMENT OF SCM

From the secondary and primary research a model has been created to draw together all the elements for consideration when developing a Supply Chain Management strategy. The model (see figure 6.2) depicts scales which must be balanced in order to operate effectively. To obtain a balance the organization has to consider the people and policies linked with the socio-technical systems and the process. The supply chain operates within an external and an internal environment, as well as a market sector, and these are indicated in the model as forces that create instability for the supply chain; and the resulting imbalance has to be recognized and compensated for.

Figure 6.2 Supply Chain Management Development Model



Some of the elements will appear on both sides of the scales. Contingency planning, for example, is required for both people and policies and for the process. When the process requirements change to meet market demands it can alter the requirement for the people. This could mean a change to the roles and responsibilities of the people and the organization may need to implement new policies to allow this to happen or a conflict or misalignment will occur.

6.6.1 People and policies

The elements of the people and policies side of the balance can be summarised as follows:

- the structure of the organization - boundaries, roles/ responsibilities power and control which have to be organic to allow for change;
- the infrastructure - facilities and information systems/ technology have to meet the needs of the personnel;
- the learning culture encourages the transfer and sharing of knowledge and the 'Investors In People' type of strategy;
- contingency planning considers the future requirements of the internal and external environment within which the organization operates;
- identification of value chain - a cross-functional approach to understanding the value chain - where value is generated and its boundaries;
- cross-functional teams promote the demise of functional boundaries, and the alignment of the supply chain structure which can deliver the product or service most effectively and efficiently

6.6.2 Process

The process, particularly in apparel and textiles, is changing with the requirements of the market sector and the external environment. As a consequence the process has to include the following:

- contingency planning - in order to ensure flexibility and that the process needs are satisfied;

- cross-functional teams - used for the process review to ensure the ability to transfer knowledge across the value stream; they solve problems cross-functionally, to ensure that process optimization has a chance of succeeding;
- identification of value chain - the cross-functional teams approach is used in order to raise awareness of the whole value chain and to then optimize the supply chain by removing waste;
- socio-technical alignment - to ensure the inputs and outputs match the requirements of the process and the people;
- inter- and intra-organizational integration and interaction - the supply chain organizations have to form relationships that generate the formation of permeable boundaries, the objective being to form a seamless supply chain. This was perceived in the second case study at Derbyshire Textiles (see chapter 2, section 4.3.6), where the supply chain organizations had achieved a high level of integration.

It is hoped that the framework (see figure 6.1) and the model (see figure 6.2) will be used by practitioners as a starting point for developing Supply Chain Management strategy for their 'whole' supply chain, and that academics will apply it to future research in to Supply Chain Management in convergent or divergent industry sectors.

6.7 Implications for further research

This research has opened up several areas for further research, many of which could apply the same methodology. These include taking the Supply Chain Management concepts into other environments and carrying out comparative case studies in other market sectors. A comparison could be drawn with a supply chain where the inputs are similar, the process (hardware) is similar but the people (software) is different. An example of this could be a comparative study of a car seat manufacturer and an apparel company. The car seat manufacturer's application of Toyota Sewing System (see chapter 2, section 2.3.7) to their process, with raw materials inputs of textiles, cellular manufacturing and the operation of a Quick Response service to several customers, would be similar to the application of Toyota Sewing System and Quick Response in apparel manufacturer.

The ecology of the organizations could be studied to compare their development using a longitudinal study (see chapter 2, sections 2.2.2 and 2.2.3). The research would benefit from this approach to Supply Chain Management development to see if patterns of ecological change can be observed, illustrating organizations evolving, adapting and surviving (see figure 2.2), within the turbulent environment of apparel and textiles.

The research has illustrated a need for organizations to operate a 'portfolio of supply chains' in order to manage and control the power in the inputs side of the supply chain (see chapter 2, section 2.2.1), they have to be able to carry out a rapid programme of innovation which will maintain their market position and give them flexibility and increased capabilities; this follows the theory of multiple contingencies (Child, 1984) (see chapter 2, section 2.2.2). This requires continuous relationship development, but actual manufacturing activities may leap-frog missing out an apparel season. The portfolio of supply chains in apparel and textiles includes the off-shore operations that have already been established by many of the large manufacturers. These meet their need for low-cost product manufacture by using a low labour rate country. The portfolio approach allows for greater capacity and flexibility in response to the constraining elements of the environment they operate in Mintzberg (1979) (see chapter 2, section 2.2.3).

