

## D4.1: Demand and Supply Chain Concepts

### OVERVIEW

#### Definitions and history of Operations Management.

#### What is operations management?

In its broadest sense, operations management is concerned with the way we plan, organise and control the resources at our disposal in order to produce particular outcomes.

There is no great mystery about this. In the same broad sense we are all operations managers in that we have to plan, organise and control our own lives. The resources we need to do this typically include:

- **Physical resources** - cars, phones, cookers, TV etc.
- **Materials** – food, fuel, water etc.
- **Human resources** – ourselves to carry out necessary tasks. We may also bring in specialists from time to time such as plumbers, electricians etc.
- **Money** – to buy the materials and other resources.
- **Time** – most tasks have to be completed within a certain time limit so we must use our time effectively.
- **Information** – what to buy, what to eat, where to be and when, who to speak to etc.

This is operations management, but most of our daily activities are so routine and undemanding, that we probably wouldn't dream of calling it that.

That does not however mean that operations management is easy. Far from it. If we carry on using the example of running our own lives, we usually don't need to look far to find someone having real difficulty doing that effectively. Yet managing our own life is (or should be!) far less complicated than managing a business organisation.

The basic principle of operations management - planning, organising and controlling resources – remains the same but a business is usually much more complex. Furthermore, its operational aim is to meet not its own needs but the many and varied demands of its customers.

If the business manufactures a product, this will increase complexity further. To see how, let's look again at the resources that need to be planned, organised and controlled.

- **Physical resources** – depending on the product, these may have to include expensive, highly specialised machinery and tooling.
- **Materials** – a wide range of materials may be needed, from the simple and cheap (for example washers, fasteners) to the highly specialised and expensive (for example titanium, carbon fibre). All these have to be sourced and purchased or manufactured to (a) meet the demand for the product and (b) be available when needed. Most materials will need to be stored or moved, and so need managing within the organisation.
- **Human resources** – the more people engaged directly or indirectly in producing the product and the wider the range of skills involved, the greater will be the task of planning, organising and controlling their activities. In many organisations operations management isn't confined to manufacturing functions but can extend into design, procurement, finance, human resources etc.
- **Money** – no business can survive without an effective flow of money to pay for equipment, tooling, materials, labour etc. Most companies must also pay corporation tax and VAT, and ensure that shareholders get a return on their investment.
- **Time** – is an extremely important resource in a manufacturing environment. Most customers want products delivered on time, and to ensure that this happens all resources must be carefully co-ordinated – materials must be available on time, shop floor operations completed on time, goods transported on time etc.



- **Information** – is critical in a manufacturing environment. Information is needed at all stages of manufacture, starting with the customer's needs and how these are to be translated into products. Information is needed about supplies (what's been ordered, when will it be available, is it the right quality?), about production facilities (is the correct equipment and tooling available, is the workforce available in the right numbers and with the right skills?) and about the future (what's demand likely to be over the next five years? Will current resources be adequate? What's the competition likely to be doing?).

The message is that while the **principle** of operations management is easy enough to understand, its **practice** in a manufacturing environment can be extremely challenging. Even relatively small-scale manufacturing operations can be complex – to the extent that nearly all manufacturing businesses must now rely on computerised manufacturing systems.

Until the 1960s many manufacturing organisations used manual manufacturing systems usually called reorder point (ROP) systems. These worked on the principle that component stocks were maintained by reordering whenever stock fell to a pre-set reorder level. Components were often ordered when not actually needed, and so ROP systems tended to result in very high inventory levels.

This was not a major problem at a time of static products, undemanding customers and low interest rates. But during the 1960s, this cosy situation started to change. Keener competition started to change attitudes, and businesses began to realise that their future depended on developing a much better response to customer needs. At the same time interest rates rose sharply, turning money tied up in inventory into a serious financial burden for manufacturing organisations.

Fortunately, IT came to the rescue. It gradually became possible to use computers as planning and production aids. As a result, several new manufacturing systems were developed. The most important are:

- **Material requirements planning systems**  
Heavily reliant on computers and most frequently applied to batch or mass production. Comprises:
  - Material requirements planning (MRP or MRP II)
  - Closed loop material requirements planning (Closed Loop MRP)
  - Manufacturing resource planning (MRP II)
- **Just-in-time (JIT)**  
Used most often in repetitive manufacturing but can be used in almost any environment. An essentially simple concept of eliminating all forms of waste by doing nothing until it becomes absolutely necessary.

