1

Examine a Supply Chain

The art of seeing the forest and the trees.[1]

Objectives

- To be able to identify the major stages in the location, transformation and movement of materials and goods in a supply chain of a manufacturing or service company
- To describe the increasing importance of supply chain management to all businesses in achieving a competitive advantage and controlling costs so that operations are profitable
- To apply the supply chain management concept to information and physical movement within logistics chains
- To understand how a supply network can be partitioned into a supply chain for each product family to achieve the desired flow of products and services to consumers
- To understand how the relationships between supply chain partners can be developed so that high value is generated for customers and partners

INTRODUCTION

This chapter introduces supply chains as groups of companies which work together to source, produce and deliver goods and services to end customers. To survive, and to be competitive, it is not sufficient for firms to restrict their vision to their own processes. Instead they must consider the whole flow of materials and goods and the information which communicates the specific needs of consumers to the various levels of suppliers. Firms should also consider the management of those flows and the part which they play within the coordination of the entire supply network. The challenge is for companies in *partnership** to collaborate in design and delivery of products and services so that a more effective service is given to consumers and each company prospers.

A basic supply chain comprises:

- a focal company, which forms goods or services for a set of consumers,
- a range of suppliers of raw materials and components,
- distributors, which deliver the goods to consumers, and
- modes of transport which move products between each location in the chain.

The overt chain is the physical movement of materials and products between each partner firm along the chain until they reach the consumer in the required form when needed. Other factors necessary to integrate the supply chain are information communication, management coordination and chain leadership. Information exchange between partners enables them to work closely in line with end consumer needs, even though the firm may be several stages removed from product or service delivery. The term 'management' refers to the organisation and control of all the internal logistics functions within one link, or partner firm, in the chain, while the coordination of the whole chain, to ensure that it functions as an effective system to provide goods and services, is called chain leadership.

Consider one link firm in the supply chain which handles the materials or goods on their way to consumers. The link's task is to provide a product by purchasing components, converting them into products and despatching those products to the next level in the chain. On receiving specific orders, the link firm holds an inventory of components, and schedules conversion so that the movement satisfies its customers' requirements. This entails cooperation between many departments and processes and the use of external services such as transport and maintenance. Information communication within the firm derives from the actual or forecast mix of product needed in a period, leading to all the data required to process that order, which are typically stored in a comprehensive enterprise resource planning system. The operations manager then has the task of planning all the required activities, organising their execution, measuring performance, and controlling outcomes so that customers receive their goods without expending an unreasonable amount of resources. This operations task would, optimally, be coordinated along the whole supply chain.

The impetus for working on complete supply chains arises because the activities across all the firms are never perfect in creating value for customers and retaining value for operating firms. Investigation by operators drawn from each link in the chain can allow elimination of costs while improving customer service. The first step is to design a chain, starting with its strategic purpose in delivering to a set of customers. The second step is to integrate the physical and information processes across each link, achieving an effective flow of goods and provision of services. This requires consideration of issues such as the decoupling point (at which materials or products are committed to a customer order), order-winning criteria and the type of product or service being provided.

A more frequent situation than designing a supply chain from scratch arises when we set out to change an existing chain to make it more effective for customers and owners. Then we need to:

- bring the owners together,
- obtain an overall view of the supply chain, its boundaries, scope and strategy,
- adopt a method to investigate activities carried out along the chain, and
- decide on simplifications which will deliver the precise needs of end consumers without wastage of effort by chain owners and operators.

Box 1.1 provides an example of the supply chain required to manufacture sweaters and distribute them to retailers throughout the world.

Box 1.1 The Benetton Supply Chain: successful vertical integration

Benetton[2] is a highly successful manufacturer and deliverer of sweaters and other woollen clothing. It makes these sweaters in Italy and sells them in its own licensed shops throughout the world. Benetton's supply chain starts with the purchase of wool yarn in northern Italy. The wool is woven into garments by dozens of small knitting firms. The garments are stored in a central warehouse. When orders are received, the sweaters and scarves are dyed into a huge range of colours, producing the exact combination of colours, sizes and styles which customers want in 6,000 shops in 83 countries on every continent.

Benetton's 6,000 outlets sell 60 million garments each year. Their one range of clothes is sold in small boutique-style shops, strictly merchandised and heavily advertised. Benetton's target market is young and multiracial. They operate in a highly competitive, mature industry with a fickle consumer base demanding a large variety of products. They change their product line ten times a year. Benetton's Italian owners match the demands of fashion by flexibility and speed. They rapidly adapt to consumer tastes while gaining efficiencies of scale. To do this their supply chain must operate very competently to support the incessant pace.

The lynch-pin of Benetton's supply chain is information communications. Benetton's agents in each country use electronic data interchange (EDI) to transmit orders daily to the head office near Venice. Eliminating the filters between customer and production, Benetton manufactures only those garment styles, colours and sizes required.

The traditional manufacturer of clothing dyes the yarn, then knits the garment. But knitting is slow and would lead to high levels of finished garments. Benetton's solution is to manufacture clothes from bleached yarn and delay the dyeing until colour information comes from customers via EDI. The process is:

- Garments are designed in-house using CAD technology
- Design data are transferred directly to computer-controlled garment cutters and knitting machines
- Garment assembly is done by sub-contractors, small family operations
- Garment dyeing is done by Benetton, retaining control of the high-technology elements
- Garments are sent to an automated distribution centre in Italy, packed in standard boxes
- On receipt of an order from their agent in one country, Benetton picks the required boxes to make up the order and air freights them direct to the destination country.

Benetton has replaced a raft of carriers, freight forwarders and customs brokers with its own integrated distribution function to manage internal freight forwarding

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and customs clearance. Again EDI is used to transmit documents ahead of consignment arrival to allow speedy clearance and on-forwarding to retail shops in the destination country.

Benetton uses a blend of in-house expertise and outsourced resources throughout the value chain. For example, manufacturing is carried out by sub-contractors who receive support for production planning, quality control and advice on technology. In return, Benetton demands exclusivity. The partnership arrangement is a version of the Italian extended family. This gives Benetton a high level of flexibility. Risks and rewards are shared without the use of legal contracts. At each stage of the supply chain Benetton consciously decides whether to process in-house or sub-contract, considering the effect on cost, flexibility, speed and service.

- Why is Benetton so successful?
- What is the key innovation which enables this success?
- How does Benetton handle information about orders and shipping?
- What are the key parts of this supply chain?

This chapter provides the answers to these questions.

1.1 THE SUPPLY CHAIN CONCEPT

The biggest challenge facing companies today is not the Internet, by itself, or globalisation or stakeholder needs. Rather, the greatest challenge is the integration of *supply chains** from vendors through manufacturers and distributors to satisfy end *customers** and obtain value for those companies. Supply chain management is the planning and *flow** of materials and products between a number of companies to deliver goods and services to end consumers. The insight examined in this book is that business supply chains are more likely to survive, grow and profit if they integrate the development of new products with a balanced supply chain in which each *link** combines to provide the goods that consumers want.

We suggest that *managers** in all the links in the supply chain need to plan and achieve a seamless stream of products in order to fully satisfy chosen customers while making a good return for each link. However there are some potential problems. Directors of different companies do not trust each other sufficiently. Managers of some chain links have more power than others and therefore push their own needs rather than working with their partner links to optimise the entire chain. A *link* is a company which performs some function within a supply chain, joining other parts into a complete chain. We accept that *entrepreneurs** will promote strategies which manipulate the chain for their own ends.

*Definitions of asterisked words in italics can be found in the glossary. Elsewhere italics are used for emphasis.

This book explains how the present view of supply chains has come about and suggests how managers in companies can work with *upstream** and *downstream** counterparts to harness the power of the concept to position and tune businesses for success. This concept can help them work with other *partners** in the supply chain to meet customer needs precisely without unnecessary actions.