6.7.1 Research implication for the professional

Supply Chain Management often sits within the purchasing or operations functional area, not across the whole supply chain. The cross-functional nature of Supply Chain Management requires an organizational structure which is measured on supply chain efficiency not on functional or boundary efficiency which sub-optimizes the whole. The need is for personnel who can make decisions based on a policy that encompasses the entire organization. This does not mean that they distance themselves from the actual process of deploying Supply Chain Management - they have to be part of the dissemination process. Dissemination should occur at all levels and should include active participation by the executives.

Professional implications for supply chain research include the time that it takes to change the supply chain (see chapter 4, section 4.4.6). This process has been viewed as long term requiring a process of ecology that regenerates the cycle, encouraging continuous improvement. This affects the importance of retaining key staff for a long period of time and the transferring of tacit and implicit knowledge. Core knowledge has to be retained within the organization. The organization has to find a strategy and structure which encourages and engages their managers and promotes a blame free environment that allows experimentation to take place and opens the organization to a greater chance of change occurring. The structure has to operate cross-functionally within an emergent and fluid strategy. The champions who drive the change have to have the skills and mechanisms to manage the supply chain effectively. They need greater control over planning and production with a further goal to increase their power over the retail environment; this would be easier for a brand leader than a maker of retail branded products. Hybrid forms of organizations will appear with the redesigning of roles and responsibilities to a less traditional form, replacing functional power within boundaries with holistic control.

The organization must be concerned with the development of people's skills and be proactive regarding the career development for their personnel. Organizational boundaries should be considered more as short- or medium-term, to be regenerated in a more fluid form to fit with a turbulent external environment. However, there are potential conflicts (Child, 1984) (see chapter 2, section 2.2.2), as previously this requirement for new structures has led to downsizing. The centralization or decentralization of decision-making will be dependent on the nature of the sector environment. In apparel and textiles, the desire should be to decentralize the decision-making process and operate as a team within an integrated supply chain.

The ecology of the organization will be dependent on the structural 'fit', and requires a contingency approach because the variables of task certainty, size, strategy and environment will alter over time (Egelhoff, 1982, Burns and Stalker, 1994 and Lawrence and Lorsch, 1967) (see chapter 2, section 2.2.2 - structure).

Learning within these new supply chain structures has to include the understanding of the socio-technical system of the organizations that form the supply chain (see section 2.2.3). Learning must be linked to the holistic approach to organizational policy (Pedler *et al.* 1997) (see chapter 2, section 2.2.3), and must occur within an open system (Koehler, 1938, Bertalanffy, 1950, and Kast and Rosenzweig, 1985) (see chapter 2, section 2.2.2 - system structure). This allows for more organic boundaries to be formed creating improved fit with the requirements of the environment.

The research challenges existing concepts of Supply Chain Management and generates evolving constructs. This has lead to the development of a model (see figure 6.2) which allows for future testing of Supply Chain Management concepts in convergent or divergent sectors, and which can be applied using a positivistic or naturalistic method.

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APPENDIX A

MULBERRY REPORT

MULBERRY

SUPPLY CHAIN PROJECT;
CARRIER BAGS

Project initiated by: Manufacturing Director

Report compiled by: Moira Lynn Massey
The Nottingham Trent University
26th November

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PROJECT TERMS OF REFERENCE

Mulberry is a manufacturer and retailer of up market leather goods and clothing. Goods are sold through own retail, franchises and independent stores

The project brief was set at the request of the production director of Mulberry. The brief was to review the supply chain for the purchase of paper carrier bags, value approximately £52,500, within the organisation. Two suppliers currently fulfil the requirements for carriers. The project was to analyse key elements of the supply chain: suppliers, company strategies/structure, tactics/operations and cultures.