- **MRP with JIT**

Some would argue that MRP (based on supply 'push') and JIT (based on demand 'pull') are incompatible but in practice they can work well together. This is mainly because their time scales are different. MRP tends to look several weeks ahead and thus drives or primes the shop floor and the supply of materials. This state of readiness can then be converted into a daily JIT operation using kanbans for the manufacturing system.

- **Optimised Production Technology / Theory of Constraints (OPT/TOC)**

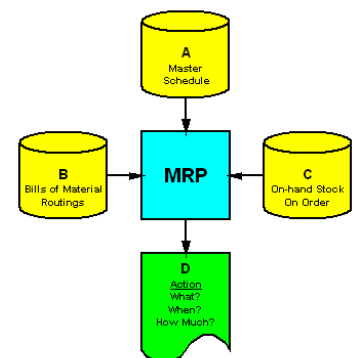
For batch production line environments. Aims similar to JIT, but there the resemblance ends. Primarily a software system based on hugely complex maths.

- **Project control**

For custom-built or one-off products and non-production projects such as plant relocations. The more detailed the project, the greater the need for the use of a computer system.

All are valid ways of scheduling and managing manufacturing production. All aim to plan and control production to give reliable delivery dates to customers. Many are implemented in large part by workplace IT systems running specific software packages.

It does not have to be a case of choosing one system and ignoring the rest. Many organisations use a combination of systems: for example, MRP II at planning level and JIT at production level. Others cling on to their manual manufacturing systems; these are however usually purpose-built and specific to that organisation and its products.



## Demand and supply chain objectives:

Two of the most important things that a manufacturing organisation has to decide are:

- How many items must be produced?
- And when are they required?

Both questions can only be answered after carefully considering many factors.

The quantity of items to be produced will depend upon both the demand from the market-place and the capacity of the production unit. Devising a master plan involves three distinct planning horizons or time periods - short term, medium term and long term - and several levels of planning. These may include:

- **Business planning**  
This is the organisation's top level plan and covers a long time period - typically 3-5 years - and is developed and agreed by senior management. It is usually expressed in terms of sales revenue per product family and production costs. For example: 'The sales revenue of Product Family A will be increased to £10m within a four-year period'. Long-range business planning also includes business forecasting.
- **Marketing, sales and operations planning**  
This is the next level in the planning hierarchy and typically covers a 1-3 year period. Marketing and sales develop relevant parts of the business plan into more specific goals and time-scales; while operations planning considers the overall requirements needed to produce the volumes of existing or new products outlined in the sales plan.
- **Other planning functions**  
These may include demand management, the master production schedule (MPS), material requirements planning (MRP), rough cut capacity planning (RCCP), capacity requirements planning (CRP) and inventory management. Each is explained more fully later.

Marketing is responsible for creating the demand for an organisation's products or services, and for identifying new markets and a need for new products. Operations planning is responsible for satisfying the demand by ensuring that customers receive the products they order at the time they want them. Marketing thus operates primarily externally to the organisation, while operations planning is primarily an internal function.

Marketing determines the marketing mix, which consists of the so-called 'four Ps':

- Price.
- Product.
- Promotion.
- Place.

