Chapter 6

Operations Management
6.1 Overview of operations management

**Operations strategy**
The total pattern of decisions which shape the long-term capabilities of any type of operations and their contribution to the overall strategy, through the reconciliation of market requirements with operations resources.  
(Definition: Slack and Lewis)

Organisations make products or deliver services and do rely heavily upon operational processes to produce effective products and efficiently deliver them on time. Operational functions or departments have the responsibility for the transformational process of converting business inputs e.g. staff, materials, machines, money etc, to produce a final product, in a way that adds value to customers e.g. creates profit margin. These functions can be critical to gaining competitive advantage for an organisation.

**Major operational functions within the organisation**

- **Marketing and sales** e.g. identifying needs, wants and values of customers.
- **Production** e.g. administration of orders, physical manufacture and assembly, effective delivery etc.
- **Research and development** e.g. vital innovation for new products or processes.
- **Customer support** e.g. customer service, after sales service, customer support etc.

Value is the reason why customers choose one rival’s product over another, if an organisation can offer certain unique features from their operational management, a customer could be willing to pay extra for it and could remain more loyal to the organisation. Aesthetics, reliability, durability, product functions and features, novelty, designs, colours and even the courtesy and friendliness of staff involved in the selling and customer support services, can make a massive difference to customer value. But this relies upon an effective operational strategy.

**Performance dimensions for operational strategy**

- **Quality** e.g. Marks & Spencer, Thornton’s, BMW etc all are synonymous with the image of high quality. Quality means fitness for the purpose, so this dimension would include other characteristics such as how the product functions and how robust and reliable it is.
- **Speed** e.g. The AA or RAC could offer superior call out response times, Concorde when it was first launched gave the fastest transatlantic flights, courier companies like FedEx Express can guarantee overnight global parcel delivery.
- **Flexibility** e.g. ability to increase or decrease production to meet customer demands, coffee shops, hairdressers and call centres and how they all respond to peak times is one such focus of this dimension. Multi-skilled staff can help an organisation achieve greater flexibility and economies of scope.
- **Cost** e.g. aiming to offer a product or service at the lowest possible price, a cost leadership strategy. Cheap and cheerful products like supermarket own economy brands or basic no frills services like Easy Jet and Ryan Air.
Porter’s value chain analysis

Value chain analysis (VCA) is a position audit tool which examines the current and internal position of an organisation. It is ideal tool to examine holistically the operational processes of an organisation. According to professor Michael Porter, an organisation receives inputs or resources from its environment and converts these to outputs e.g. products or services. In doing so it achieves added value by this process, creating margin or profit for the organisation. Value is the reason why customers choose one rival product over another, either because the product or service is lower in price or it offers certain features the customer is willing to pay extra for. Porter grouped the various business processes or activities of an organisation into what he called the value chain; he divided the organisation’s activities into nine types, classified as either primary or secondary activities. These activities incur costs, but in combination with other activities provide customer satisfaction and therefore added value.

- **Primary activities** are processes or activities directly involved in the provision of the good or service the organisation makes or provides e.g. inbound logistics, operations, outbound logistics, marketing/sales and after sales service

- **Secondary or support activities** support the primary activities by providing necessary support and resources, but are not directly involved in the provision of the good or service the organisation makes or provides e.g. infrastructure, human resource management (HRM), technology and procurement

- **Activities** are business processes the organisation manages in order to add value e.g. the product or service is worth more than the cost of the individual parts or resources used to provide it, this allows a margin to be earned by the organisation

A value chain is the sequence of business activities by which, in the perspective of the end user, value is added to the products or services produced by an organisation (CIMA).
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<tr>
<th>Category</th>
<th>Description</th>
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<tr>
<td><strong>Inbound logistics</strong></td>
<td>Business processes which receive, handle and store inputs e.g. warehousing, stock control and inbound transport.</td>
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<tr>
<td><strong>Operations</strong></td>
<td>Business processes which convert inputs to output e.g. staff, materials, and machines used to assemble the final product, or provide a service.</td>
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<tr>
<td><strong>Outbound logistics</strong></td>
<td>Business processes which deliver the actual product (output), when it leaves the organisation e.g. outbound storage and transport of goods to the customer.</td>
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<tr>
<td><strong>Marketing &amp; Sales</strong></td>
<td>Business processes of selling, researching customer needs and development of an effective marketing mix e.g. product features, price, promotion and place, to satisfy customers.</td>
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<tr>
<td><strong>After sales service</strong></td>
<td>Business processes that deal with returns, complaints and customer support after the product or service (output) has left the organisation e.g. customer service and support teams, repair and warranty departments to supply parts or consumables, and after sales servicing.</td>
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<tr>
<td><strong>Procurement</strong></td>
<td>Business processes to manage and negotiate the acquisition of resources (inputs) for the primary activities e.g. components, raw materials and equipment. Ensures resources that are required are in the right place at the right time and right cost e.g. purchasing departments.</td>
</tr>
<tr>
<td><strong>Technology development</strong></td>
<td>Business processes required for innovation, product design and testing, or the invention of new processes e.g. research and development (R&amp;D) departments.</td>
</tr>
<tr>
<td><strong>Human resource management (HRM)</strong></td>
<td>Business processes to procure and look after the organisations most valued asset its staff e.g. staff recruitment, selection, training, development, retention, induction, reward systems, appraisals and the maintenance of staff records.</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Business processes to support of the whole of the value chain and not belonging to any of the other eight categorisations of processes above e.g. head office, legal, finance, IT, buildings maintenance, quality control, staff canteen etc.</td>
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Business process re-engineering (BPR)

