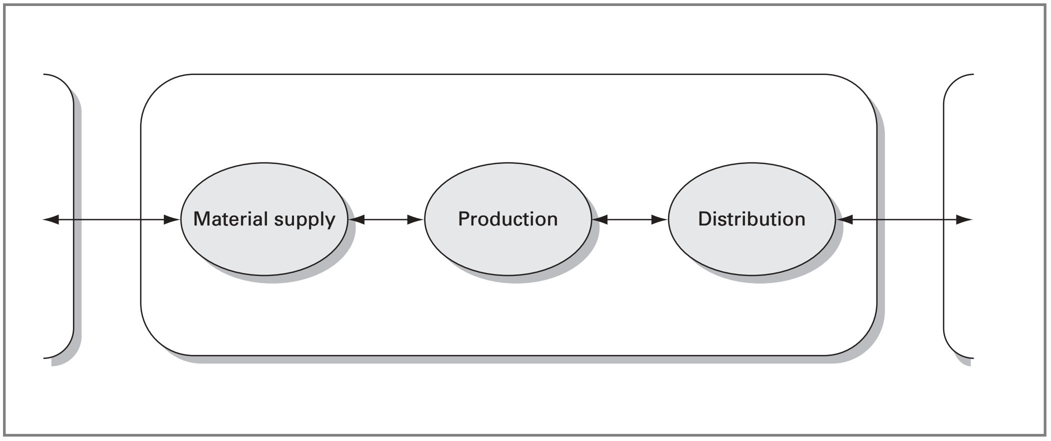
PART 3
Logistics and Supply Chain Structures



The third part deals with logistics and supply chain structures. Chapter 7, the first of four chapters concerns different design and structural aspects of the items and products in the supply chain. Chapter 8 deals with common sourcing strategies, design of supplier structures and their impact on a company and supply chain. Chapter 9 clarifies production conditions from a logistics point of view and how they impact on logistics and supply chain management. Chapter 10 about distribution structures concerns alternatives for distribution structure design and the role of distribution for supply chain value adding.

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CHAPTER 07

Products in the logistics system

It was stated in the first chapter that the aim of logistics is to achieve the efficient flow of materials. Naturally, materials themselves play a central role in the logistics system. Distribution companies refer to flows of products in and out of the company, whereas manufacturing companies use different terms depending on where the materials are located in the flow. In the outbound flow, i.e. the material flow to customers, materials are referred to as products, while the inbound flow consists of raw materials and components from suppliers. Materials flowing within the company, in which value is directly added, are called *manufactured parts* and *semi-finished products*. The concept of *item* is often used as a common term for all these aspects of materials. This chapter treats various aspects of the products and items which flow through the logistics systems of companies and supply chains.

The chapter is closely related to several other chapters in the book. There are direct links to Chapter 9 Production processes and layouts, Chapter 10 (especially Section 10.6 Postponement and speculation), Chapter 11 Demand management, Chapter 14 Transport planning and Chapter 16 (especially Section 16.4 Supply chain design).

7.1 Products, Product Groups and Product Ranges

Products in this context are physical objects that are sold and delivered to customers. However, it should be explained that the concept of product in general terms has a considerably wider meaning. For example, services of various kinds are referred to as products. For practical reasons products that are similar from the distribution and manufacturing viewpoints are often classified into **product groups**. Long-term forecasts and planning are often based on such classifications. A company's total number of products is called the *product portfolio* or **product range**.

Most companies have a large number of products whose material flows must be controlled. The number of items influences logistics work and the logistics system in various ways. The larger the number of items, the greater the workload required for their operative control, and the more complex and difficult to analyse the logistics system applied. In addition, the number of items has a considerable effect on profit variables which can and must be influenced by logistics measures; for example, capital tied up and delivery service. Most products are necessary for competitiveness on the market, but there are often products of dubious profitability which could be removed from the range without the company losing any competitiveness. Most companies have an almost constant stream of new products. To avoid having an unmanageably large range of products it is necessary to regularly phase out some products, especially those that are no longer justified in terms of the extra work and complexity of control required for their marketing.

The selection of a product range is strategically important for a company. A wide range may be important to spread risks or to even out demand for products with different seasonal variations. It may even be a prerequisite for competing at all – for example, when the market demands suppliers with complete product ranges. The positive effects of limiting the range of products are often so obvious, however, that logistics aspects should be considered in decisions made on retaining or phasing out an existing product.

A common approach to the issue of limiting product ranges is to use an ABC analysis as described in Appendix A. By ranking products in order of diminishing profit contribution, a clear picture is obtained of which products contribute most to the company's profitability. It is often the case that a small part of the range accounts for a large proportion of profit contribution. It is primarily these items that should be retained in the product range.

Limiting the product and **component range** has a number of effects on a company's logistics system. Range limitation always results in a decrease in the administration work required to control flows of materials. Fewer products simplify forecasting, and the quality of control systems can be improved by allocating more time to the most profitable products. This impacts on financial results in the form of less capital tied up, more efficient utilisation of resources and better delivery service.