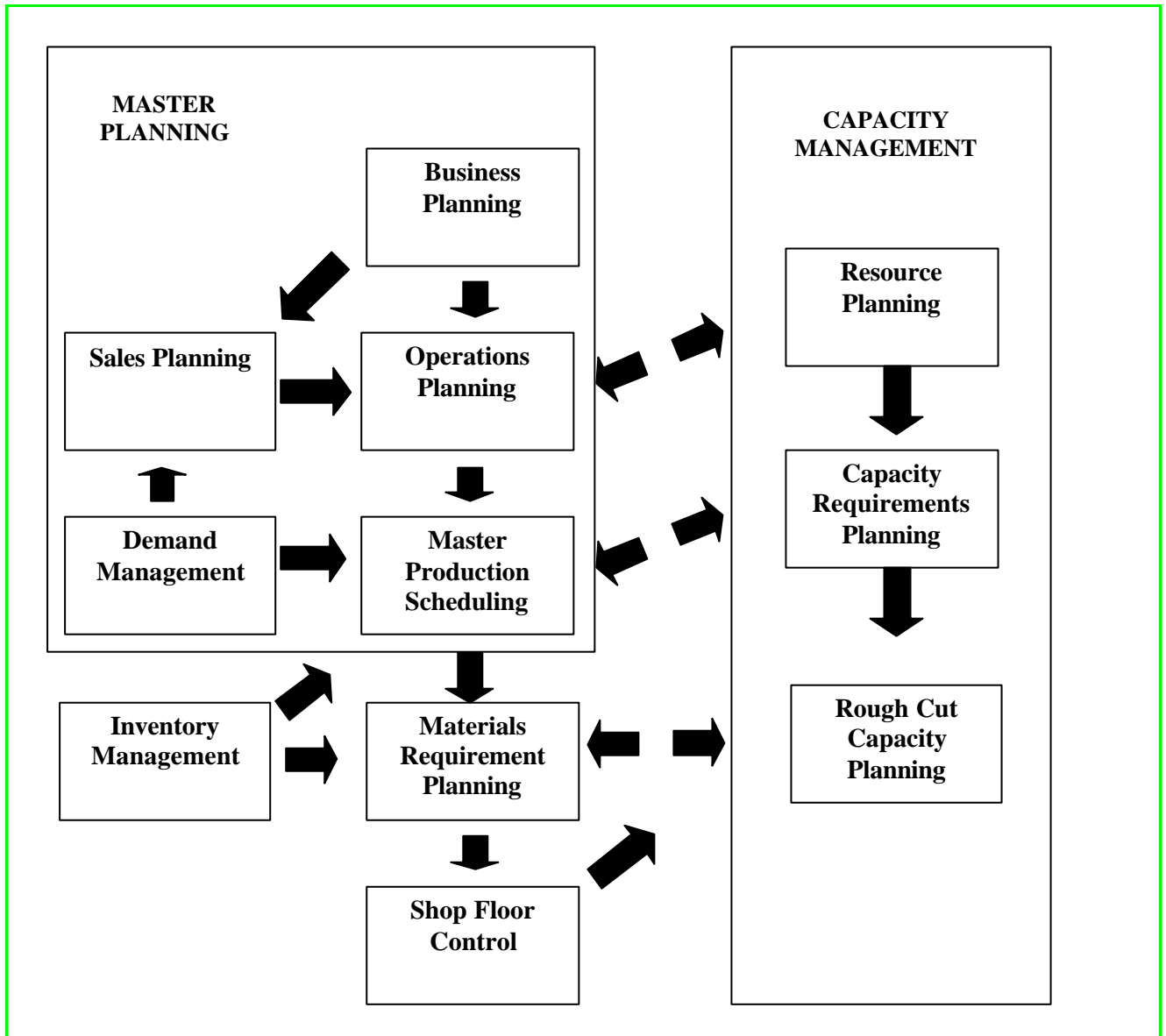
The demand for products can be influenced by altering any of these elements:

- Reducing **price** generally increases demand and vice versa, so price is a powerful tool for stimulating or damping down demand.
- Customers generally want the benefits a product provides rather than the product itself, so if sales and marketing promote the product in terms of its unique attributes - those that distinguish it from competing products - then demand may rise. (Or fall, if a competitor starts offering better product attributes.)
- **Promotion** can increase demand by raising customer awareness of or desire for the product. Marketing can do this by better or more frequent advertising, or by special offers. Promotional campaigns can be used to stimulate demand when a product starts to age and demand is flagging, or to create awareness of a new product.
- **Place** is concerned with customer location. Some organisations only distribute to other manufacturers or wholesalers, on the grounds that shipping large orders to a relatively small number of customers is better than shipping many small orders to many locations. Other organisations prefer to sell direct to consumers because they want them to associate the organisation with the product. Variations in demand due to place can be difficult to quantify, but an event such as the loss of a major distributor could produce a sudden and dramatic drop in demand.

Thus, **marketing and sales departments play a key role in determining the demand for products, and so must be included from the start in the master planning process.**

However, not all demand originates from external sources. The master planning process must also consider the demand from internal customers. For example, there may be branch warehouse orders, inter-plant orders, safety stock orders, special promotional orders and orders from the service, quality control or engineering departments.

Those involved in master planning must therefore consider all sources of demand when calculating overall demand. The master planner must also work closely with operations planning to keep demand levels and production resources balanced, so that production is always efficient and customers always receive their orders correctly and on time.



**Figure D-4 01 Planning and Control hierarchy**

## Hierarchy of master planning relationships

Figure D-4 01 shows the overall planning and control hierarchy in a typical manufacturing organisation. The three planning levels which comprise master planning are:

### 1 Business planning

The top level. This is the long-range plan, developed and agreed by senior management. It usually restricts itself to broad categories - such as sales or production - and is expressed in terms of costs and revenue per product family.