The project term was two days of interviews within company and one day externally with suppliers. This was followed by two weeks of collation and analysis of data. The project was selected due to disruptions which were occurring in business, which were related to stock outs, forecasting demand and order lead times.

Key personnel were made available in order to build a holistic view of the supply chain.

SUMMARY

Sources of information were both internal and external and included: buying office, creative services department, customer services division, retail division, warehouse and despatch, accounts, reprographics house, and suppliers.

These sources were analysed to look at problem areas such as stock outs, stock piling, identification and handling of stock, and accounts processing. Process flows were examined at each stage and a supply chain map was created as a visual representation of the total process.

The following procedures were carried out:

- A review of purchasing policy to ascertain ways of standardising and improving process and operations
- A review of packaging delivery standards and carton identification
- A supplier audit
- A review of handling and transport of packaging.
- Investigate cash value of current ways of operating, e.g. stock-outs; stockpiling, including warehousing; high levels of inventory holding by retail.

The potential benefits for implementing change could be:

- The reduction of price of end product due to supply visibility regarding cost
- Develop reliability of stock availability, forecasting ability and measurement of consumption
- Reduce the risk of stock outs
- Reduced lead time from initial design to receipt of goods
- Increase in stock control
- Reduction in inventory holding
- Standardise pack size for deliveries and computer system

INTERVIEWEES, internal and external

Mulberry

Buyer

Creative Services

Customer Services Manager

Merchandiser; retail

Merchandiser's assistant

Warehouse supervisor

Also phone interview with invoicing department

SUPPLIERS

* Some of the supplier detail has been removed for this Appendix in order that supplier remains anonymous

Supplier 1

Interviews: Sales Area Manager, administration office and warehouse supervisor

Location : Leicester

Supplier 2

Interviews: Sales Area Manager

Location: London

DESIGN SPECIFICATION

With reference to the size; industry standard description is: width; gusset; height (see copy of purchase order). Mulberry's size description is: width; height; gusset (see copy of design sheet).

- There would be an opportunity to alter the description to the industry standard, avoiding any possibility of errors in sizing.

MATERIALS

- 130gsm, Kraft paper ribbed brown. Outside uncoated side of kraft paper to be printed with approved artwork design: Pantone colour 202.
- 7mm cotton cord for handles dyed Pantone colour 202 length of handles 50cms each handle.

SIZING: in millimetres

	WIDTH		GUSSET		HEIGHT
Small Kraft Carrier Bag	200	X	120	X	290
Medium Kraft Carrier Bag	420	X	120	X	340
Large Kraft Carrier Bag	500	X	170	X	450

Packaging and Delivery

Packing: the carrier bags are packed in packs covered in plastic and grouped together in a cardboard carton.

- Small size carrier bags were packed; 100 in a carton (two packs of 50 inside).
- Medium size carriers were packed in the same manner.
- Larger sizes of carriers were packed 50 to a carton (two packs of 25 inside).

The carriers were packed in sealed cartons some cartons with strapping; it was mentioned that strapping helped in picking/moving the cartons.

Supplier 1 was unsure how the carriers were packed within the cartons.

- It would be an opportunity to standardise how Mulberry would like their carriers delivered.

Deliveries: delivered by the hundred, occasionally 50's. 50's are difficult for the warehouse to process as the computer system only recognises the carrier bag code as a pack of 100. Split packs are usually held aside to be matched with the next part delivery; which results in variations in stock holding figures. Packs are not barcoded.

Carton labelling/marking

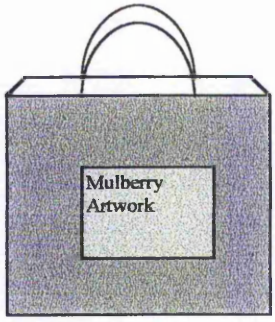
The exterior of the cartons' are marked with: the Mulberry code; size dimensions; quantity. The pickers mainly use the code to identify the cartons.

Call-offs

Administrative clerk keeps track of free stock and physical stock and places a call-off with the supplier when stock is required. Supplier 2 has established a monthly set call-off system approximately 3,000 carriers per month over the sizes. Call-offs are phoned to supplier; receipt is approximately three days after the call-off.