Supply chain integration provides a key opportunity for you, as future *leaders** and managers of companies along the chain, to work together through shared information and joint provision and delivery of goods and services for customers. Picture a simple supply chain of one vendor transporting materials to a manufacturer who converts them into finished products and despatches them to a wholesaler's warehouse for delivery, at the right time, to a retailer for customers to purchase when they wish. Assume that the supply chain processes and information systems are already well designed for their purpose of supplying those goods at a profit over the costs of operating the various firms in the chain. As managers of the links in the supply chain you then have three tasks:

- to plan the flow of materials and goods along the chain by information exchange,
- to make the necessary physical movements and conversions in the required quantities and at the required times for end consumers, and
- to manage changes and developments to the benefit of all companies without disadvantaging customers.

The opportunity requires the chain managers to plan the way in which all the tasks required will be carried out before receiving customer orders. Frequently, the tasks are complicated due to the number of components in the finished product and the need to respond very quickly to customer orders from any location in the world. However, the power to share information in digital form and transfer it instantly from one firm to another gives them an enormous opportunity to optimise supply chain preparation.

Unfortunately, the firms along the supply chain are independent companies with separate owners, managers and stakeholders. Such *sovereign companies** are not used to working closely together for the good of the whole chain. Their managers keep product volume and cost information to themselves; if pressed they will provide inflated volumes, 'to be on the safe side' and ambit claim costs, to allow for negotiation and squeezing by, for example, powerful retailers. They work predominantly with their immediate suppliers and customers. They aim just to finish today's work, within a plethora of questions by employees and government regulations. So the challenge is to overcome the inertia of past practices (mainly manual records, batch computer systems and islands of data) and to implement transparent planning, scheduling and operating for every *transaction** (rather than batch or mass production) for every product in the chain. In short, to integrate the supply chain.

A useful analogy, to help visualise a supply chain, is a *stream** along which materials and products flow to the consumer. Imagine the stream, or *channel**, contains water flowing downhill, or left to right in Figure 1.1. Raw materials enter on the left, they are converted to components and products, and they flow to the right where customers buy them because they see value in having them. This stream analogy suggests that barriers (between companies responsible for part of the chain) should be minimised. Any

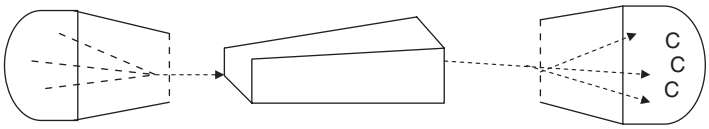

Figure 1.1 Chain representation: from tributaries through product manufacture to distribution

(C = Customers)

bends, constrictions or delays will slow the rate of flow so the customer has to wait longer for her product and hence sees less value. The flow of the stream, or turnover of the business supply chain, will be reduced. To improve the flow, waste must be reduced throughout the supply chain, so that the customer receives more value and the companies get more return for their efforts. This concept of waste removal is developed below. In the channel, tributaries on the left represent multiple suppliers delivering different materials and components. A delta with multiple mouths to the sea represents the many product groups and delivery routes to different customers. The central box stands for a manufacturer or distributor. The information that makes the stream flow is not shown.

A basic chain

The major components of a supply chain are physical movements, *information flow**, management coordination and leadership of the chain. The first task is to create a flow of information between chain partners so that physical flow takes place exactly as required. The second task is a series of physical movements: procuring parts, manufacture of the finished product and its *delivery** to the customer. The third task is the management of chains, and the fourth task is chain leadership.

Assume that you want to buy a new car because your present model is worn out. You need a four-cylinder sedan with automatic gearbox, four doors and air conditioning. This car requires 8,000 parts from 300 suppliers in all parts of the globe. Consider the simplified supply chain for a car model named 'Camry' which comprises an ignition module made by a firm called Bosch from metal components supplied by Kawasaki Steel and assembled into the finished car by Toyota Australia, which keeps an inventory of finished cars. You intend to purchase the finished car from a dealership in Melbourne, Australia. The simplified supply chain is shown in Figure 1.2.

The physical task of operating an integrated supply chain commences when a customer places an order with a distributor or manufacturer. Figure 1.2 shows the flow of materials and components for conversion by the manufacturer into a finished product. Inventory of finished cars is shown, indicative of inventory held at many places in the chain. The flow of finished product by distribution from the manufacturer to the end customer is also shown.

Of equal, or greater, importance is to plan the flow of materials and goods along the chain in response to your order. This will require information and communication to confirm your order, to plan production, to purchase materials and components and all the other preparatory tasks necessary before the physical operations shown in Figure 1.2 can be carried out. These planning tasks are shown in Figure 1.3. Such information typically flows in the opposite direction to the physical flow, from right to left in

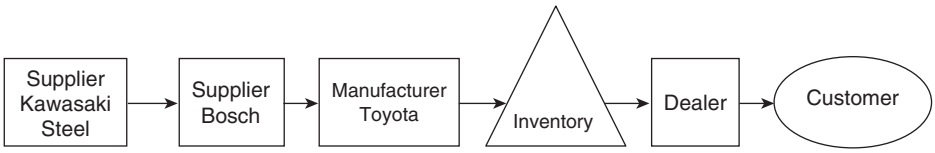

Figure 1.2 **Basic supply chain – physical movements**

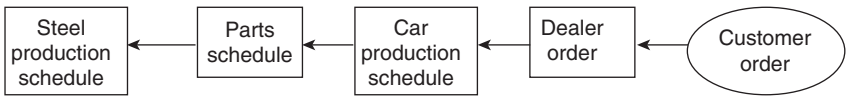

Figure 1.3 **Basic supply chain – information drives flow up the chain**

Figure 1.3 from the customer order until steel production is scheduled. All these informational tasks are needed before the physical tasks can be carried out.

The other task is the management of each link in the chain and the coordination of all the links. It involves all the decisions that directors, managers and operators at Benetton or Toyota, and their suppliers and contractors, make as they design, organise, inform, schedule and control the supply chains for clothing and cars. This task is described in the next section.

Chain and network definitions and major factors in each chain process

The term 'supply chain' is used because of its current popularity. The definitions underpin the development of concepts in this book:

- A supply chain is the *information-directed* flow of one *product family** from sources to end customers, managed by a number of partner firms, with reference to one *focal company**.
- *An integrated supply chain** requires movement of material, parts and product, and the provision of service, in the value chain. These moves are planned and managed as part of a system which is known as a supply chain for one group of products and as a network for all the range of products (and services) provided through a focal company.
- Supply chains use *electronic communication** and person-to-person communication, throughout the processes in the firms, to provide value for customers and firms.
- Better *design** and *execution** of *provision** and flow, by all partner firms in concert, will improve the efficiency of the operation. The system-wide perspective allows the firms to make appropriate *trade-offs** between variable costs such as purchasing, production, transport, inventory and distribution and between the resource costs of equipment, information systems and people.
- Close coordination between these operations and the strategic environment produces high levels of service and performance for customers while reducing the total costs incurred, so that value is sustainably generated for all chain partners.

- The objective of the supply chain is to maximise the overall value generated, where value is the difference between what the final product is worth to the consumer and the effort the chain expends in filling the customer's request.
- A *supply network** is the sum of supply chains across all products and services provided to end customers through a focal company.

*Value stream**, an equivalent term to supply chain, emphasises the flow of products along a stream and the value that partners must provide for themselves and customers. The concept of a value stream originated with Michael Porter,[3] who said that it should be disaggregated into strategic activities from *inbound logistics** to product distribution. The firms in the value stream generate competitive advantage by performing these important activities better or more cheaply than their competitors. Porter splits value stream activities into primary activities (inbound logistics, operations, outbound logistics, marketing and sales and service) and support activities (infrastructure, human resource management, technology development and procurement). Support activities are integrating functions that span the primary activities of the firms in the value stream.

Competitive advantage is derived from the way in which firms organise and perform these activities within the supply chain. To gain competitive advantage over its rivals, a firm must deliver value to its customers by carrying out these activities more efficiently or in a different way.[4] The word 'integrated' is added to supply chain to emphasise that we advocate a system view across the entire chain. It is not useful to improve only one partner in the supply chain. Rather chain leaders should strive to make each part work highly effectively in the performance of the entire chain. 'Integrated' also distinguishes this term from the careless use of 'supply chain' to refer to the logistics of one company.

