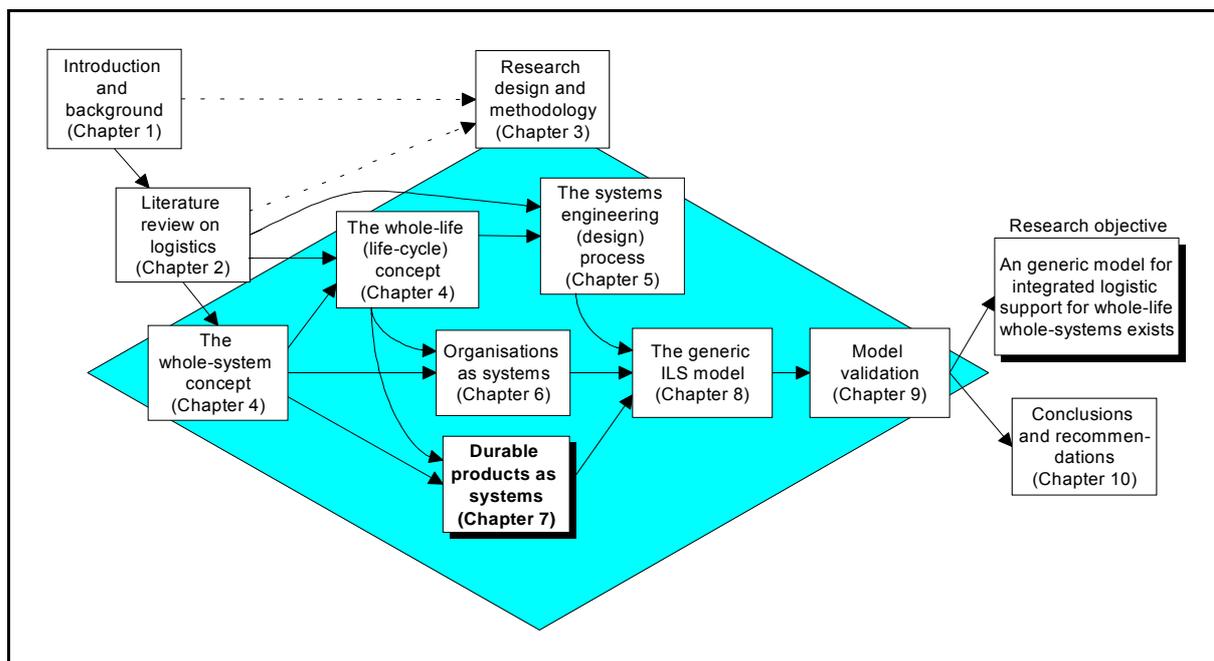


Chapter 7

Product systems

“When customers make a purchase they buy more than just a product; they have expectations regarding the degree of after-sales support the product or service carries with it.”

Norman Blem [1995:39]



7.1 Purpose and outline of the chapter

The purpose of this chapter is to describe the concept of a product and how a durable product can be viewed as a system. It will also be shown how non-durable products and services interface with the higher level systems of which they are part. Knowing the system characteristics of products and services and how they interface with the higher level systems will allow understanding of how the product generates the need for support. This understanding is essential for the development of an integrated logistics support model applicable to the life-cycle of products and services.

The outline of the chapter is as follows:

- A definition for a product is provided that includes the customer's view of value.
- Different classifications of products are provided.
- Support relationships between products and the realisation systems are investigated.
- The notion that capacity is required to be able to deliver the support is introduced.
- Master planning as a tool to arrive at support capacity requirements is investigated.

7.2 Definition of a product

A formal definition for a product is provided by Kotler [1984:463]: *"A product is anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want or need. It includes physical objects, services, persons, places, organizations, and ideas."* At first it may seem strange to use one word, product, to describe both products and services, and using a definition from a not such a recent source. This approach to a product as being the offering to the market, is echoed by more recent publications as well [Schonberger & Knod, 1997:6; Chase, Aquilano & Jacobs, 2001:9].

Schonberger and Knod [1997:6] argues that goods and services form a continuum on a tangibility scale and that examples at either end of the continuum (a pure good or a pure service), are rare. Figure 7.1 shows a few examples on the tangibility scale.

A large number of commonalities between goods and services are listed by Schonberger and Knod [1997:6-7], but only two differences can be identified:

- *"Goods may be stored; services are consumed during delivery."*
- *Goods are transformed from other goods; in services, sometimes the clients themselves are transformed."*

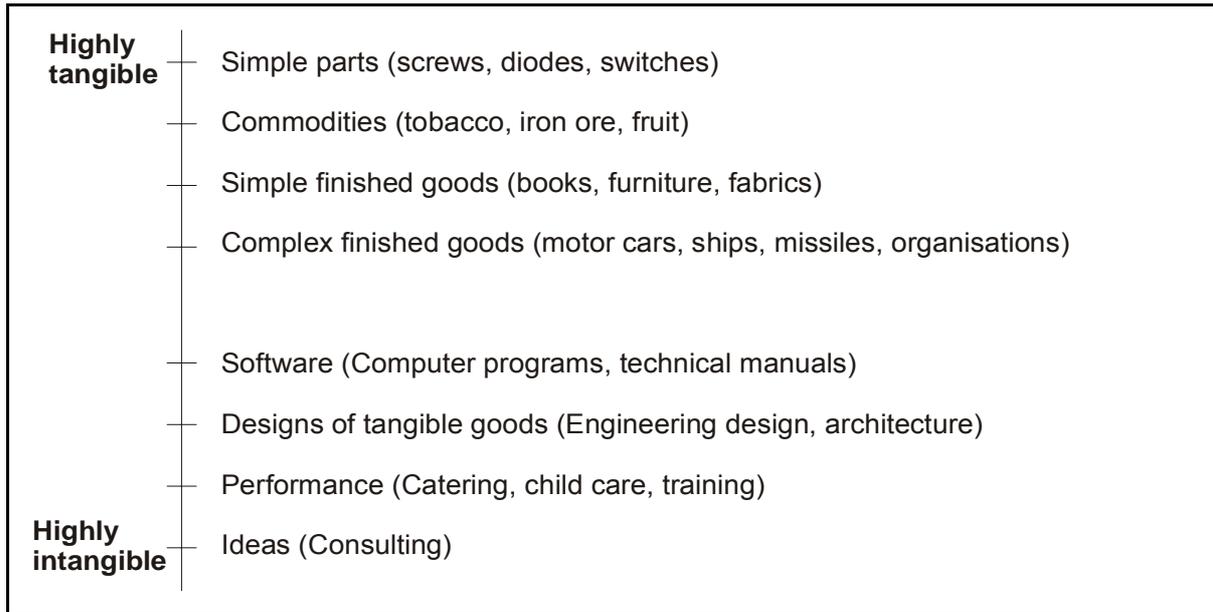


Figure 7.1: The tangibility scale

Adapted from Schonberger & Knod [1997:330]