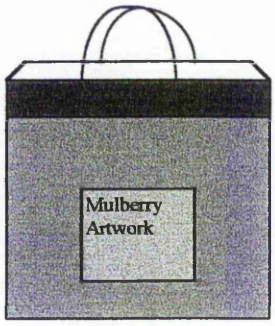
DESIGNS WHICH MULBERRY HAVE ASKED ITS SUPPLIERS TO QUOTE FOR.

DESIGN 1.



- Kraft paper printed on rib side solid colour with lettering and logo unprinted; Outside uncoated side of kraft paper; kraft showing through.
- Inside of carrier bag unprinted (brown kraft)
- Printed gusset (retail outlets)
- Printed board base inset to match kraft
- Matching solid dyed cotton cord handles

DESIGN 2



- Outside uncoated side of kraft paper printed on rib side solid colour
- Inside of carrier unprinted (brown kraft)
- Printed gusset (retail outlets)
- Top lip of carrier turned over to face of carrier bag to give an unprinted kraft paper border to the top of carrier
- Printed base board inset to match kraft colour
- Matching dyed cotton cord handles

DESIGN 3

- Outside uncoated side of kraft paper printed on rib side solid colour with lettering and logo unprinted (kraft showing through)
- Inside of carrier printed solid colour and finished with spot varnish of Mulberry tree logo.
- Printed gusset (retail outlets)
- Printed carrier base inset to match solid colour of carrier
- Matching dyed cotton cord handles

PRICING FOR 1996

CARRIER BAG 1996 CONTRACT

Company	Product code	Price per 1,000	Product code	Price per 1,000	Product code	Price per 1,000
Supplier 1	**AC003/000**	**£359.00**	**AC005/000**	**£647.00**		
Supplier 2	**AC003/000**	**£359.00**	**AC005/000**	**£647.00**	**AC007/000**	**£898.00**

Terms: Carriage paid to Mulberry' warehouse.

Supplier 2: 60 days end of the month

Supplier 1: 30 days end of month

Cancellation date: 2 weeks after each call-off.

CARRIER BAG 1997 CONTRACT

The suppliers were requested to quote for all three carrier bags and all three styles:

- full quantity
- half the quantity

Forecasted quantities for 1997

SMALL	28,000
MEDIUM	25,000
LARGE	18,000

Sale of carrier bags from 1/10/96 - 30/9/96

AC003/000	24,100
AC005/000	21,000
AC007/000	15,400

SUPPLIER 1

Privately owned

Turnover : £5 million; the company has grown from £3 million to £5 million in three years.

Head office: in S.E. London

Employees: 25

Structure: Factory in UK -
Factory in Far East -
They have a financial stake in this factory.

Lead time: Mulberry's production is made in the Far East company; a lead time of approximately 16 weeks from placing order to goods arriving in UK warehouse awaiting call-off.

Supplier 1 - have supplied Mulberry for almost two years.
Last year they made the Mulberry production in two batches.

Clients: Vivienne Westwood, Bruce Oldfield, Joseph, Selfridges, Harrods
Their UK factory mainly deals with advertising/promotional companies who are not price conscious.

SUPPLIER 1: QUOTATIONS (to be completed)

	Product code SMALL	Price per 1,000	Product code MEDIUM	Price per 1,000	Product code LARGE	Price per 1,000
Design 1						
Full quantity						
Half quantity						
Design 2						
Full quantity						
Half quantity						
Design 3						
Full quantity						
Half quantity						
Origination costs						

SUPPLIER 2

Largest carrier bag manufacturer in UK

Turnover: 19 Million

Structure: 3 main companies

- UK - selling retail packaging to major retailers.
- North America - selling to other carrier bag merchants; not the end user
- Hong Kong- manufacturing operation, one factory in Hong Kong and two in New Territories & China.
- Italian offices

Employees

- Approximately 40 in UK office/warehouse.
- Approximately 1,000 in HK and Far East

Clients: Gucci, Monsoon, Jigsaw, Joseph, Selfridges, Boots, Body Shop, etc.