This book focuses, firstly, on manufacturing operations and the service components of the resultant products. Secondly, service businesses, where the main or sole objective is to supply a service, such as credit from a bank or 'wellness' from a hospital, are included (see Chapter 3). Many of the principles of manufacturing supply chain integration apply to service chain management. Many manufactured products include a service component, such as the two-year warranty which a new car has. Such concomitant services, and the use of services in manufacturing and in the supply chain, are covered. All supply chains include transport, maintenance and professional services (such as process design and information systems). These are also included.

The *objective* of supply chain integration is to synchronise the requirements of the customer with the flow of material from suppliers in order to achieve a balance between the goals of high customer service, low inventory investment and low unit cost. These goals are often seen as conflicting but this is not necessarily so. We examine methods of designing and implementing supply chains so that the aims of all the interested parties are achieved. The design and operation of an effective supply chain are of fundamental importance to every business.

Each process in the integrated supply chain can be considered as comprising four factors: information communication, physical product flow, management coordination and chain leadership (see Figure 1.4). Information and product flow have already been defined. The third factor in the supply chain process involves management. Management[5] is the detailed planning, organisation, coordination and application necessary to move goods. It includes the *performance measurement** towards the supply chain's goals to ensure resources match destination aims. Activities in the

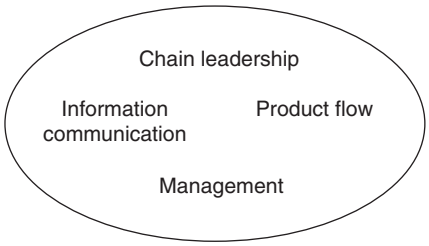

Figure 1.4 Major constituents of a process

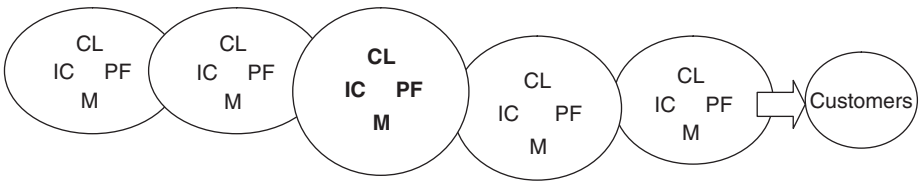

Figure 1.5 Supply chain as a series of company links (processes) providing goods and services to customers

(CL = chain leadership; LC = information communication; PF = product flow; and M = management)

links of the chain are carried out by employees who are steered and guided by managers. Managers are the people who use knowledge to encourage and allow employees to behave democratically and with enterprise to achieve broad company goals through free application of resources to provide products and services for customers.

Chain leadership signifies the application to the local process of the vision for where the overall supply chain is going. Leadership includes the means of getting to that required goal by instructions, regulations and coaching. Leadership also signifies strategic organisation and control of the value chain by the focal company and its partners, as exemplified by Benetton (Box 1.1).

Building on the major parts of a supply chain process just discussed, Figure 1.5 brings together those logistics processes in five firms to span the supply chain for a set of end customers. The four factors in each link of the chain need to be properly designed so that the overall chain capability is achieved. The supply chain, as a total *system**, will only work effectively and efficiently if proper consideration is given to these factors.

Developing the basic chain into an integrated supply network

The information and material flows and management described can now be assembled together with some extra detail of the partners involved into an integrated supply network. For the purpose of this discussion we adopt the assumptions in Box 1.2 to simplify the explanation. Building on the basic chain in Figure 1.1 and the major factors of each process along the chain, we now develop the *Double-Bell model** of the integrated supply network, as depicted in Figure 1.6. Each process in the chain from sources to end customers contains the four key components just discussed.

Box 1.2 Simplifying assumptions

- *Make-to-stock** manufacturing business.
- Orders are placed on a distribution centre, which replenishes its stock from the manufacturer.
- Supply chain comprises about 100 vendors supplying materials and components into a single factory where manufacture and assembly are carried out.
- Manufacturer distributes to 5–10 wholesale distributors. They deliver to retailers who sell to end consumers.
- Transport is a commodity in the chain which does not have a strategic effect on chain operation. It can be bought competitively from transport companies as and when it is required.

The 'Double-Bell model' is a generic representation of a complete supply network from sources of materials to end consumers. The left-hand bell indicates large numbers of suppliers of materials and components proceeding through several *tiers** and journeys to the focal manufacturer. The central ellipse is the conversion process in which materials are transformed into finished products and services. The right-hand bell represents the distribution of those goods to numerous end consumers through *intermediaries** and delivery transport. The Double-Bell model represents the main links and relative components in a generalised supply network. Typically, the network comprises 5–10 supply chains catering for each major group of products or services. The model can also be used to represent service supply chains. In this case the central ellipse

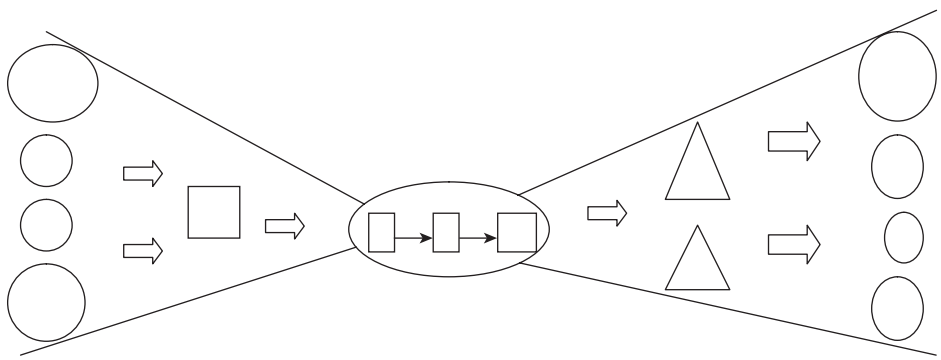

Figure 1.6 The Double-Bell model of the supply network for business

The left-hand bell shows many suppliers (circles) sending materials and components into the factory (central ellipse) by transport (arrows). The factory contains several processes (rectangles) producing or mixing finished goods,which are placed in a despatch bay. The right-hand bell represents the movement of products through distribution stores (triangles) to many end customers (ovals) by transport. In one sense, this model only represents the physical movement of materials and products along the supply chain. If each symbol, or process, is regarded as comprising goods, information drivers, management and leadership, the model starts to represent an integrated supply network.

becomes the chain partner which delivers the service. The model aims to help students to think about a particular supply chain. What is its extent? What range of customers is supplied? Which partners are most important? What are the flow paths for products and for information? How will the chain be managed and coordinated?

At the start of the physical chain, there are, say, a hundred suppliers arranged in two tiers. Tier-one suppliers deliver materials and components direct to the manufacturing factory according to the purchasing schedule. Tier-two suppliers deliver such resources to the tier-one suppliers. Vehicles are used to move the materials between the suppliers and the *factory**. Stocks of materials are also involved to enable on-time supply of long lead-time items.

The factory receives materials and converts them into finished products by means of a number of production processes. Handling of materials between the processes is also required. Finished goods are packed for their journey to the customer and built up into multiple units on pallets and in containers. Frequently, such products are placed in a despatch warehouse until suitable *freight transport** is arranged.

The finished products now proceed through a distribution system to large numbers of end customers. Typically, goods are transported in bulk to a distribution centre and stored in it. *Distribution centre** is a name for a warehouse which is a staging post on the way to customers. At the distribution centre the exact mix of goods required by the customer order is assembled, packed and delivered to the customer by a form of transport.

A fuller description of the information, which drives the 'double-bell' integrated supply chain, is given in section 1.3.

Another model, which has been suggested for the underlying structure of supply networks, is that shown in Figure 1.7 by Harrison and van Hoek.[6] In this model the chain is structured around three factors: flow of materials and products, flow of information and the time taken to respond to demand from the source of supply. The *network** is a system of interdependent processes and it extends from the focal firm at the centre across suppliers and customers. The end customers, on the right, initiate demand for products and services. After that, the system takes over. This model treats upstream suppliers and downstream customers in the same way as the Double-Bell model. Harrison and van Hoek's supply network is run by *supply chain management** which comprises *planning** and controlling all the processes from raw material production to purchase by the end user and recycling of used products. This chain management views the supply chain as a single entity which:

- requires strategic decision-making,
- views balancing inventories as a last resort, and
- demands system integration.