This fine line between goods and services, collectively labelled products, is further explained by Kotler [1984:463] in Figure 7.2 where the core, tangible and augmented product is shown. At the core of any product are the benefits that the customer seeks, as opposed to the features the goods or service may exhibit.

Schonberger and Knod [1997:13] take a more customer oriented approach to defining the wants of the customers, which must ultimately be translated into a product, in order to satisfy customer requirements. They define six generic requirements set by customers:

- High levels of quality.
- A high degree of flexibility.
- High levels of service.
- Low prices.
- Quick response or short lead times.
- Little or no variability.

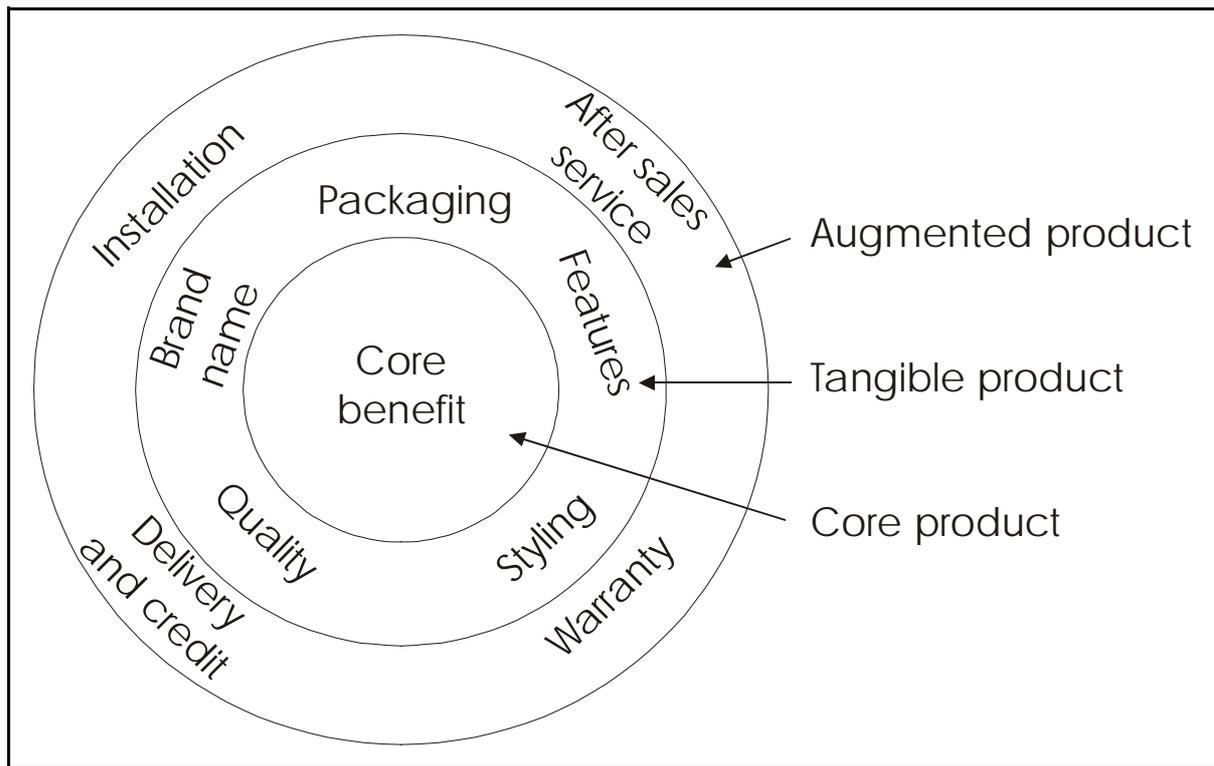


Figure 7.2: Three levels of product
Adapted from Kotler [1984:463]

These requirements are expressed by the customers as order qualifiers and order winners (See § 6.5). Also, the customer does not treat the requirements as a trade-off list. They expect all requirements to be met. Thus the customers view the obtaining and use of a product from a system perspective, because meeting the order qualifying requirements and exceeding the order winning requirements will create an emergent (system) property, namely customer satisfaction.

Kotler [1994:38] expands on this idea of value when he proposes a diagram which shows the determinants of customer delivered value (Figure 7.3). Customers prefer to buy from the company they perceive to deliver the highest customer value. It is thus clear that in order to be successful, the market satisfaction (one of the necessary conditions for achieving the goal - § 6.4) is dependent on creating products that meet the order qualifiers requirements and exceed the order winning requirements. It is also clear that the term product can be used to describe both goods and services.