### 2 Sales and operations planning

The second level in the hierarchy. Operations' planning develops the overall level of manufacturing output for product families, groups of product, options, or special features to meet the sales plan. It is usually expressed in standard hours but may also be detailed in money, tonnage etc. It must reflect the business plan, and more detailed planning should not take place until these two plans are balanced. The agreed operations plan then becomes senior management's authorization to proceed with the more detailed plans.

### 3 Demand management and master production scheduling

The third level in the hierarchy. Demand management must provide detailed sales forecasts and ensure that customer orders are entered correctly. The master production schedule (MPS) is then generated; it provides build schedules for specific products, the quantities required, and the dates when they must be completed. The MPS is then used as the input for material requirements planning (MRP).

Successful master planning must take into account any limitations in the downstream capabilities of the organisation. It must balance the many conflicting demands of sales, finance and manufacturing before the MPS is approved for execution.

### 4 Material requirements planning (MRP) and capacity requirements planning (CRP)

The fourth level in the hierarchy. MRP determines the quantity and timescale of each dependent part needed; CRP defines the labour and equipment hours needed in each time period. The required capacity and timing is based on the due dates established in the MPS and subsequently by the output of the MRP system.

Good planning includes suitable tests to support planning functions by confirming that plans are reasonable and achievable. For example:

- Overall resource planning supports operations planning.
- Rough cut capacity planning supports master production scheduling.
- Capacity requirements planning supports material requirements planning.

## Activity relationships

- **Master planning**

This provides quantities and due dates to MRP, performs initial tests of achievability for capacity management, and includes aggregate inventory planning as part of the management function.

- **Material requirements planning (MRP)**

This explodes the MPS to calculate time-phased item requirements, netting off on-hand and on-order quantities. It calculates quantities and corresponding need dates, and then converts them to labour and equipment requirements in capacity requirements planning. It also establishes release dates for shop floor control and purchasing, and aims to keep them updated. Lack of material availability may necessitate revisions to the MPS.

- **Capacity management**

This interfaces with master planning, material requirements planning and shop floor control to plan and control long-term, medium-term and short-term labour and equipment needs.

- **Inventory management**

This provides aggregate plans and distribution requirements for master planning, as well as item level information - such as ordering policies and quantities - for material requirements planning.

## Master planning overview

Master planning covers four activities:

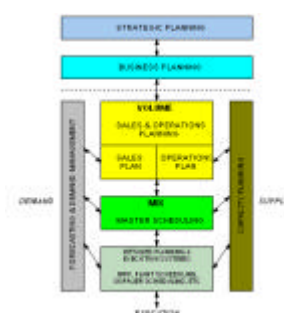
- Business planning.
- Demand management.
- Sales and operations planning.
- Master production scheduling.

**Business planning** is the organisation's top level plan, agreed by senior management and typically looking 3-5 years ahead. It usually restricts itself to broad categories such as sales or production and is expressed in terms of costs and revenue per product family. It also includes business forecasting.

**Demand management** encompasses the activities of forecasting, order service and demand planning control. Its key objective is to recognise all the potential management sources of requirements, such as forecasts, customer orders, branch warehouse requirements, inter-plant transfers, international requirements and service part demand.

**Sales and operations** planning is the process of setting the overall organisation ‘game plan’, aggregate manufacturing output level or overall manufacturing budget. The objective is to reach management agreement on what the overall output rate should be. The sales and operations plan is management’s ‘handle’ on the business. It establishes the framework for detailed MPS preparation, manufacturing execution and interfaces to other functional areas. It is an agreement between marketing and finance on what, in aggregate terms, will be produced and made available for sale to customers. Once the plan is set, manufacturing’s job is to execute the plan while marketing’s job is to sell it.

**Master production scheduling** encompasses the variety of activities involved in preparing and maintaining the MPS, which is an anticipated build schedule for the organisation’s products. It is expressed in specific product configurations for any required planning horizon. The MPS is not a forecast of product demand but a statement of production; it is manufacturing’s disaggregation of the production plan into individual product items, which should always be capable of being aggregated back to the production plan. (That is, the sum of the parts should always be equal to the whole!)



## Forecasting

Forecasting can be defined as an attempt to predict the future by looking at past (or historical) patterns or by gathering non-numeric (judgmental) information from sources such as potential customers or 'experts'.