Harrison and van Hoek's model considers the aim that:

> Supply chain processes (supply, source, make, distribute and sell) are integrated together to meet end-customer demand. Demand signals are shared across the chain rather than being massaged by the 'sell' process next to the market. Demand fulfilment is also envisaged as an integrated process, as materials are moved from one process to another in a seamless flow. Information is the 'glue' that binds the supply chain processes together.[6] (p. 15)

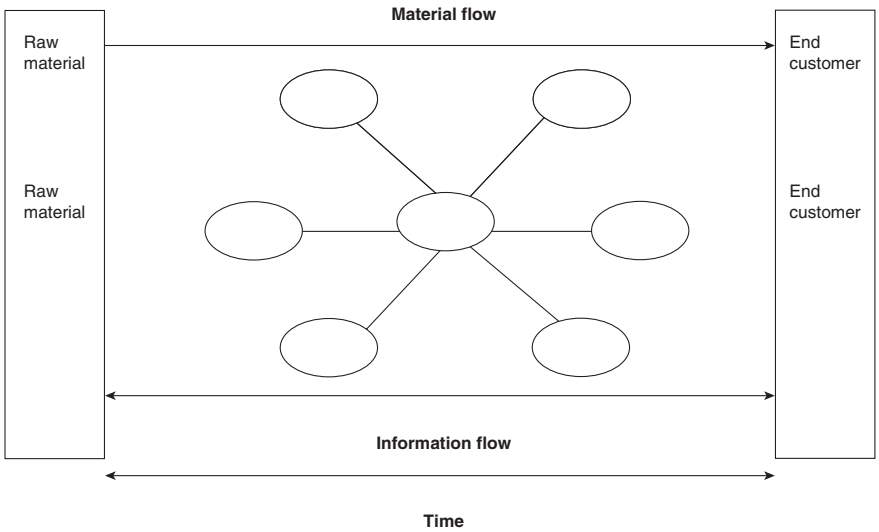

Figure 1.7 Supply network structure[6]

Source: Logistics Management and Strategy, by Harrison A and van Hoek R, reprinted by permission of Pearson Education Limited, copyright 2002, 2005.

How does a service supply chain compare with the product chain described above? Service chains are typically simpler than product chains because they place more emphasis on intangible assistance by people. If we consider a retailer or a restaurant to be typical service businesses, then the inbound supply chain has all the levels of supply companies but is usually simpler on distribution: customers come to these businesses themselves. In a professional service, such as an accountant or a consultant, the supply chain concept has very little relevance. The emphasis is on employing a number of people who render specialised advice to clients. There are few materials or products involved. In a mass transport service, such as a railway or an airline, the supply chain comprises building the *infrastructure** to enable the transport of people or goods and then providing the service to customers as they require.

Why work on supply chains?

One of the biggest challenges for businesses is to integrate supply chains for the benefit of customers and to make a profit. One key reason that this is necessary is because most current businesses are not very efficient. Numerous studies[7] show that almost all businesses contain enormous amounts of *waste**: misdirected efforts, poor or missing information, ineffectual management, lack of leadership, authority or trust, power plays, delays and excessive inventory. Hence the need to reduce waste throughout the supply chain must be considered, so that the customer receives more value and the companies get more return for their efforts. The people who first realised this ubiquitous waste were Japanese manufacturers, especially Toyota. Waste is any human activity which absorbs resources but creates no value.

For example, Womack and Jones[7] have a rule of thumb that states the gains expected when waste is removed from a production system:

> Converting a classic batch-and-queue production system to continuous flow with effective pull by the customer will double labour productivity all the way through the system (for direct, managerial and technical workers, from raw materials to delivered product) while cutting production throughput times by 90 per cent and reducing inventories in the system by 90 per cent as well. (p. 27)

If we accept that amount of waste within a business system run by one management, then there is likely to be even more waste when three firms in a supply chain provide a product. Since each company is autonomous, it is busy running its own business. Such inward focus is unlikely to be efficient in terms of the whole supply chain. It will contain lots of waste.

So far we have examined a supply chain which is in place, carrying out the short-term planning and activities necessary to provide a range of products to end consumers. Later we want to talk about the strategic planning and development of a chain for some products, either because they are new products or because the chain is operating in the wrong ball park, that is it is fundamentally wrong in some way. We define the integration which creates value for customers and operators in section 1.5. The overall issue of creating supply chains is discussed in Chapters 6 to 8.

If company managers are running an existing *value stream*, they are interested in creating *value* for the customer and for their company. ('Value stream' is an alternative phrase for a supply chain which emphasises the intention of creating value for customers and companies.) Managers overseeing the manufacture of Toyota cars want customers to recognise sufficient value in their cars so that they recommend them to their friends. They also want Toyota to pay their salaries and make a profit for reinvestment. But there is a second important meaning to the *value* in value stream. Value streams will only work if people put values, good company and partnership behaviours ahead of numbers. Soft values of contributing and sharing outweigh the short-term gains of outsmarting and putting down. Jack Welsh, the highly successful CEO of GE, says:

> Early in my career … there was way too much focus on the numbers … and a lot less focus on the softer values of building a team, sharing ideas, exciting others.[8] (p. 22)

Every supply chain is unique. It differs in some way from other chains. Exceptions can be found for all the statements in this chapter. This makes the study of chains and their practical *implementation** an interesting and frequently challenging task. Different industries and varied products create different situations. This book covers a wide range of industries to give specific points of reference. There is a great contrast between clothing manufacture, car manufacture, meat processing and selling petrol. Generally, supply chains only comprise part of the range of activities carried out by the firms which constitute links in the chain. Supply chains are frequently not linear, they are really networks. Chains do not last forever: they form, work for a while and then change their configuration.

Having considered the basic elements of a supply chain, we recommend you study the case at the end of this chapter, 'Designing a European supply chain'. This case

Table 1.1 Comparison between supply chains

Product/Industry	Number of levels	Number of suppliers	Number of products	Lead-time	Number of customers
Newspapers	3	2	1	6 hours	300,000
Milk	4	200	3	24 hours	150,000
Fast-food meal	3	30	6	5 mins	500
Sausages	6	4	12	4–12 days	15,000
Beer	3	6	3	10 days	2.5 million
Furniture	4	5	200	3–5 weeks	800
Pharmaceuticals	3	150	50	6 weeks	5 million
Hire car	2	5	15	1–2 days	1000
Car manufacture	5	1,100	8	3 weeks	200,000
Car parts	3	800	80,000	3–24 hours	400,000
Steel reinforcing	2	2	20	1 week	300

examines the practical organisation of supply chains when faced with the need to streamline operations.

1.2 VARIED CHAINS SATISFY CUSTOMER NEEDS THROUGH DESIGN

Supply chains occur in infinite variety to serve the product and service that the customer requires. Is the product a commodity, like milk, or customised, like picture framing? Is the product small and immediate, like a newspaper, or expensive and long delivery, such as a luxury car? Is the product a pure good, such as a pair of socks, or a mixture of goods and services, such as fast food? Is the product made for immediate sale, like a bottle of beer, or for stock until a need arises, such as spare parts for cars? Does the product have a distinct use-by date, such as milk or sausages? Is product sale regulated, as occurs with pharmaceutical drugs and cigarettes? Table 1.1 compares some characteristics of chains used to achieve these contrasting products. The 'lead-time' column refers to the length of time taken to supply the product.

The response in terms of supply chains varies between these products. The newspaper supply chain has few levels. It is very fast to produce a single product which has a very short lifetime, measured in hours. Fresh milk has a longer supply chain but the product has a life of a week. Milk is collected in tankers from the dairy farm, processed and packed in a factory, delivered via a cold store to a supermarket and selected by the customer off the shelf. Sausages have many players in their value chain, from farm to abattoir, meat packer, sausage maker, cold store and retailer.