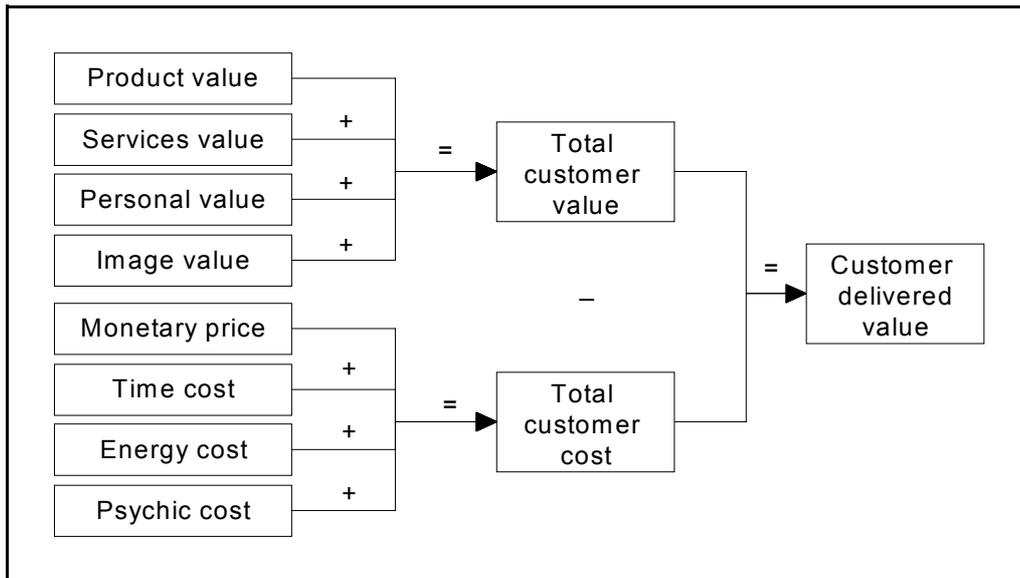


Figure 7.3: Determinants of customer value
Kotler [1994:38]

Comparing the views of Kotler, Schonberger and Knod to the generic system measurements of ability, availability and affordability, it is realised that they also use a system perspective to the customer view of a product. The comparison is shown in Table 7.1.

System measurement	Kotler's [1984:463] equivalent	Schonberger's [1997:13] equivalent
Ability	Core benefit Tangible product <ul style="list-style-type: none"> • Features • Quality • Styling • Brand name • Packaging 	High quality High flexibility
Availability	Augmented product <ul style="list-style-type: none"> • After sales service • Installation • Delivery and credit • Warranty 	High service levels Short lead time Little or no variability
Affordability	Total customer cost [Kotler, 1994:38]	Low price

Table 7.1: Comparison of customer expectations and system measurements

7.3 Classification of products

Several product-classification schemes have been defined to aid in understanding the characteristics of products in order to better satisfy customer requirements. These product characteristics (and thus the classification schemes) can be used to explain the relationships between a product and the associated support it needs to satisfy customer requirements of ability, availability and affordability.

7.3.1 Durability and tangibility classification of products

Kotler [1984:465] classifies products into the following three groups:

- Nondurable goods are tangible goods that are normally consumed relatively fast in one or a few uses. A characteristic of this type of good is that after sales service is normally limited to a toll free number where consumer enquiries and complaints are handled. A repeat purchase is normally based on a short term need and the fact that previous goods have been consumed.
- Durable goods are tangible goods that get used repetitively over a longer period of time. A repeat purchase of durable goods is based on the following factors:
 - Ultimate failure where it is not cost-effective to restore the capability once more i.e. cost of repair is more than the cost of replacement.
 - Unavailable support that makes restoring the capability impossible e.g. discontinued or unsupported product.
 - Introduction of a new technology that improves the ability, availability, affordability and/or the safety of the new product to such an extent that a new product is actively sought by the customer. The new technology may render the old product and its old technology obsolete. In such a case it is referred to as a disruptive technology [Christopher in Sheridan, 2000:8] e.g. computers and word processors replacing typewriters.
 - A perceived benefit that is subjective, e.g. buying a new car when it only provides the new owner with more status.

- Services are activities, benefits or satisfaction that are on offer by a company. Services are essentially intangible and does not result in the ownership of anything. It may or may not be tied to a physical product. It may also be viewed as the contact between the organisation and the customer, a service component that exists for every organisation. Field services are where the service provider goes to the customer and facility based services where the customer comes to the service provider [Chase *et al*, 2001:208].

7.3.2 Industry sector classification of products

Two broad industry categories are defined for the classification of products namely consumer goods and industrial goods. Each of these categories are further broken down into sub-categories.

- Consumer goods can be classified according to consumer shopping habits [Kotler, 1984:465-467]. The following categories exist:
 - Convenience goods are goods purchased on a regular basis without a lot of comparison to alternatives e.g. newspapers, toiletries and tobacco.
 - Shopping goods are goods where the customer compares alternatives based on the order qualifiers and order winners e.g. furniture, appliances.
 - Speciality goods is where the customer goes for unique characteristics and/or brand identification e.g. specific brands of fancy products.
 - Unsought goods are goods the customer does not know about e.g. new technology goods such as DVD and WAP devices. Alternatively the customer knows about it but does not normally think of buying e.g. life insurance and tax services.
- Industrial goods refer to those goods that are bought by organisations. Kotler [1984:467-469] classifies the industrial goods according to how they enter the production process and their costliness.
 - Materials and parts that are used or transformed in the transformation into the final product e.g. raw materials, manufactured materials/parts.
 - Capital items are normally used to execute transformation processes e.g. buildings and fixed equipment, as well as tools, operational and office equipment.

- Supplies are those goods that are used to operate and support the transformation process, but do not become part of the finished product e.g. operating supplies (lubricants, coal, computer supplies) and maintenance and repair items (spare parts for repair of capital equipment, cleaning material).
- Services are those products that get consumed internally e.g. business advisory services (legal, management consulting) and maintenance and repair services (overhauls, corrective maintenance and cleaning).

7.3.3 Hierarchy classification of products

As stated in Chapter 4, systems exist in a hierarchy. A systems hierarchy was proposed by Barnard [1987] in an internal document for Armscor, the South African Armaments Corporation. This systems hierarchy was proposed specifically for military systems. Barnard's hierarchy was adapted by Rottier [1999:13] to show how the levels of the system's hierarchy can be applied to goods systems, a human reference environment as well as in a service environment. The adapted hierarchy of systems is shown in Table 7.2.

From the table it is evident that the relationships between the examples of systems in the systems hierarchy are not very strong on the lower levels, maybe non-existent, but on the higher levels in the hierarchy, these systems tend to move closer together and become part of one another. It thus follows that the major system to system interaction takes place on system level 9, the level where a system can become self-sustained, perform as a realisation system and take responsibility for system outcomes. Products supplied by the realisation system can be delivered to a customer on any of the system levels. Generally speaking, anything supplied to level 4 and above can be classified as durable goods while anything supplied to level 3 and below will be classified as non-durable goods. Viewing it from the above perspective, raw materials used during production of non-durable and durable goods can be also be considered as non-durable is consumed during the production/transformation process and does not exist in its original form after the production/transformation process has taken place.