A decrease in the number of similar products may also result in increased quantities of retained products manufactured, which provide other advantages from the logistics angle. For example, benefits of scale in production and fewer manufacturing orders will lead to less planning and follow-up work. Figure 7.1 illustrates two cases that show these relationships. In the first case, five similar products are manufactured in a certain production department: A, B, C, D and E. In the second case, the five products have been reduced to three: A, B and C. If the aggregate demand for the different products in the two cases remains unchanged and for simplicity's sake we assume that the production time per unit is also unchanged and that all products are

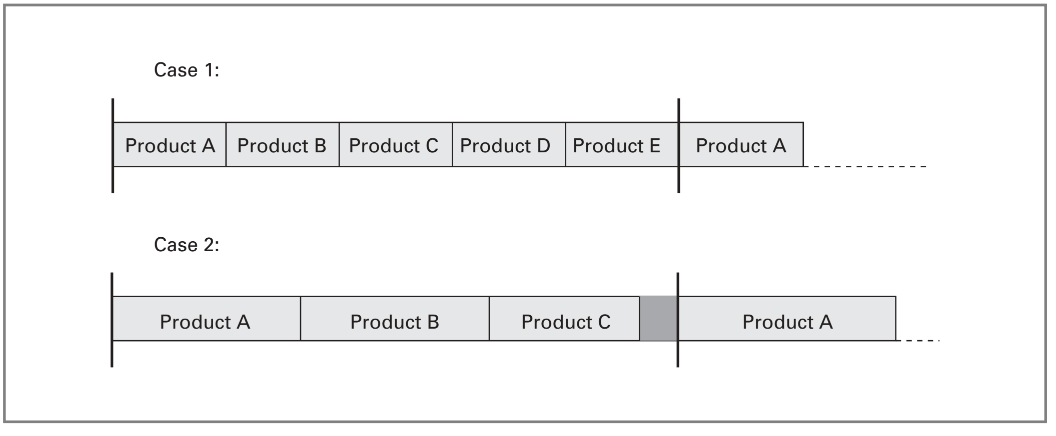


FIGURE 7.1 Change in the number of manufacturing orders after limitation of range
The rectangles represent manufacturing time for each product.

manufactured in all periods, the annual number of production orders can decrease by 40 per cent, from five to three in each period. Normally the total set-up time for starting a new order will also be reduced by the same amount since fewer modifications need to be made, resulting in less capacity required for production resources. The shaded area in case 2 represents the decrease in set-up time obtained when products D and E are removed from the range.

The decreased capacity required makes possible a reduction in manufacturing costs, or using the surplus capacity to increase production volumes – assuming that there is sufficient demand on the market. The surplus capacity can also be used to make more frequent set-ups, since more set-up time can be accepted within the framework of the existing capacity. It then becomes possible to manufacture smaller quantities each time, which gives gains in the form of less capital tied up in stocks and more flexibility for changes in customer demand.

Limiting the product range also gives positive effects on capital tied up. The following formula is usually applied to give a rough estimate of the relationship between capital tied up and the number of items. It is based on the formula for calculating economical order quantities as detailed in Chapter 12.

$$\text{Stock size} = \text{constant} \cdot \sqrt{\text{turnover} \cdot \text{number of products}}$$

If, for example, it is possible to reduce the number of items and retain the same overall turnover for a certain product group from 40 to 30, total stocks will be reduced to $\varpi \sqrt{3/4} = 0.87$, i.e. by 13 per cent. The risk of obsolescence is also reduced with the number of products since products are removed from the low turnover and slow moving parts of the range.

7.2 Product Structures

Manufacturing companies make products by processing raw materials and assembling purchased components and their own semi-finished products. The material contents of such products are defined with the help of product structures, also called **bills-of-materials (BOM)**. A **product structure** specifies how a product is designed from raw materials and purchased components, through manufactured parts and semi-finished products, to the final manufacture or

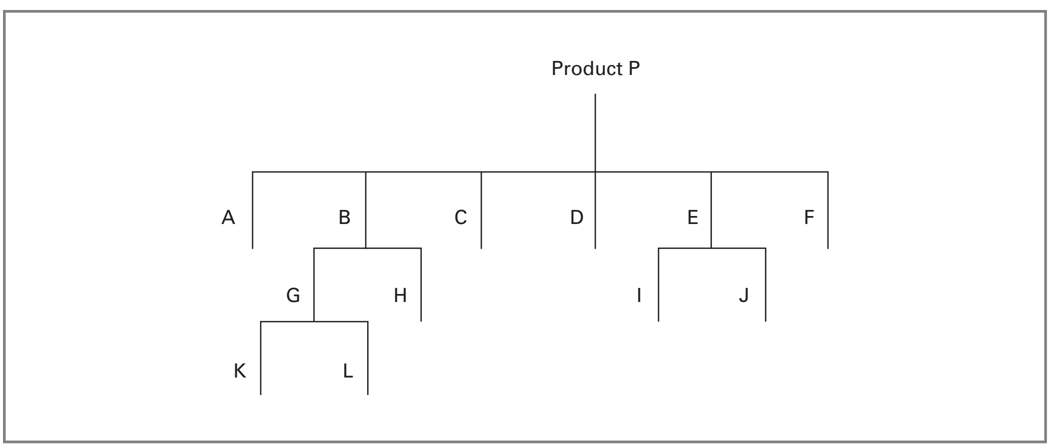


FIGURE 7.2 Illustration of a product structure

A to L refer to components included in product P.

assembly of a product. The structure also specifies quantities of each item included in the final product; for example, each chair has four legs.

A product structure may be illustrated in the form of a tree, as in Figure 7.2. The appearance of the tree indicates the complexity of the product. Product P in the figure consists of four structure levels. The upper structure level consists of six different items. The semi-finished product B consists of part G and component H, and the semi-finished product E and the components I and J. Part G consists of components K and L. The items A, C, D, F, H, I, J, K and L are purchased components which do not have their own product structures.

The structure information in the form of which and how many products and other manufactured items are included plays a decisive role for many functions in logistics. It provides a specification of how items and products are manufactured and it is the basis of product accounting. Component materials can be reserved by all the registration with the help of structures. Structures are also a prerequisite for the use of material planning methods based on material needs derived from forecasts of finished products: for example, material requirements planning which is described in Chapter 12.