An extended product and service is provided when someone buys a fast-food meal. All the partners in the meat chain, as with sausages, are present. Similar types of supplier deliver bread and vegetables. Then these food ingredients have to be converted into a hot, cheap meal in a minute or two after you have placed an order at the counter.

A further set of supply chains is required to provide industrial products. Where a company rather than an individual buys the product, the parameters are frequently quite different. Delivery at the agreed time, quality and correctness are the most important

criteria. There is less emphasis on the product packaging and more emphasis on repeat purchases in a permanent relationship.

The overall aim of a supply chain is to satisfy the needs of the end consumer, who uses the goods produced. This aim is achieved by each partner in the chain treating the downstream link that it supplies as a customer. Focusing on one partner with a number of production processes, again each process should treat its downstream process as a customer. This relationship, which was first brought into prominence in *total quality management**, is an important means of obtaining maximum value from the chain with the use of minimum resources.

How then should one design a supply chain? We examine the situation where there is an existing supply chain, comprising a number of constituent partner firms, which requires extensive modification to match current and future conditions. Saw and McCullen[9] say, there are four design tasks which must be addressed in parallel:

- process design,
- information system design,
- organisation design, and
- physical network design.

There is very little published information on groups of companies designing supply chains in their entirety. In fact, logistics design has barely progressed beyond distribution audits in the literature. It is likely that a number of companies have held meaningful *strategic planning** meetings with their whole supply chain partners, but if they have, they are not telling anyone about it! Our own experience leads us to think that true supply chain planning, open-ended, trusting and sharing, is extremely rare. Hence we use theory which we consider helpful, if not yet adopted by many companies. These authors go on to propose four design rules:

- control systems principles,
- time compression,
- information transparency principles, and
- link elimination.

Design can also be seen as containing three elements:

1. Content – the area of 'order winners'[4] and policies, covering processes, information and physical operations, which are tools to obtain a customer-satisfying strategy.
2. Process – the method by which a supply chain strategy will be constructed by a group of managers and approval obtained for the resultant action plans.
3. Implementation – the way in which the action plans will be operationalised sequentially through all the necessary firms and employees. This involves multi-organisation change processes, project management and perseverance.

An example of such elements was the derivation and implementation of a strategy for fresh sausages by a meat-processing company. A planning process was facilitated during seven meetings over a three-month period to give the required content in the form of an action plan for the next two years. The planning team proceeded to implement the sausage strategy with enormous success over a 12-month period, a 10-fold increase in turnover to Aus$4 (£1.5) million per year. One problem with this example was that the strategy did not address information communication to any extent. The need for information communication is examined in the next section.

An important part of supply chain design is the trade-offs between the functions of links and processes in the chain. Considering a supply chain as a system, one is concerned about the output of the whole chain. Individual processes do not need to have optimum design. Trade-offs exist between processes that assist total system performance. The aim is to get the required performance at an economic cost, rather than to optimise travel times or inventory levels. If the trade-offs are correctly chosen, the integrated supply chain may produce superior results compared to a series of individually optimised components.

1.3 INFORMATION COMMUNICATION SUPPORTS MANAGEMENT

Building on the Double-Bell model described above, we now delve further into the information required by the supply chain. How can information be moved to the right places in the right forms so that managers can organise, measure performance and control the chain and its *stages?*

We saw how communication of information is necessary before the supply chain can perform its physical task. The basic information comprises:

- an order,
- a production schedule,
- a purchase order,
- an inventory record, and
- a despatch advice.

An order is a list of products and quantities required by the customer. A production schedule is an instruction to manufacture products in a particular order. A *purchase order** is a list of materials or components required from a supplier. An inventory record is a statement of the quantity of materials or goods available at a location. For example, at a distribution centre, records are kept of all the products that have been received in bulk from the factory. As products are selected, or picked, for customer orders, so the records are adjusted. Finally, at the completion of picking an order, a despatch advice will be issued to accompany the goods to their destination. These simple pieces of information will exist at each link in the supply chain for a manufacturing company. Similar information is required in the supply chains of service companies.

Companies use computer information systems to achieve these information requirements. An *order-processing** system is used to carry out checks on the incoming order. Typical checks are to find out whether the order fits within the range of products and services made and to make sure that the customer is able to pay for the goods ordered. If these checks are satisfactory, the order-processing system will instruct a storeman, via a warehouse management system, to pick and despatch the desired products. A *warehouse management system** keeps track of all the goods in the warehouse as they are received, put away, moved and picked-to-order.

Many manufacturing companies have an *enterprise resource planning** system to assist them to purchase and manufacture all the required parts to assemble a complex finished product such as a car or a refrigerator. The basic functions of this system are to schedule sufficient production each day, allowing for rates of manufacture and the

order in which components are assembled into the finished product, so that the desired mix of products is produced every day. Many companies involved in distribution use a *distribution requirements planning** system to track each finished product from the factory through levels of warehouses to the end customer. Distribution requirements planning is a technique to manage product flows and inventories by providing planning records that carry demand information from receiving points to supply points and returns supply information to the receiving points. Alternatively, companies use efficient consumer response systems to assist the salespeople to focus their efforts on meeting customer needs fully by coordinating their efforts with their trading partners. For further development of these areas, see Chapter 5.

An important source of information for operators and management is summaries of performance over a period of time. Key performance measures, such as quality, on-time delivery and costs, enable managers and supervisors to check that they are achieving their customers' requirements.

Information needs to be exchanged between partner companies in the supply chain. Historically, this was done by telephone, mail or by facsimile. With the current availability of communications by telephone and the Internet, it is possible to make up-to-date status of orders, production and deliveries immediately available to all the members of the supply chain. *Electronic data interchange (EDI)** is an important means of computer-to-computer communication. It enables instantaneous transmission of documents between companies in the exact formats that each company's database requires.

In this age of electronic information, person-to-person communication is still important to learn about the current situation, to correct wrong impressions and to decide on courses of action. People speak to each other on the telephone, in offices and in meetings. Computer systems cannot be relied upon to carry out tasks automatically without human supervision unless the task is very simple and it is carefully implemented.

1.4 MANAGEMENT AND LEADERSHIP OF CHAINS

Management refers to the attainment of organisational goals through planning, organising, leading and controlling production or service facilities ranging from manufacturing equipment through distribution centres to supermarkets. We use the word 'management' to refer to these activities within one company, or link, in the supply chain. Managers have to take *strategic decisions**, which alter the whole position of the company, *tactical decisions**, which fill out the specifics of strategy, and *operating decisions**, a huge number of short-term decisions to keep the company running properly.

Leadership is the ability to influence people towards the attainment of goals.[5] Although strictly it is one function of management, we will use 'leadership' to refer to the coordination of companies in the supply chain to attain chain-wide goals.

Consider management of the central warehouse of Benetton (see Box 1.1). Managers have planned that facility so that it has the technology and the capacity to respond to customer orders by picking and despatching sweaters. Managers have appointed and trained the workforce. They motivate the workforce and control operation of the warehouse so that distribution is effectively carried out.

In addition to this management of the warehouse, and other chain facilities, the Benetton chain must be led to ensure that all the facilities pull together to get the garments into the world-wide shops. Leadership can be exercised directly in the facilities Benetton owns, such as the central warehouse. Leadership is closer to coordination when Benetton's managers influence the salespeople in the thousands of franchised shops to fit into their overall aim of operating the supply chain.

The leadership of supply chains becomes more complex when one considers the elements of power and trust that may, or may not, be displayed between the various firms in the chain and between each manager in each firm.[10] Few chains have effective leadership at the moment. The most that has been observed is chain coordination.

1.5 SUPPLY CHAIN INTEGRATION AND STRATEGY

An efficient, integrated supply chain plays a major part in the success of the business strategies of its constituent companies. It is now recognised that, in many cases, competition is between supply chains rather than individual companies.[11] Getting the product and service to the end consumer when they want it is critical. Consequently, the partner companies should work closely together to define and execute a supply chain strategy which will both satisfy customer needs and allow them to make an adequate return.