	System level	Military [Barnard]	Goods manufacturing sector [Rottier]	Services sector [Rottier]	Human reference [Rottier]	Durable goods
12	Multi national	Multi-national peace keeping force	Multi-national manufacturing corporation	Multi-national service corporation	Human race	International transportation system
11	National or Social system	National defence force	Manufacturing corporation part of country's economy	Service corporation part of country's economy	National population	National transportation system
10	Group of companies	Defence force arm	Manufacturing corporation in sector	Service corporation in sector	Societal grouping	Regional transport system
9	Self-sustaining system	Air transport wing	Manufacturing enterprise serving a market	Service enterprise serving a market	Human taking responsibility for self	Local transport system
8	User function operational capability	Transport aircraft with ground support	Car manufacturing capability	Operational division	Human	Family transportation capability
7	System	Transport aircraft	Body shop	Business systems	Blood circulation system	Motor car
6	Sub-system	Communication sub-system	Robotic welding capability	Information system	Blood pumping capability	Propulsion capability
5	Equipment	HF radio	Robot	Computers, databases	Heart	Drive train
4	Assembly	PC board	Gearbox	Sub-routines	Heart valve	Gearbox
3	Components	IC	Gears, bearings, wheels	Code line	Tissue, bone, muscle	Gears, bearings, wheels
2	Materials	Silicone	Steel, plastic, ceramics	Data elements	Cells	Steel, plastic, ceramics
1	Natural resources	Ore	Ore, chemicals	Meta data	Water, chemicals	Ore, chemicals

Table 7.2: Examples of systems in the systems hierarchy
Adapted from Rottier [1999:13] and Barnard [1987]

7.4 Support relationships between products and their realisation systems

Using the knowledge of the classification of products, it is easy to see the relationship between, for example the manufacturer of cars (the realisation system of the motor car) and the customer (human system) who owns and operates the motor car (the system of interest). Showing these relationships in Figure 7.4, the concept of a supply chain immediately comes to the fore.

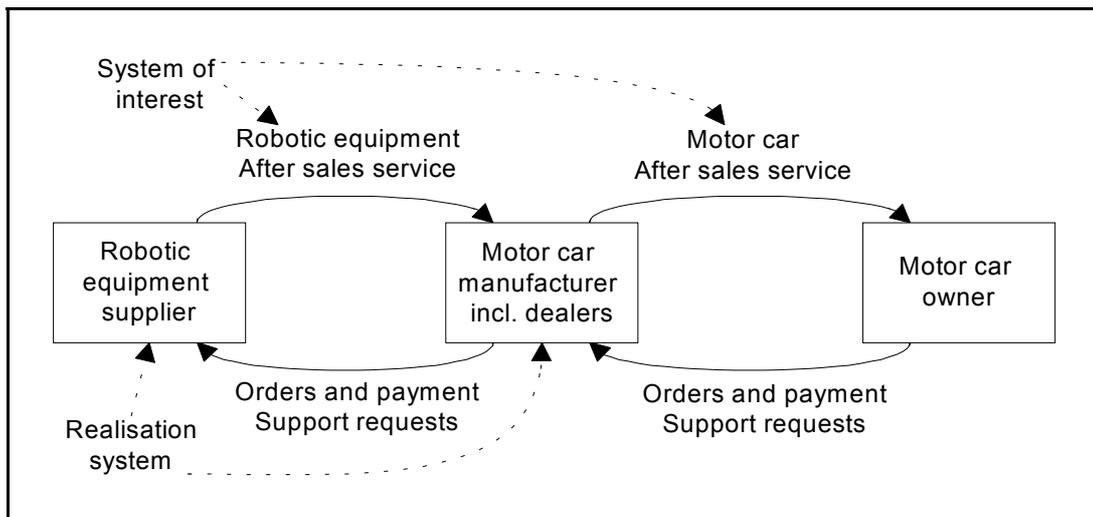


Figure 7.4: System support relationships

A further relationship exists between the manufacturer of the motor car and the supplier of the robotic equipment the motor car manufacturer uses. To the car manufacturer the robotic equipment is a durable product that needs to be operated and supported in the manufacturing of the car. The car manufacturer will buy support from the robotics supplier in the same way the owner of the car will buy support from the motor car manufacturer through its dealerships. Similarly, the owner of the car will buy non-durable goods (e.g. fuel) in order to be able to realise the benefits of owning the car.

From the above it is also clear that both the robotic equipment supplier and the motor car manufacturer operate in both the goods manufacturing sector in providing a durable system or product to their respective customers, as well as in the services sector in providing after sales support for the durable system each has supplied. It is also obvious that a supplier of consumables (non-durable products) to the motor car manufacturer (or

the owner of the motor car) will not supply after sales service to the same extent as the robotic supplier, due to the nature of its product. After sales service will be limited to technical advice with regards to the use of the product and handling problems surrounding its use and making sure the non-durable item is available to the customer at the right place at the right time.

The more complex the product (or service) the more extensive the after sales service/support normally is. In both cases (supply of a durable product and the supply of a consumable product) the organisation supplying the product is the realisation system, while in both cases the product delivered to the customer is the system of interest. In both cases the system of interest require after sales support from the realisation system, irrespective of whether it is a durable or a consumable product.

Table 7.3 provides some examples of support requirements for the different classifications of products. From the table it is obvious that a major part of the support of a product lies within the realisation system and/or the resource environment. If the support from the realisation system and/or the resource environment cease to exist, the product will most probably reach the end of its life-cycle.

The multiple dimensions of systems and the engineering of systems were introduced in § 5.4. The two distinct dimensions are the technical component or activities and the managerial component or activities. These components are as applicable to a product as it is to any other system and have to be considered for all products that will allow the product to meet all dimensions of the customer expectations. As indicated in Table 7.3, all the support activities (both managerial and technical), are necessary for the product to be able to meet customer requirements and expectations as expressed in Table 7.1.