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<tr>
<td>The fundamental redesign of existing business processes to achieve improvements in critical areas such as cost, speed, quality or service.</td>
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BPR identifies and analyses existing processes to innovate, in order to rationalise or add value, it aims to redesign and reassemble existing processes to operate as efficiently and effectively as possible. Re-engineering business processes can often help an organisation shorten lead-times, improve customer service or add more value to the product or service being sold.

Example

Ford in the 1980s employed a large number of staff for the purpose of matching goods received notes to orders and then to invoices. The Pareto condition e.g. 80% time wasted reconciling 20% of the orders and invoices applied here. Through the use of BPR techniques, Ford introduced a computerised system where orders were entered, any goods received that did not match to orders input, were automatically rejected at the door and payment refused. This simple yet effective re-design saved thousands of pounds through reduction in headcount.

Hammer & Champy (1993) defined the process of reengineering as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed."

1. Fundamental rethinking to innovate and redesign business processes
2. IT primarily the enabling factor for dramatic improvement
6.2 Capacity planning

**Capacity**
The ability of an operation to perform and produce. The maximum limit to the volume of product or service an organisation can produce, in a given timescale and bound by its constraints such as existing of technology, resources and business processes. Capacity can be quantified by using efficiency and utilisation measures.

- **Over capacity (spare capacity)** resources e.g. staff and machines are not being fully utilised (idle) and not operating at full capacity.
- **Under capacity** customer demand is greater than the maximum capacity (supply) the organisation can fulfil e.g. full order book, customer queuing, waiting lists etc.

**Organisational differences in operations (McDonald)**

- Degree of volume that can be produced e.g. standardisation and mass production can lower unit cost.
- Degree of variety required from the process e.g. to flexibility match products or services to customer demand levels.
- Demand variation e.g. seasonal demand could exist.
- Customer visibility e.g. the level of visibility by a customer when an operation is performed, normally when services are performed, you cannot separate the person from the service being provided.

Forecasting demand can be complex and unreliable in an uncertain environment. A balance needs to be struck between capacity planning and meeting customer demand. If an organisation that does not mange its operations effectively it maybe tying up money unnecessarily e.g. cost of idle labour and high cost of holding inventory levels, or it may not be able to extend its supply of product or service flexibly enough to meet surges in customer demand at ‘peak’ moments. Organisations must have the flexibility to extend and contract their supply when frequent or volatile changes in demand occur.
Market forecasting methods for predicting demand levels

- **Survey or sample of buyers intentions** ideally suited for short and medium-term sales forecasting, the results can be fairly accurate and realistic. A sample of customers could be asked would you buy this product and in what quantity? This data can then be extrapolated from the sample taken, to create a population forecast for likely demand levels.

- **Composite of sales force opinions** human judgement applied by the staff within the organisation e.g. sales people, who may have an overall understanding of demand growth in a particular market.

- **Expert opinions** industry experts or consultants and ‘what they say’ but this method often hampered by a lack of expertise available.

- **Past-sales analysis** projections (trends) using a study of past or historical performance e.g. high low method, time series and regression analysis, or scatter graphs. Major limitation of this method is that past performance may not be a good indication of the future.

- **Market test methods** e.g. consumer trials and testing of new products or product features, giving direct and often qualitative opinions, but valuable assistance in determining future ‘potential’ for customer demand.

- **Queuing theory** e.g. a mathematical study of the formation of waiting lines or queues (electronic or physical), for when customer ‘arrivals’ occur at random intervals. The theory can produce several performance measures e.g. average waiting times, or expected number of customers at certain times. Queuing theory is generally considered a branch of operations management because the results can be used to plan for resources needed to provide a product or service. Examples include software intelligent agents monitoring call centre phone activity or direct (or CCTV) monitoring of physical customer queues in a supermarket. Often viewed as too mathematically restrictive to be able to model all real world situations exactly on it.