To get full benefit from a supply chain it is necessary to link all the partners involved so that goods and services flow effectively to consumers. This is achieved by working collaboratively with customers, suppliers, trading partners and service providers. The overall aim is to create a flow of products exactly as required by customers, responding dynamically to changes in their orders. First, it is necessary to establish the boundary of the supply chain, how many tiers of suppliers must be included, which service providers are important in chain flow outcomes? Secondly, where will the *decoupling point** be placed, that is the point at which planned production of materials and components changes to exact assembly and delivery of products and services pulled by customer orders? Treatment of planned, or pushed, components is very different from the processing of known customer orders. Thirdly, what physical and human resources need to be built up to provide a capability which will confer distinctive competencies compared to competing supply chains?

Within this integrated chain, managers now need to know the *order winners**. Which parameters are critical in the eyes of customers? Are they quality, speed of delivery or low price? Given the order winners, managers can design the supply chain to achieve them by choice of configurations and policies in each link. This includes *strategic decisions** on policies such as capabilities, quality assurance, response times and degree of customisation of product or service.

An important issue in chain integration is the inherent variability in demand for a product and the variable nature of purchasing, provision and travel times. The chain design should take account of these types of uncertainty to give a robust chain which is capable of the expected delivery time and also responsive to changes in volume, process and mix of orders placed or services demanded.

A new element of supply chain integration is the opportunity, which information systems offer, for firms to be responsive to customer orders rather than to anticipate

orders by making goods in advance. For centuries the dominant business model required anticipation of what customers will demand in the future. Manufacturers produced products based upon a market forecast, unordered inventory was held by *wholesalers**, distributors and retailers. *Cycle times** to provide correct stock were long. The differences between plans and results increased costs and risks and frequently led to adversarial relationships between supply chain 'partners'. The availability of low-cost information enables manufacturers and whole supply chains to be more responsive than anticipatory. Time-based competition is used in the responsive business model. Managers share information to improve the speed and accuracy of supply chains. When all partners in the chain synchronise their operations, inventory can be reduced and duplicate practices eliminated. The fewer steps in the responsive process equate to less cost and less elapsed time from order commitment to delivery.

Pulling together the order winners, the centralised information and timeliness of supply, requires supply chain managers and leaders to decide on the policies needed in various functions in each link of the supply chain so that a successful strategy delivers benefits to customers and providers.

Summary

Supply chain integration, for a chain of manufacturing and service companies, requires the major stages in the location, transformation and movement of raw materials and finished goods to be 'bounded', designed and operated very competitively. Using the current limited understanding of the concept of supply chain management, how does a manager in one company work with up- and downstream counterparts to position and tune their businesses for success? There is now strong evidence of the importance of integrated supply chain strategy and management to achieve sustained competitive advantage.

As well as physical movements, the concept of supply chain management needs to be applied to information, leadership and management of constituent firms within supply chains. The concept can be represented by the Double-Bell model which comprises all significant provision and information steps from creation of raw materials to delivery of end products and services to consumers.

A supply network comprises all the product market families going through a focal company (typically a manufacturer or distributor) to end customers. Thus the network comprises a number of supply chains to achieve the desired flow of products to end customers. Each chain can be different from the others to a greater or lesser extent, dependent upon resource availability and economic forces. Widening to various industries providing different goods and services, the range of possible supply chains is huge. The combination of products, lead times and numbers of customers creates a multitude of chains.

Supply chain integration provides an opportunity for you, as future managers of companies along the chain, to work together through shared information to provide and deliver goods and services to customers. Consider a simple supply

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chain of one vendor transporting materials to a manufacturer, who transforms them into one family of finished products and despatches these goods to a *distribution centre** for delivery, at the right time, to a retailer for customers to purchase. Assume that the supply chain processes, information systems and services, such as transport, are already well designed to supply those goods at a profit over the costs of operating the whole value chain. You then have three strategic tasks:

- to plan the flow of materials, goods and services from sources to customers along stages of the chain by information exchange, electronic and verbal,
- to perform the necessary physical movements and conversions in the required quantities and at the required times for consumers within acceptable costs, and
- to manage innovations, changes and developments to the benefit of product market families for all companies and to the advantage of all desired customers.

Questions

1. Name the key parts of a physical supply chain in sequence from sources to end consumers.
2. How does a supply chain for a family of products fit into the Double-Bell model of a supply network?
3. Why does the existence of several separate companies along the supply chain make it more difficult to flow materials and products to customers?
4. What does each bell represent in the Double-Bell model?
5. Explain how the supply chain can be considered a series of links and movements.
6. What is the function of information communication systems in running the supply chain?
7. Draw a supply network for a family of products in an industry with which you are familiar. If you do not have a familiar industry, use a case from this book or other literature.
8. What are the two key aims of a supply chain?

Case: Designing a European supply chain[12]

Derek Stuart, Director of Logistics Europe at Shavers Inc., was discussing a new design for Shavers supply chain with the IT Director, Brenda Hunter, and the Distribution Centres Manager, John Beale. In the face of poor customer service and excess inventory, the President of Shavers had charged Derek with the task of overhauling the European logistics with a wide scope.

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Shavers Inc

The Shavers company is a long-established company with a corporate brand name that is recognised world-wide. It is a large company with world headquarters in the USA and operations throughout the USA, Asia and Europe. Shavers aims to achieve leadership in male and female shaving and deodorants, anti-perspirants and dental care. The corporate strategy is to run the business on a global basis, maximising the power of Shavers' well-established brands. Shavers' mission, in part, states:

- We sell the same products world-wide.
- We treat all markets the same.
- We package fast-moving commodity products to suit local requirements.

A typical European supply chain comprises product design in Massachusetts, manufacture in England and Germany, and distribution from 13 warehouses to 20 countries. Four hundred and fifty different products are sold throughout Europe, although extra variants were caused by packaging and promotions.

Derek Stuart believed that, despite the company's commitment to a global marketing strategy, there was a lack of integration of its supply chain management, particularly across Europe. Responsibility for logistics was very fragmented with each country managing its manufacturing needs and distribution. A European HQ had been established in London, but decisions on everything from inventory levels to purchasing were made locally. There were 13 distribution centres (DCs) across Europe, all carrying identical stock except that packaging varied locally, plus a number of transport interchange depots. Shavers was not achieving its aim of satisfying its world-wide customers with common products in local wraps in Europe because of poor delivery performance. This lack of customer service reduced competitiveness, revenue and profit.

Current supply chain

John Beale, DC Manager, brought a diagram to explain the concept behind Shavers European supply chain (Figure C1.1). Currently, parts were bought from suppliers in the USA and Asia for manufacture in three European factories. Finished products were delivered to 13 distribution centres where they were packaged for local markets and delivered to customer stores. These stores included chain retailers, wholesalers and pharmacy warehouses. Sales and most logistics decisions were taken in national offices in each country. Figure C1.2 shows where decisions were then taken across the range of logistics functions. The large number of DCs, with separately planned stock and once-a-month ordering, led to high levels of inventory, typically three months sales cover.

Even allowing for all this inventory, service levels to retail customers were low. Order fill averaged only 78%, and the order cycle time varied from five days to more than 20 days. Service performance was increasingly important as European retailers continued to grow their purchasing power and to place ever-greater demands for service on their suppliers.