	Product example	Support required for	Typical technical support activities	Typical support management activities
Durable product	Motor car	Durable product	Providing spares and consumables, preventive and corrective maintenance, customer training, technical data	Spare location and quantities, after sales service location, skill levels required
		Distribution system	Warehousing, preventive and corrective maintenance of transportation	Distribution system management, inventory management
		Production system	Production equipment maintenance spares, preventive and corrective maintenance of production equipment	Maintenance spares inventory management, maintenance management, supply management
Consumable product	Fuel	Distribution system	Warehousing, preventive and corrective maintenance of transportation	Distribution system management, inventory management
		Production system	Production equipment maintenance spares, preventive and corrective maintenance of production equipment	Maintenance spares inventory management, maintenance management, supply management
Facility based service	Car wash	Service delivery system	Service requirement consumables and spares, service equipment maintenance spares, preventive and corrective maintenance of service equipment	Service requirement, consumables and maintenance spares inventory management, maintenance management, supply management
Field service	Car service at customer's home	Distribution system	Warehousing, preventive and corrective maintenance of transportation	Distribution system management, inventory management
		Service delivery system	Service requirement consumables and spares, service equipment maintenance spares, preventive and corrective maintenance of service equipment	Service requirement, consumables and maintenance spares inventory management, maintenance management, supply management

Table 7.3: Example support requirements

7.5 Capacity required to support the product system

Chase, Aquilano and Jacobs [2001:217] define the line of visibility as the dividing line between those activities the customer can see and those activities that he does not see. For an organisation to provide the product or service and to support its product or service many activities are required that the customer does not see. These activities relate primarily to making sure that the right capacity is available at the right time at the right place.

Capacity refers to a provider's capability of performing transformation activities of goods and services demanded by the customer [Schonberger and Knod, 1997:228]. Transformation can take place as reshaping, conversion, fabrication, and assembly of material, but transformation can also take the form of storage or a change in the location of material. Transformation can also be changing the state of a system e.g. restoring the capability of a system through corrective maintenance after the system has failed [Chase *et al*, 2001:8-9]. Thus capacity consists of many different elements all of which must be present to be able to deliver the output (products, services and support) required through the transformation activities. Having capacity is thus an emergent property of the realisation system's elements working together.

Transformation can be presented very simply as input-process-output supported by elements within this model needs to be integrated to achieve the desired output (Figure 7.5). Starting with the output, the processing (transformation) needs are determined. Once these needs have been established, the resource needs (inputs) can be defined. The management component entails the planning, organising, directing and control of the activities necessary to get the inputs and perform the transformation to deliver the outputs. A major element of management is to establish sound policies for decision making within the transformation process to ensure the achievement of organisational goals. The technical and management dimensions are again very obvious in this model.

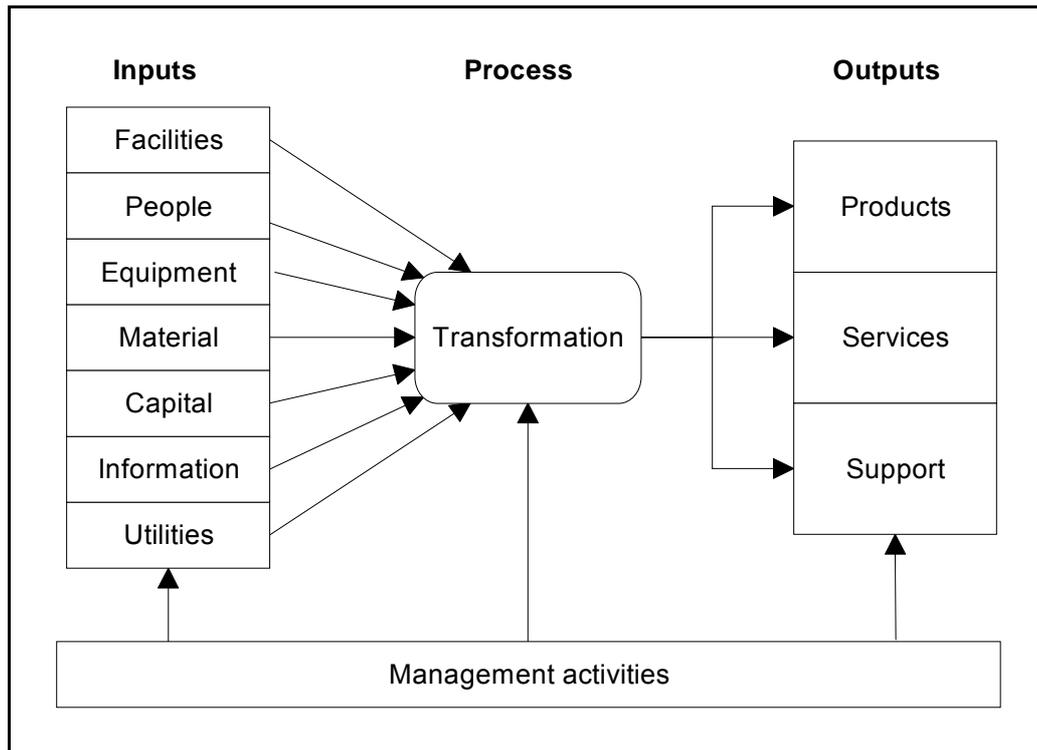


Figure 7.5: Input-Process-Output model
Adapted from Schonberger and Knod [1997:6]

7.6 Master planning as a tool to arrive at support capacity requirements

Master planning is the natural consequence of the input - process - output model applied to the realisation system providing the product, service and support. Master planning is done to ensure that demand and supply meet. Master planning consists of demand management, capacity planning and master scheduling. Master planning has as its aim to balance all demand from all sources of demand to ensure that sufficient capacity exists within the organisation to meet the product demand within the specified long, medium and short term time frames. Doing master planning within the realisation system allows the product delivered to the customer, to exist as a system meeting ability, availability and affordability requirements. Without master planning the customer will not be able to derive system benefits from the product or service provided.

7.6.1 Output and support demand management

Demand management has as its purpose to consider all sources of demand to establish and influence the output requirements of products, services and support over the long-, medium- and short term [Chase *et al*, 2001:434]. Different time horizons are included in demand management for different reasons [Schonberger and Knod, 1997:179-180]:

- Long term demand management is used to provide information for the business plan to ensure sustained long term profitability.
- Medium term demand management is used to provide information to obtain resources to meet the medium term aggregate demand.
- Short term demand is aimed at providing information of what output is to be supplied, when and in what quantities.