Factors effecting capacity levels

- Resources available e.g. labour and skills, machine time and other ‘bottlenecks’ that restrict the organisation’s capacity to supply.

- Physical space e.g. maximum seating in a football stadium or production floor space restricting capacity.

- Efficiency, idle times and wastage levels e.g. reduces efficiency and time taken to convert inputs (resources) into the product or service.

- Lead time e.g. high set up times or other inefficiencies can make supply very unresponsive (inelastic) to changes in customer demand.
Achieving workforce flexibility

The flexible firm model proposed by John Atkinson, divides employees into three categories: core, peripheral and external labour.

The shamrock organisation (a concept by Charles Handy), divided employees into three categories: core, contractual and flexible labour.

Both models are similar and can be used to explain how an organisation might achieve greater flexibility.

Types of workforce flexibility

- **Functional flexibility** (task flexibility/multi-skilled employees) concerns breaking down traditional occupational boundaries. For example manufacturing workers may be required to take on other indirect tasks such as quality control, cleaning of the work area, maintenance, or learn different production processes. This enables staff to be used more flexibly and moved around in order to save cost e.g. staff can cover for absenteeism. This is often achieved through secondments, training and job rotation.

- **Financial flexibility** can be achieved by performance related pay systems e.g. if production staff are paid per unit of product, this will help achieve better cash-flow for the organisation during off peak periods. Financial flexibility aims to convert staff cost from fixed to variable, therefore during times when the organisation has off peak demand, lower productivity means lower staff cost.

- **Numerical flexibility** enables a firm to adjust rapidly to changing levels of demand by increasing or decreasing the number of employees. This is often achieved by reducing permanent full-time staff and making more use of subcontractors, temps or part-time workers.

- **Temporal flexibility** can be achieved by varying the hours worked by employees in response to changes in demand e.g. time off in lieu after working long shifts, to accommodate a surge in demand. This is often achieved through flexible working hours e.g. compressed shifts or flexi time arrangements.

The “flexible firm”

The concept of the flexible firm was proposed by John Atkinson, he recognised that organisations will require greater flexibility if they are to adapt swiftly and meet the ever evolving market and competitive challenges they face. Greater workforce flexibility maybe required due to uncertain market conditions or seasonal changes in demand, flexibility helps achieve greater cost-effectiveness for an organisation. The flexible firm model suggests that we can design flexible staff arrangements to proactively meet business needs. Numerical flexibility can be achieved through more use of peripheral workers e.g. part-time, temporary staff, or external labour e.g. freelancers, sub-contractors, self employed. However core workers e.g. full-time permanent employees, can often provide greater functional flexibility.
The 'Shamrock Organisation'

Charles Handy used the 'Shamrock Organisation' to apply a model to workforce flexibility. The three leaves of a shamrock were used to symbolise an organisation's human resources.

- The inner core of permanent key employees who keep the company operating and developing e.g. full-time professional staff
- The contractual fringe (or external labour) e.g. self-employed subcontractors or freelancers, who are engaged to provide services as and when needed and often paid by results
- The flexible (or peripheral labour) workforce e.g. temporary, casual and/or part-time employees on short-term contracts, taken on as and when needed

The three parts of the shamrock all have advantages and disadvantages. The inner core are well paid e.g. superior reward and recognition packages, but may do work that is stressful and work very long hours, therefore are more committed. Workers on temporary, casual and/or part-time contracts (the flexible workforce or peripheral labour) are perhaps less secure but offer numerical flexibility. The contractual fringe (or external labour) also offer numerical flexibility and help achieve more effective cost control, but being external and not belonging the organisation, may not care very much about the organisation itself. Often inner core and contractual fringe can perform identical jobs, side by side, often on different wage or recognition packages. By the use of outsourcing the organisation is attempting to shrink its inner core leaf (downsizing) and enlarge its contractual fringe leaf as a basis of improving both numerical and financial flexibility.

Greater flexibility of core staff within an organisation an be achieved by

- Shorter term contracts for inner core staff and more temporary or part-time staff. can achieve numerical flexibility.
- Greater use of performance related pay systems and a lower composite of fixed salaries can achieve financial flexibility.