The product structure determines the complexity of the product from a logistics viewpoint. Above all it is the product's structural depth and breadth that are decisive for its complexity. The structural depth of a product, i.e. the number of structural levels from raw material and purchased components to finished product, are first and foremost a consequence of its characteristics. The number of structural levels also depends to some extent on how it is designed and the technical production solutions for manufacturing it. The structural depth may also be influenced in this way. Deep structures arise as a result of numerous sub-stages in acquisition of materials and components, and manufacturing and assembly/final manufacture. Every sub-stage comprises one structural level and results in a separate item that must be planned, ordered to manufacture and delivered to stores and retrieved from stores for its use in other structural levels. Every node in the product structure is a planning point. The deeper the structure, the more planning points there are. For this reason the structural depth influences administration work required for controlling the flow of materials for each product. The number of structural levels in a manufacturing company normally lies between three and seven, but there are those with more than ten levels, especially in the mechanical engineering industry.

The structural depth is significant for the clarity and simplicity of the design of manufacturing and flow of materials. Large structural depth results in long leadtimes. Every planning point requires administration, causing another increment in leadtime. Less clarity and increased complexity in the flow of materials, which are part of deep structures, also extend the total leadtime for manufacturing products. Certainly, manufacturing in several structural stages is a necessity in most cases due to production economy. But by considering the logistics perspective and costs it is possible in many cases to achieve solutions which are more efficient in terms of the flow of materials as well as total costs.

A **product's complexity** in terms of breadth is related to the number of **items** at each structural level. In general it is the upper structural level which has the largest number of items. There may be hundreds of items at one structural level, and in many cases over a thousand. Again, the mechanical engineering industry tends to have many items in its products.

The significance of the breadth complexity for logistics applies especially to the operative control of materials. Broad structures mean that many items must be available simultaneously for the initiation of manufacturing at higher structural levels. For example, sufficient quantities of items A, B, C, D, E, and F in Figure 7.2 must be available for the manufacture of product P. The more items are involved, the more difficult and complex it is to handle the issue of coordination. These problems can be illustrated with the help of an example: assume that a product consists of 10 component items and that all of these have an inventory service level of 95 per cent, i.e. that in 95 per cent of cases there are sufficient items in stock. The probability of all items being available when manufacturing is to start will be $(0.95)^{10} = 0.60$, or only 60 per cent. The more items and the lower the inventory service levels, the higher is the probability of shortages when starting manufacturing, unless special material planning measures are taken.

In the same way as for deep structures, the structural breadth is to a large extent determined by the nature of the product. For example, a large number of items is unavoidable when assembling a car. There are certain options for reducing the structural breadth, however. One approach is to purchase ready-assembled, semi-finished products instead of purchasing all the individual components and assembling them in the plant prior to final assembly. This strategy involves selecting systems suppliers that deliver entire subsystems for the product instead of component suppliers.

Another way of reducing the number of component items is to integrate. This means that two or more items are replaced by one, or that two or more functions are integrated in one item. A simple example is that of replacing an item manufactured by welding together a number of steel parts by one cast item. The feasibility of achieving integration of different items is largely determined by developments in the production engineering area.

Product complexity from the logistics viewpoint is also affected by the size of the range of items, i.e. the quantities of raw materials, the number of purchased components and semi-finished products manufactured within the company. Limiting this range is a **standardisation** issue and depends on reducing the number of different dimensions, material qualities, shapes, colours and so on used in the design and manufacture of products. The strategy of limiting the range of components is called **component commonality** and means, for example, that instead of using different dimensions of screws each adapted for a specific purpose, one larger dimension is used for all purposes, even those that could have utilised a smaller screw dimension. The effects of component commonality are similar to the limitations on product range as described above.

7.3 Standard Products, Customer-Specific Products and Customer Order-Specific Products

In a manufacturing company, products can be categorised into standard products, more or less customer order-specific products, and customer-specific products. This division is related to the degree of customer order control in the manufacturing of products. The principal difference between product categories is related to where the **customer order decoupling point (CODP)** is located.

The customer order decoupling point is defined as the point in a product structure at which the product’s manufacture and delivery is determined by a customer order. From this point on, manufacture is governed by the customer order, whereas manufacture and purchase of items at lower structural levels are governed by forecasts and must be based on estimated future needs. In the case of customer order decoupling points, the items in lower structure levels are generally kept in stock. One general example of the significance of the customer order decoupling point and the various control principles applied from each side of it are shown in Figure 7.3. The example refers to a personal computer, which is assembled and packaged for customer orders but whose components, such as the main unit, screen, mouse and packaging, are taken from stores. The inventory control of these components is governed by forecasts of expected future sales.

It is possible to differentiate between five different types of company when referring to where the customer order decoupling point is located in product structures, which determines the degree of customer order control. The different types are illustrated in Figure 7.4.

CASE STUDY 7.1: DESIGN FOR LOGISTICS – IKEA'S TABLE LACK (Baraldi, 2006)

In 1981 IKEA launched the small table "Lack". The goal was a price that no other competitor could ever come close to. This required IKEA to design a product that could be produced and transported as such a low cost that it would become the price leader. Compared to its competitors' products, the logistics costs would make a greater impact on Lack's value because of its low price and because Lack needed to be easy to handle by logistics personnel and by consumers taking it home, while minimising the risk of logistics damage.