Two main input sources are used for demand management, namely forecasts and actual orders. Naturally master planning becomes much easier and the outcome more predictable and exact if one can work only on actual orders as opposed to forecasts. Performing demand management with actual orders is far more accurate than working with forecasts due to far less uncertainty present in actual orders than in forecasts.

Demand management is concerned only with independent demand. Independent demand is defined as the demand for the output of the organisation which cannot be derived directly from the demand for other products or influences e.g. the sales of motor cars. Even though external influences such as the interest rate may influence the quantity of demand, it cannot be calculated directly what the effect of a 1% interest rate increase will be on the demand for new cars. Dependent demand on the other hand is the material requirements calculated from the independent demand and is not included in demand management. An example is the demand for tyres in motor car production; for every one car to be produced and sold (independent demand), five tyres (dependent demand) will be needed. However, certain dependent demand items may also exhibit independent demand characteristics. If the organisation producing cars also sell tyres as a spare part the spare part demand will also be an independent demand and needs to be included in the demand management. The relationship between dependent and independent demand is normally documented in a bill of material (BOM) as the quantity per next higher assembly (Qty/NHA) and is

commonly used in the goods manufacturing environment to calculate quantities of dependent demand items needed.

The application of demand management to the support environment entails the consideration of all orders and forecasts for support services in the case where such services are on offer to the market e.g. after sales service of the durable product in the form of preventive and corrective maintenance. The other support demands (those that are not sold to the customer *per se* but are required for the continuance of the product or service delivery to the market) must also be planned for, but can be done only after the first loading of the master schedule. (Also see § 7.6.2 and Figure 7.7). This additional support demand takes the form of operational requirements and distribution demand, as well as demand for preventive and corrective maintenance of production, service delivery and transportation systems. As with the case of output demand management, support demand management also come in the form of orders and forecasts. Operational requirements and preventive maintenance are the equivalent of an order (little uncertainty about the requirements) whereas corrective maintenance is similar to a forecast.

7.6.2 Output and support capacity planning

Once demand management is in place, information is available to make long, medium and short term capacity planning decisions. Mention was made in § 7.5 of the capacity elements required for transformations of input into output. These capacity elements required for transformations (and thus capacity) are:

- Facilities (e.g. buildings, warehouses and land).
- People skilled and trained to perform what is required of them.
- Equipment (e.g. machines and trucks).
- Material (e.g. raw material, spare parts and consumables).
- Capital to buy the required capacity and operate it on a continuous basis.
- Information of what to do, when to do it and how to do it.
- Utilities (e.g. electricity, water, steam and communication).

Different time scales apply to different capacity element decisions. Long term demand information is used to do strategic capacity planning as long term investments are based on long term trends. Overall strategic capacity changes (increase or decrease) are based on the long term demand information and is normally associated with facility, capital, location, new product range and process selection decisions. Medium term demand information is used to establish the capacity need for obtaining people and their training, equipment, longer term material supply contracts, inventory levels and location, as well as process design, commissioning and maintenance of the production capability. Short term demand information is used to establish the capacity needed for the volume and timing of output to be supplied, and considers capacity unavailability due to planned (preventive) maintenance. Allowance is to be made for unavailability of capacity or downtime due to unplanned (corrective) maintenance. Short term demand is planned in the master schedule and must consider available short term capacity to ensure that the master schedule is not overstated. Overstatement of the master schedule implies overloading of the existing capacity resulting in not meeting the output volume and timing requirements. Setting up the master schedule is discussed in more detail in § 7.6.3. Figure 7.6 shows the relationships between demand management and capacity planning. The financial planning interface is shown for completeness.

The dependent demand calculation discussed in the § 7.6.2 need not be limited only to the material required. The relationship between independent and dependent demand items and other capacity resources, including support resources, can also be defined, resulting in a capacity plan for all capacity elements in the short, medium and long term.

From Figure 7.6 the interfaces between the output or market demand management and capacity can be clearly seen. It is however not so clear exactly how the support demand is generated and how it interfaces with capacity planning. The driving force behind demand management is and will always be the market demand in the form of orders and forecasts. The orders and forecasts serve as an input to do the first round of setting up the master schedule considering available capacity. This loading will place a certain production load on the available capacity. The volume and timing requirements of the master schedule will serve as an input to do the production requirements planning in order to meet the master schedule.