### Why forecast?

Forecasting is perhaps the most misunderstood technique used in the management of a business. At the outset everyone knows that the forecast will be wrong to some degree, and as a result many people may challenge the credibility of the forecast as a whole. It may then be only a short step to deciding not to bother with forecasting, or at least not to take it seriously.

Forecasting can, however, be one of the most important activities an organisation can carry out. The point of trying to predict the future is to enable senior managers to plan and prepare ahead of events rather than after them. It allows organisations to be proactive (a position of relative strength) rather than reactive (a position of relative weakness). The future is not something that never happens – it will materialise, so it can be argued that not forecasting is more futile than a forecast that contains inevitable inaccuracies.

Thus, forecasts will be wrong but this does not lessen their importance. It simply means that we must strive continuously to improve forecasting methodology.

### Relationship to planning

The purpose of sales forecasting is to enable the many activities that depend on the sales forecast to be planned.

Management must plan ahead to ensure that customers get the products and services they want – on time and at a satisfactory cost.

To do this, management needs to ensure the availability of:

- New product designs.
- Capable and trained human resources.
- Well-maintained equipment.
- A suitable flow of materials.
- Adequate facilities.

There must be very few organisations that will NOT benefit from an appropriate level of forward planning based on competent forecasts of future needs.

## e-Business:

As an activity, e-business is still relatively new and there are still differences in how it is defined, particularly in relation to e-commerce. Throughout this module 'e-business' is defined as electronic **business-to-business** trading, while 'e-commerce' is defined as electronic **business-to-consumer** trading.

The number of online e-business 'communities' and market-places continues to grow rapidly, allowing an increasingly efficient flow of information from consumers or businesses to all the organisations in a supply chain.

All types of business can use e-business and e-commerce to improve their supply chain. The key to success however is the sharing of information, and so the full benefits can only be achieved through mutual trust.

Even now some OEMs (Original Equipment Manufacturers) will not share their information with a supplier. It is not uncommon for suppliers to be chosen on the basis of best (that is, lowest) price and asked to produce components to a tight specification at relatively short notice.

More enlightened organisations will use e-business to share and discuss product knowledge with suppliers – often, for example, seeking advice on ease of manufacture and changing component design or specification if there is an advantage to be gained. They also tend to be more willing to disclose demand information so that their suppliers can plan ahead and deliver better quality and usually cheaper items.

There are similar advantages with e-commerce, which offers the customer round-the-clock access to products, information about specification and availability, instant electronic payment and rapid delivery. Customers are better served; businesses have relatively easy access to many more customers.

## The internet and lean and agile thinking

In terms of the supply chain the internet has taken the Just-in-time philosophy and lean and agile thinking a stage further.

**Lean thinking** is about eliminating from the organisation anything that can be defined as waste – for example overproduction, defective production, excess inventory and unnecessary or inappropriate waiting, moving, transporting.

The internet has created another form of waste - the agent or 'middle-man'. An example of this is the ability of consumers and holiday and travel operators to deal directly with one another rather than via a travel agent.

**Agile thinking** is the ability to respond quickly to meet customer needs. It is logical to assume that an organisation's agility depends on its leanness, so agile thinking and lean thinking are very closely linked.

These can be achieved by examining the operation's performance objectives, to meet the needs of the customer in terms of – quality, dependability, flexibility, speed of delivery and price.

The internet can greatly improve the ability of organisations to be both lean and agile. Indeed, any organisation that does not make effective use of e-business and e-commerce risks becoming uncompetitive.

This warning applies to organisations of any size, for the internet can be a great leveller. A start-up business with a handful of employees can have as effective a web presence as a major competitor, and a small company can rapidly take market share from a large one if it offers consumers or other businesses a better deal or a better trading experience.



**Exercise D-4 01 “Leagile” rating**

15 minutes

How would you rate your organisation in terms of both leanness and agility?

**Exercise D-4 02 Ebusiness involvement**

15 minutes

What is your organisation’s current and planned involvement with e-business or e-commerce?

**Exercise D-4 03 Ebusiness – opportunity or threat?**

30 minutes

What is the actual or likely effect of e-business and e-commerce on your organisation and its competitive position? Is it an opportunity or a threat?

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For permission and other enquiries contact:

The Institute of Operations Management  
University of Warwick Science Park  
Sir William Lyons Road  
Coventry  
CV4 7EZ  
Email: [quals@iomnet.org.uk](mailto:quals@iomnet.org.uk)