In designing Lack, the following key logistics functions and features were considered: weight, shape/volume, service level and quantities/variants. The logistics goals are affected by the following functions and features:

- *Low weight*: reduced transport costs, reduced transport damage, easier physical goods handling, easier pick-ups by customers from IKEA's self-service warehouses.
- *Shape and volume*: Lack is packed in flat packets, as are all IKEA's products. This allows for high load utilisation in trucks, containers and pallets.
- *Service level*: Lack is one of the items requiring the highest delivery precision. It is assigned a 99 per cent service level at the warehouses. This may however require less than truck load deliveries to warehouses.
- *Quantities and variants*: it is more cost-efficient to keep the finished goods stock upstream in distribution centres or at the manufacturers. This has pressured IKEA to cut delivery lead-times aggressively throughout the supply chain and to develop a global planning approach for planning and execution stock replenishment. The number of variants also drives costs which is why these have had to be kept at a minimum level.

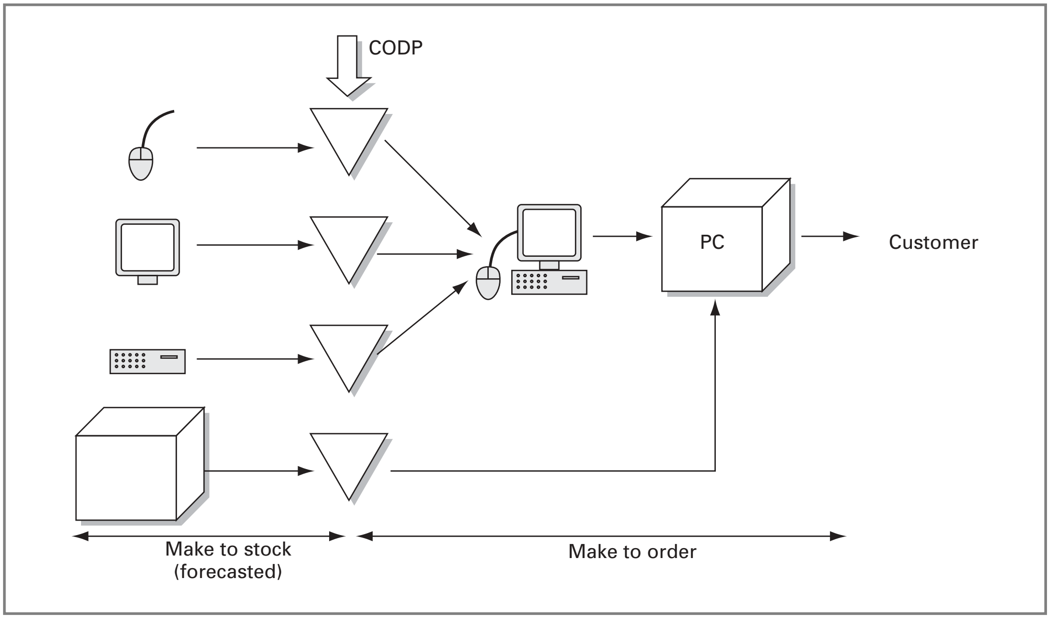


FIGURE 7.3 Control principles on each side of the customer order decoupling point (CODP)

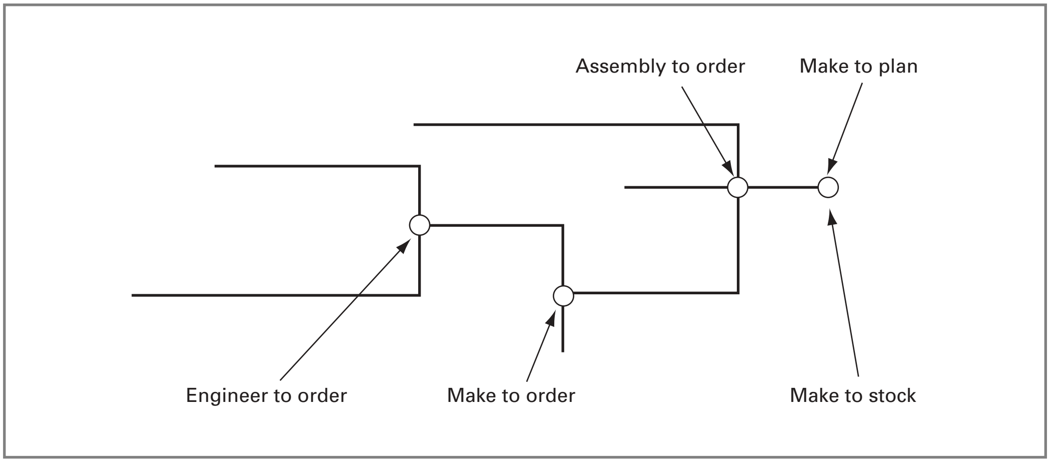


FIGURE 7.4 The location of the customer order point for different types of company

Engineer to order (ETO) means that the company's products are designed to customer order specifications to a greater or lesser degree. Design work, preparations for manufacture, materials sourcing and manufacturing are carried out and governed both in terms of time and content by customer orders received. The customer order decoupling point lies at a very low level, i.e. far down in the product structure. Stocks in this type of company consist of unsophisticated purchased components and raw materials.

Make to order (MTO) is similar to the above type, but in this case products are generally fully designed and ready for manufacture before customer orders are received. A large part of materials sourcing and manufacturing of parts and semi-finished products is carried out without any connection to specific customer orders. Some component manufacturing and all assembly/final manufacture are carried out directly to customer orders. Materials from external suppliers are also sourced to some extent to customer orders. The degree of integration of production and customer orders is thus less for this type of company than the previous type, and the customer order decoupling point lies higher in the product structure. Stocks consist mainly of purchased components, raw materials and components produced within the company.