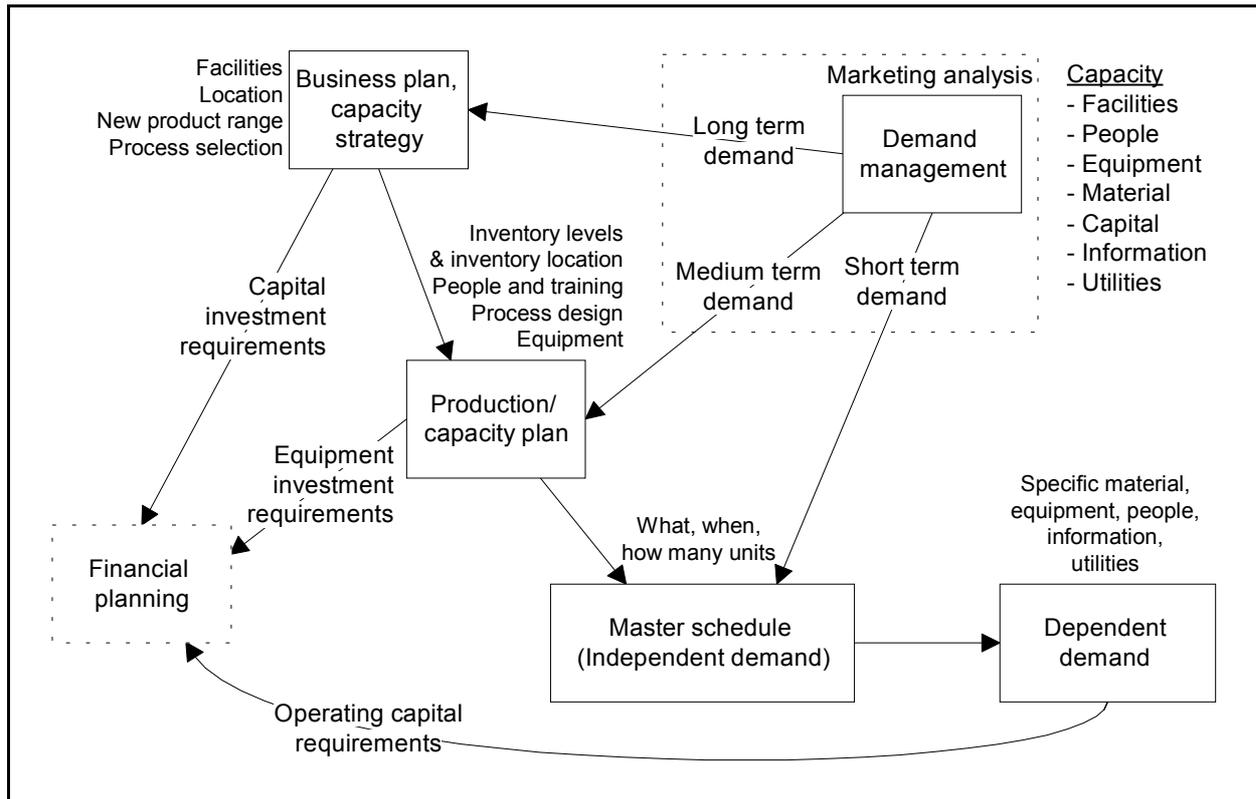


Figure 7.6: The interface between demand management and capacity planning

The input required may include capacity load implications such as setup times and additional quality checks. The output planned will require distribution which implies a load on the distribution capacity. The production and distribution requirements will imply the deterioration of production and distribution equipment used (failures and potential failures) that necessitates preventive and corrective maintenance (PM and CM). Preventive and corrective maintenance requirements along with the production and distribution requirements are then analysed as part of the support demand management to determine an aggregate support capacity load. This support demand management is part of traditional operations and maintenance management. The support capacity load is then fed back into the capacity planning system which may influence the master schedule. It is thus an iterative cycle between demand management and capacity planning until a viable master schedule can be achieved. The iterative process of balancing supply with demand is shown in Figure 7.7.

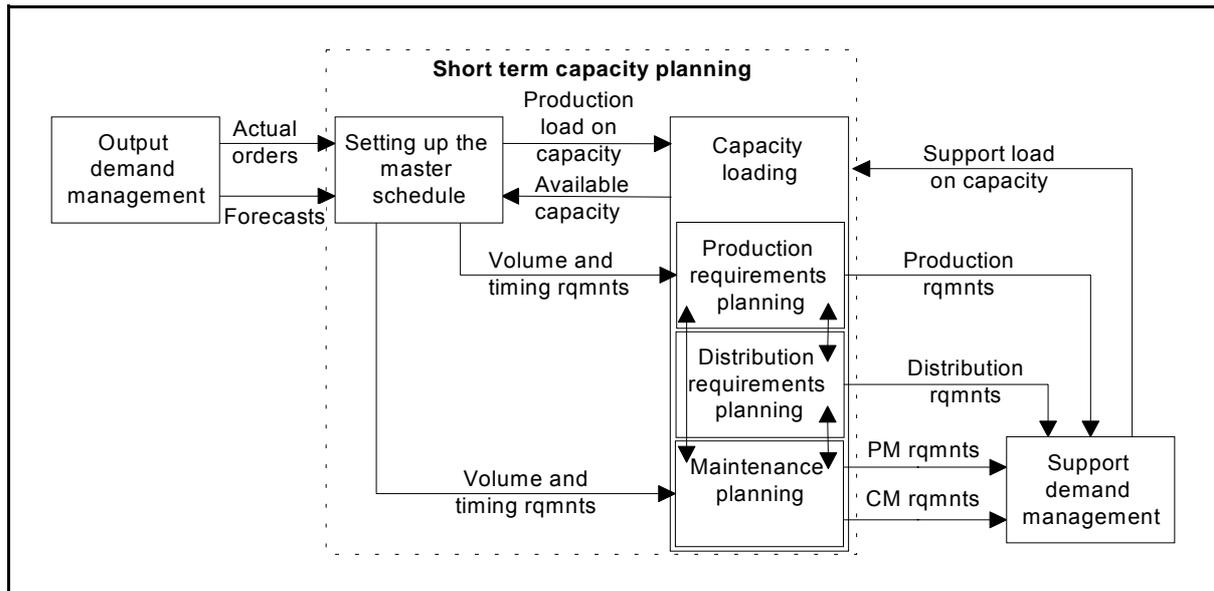


Figure 7.7: Support demand management interfaces

7.6.3 Setting up the master schedule

The master schedule is an achievable end-item plan of what should be produced, when and in what quantities, and is at least as long as the cumulative lead time. Only independent demand items are included on the master schedule. Dependent demand is calculated. The master schedule attempts to match supply with demand. The demand side consists of two components, namely actual orders and short term forecasts. The supply side consists of the actual master schedule, i.e. the specific quantities planned for a specific time slot based on forecasts and actual orders, quantity on hand (if stock can be kept) and quantity available to promise (ATP). The demand time fence is the time within which changes to the quantities of the master schedule or the design are not desirable or acceptable as any changes may cause the master schedule to become invalid as it may be impossible to adjust the capacity necessary to handle the changes and still meet the due date. An example of a master schedule is shown in Table 7.4.

Time bucket		1	2	3	4	5	6	7
Supply	Sales forecast	60	70	60	65	70	50	50
	Actual orders	40	30	20	10	7	5	3
Demand	Master schedule	100		100		100		
	Available to promise	30		70		85		
	On hand	20	80	50	90	25	55	5

Demand time fence (DTF)

Available to promise = Master schedule - Actual orders up to next MS entry

On hand = Opening stock + Master schedule - Actual orders (within DTF)

On hand = Previous on hand + Master schedule - Sales forecast (outside DTF)