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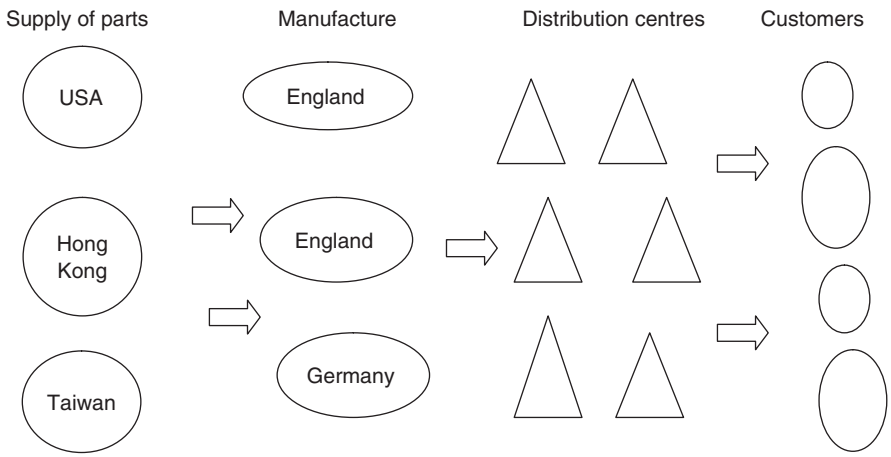

Figure C1.1 Concept diagram of Shavers supply network

Each symbol represents goods,information,management and relationships. Except for manufacture, the symbols do not represent all the entities in the supply chain.

Function	Responsibility		
	Europe HQ	National	Local region
Production operations	◗	◗	
Master scheduling		●	
Finished goods inventories		●	
Purchasing		●	
Sales forecasting		●	
Distribution centres		●	
Distribution		●	
Order-processing		●	
Packaging design	◗	◗	
Planning information systems		●	
Systems design and support	◗	◗	

Figure C1.2 Decision-making responsibilities in Shavers (◗ = half; ● = whole)

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Many of the markets in which Shavers competed were highly volatile, with high levels of promotional activity requiring special promotional packs. In situations such as this, forecasting was difficult and consequently there was always great pressure placed on manufacturing to make frequent changes to its production schedules. Manufacturing worked on a monthly planning cycle and hence needed to have reliable forecasts to cover the planning period as well as the extended lead times required by suppliers.

A new design

To Derek Stuart, it seemed clear that the global approach to marketing would require Shavers to have a greater degree of central coordination and planning. A European logistics strategy required a number of fundamental decisions to be made at a European level rather than locally. He especially felt that areas of particular strategic importance were:

- finished goods and work-in-progress inventories,
- distribution operations and location,
- supply chain strategy,
- development of forecasting and requirement-planning systems, and
- purchasing.

John Beale held the view that the large number of distribution centres was hindering the achievement of good service levels as well as costing too much. Brenda Hunter, IT Director, saw the need for modern planning and control systems to provide for customer demand by effective scheduling, manufacturing and distribution planning for each product on offer.

The three executives looked at finished goods inventory first. Centralised responsibility for inventory would require the establishment of a European planning function. The task of the function was to obtain sales forecasts from each local market, monitor finished goods stock levels at each DC and develop production plans and stock movement schedules to drive the flow of finished goods to DCs to ensure a high service level.

To start to obtain a better distribution network, John recommended the setting-up of a central European distribution function. This would be required to find the best configuration of DCs and provide input to the proposed business information systems. At that time close working relationships between local business managers and the local DC managers, or transport contractors, made for a difficult transition.

Brenda considered that the planning and execution systems that Derek and Stuart wanted would require the creation of a European business process group. This group would specify, purchase and implement the necessary enterprise requirements planning and web-based systems to give common systems across the whole of Europe. This was the only way, she said, that the integrated logistics management required by Derek could be achieved.

Up to this point all planning had been done in monthly quantities, with the consequence that stocks were at a high level. Once a European-wide forecasting system was installed, Shavers should be able to forecast overall European demand centrally much more accurately than they could by adding up all the local sales forecasts. This would lead to weekly requirements planning, backed up by capacity-constrained master scheduling. The essence of this was that the production of blades and razors in the factories would be driven by accurate, stable, European forecasts while the more volatile packaging requirements were

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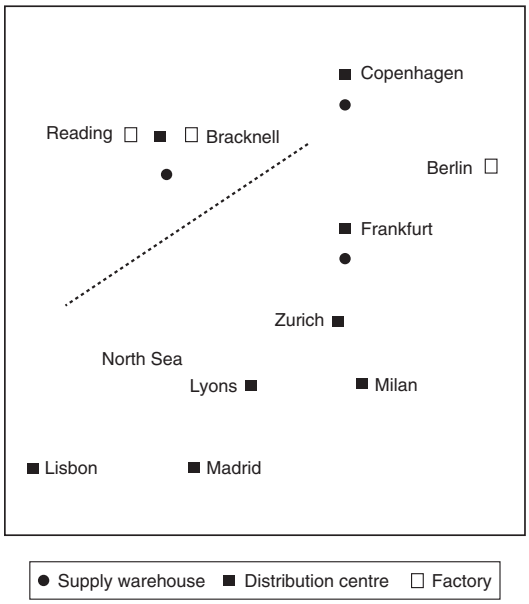

Figure C1.3 **Revised European DC network**

driven by national and regional, item-level forecasts (close to real-time demand). Differences between the two would be buffered by work-in-process inventory which, in turn, required the centralisation of inventory responsibility. Although, in reality, there was a close partnership between the European and factory planning teams, the centralisation of control over work-in-process would be a major step forward, which had already been achieved by the corresponding division of Shavers in the USA.

A further plank in Derek's European vision for integrated logistics management was the centralisation of responsibility for all purchasing. This did not mean that purchasing teams within the factories would be disbanded, rather that they now reported to a central executive with a brief to act locally but think European. In his view, Shavers should benefit from significant reductions in purchase prices achieved. This would require standard purchasing systems and projects to reduce inventories of raw material and work-in-process.

Derek sent John Beale and Brenda Hunter away to investigate their areas further.

Distribution

It was apparent to John that, once a European logistics management structure was in place supported by accurate information, there would no longer be a need for 13 DCs. Shavers wanted an order-to-delivery time across Western Europe of two days. John therefore commissioned an exercise which evaluated product flows between the three factories and the markets in all 20 countries. From this work he determined that eight DCs would be required. These were to be located in Bracknell, UK; Copenhagen, Denmark; Frankfurt, Germany; Zurich, Switzerland; Milan, Italy; Lyons, France; Madrid, Spain; and Lisbon, Portugal (Figure C1.3).

The wider distribution area to be served by the German DC provides an example of the reduction in DCs. In Germany, Shavers needed a regional distribution centre located within 100 km of Frankfurt. Its function was to be both a supplier warehouse receiving all production from their largest European factory in Berlin and a regional distribution centre

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holding stock and supplying customers in Austria, Belgium and the Netherlands as well as Germany (Figure C1.3). With this facility in operation, DCs can be eliminated in Austria, Belgium and the Netherlands. However, because of the promotional demands of Belgium and the Netherlands, it was necessary to retain cross-docking depots in these countries. These depots will be operated by third-party transport contractors. Here customer orders and promotional packs will be made up from stock delivered daily from the Frankfurt DC.

A similar regional distribution plan will be implemented in Scandinavia. Four separately stocked DCs will be closed and replaced by a new regional distribution centre in Copenhagen, set up and operated by a Danish contractor. All customer orders and promotional packaging for the whole of Scandinavia will be carried out at this facility. At the same time, the rationalisation of divisional warehouses in Spain will enable Shavers to set up a third-party-operated facility south of Madrid.

Shavers originally owned and operated its own DCs. Derek believes the company should move progressively towards more contract operation. The policy is one of concentrating investment in core activities and outsourcing supply chain operations when and where conditions are appropriate. The growth of the third-party-provider industry has ensured that there is no shortage of bidders willing and able to provide a very competitive service in DC operations.

Shavers Europe has used contract carriers for the last 20 years or so, but the role played by third parties in warehouse operations had been mixed. DCs operated by Shavers and those run by third-party operators had worked very well, although warehousing contractors were changed from time to time for reasons of service or cost. However, Shavers' return on capital investment on the one hand, and the expansion of the third-party warehousing and distribution industry on the other, made it increasingly difficult to justify their own DCs. The question was not so much whether they should run their own versus a third-party operator, but the extent to which various logistics management functions and the information systems to support them should remain with Shavers or be handed over to third parties. The policy established by the company differentiates between planning activities, which will all remain with Shavers, and operations functions and systems, which will be considered for placing in the hands of appropriate third parties.