Assembly to order (ATO) means in principle that all materials are sourced and all component manufacturing is carried out without connection to specific customer orders. The final form of the products and their characteristics are achieved through ordering variants when assembling/final manufacture to customer order. Apart from the final step of ordering variants, the products are completely standardised and defined and designed by the manufacturing company itself. The degree of integration is relatively low and the customer order decoupling point lies just under the final product's structure level. In this type of company stocks consist of all purchased components, raw materials, and components and semi-finished products that are produced within the company.

The remaining two types of company, **make to plan (MTP)** and **make to stock (MTS),** have the smallest correlation between manufacturing and customer orders. Products are fully known and specified when the customer order is placed, i.e. the customer order decoupling point lies after the level of final product in the product structure. In the case of make to stock, standard

Characteristics	Engineer to order	Make to order	Assembly to order	Make to plan	Make to stock
Delivery time to customer	Long	Medium	Short	Short	Very short
Typical production volumes	Very small	Small	Medium	Very large	Large
Product variants	Very much	Many	Many	Few	Few
Basis for planning	Customer order	Forecast/ Customer order	Forecast/ Customer order	Delivery plan	Forecast
Integration with customer	High	Medium	Low	High	No
Number of customer orders	Very few	Few	Medium	Few	Medium

TABLE 7.1 Characteristics of different company types

products are kept in stock awaiting customer orders. Make to plan may also refer to completely standardised products without any connection to specific customers but it may also refer to customer-specific products that are delivered to individual customers. Customer-specific products are designed for a particular customer, but the product is known when the customer order is received. Examples of this type of relationship are suppliers to the car industry and other repetitive industries. Instead of manufacturing activities being initiated by customer orders, delivery plans and forecasts respectively and stock levels initiate manufacturing in both of these types of company. Stocks in this case consist of end products and all purchased components, raw materials, and components and semi-finished products produced within the company.

A summary of the characteristics of these different company types is given in Table 7.1. The characteristics stated refer to commonly occurring and typical relationships for each type of company. Deviations may occur in individual companies. Integration with customers in this table describes to what degree the customer, through the customer order, affects the form of the product and thus its composition in terms of materials and manufacture.

7.4 Product Variants and Dealing with Variants

A range of products can be characterised in terms of breadth and depth. A broad range has many products which are not especially related to each other, while a deep range is characterised by a few basic types, each with a number of variants. Being able to supply many different qualities and variants of the same product is often a prerequisite for being able to compete on a market that is increasingly characterised by demands for satisfying individual customers' unique needs. From a marketing point of view it may be a drawback to have to limit the range by reducing the number of variants. However, a deep product range carries with it a number of problems from the logistics perspective, especially if the different variants are manufactured to stock. It is difficult to avoid large amounts of capital tied up, and also to avoid high obsolescence

A	Lamp shade	B	Foot	C	Cable
1	Cylindric	1	Cubic blue	1	Length 1 metre
2	Cone	2	Cubic red	2	Length 2 metre
3	Double cone	3	Cubic yellow	3	Length 3 metre
		4	Cylindric blue		
		5	Cylindric red		
		6	Cylindric yellow		
D	**Plug**	**E**	**Switch**	**F**	**Bulb**
1	Earthed	1	Two positions type	1	25 Watt
2	Unearthed	2	Three positions type	2	40 Watt
		3	Continuous type	3	60 Watt

TABLE 7.2 Options in the manufacture of a table lamp

costs, i.e. costs for scrapping products due to changes on the market or changing customer requirements reducing demand for them.

One simple example is sufficient to illustrate the fact that the number of variants can easily become unreasonable. Assume that a lamp company manufactures basic table lamps. The various options with regard to lampshade, foot and so on are shown in Table 7.2. This simple lamp has a total of 972 variants. Naturally, it is almost impossible to forecast demand for so many variants, and even more difficult to keep all in stock. Typical for this type of problem with variants is that the number rapidly increases with each option added. To give an example: if it was possible to choose between three colours of lampshade, the number of variants would increase to 3 times 972, or 2916.

One strategy which can be applied to this type of problem to make handling more efficient is called **postponement**. This means trying to avoid manufacturing products to stock. Instead, the component parts are stocked and the end product is not manufactured until a customer order is received specifying which variant is required. To create very short delivery times it is even possible to allow local distributors to carry out final assembly of the product after the customer has placed his order. For the postponement strategy to be possible, the leadtime for final assembly to customer order must be shorter than the delivery time required by the customer. The opposite strategy, *speculation*, means that variants are manufactured on the basis of forecasts, with the risk that there will be insufficient demand for certain variants.

There are two main alternatives for the application of postponement strategy to handling a large number of **product variants**. One is called basic version with accessories, and the other **modularisation**.

Basic version with accessories

The simplest alternative for dealing with a number of variants of standard products is to create variants by providing a number of basic versions with different types of accessories. Application of this principle means that demand for basic versions of the product is forecast and the products manufactured to stock. Manufacturing may also take place according to a production plan, i.e. a plan for the quantities manufactured in one week, or other time period. Incoming customer orders are then booked according to those quantities. The various optional accessories, which ideally can be easily added to the basic version of the product, are also manufactured separately

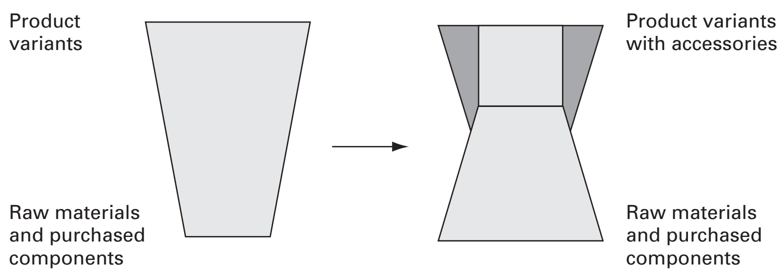


FIGURE 7.5 General illustration of dealing with variants by basic version and accessories
The breadth of the cones is proportional to the number of items. The shaded area represents items that are accessories.

to stock. When a customer order is received, the basic version is supplemented with those accessories desired by the customer. In the example of the lamp in Table 7.2, the bulb and the switch are assumed to be accessories. The number of variants is then reduced from 972 to 108, and the number of items which must be forecast and stocked will be these 108 variants plus 3 switches and 3 bulbs, i.e. a total of 114 items. It is still a large number, but the reduction is significant even in such a simple example.