Supplier 2 has been supplying Mulberry's for approximately 6 years.

Lead time: Approximately 16 weeks from receipt of order in Hong Kong

They manufactured Mulberry's order in 3-4 batches last year; the printing of the carriers may be carried out all at the same time in order to ensure colour continuity and minimise set-up time for machinery.

SUPPLIER 2: QUOTATIONS (to be completed)

	Product code SMALL	Price per 1,000	Product code MEDIUM	Price per 1,000	Product code LARGE	Price per 1,000
Design 1						
quantity						
Half quantity						
Design 2						
Full quantity						
Half quantity						
Design 3						
Full quantity						
Half quantity						
Originati on costs						

Observations made while carrying out interviews with key personnel in Mulberry and with suppliers

Observation	Possible action
Potential stockout situations (cost unknown)	• Obtain further information from suppliers on production schedule data and reliable production dates • Monitor stock levels, internally and externally, and monitor orders for carrier bags on a weekly, monthly basis • Establish a programme to enable you to plot peaks and troughs of invoiced sales of carrier bags for last year and the coming year to aid future forecasting • Information for demand schedules and forecasting communicated to suppliers • Establish a programme to verify how small, medium and large carrier bags are ordered and delivered to stores throughout a 12 month period • Review sales and marketing activities over the year and include details in monitoring usage patterns
Uncertainty of supply & distortion of demand Lack of trust in continuity of stock throughout year. Resulting in stock piling by retail: • Stock is allocated to retail but non-despatched. • Stock is stored in the warehouse at a cost to the company. • Stock piling absorbs variability in demand causing distortion at each interface in the supply chain	Establish more control over supply • closely link the flow of materials to actual usage • Automatic replenishment; can packs of carriers be barcoded and included in retail model stock system • Monitor distribution throughput rate • Expansion of existing stock information system to include: Stock held in suppliers UK warehouse's Stock held in Mulberry's warehouse Stock in transit from the Far East including lead time
Pack sizes All carriers are sold in packs of 100 although usage varies over carrier bag sizes, the small carrier has the highest usage.	Medium size carriers are already packed in boxes of 50 could the computer system be set up to accept packs of 50. This may help in stock situation of the larger carriers and reduce inventory in stores.

Observations continued

Observations	Possible action
Product Request for small kraft envelopes for packing stationery at point of sale; comment made by Retail, Customer Service Department and buyer's assistant	• Discuss with marketing /design office to review possibility of re-instating kraft envelopes • Opportunity to redesign kraft envelope to fit with new carriers
Inventory The warehouse services two sections of Mulberry; Retail and Wholesale/Franchise. There is an imaginary divide within the warehouse except in the area of invoicing where two separate systems are in operation. This allows the retail section to order stock from the overall stock of carrier bags and store the goods within the warehouse without allocation and dispatch. This would account for fluctuations in available stock for call off while still having physical stock stored in warehouse • This accumulates cost • Obscures demand patterns • Restricts flow of goods	• Use information to replace inventory • An opportunity to reduce inventory holding by warehouse through accurate measurement of peaks and troughs of demand throughout the year. Stock is being held in warehouse and in suppliers warehouse at a cost. • An opportunity of devolving stock holding responsibility to supplier; supplier could deliver direct to retail stores. This could reduce buffer stock held by Mulberry. An opportunity to sole source product to one supplier allowing them to monitor the complete process for the company. This would remove the need for Mulberry to warehouse stock of carrier bags (removing cost from the supply chain)
Retail usage Retail have difficulty in monitoring usage of carrier bags. Orders can be traced through order/invoice system but weekly / monthly usage is more difficult to measure	• A Kanban system could be introduced in store to flag up requirement for re-ordering which could include a system to record usage • Could barcodes be used on packs to measure the opening of a new pack of carriers using EPoS system.
Additional services Supplier 2 offer other services to their customers, these include: • deliveries direct to retail outlets • monitoring stock levels and maintaining continuity of supply. They have an alliance with Lynx transport company have a computer link to facilitate this service.	• An opportunity for devolving responsibility for stock continuity.