Table 7.4: Master schedule example

The development of the master schedule as shown in Figure 7.8 entails considering the production/capacity plan which is a statement of the medium term demand, the short term forecasts and the capacity requirements set by the dependent demand such as setup times. The capacity support requirements (preventive and corrective maintenance allowances) are also considered. Whenever a new short term demand arises in the form of an order, the master schedule is checked to see whether the demand can be filled by selling from stock (the quantity on hand is more than zero). If the order can be filled from stock, the master schedule is updated (quantity on hand) and the product delivered to the customer. If stock is not available, the master schedule is checked for stock available to promise in a future time bucket. If delivery is possible in a future time bucket, the master schedule is updated (actual orders) and the promise is made to the customer when delivery will take place. If there is none available to promise, it implies that the actual orders (demand) now exceed what has been planned to supply. This requires an update to an existing master schedule entry or a new entry on the master schedule line. Once the new entry has been placed on the master schedule line, a check must be done to see the amount of capacity is required and whether the order can be executed with the available capacity in that time bucket. If the newly placed master schedule is not realistic, the master schedule of the new order must be placed later or priorities of existing orders be changed. The process of checking whether the master schedule is realistic is repeated until the

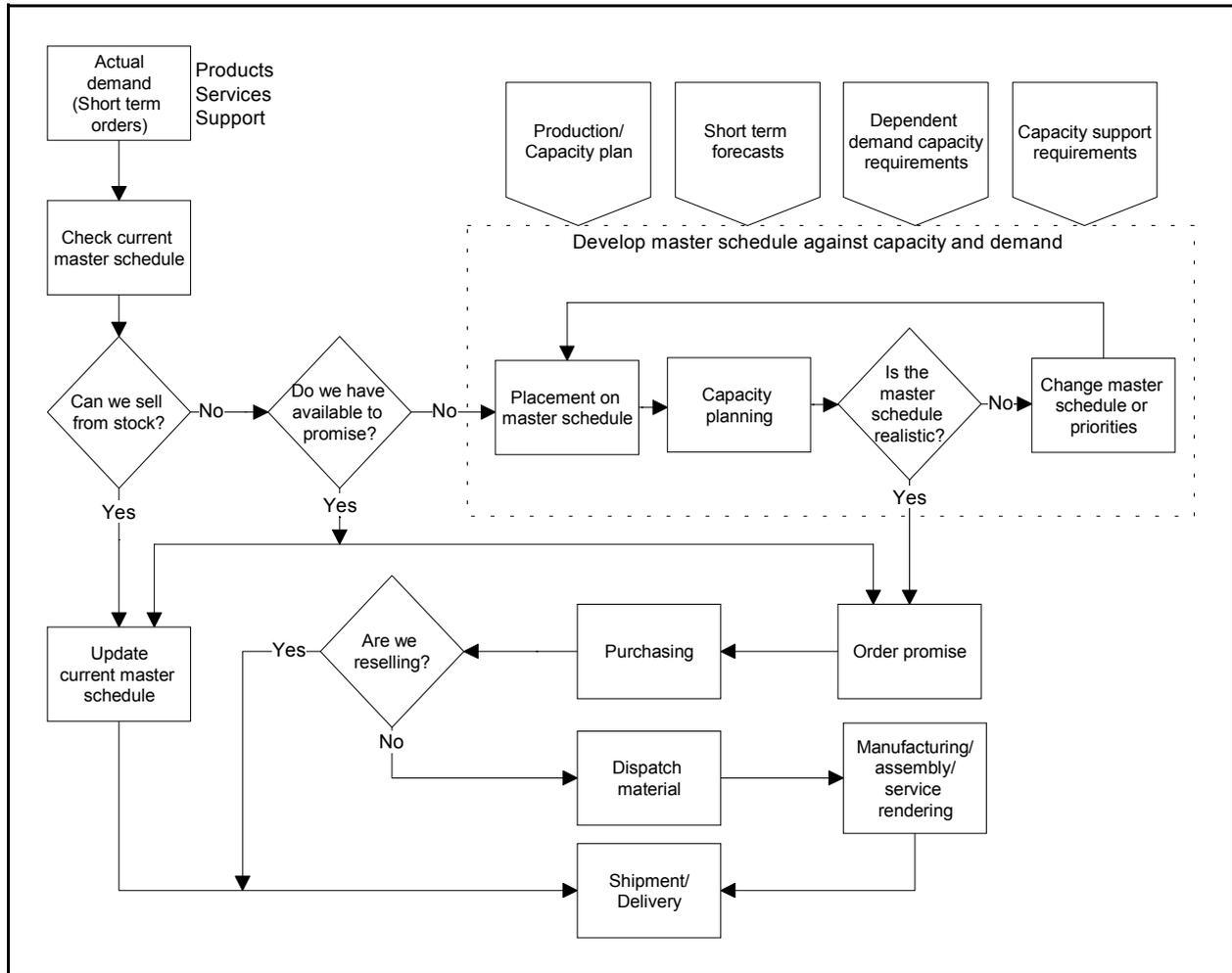


Figure 7.8: Master schedule development and execution

master schedule is achievable. Only then can the order promise be made. The master schedule continuously drive the purchasing of materials and consumables, the scheduling of processes and other resources to transform the input into outputs in order to finally deliver the output to the customer. It is obvious that if the support load on the capacity (dependent demand capacity requirements and capacity support requirements) are ignored, it will not be possible to set up an achievable master schedule.

7.7 Chapter summary

Products (a collective term to describe goods and services) are the output of an organisation in exchange for a reward which allows the organisation to achieve its objectives. Customers expect to experience value in buying the product in order for their needs to be fulfilled. Irrespective of the nature of the product (durable, consumable or service), or where the product fits in the hierarchy of systems, customers have multi-dimensional expectations which can be translated to the ability, availability and affordability of the product in meeting their requirements.

In order for the organisation to meet the multi-dimensional nature of customer expectations, capacity is required to transform inputs into outputs. The capacity requirements for support derived from the actual market requirement can be categorised as follows:

- The direct after sales service and support that is part of the market demand where the customer is willing to pay for it (normally after sales service and support for durable products).
- Production system support required to have the right inputs at the right time.
- Distribution system support required to have the output at the right place at the right time.
- Distribution system support due to ageing and deterioration of equipment used for distribution of outputs (preventive and corrective maintenance).
- Production system support due to ageing and deterioration of equipment used to transform inputs into outputs (preventive and corrective maintenance).

These dimensions of support can be categorised as support for the product itself and support for the systems that produce and deliver the product. Thus the nature of the product (durable, consumable or service) does not determine whether support is required, but which activities are associated with the product to keep the customer satisfied. These activities are, as for any system, divided into management and technical activities.