The principle behind the use of basic version and accessories is illustrated in Figure 7.5. The breadth in the pictures is proportional to the number of different items that occur at different structure levels from raw materials and purchased components to finished products. The picture on the left represents the case of manufacture of all product variants to forecast, and on the right a limited number of basic versions manufactured to forecast and the remaining product variants created through supplementing basic versions with accessories of different sorts. The shaded areas in the picture on the right correspond to customer order specific variants created with these accessories.

A more far-reaching alternative is to arrange for the replacement of certain parts included in the basic version, i.e. to modify the basic version kept in stock. This could be the flexible cable in the example of the table lamp above. Assume that the basic version is a table lamp with a flexible cable 1m long, with an unearthed plug and a 25W bulb. If the customer wants any of the other lengths of flexible lead, switches or bulbs, these are changed at the time of the customer order. The number of variants which must be forecast has then been reduced to 54. In addition to this, 5 more items must be forecast and stocked, i.e. two and three-metre flexible cables, unearthed plugs and 40W and 60W bulbs.

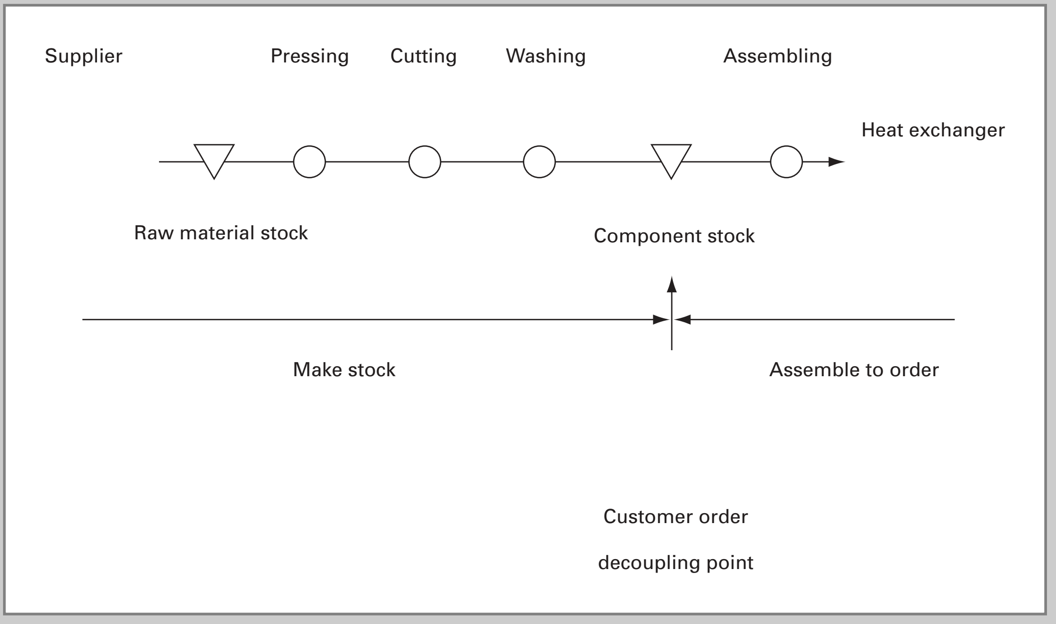
Modularisation

A more radical method of solving the problem of variants is to modularise the products and create variants to customer order by combining variants of different modules. Modularisation means that the products are divided into well-defined and standardised parts which can be combined with each other. In the example of a lamp, the lampshade, foot, flexible cable, switch, and bulb would be modules. For the approach to be really efficient it is desirable that there are as few dependencies between the different modules as possible, and as few mutual restrictions as possible in the choice of different module variants. In the example of the lamp it is desirable that all switches can be used for all lengths of flexible cable.

CASE STUDY 7.2: USE OF THE CUSTOMER ORDER DECOUPLING POINT AT ALFA LAVAL CORP.

Alfa Laval AB is a global manufacturer of, for example, heat exchangers. A heat exchanger is made from a number of standard components made to stock. When a customer order is received, standard components are withdrawn from the component store, adjusted and assembled to a finished customer-specific heat exchanger. The customer order decoupling point is consequently at the component stock. The delivery time from customer order to delivery equals the assembly time from withdrawal of standard components to finished product.