Requirements planning systems

Shavers Europe could not achieve the higher level of customer service needed and obtain the inventory reductions available through the warehouse rationalisation programme without centralised planning and shorter order processing times. After the meeting with Derek, Brenda therefore investigated and purchased an enterprise requirements planning (ERP) system which will provide:

- order forecasting,
- demand management,
- master production scheduling,
- materials requirements planning,
- purchasing,
- factory scheduling and inventory management,
- distribution requirements planning (DRP), and
- delivery recording and invoicing.

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This ERP system will provide a real-time view of the whole of Shavers' European business from customer orders to warehouse stocks, from DC stocks to factory replenishment, from order entry to delivery and payment. It will embody weekly production planning by factories and DCs, intranet transmission of information between DCs, depots and factories, and web-enabled visibility for customers, local sales offices and contractors. Although implementing the ERP system at the factories and DCs would be a substantial task, Brenda considers that the longest implementation time will be interfacing ERP and, especially, DRP to every sales office, warehouse and factory around Europe. The DRP operating concept is very simple. Once a week, sales forecasts from each country will be updated and transmitted to the central production and distribution planning office. Real-time data available will include stocks levels by stock-keeping unit (SKU) by location and the status of production schedules from each factory. The distribution requirements planning module will show stocks and movement instructions for replenishment for the current week and 20 weeks into the future for each DC and depot. At the same time, the opportunity was taken to centralise capacity planning and master scheduling at the European headquarters.

Outcomes

Shavers made substantial progress towards achieving a European logistics strategy in the three years after Derek's meeting with Brenda and John. Impressive results had been obtained from the integrated supply chain strategy for Europe:

- Customer service performance greatly improved: order fill rate, which previously averaged 78% in key markets in Europe, had reached 98%.
- Logistics operations costs rose by less than inflation over the period and represented a smaller percentage of sales in all markets.
- Despite an increase in SKUs of more than 50% from 450 to 700, an increased rate of new product launches and more sourcing of components from outside Europe, inventory levels had not risen.
- The total number of logistics employees was reduced in both warehouse operations and planning functions.

In the centralisation of responsibility for finished goods inventory, both Derek and John encountered a great deal of resistance from local business managers. Managers viewed this change as taking away 'their' stock of finished goods. There was widespread belief that service levels would suffer as inventory levels reduced, but experience showed that this was not the case.

Figure C1.4 shows how the location of various responsibilities had changed three years later. Each factory now reports to the Director of Logistics Europe (Derek). European HQ has taken over responsibility for planning and control functions (such as master scheduling), distribution centres and requirement planning. Forecasting and purchasing responsibilities are shared between European HQ and national offices. The move that elicited the most organisational resistance was the setting-up of a European warehousing and distribution function. Derek and his senior managers consulted widely to explain the major management advantages which would flow from this re-organisation. They made many procedural changes to satisfy regional concerns without retreating from the overall plan.

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Function	Responsibility		
	Europe HQ	National	Local region
Production operations	●		
Master scheduling	●		
Finished goods inventories	●		
Purchasing	◗	◗	
Sales forecasting	◖	◗	
Distribution centres	●		
Distribution	●		
Order-processing		●	
Packaging design	●		
Planning information systems			●
Systems design and support	◖		◗

Figure C1.4 Decision-making responsibilities in Shavers three years later (◗ = half; ● = whole)

Pitfalls

At this important three-year point, Derek Stuart also reflected on the major issues that had been learned and what things he might have done differently if they were starting the project over again.

After some thought he concluded that the problems could be categorised under chain-wide management, requirement planning systems, people and customer service targets.

i. Chain-wide management

Shavers Europe is still pushing products from factories through distribution centres to supply customers, but this is being done on a weekly cycle. This is a considerable improvement, bearing in mind that the forecasts on which this pre-production is based have improved dramatically and the reduction in inventory enables product to move through the whole of Europe much faster than it previously did.

ii. Requirements planning systems

Although, in theory, the redesign of systems should follow after strategic and operational plans have been developed, in practice changes in technology and the life cycles of large information systems tend to result in hardware and software investments which do not

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always follow user requirements. Shavers has undergone during the last eight years a total change from mainframes through mid-range machines and is now moving to a client-server environment. This created a momentum for application software replacement that was not always user-driven. Derek anticipated this would be less of a problem in the future.

Another factor that has affected Shavers' application systems plans within Europe has been the shortage of European software that sufficiently recognised the needs of Europe, necessitating costly revisions. Associated with this has been the lack of investment by certain software houses in support of European customers. The fact that software companies which have not invested are suffering a decline in business as a consequence is of little consolation to those companies who have bought their particular software packages.

Software purchasing decisions are probably the most difficult to make, since it is often extremely difficult for those with authority to understand what they are buying. Conversely, those with the knowledge of the application systems capabilities have generally too little influence on the buying decisions and may perhaps not be involved until a very late stage. This can seriously affect achieving a Class A result. Probably the most significant aspects of systems implementation within the context of European logistics at Shavers has been the performance of international data transmission networks, interfaces and the implementation effort. First, wide area data transmission networks have improved by an order of magnitude. Hence Shavers can be confident that data can be centralised from all factories and DCs and the results of planning decisions can be instantaneously sent to regional centres. Secondly, interfaces between different pieces of software and with EDI and web applications have become far simpler to install and use. Thirdly, installation teams have been allocated to ensure that choices in business process models and data integrity are built to near-perfect accuracy.

Brenda considers that the longest implementation time will be interfacing ERP and especially DRP to every sales office, warehouse and factory around Europe.

Shavers can now claim to have a European data network supporting centralised planning and forecasting in real time.

iii. People

The most common reaction to the centralisation of any activity is the fear of loss of control by local management. In every situation entailing the transfer of responsibility for an operation from that of national or regional managers, there has been resistance. Although this resistance appeared to be irrational and even illogical in the context of a European vision, the reaction is understandable. It is only human to believe that the formula for success in the past will continue to apply in the future, especially when it is proposed that as a consequence of change one's own job and power are diminished. It has, however, been gratifying to see that, after the fact, each step has been embraced enthusiastically and that local management has admitted that their fears were not justified. In retrospect, Derek considered that the most effective means of reassuring managers was a face-to-face discussion to build up trust and understanding.

Overlaid on the top of management issues, such as those discussed, have been those arising from national differences. Despite a strong European business culture and the general acceptance of the advantages of a European Union by senior management, the difficulties in this respect are much greater than had been anticipated. It also has to be said that for an American company working across Europe with English as the working language, it should not be a surprise that meetings need to be longer and there are occasional

(Continued)

errors of communication. Remember that each local manager is working in a foreign language.

Also on the subject of people, European centralisation has created excellent career opportunities for some managers. The gradual movement towards third-party operation has shifted the emphasis from warehouse management skills to those of negotiation and management control and this has been achieved through training and some reassignment.

iv. Customer service targets

Although defined customer service performance targets are a necessary prerequisite for the design of a supply chain, Derek sees them as a pitfall both because of their importance and the degree of misunderstanding which frequently arises between sales management and logistics management. The single most important dimension affecting the distribution strategy is that of order cycle time. That is the cycle that begins with transmission from the customer through order processing, distribution centre consolidation, picking and despatch to final destination. The key to cut order cycle times was to look for ways to streamline order-processing procedures in order to cut processing times, thus freeing up more time for the physical distribution side of the order cycle. This Shavers achieved.

Another very important measure of customer service performance is that of order fill rate. While not affected directly by the warehouse network, it is a prime measure of the effectiveness of the forecasting and planning side of the business. One of the management reporting deficiencies before Shavers redesigned the European supply chain was the lack of any customer service reporting system. Prior to installing a DRP system, Shavers were also unable to utilise forecast error and order fill rate parameters in the setting of advanced stock levels by product family in each DC. This deficiency has been rectified.

Acknowledgement

This case study[12] has been developed from work by Martin Christopher and David Taylor in 1997.

Case questions

1. What changes did Shavers make to integrate its European logistics?
2. What are the pros and cons of centralised distribution for a fast-moving consumer goods company?
3. What is the effect of supply chain design on:
   (a) information,
   (b) organisation, and
   (c) people?

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