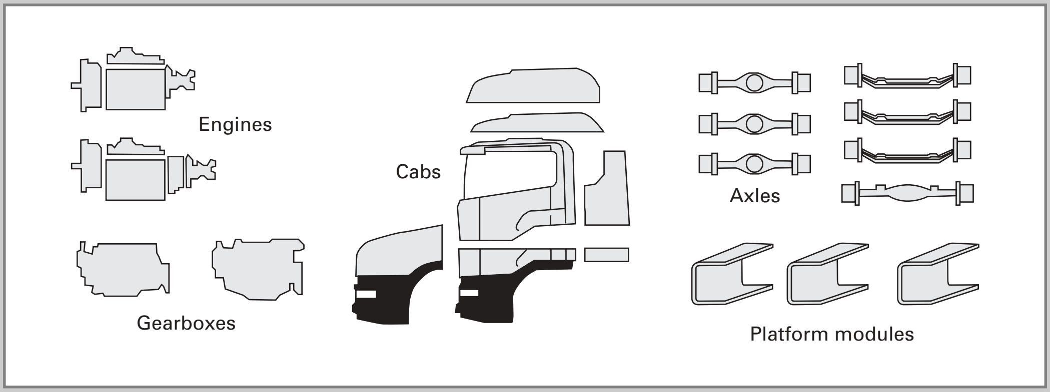
Manufacturing of heat exchangers is described in the figure below. Triangles illustrate stock points and circles illustrate production operations.



CASE STUDY 7.3: MODULAR DESIGN AT SCANIA TRUCKS

Scania Trucks is the fourth largest heavy truck manufacturer in the world, with plants in Europe, South America, Asia, Africa and Australia.

Scania's manufacturing system is based on a modular product design, allowing them to have fewer components in its assortment but without fewer product variants compared to its competitors. Each truck is based on a number of standardised modules. Engines, transmissions, axles and cabs are examples of such modules. Every module exists in a number of variants: for example, engines with different horsepower. It is possible to combine the different module variants into a very large number of possible truck configurations, even if the number of variants for each module is limited. Diagram of Scania's modularisation programme:



The different modules are forecast, planned and manufactured to stock, while the final composition of products is made to customer order. When processing customer orders, the customer's requirements are specified with respect to which variants are desired for each respective module, called *configuration*. If dealing with the issue of variants for the table lamp in Table

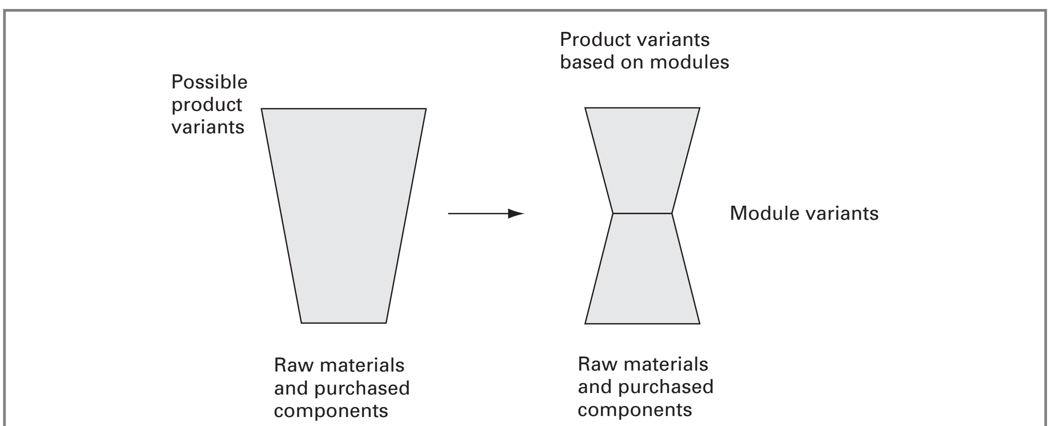


FIGURE 7.6 General illustration of dealing with variants through modularisation

The breadth of the cones is proportional to the number of items.

7.2 is based on modularisation, it is not necessary to stock any product variants. Instead, the different items which make up variants for each module are stocked. The total number of items which needs to be forecast and stocked will be reduced to only 20. In the same way as for the basic version and accessories, dealing with variants by modularisation is illustrated in Figure 7.6.

7.5 Product Lifecycle

The time during which it is financially defensible to sell a product on the market is limited. Terms used in this context are technical product life and financial product life. The sales volumes of a product normally vary in a very characteristic fashion during its lifespan, as illustrated in Figure 7.7, the **product lifecycle**.

It is possible to differentiate between a number of different phases in the product lifecycle. During the introduction phase, i.e. the period immediately after the product is launched on the market, the demand is often small and grows slowly due to buyers' resistance and the product remaining relatively unknown to customers on the market. During the growth phase, awareness of the product increases which, if its reception on the market is positive, leads to a rapid rise in sales. During the subsequent phases, maturity and saturation, sales reach their highest level. These phases are often considerably longer than the others. When the product is no longer able to attract the market sufficiently, a decrease in sales starts and the decline phase of the product lifecycle is initiated.

Where in its lifecycle a product is at any one time has a crucial effect on which logistics strategies should be chosen and which performance variables should be prioritised to work towards. The selection of suitable forecast and planning methods is also affected.

It is very important to get the product accepted during the introduction and growth phases, otherwise there is a risk that sales will never pick up properly. For this reason it is essential to be

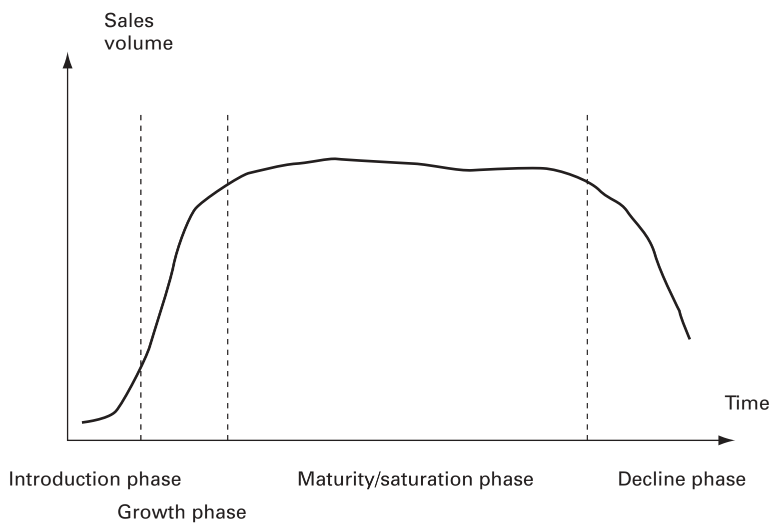


FIGURE 7.7 Product lifecycle and its phases
The curve shows how sales volumes vary during the product's life.

able to deliver as demand increases, and the focus of logistics must therefore be high delivery service. Missed delivery times or the incapacity to deliver from stock, if it is a stock item, will both decrease the probability of a customer placing repeat orders during these phases. It is also important during these phases to quickly raise sales volumes in order to capture market shares and establish the product on the market. This places great demands on the production and distribution systems and their flexibility.

The first two phases are further characterised by the extreme difficulty of predicting future demand. This depends not least on the fact that there is no sales history. Traditional forecast methods for predicting demands are not applicable, and companies are forced to rely largely on test sales, market research and assessments by experience. Due to the unreliability to which these difficulties in forecasting lead, there is a great risk that large stocks are built up which must be discarded if the product does not succeed on the market. To decrease this risk it may be advisable to manufacture smaller quantities at a time, or manufacture to customer orders as much as possible, even if order quantities are financially too small – provided that delivery times to customers are still competitive. If stocks must be accepted, the risks can be decreased by accepting stocks kept in a central warehouse and delivering directly to customers from this warehouse instead of establishing local warehouses for different markets, even though this may mean additional costs for transportation.

During the maturity and saturation phases, volumes are larger and more stable. The focus of logistics must therefore be aimed primarily at ensuring large volumes through stable material supplies from suppliers and stable flows of material in production, as well as stable deliveries to customers. Storage and distribution capacity must be expanded, and manufacturing methods and production planning must be adapted to high-volume production. Consideration of production and distribution costs is more important than during the two introductory phases.

Owing to the relatively even delivery volumes that normally occur during the maturity and saturation phases, forecasting of future demand can be based on historic values, and traditional forecast methods can be used. Since activities can be planned to a greater degree, material planning can be based on more long-term production plans. To be able to ensure delivery volumes, efficient long-term and medium-term capacity planning is important.

During the decline phase, the same type of problems arises as in the introduction and growth phases – unpredictability and difficulties in forecasting. In order to avoid unnecessarily high obsolescence costs for unsaleable products it is important that stocks are reduced as the rate of deliveries fall, both in terms of volume in stock and the number of storage points in the distribution network. The focus of logistics during this phase should be primarily aimed at decreasing the amount of capital tied up in different sections of the material flow.

If the products in question are capital goods, i.e. durable goods, the decline phase is also a period in which spare parts activities must be developed for the products that will later be phased out. In this context logistics plays a decisive role, not least because the aftermarket activities related to spare parts deliveries are generally very profitable. In addition, they are crucial to retaining customers and creating better conditions for succeeding with new products designed to replace them after they are phased out. An important focus for logistics in this case is on inventory service level and general customer service.

7.6 Conclusion and Summary

Products and their constituent items make up the flow of materials within and between companies, which is controlled by logistics processes. How efficiently these flows can be controlled with respect to costs, capital tied up and customer service depends also on how many products and items the company has and on the breadth and depth of the product and item ranges. In manufacturing companies, the control of the flow of materials also depends on the complexity of products' component parts, i.e. the complexity of the product structure.

Depending on where in the product structures the customer order decoupling point lies, different types of manufacturing may be categorised. Customer order decoupling points are the points from which manufacturing is governed by customer orders. The categories of usual manufacturing types are: *engineer to order*, *make to order*, *assembly to order*, *make to plan* and *make to stock*.

It is often impossible for companies that manufacture a large number of product variants to deliver finished products from stocks. Different approaches are used instead to create variants to order. Two different strategies for handling the issue of variants were described in this chapter: basic version with accessories and modularisation. Finally, the need to apply different logistics focuses in different phases of the product lifecycle was discussed.

Key concepts

Assembly to order (ATO) 153
Bill of material (BOM) 149
Component range 148
Component commonality 151
Customer order decoupling point (CODP) 151
Design for logistics 152
Engineer to order (ETO) 153
Item 150
Make to order (MTO) 153
Make to plan (MTP) 153
Make to stock (MTS) 153
Modularisation 155
Postponement 155
Product complexity 150
Product group 147
Product lifecycle 159
Product range 147
Product structure 149
Product variant 155
Standardisation 151

Discussion Tasks

1 The customer order decoupling point is defined as the point in a product's structure from which manufacture and delivery are determined by customer orders. Does this mean that the product's appearance and performance must also be determined by customer orders, and if not, can we then talk about different types of decoupling points? What is the connection between them?

2 A company presently making products to stock consider switching to a make to order strategy. What positive and negative impact could such a switch result in?

3 Component commonality means eliminating the range of components used in products. A component commonality strategy may impact logistics in several ways. How

could a component commonality strategy be used within and affect a clothing manufacturing supply chain?

4 This chapter describes two main alternatives for manufacturing and delivering a large number of variants using postponement strategy. What aspects are involved in the choice between these two alternatives with respect to the number of possible variants, demands on the suitability of initial design, options for the customer to configure the variant designed, and demands for short delivery times?

5 The selection of a suitable logistics strategy is influenced by which phase of its lifecycle a product is in. Product lifespans in most industries have decreased over a number of years. How may this shortened life span influence logistics strategies in each phase of a product's lifecycle?

Further reading

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