Job enlargement, multi skilling and empowerment of the organisations staff can achieve greater functional flexibility

The characteristics of service organisations

- **Intangibility** e.g. no material substance or physical existence of the service contrasted to a tangible good, difficult tell in advance what you will be getting.
- **Legal ownership** e.g. little physical evidence exists for its performance, so you can never return it if it is faulty.
- **Instant perishability** e.g. unlike physical goods, services cannot be stored, unused capacity cannot be stored for future use.
- **Heterogeneity** (not perfectly identical or variable) e.g. each time the service is performed even to the same customer it is different each time, physical goods tend to be homogenous (perfectly identical) when produced.
- **Inseparability** e.g. the service cannot be separated from the person who provides it and it is normally produced at the same time the customer requires it.
### 6.3 Strategies for balancing capacity (supply) and demand

**Operational strategies**

- Level capacity strategies
- Chase demand strategies
- Demand management strategies

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<td>The organisation manufactures or produces at a constant rate of output ignoring any changes or fluctuations in customer demand levels. This often means stockpiling or higher holdings of inventory when customer demand levels fall.</td>
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<tr>
<td>✓ Utilisation of operational resources at all times.</td>
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<td>✓ Efficient production levels can be held at a constant rate.</td>
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<td>✓ Lowers unit cost e.g. mass production of uniform products.</td>
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<td>✗ High risk of stock obsolescence if customer needs change.</td>
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<td>✗ High staff cost when under-utilised e.g. service organisations during off peak times.</td>
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<th>Chase demand strategies</th>
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<td>The opposite to a level capacity strategy. The organisation continually chases customer demand and extends or contracts its supply (output) to match existing customer demand levels e.g. a Just In Time (JIT) system. This strategy will require flexible utilisation of operational resources.</td>
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<tr>
<td>✓ Flexible utilisation of resources e.g. economies of scope, the cost savings achieved by utilising the same staff or machines for a multitude of different tasks.</td>
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<tr>
<td>✓ Minimisation of stock levels (aim is zero stock) and therefore cash-flow tied up when resources are under-utilised.</td>
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<tr>
<td>✗ Over reliance on flexible staff during peak periods of time e.g. overtime, temps or sub-contractors, may hinder responsiveness.</td>
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<td>✗ High risk of disruption when the organisation fails to respond to surges in demand and does not deliver on time.</td>
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<th>Demand management strategies</th>
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<td>Aims to influence customer demand levels at certain times, in order to match demand closer to the organisations most efficient operating capacity (supply). It is a strategy to smooth out customer demand during peak and off peak periods.</td>
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<tr>
<td>✓ When off peak rather than contract resources make the customer come to you.</td>
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<tr>
<td>✓ Through careful customer management you maintain efficient levels of production and inventory.</td>
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<tr>
<td>✗ Not always effective e.g. promotions to encourage demand off peak may not work.</td>
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<tr>
<td>✗ Offers of discounts during off peak periods can financially harm profitability.</td>
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As an illustration of capacity management, through demand management strategies, a car manufacturer in times of 'over capacity' could attempt to stimulate more demand from customers during such times e.g. cash back offers, 0% finance, price reductions, attractive warranties, free insurance and aggressive advertising. During times of 'under capacity' they could attempt to stimulate less demand e.g. 'buy next years models now' reduce advertising and the restrict availability of certain makes or models, however restrictions can make the organisation appear to be ignoring customer needs and likely to lead to customer dissatisfaction during such times.

A service organisation just like a manufacturer, can use demand management strategies. Thomas Cook, the holiday operator, often slashes holiday resort prices during the winter season to encourage customers to switch the time they go on holiday, also discounts are offered to encourage customers to book earlier before peak season. Like a manufacturer, service organisations too can have the effect of dissatisfying customers e.g. high prices charged during school holidays to discourage customer demand and book at other times.

Unlike manufactured e.g. physical goods, services cannot be stored they have instant perishability. It is more likely that service organisations should be using chase demand or demand management strategies rather than level demand strategies, especially when demand levels are volatile. Tesco as a chase management strategy, installed automated scanning and payment machines for customers to pay for goods themselves, rather than human operated checkouts, this has helped to avoid customer queuing during 'peak' periods.

**Example 6.1**

Explain why a level capacity strategy could be difficult to adopt for an organisation operating a just in time system (JIT)?
Example 6.2

Explain the relationship that exists between a chase demand strategy and a flexible organisation?
Example 6.3

Explain how a service organisation differs from a manufacturer when considering capacity planning?
6.4 The concept of sustainability in operations management

Sustainability within operations management is about preserving natural resources for future generations. A fully sustainable operation is one that has a zero impact, or a positive impact on the ecological environment. More companies are beginning to consider how their operations affect the environment and future generations, they are beginning to acknowledge new practices of doing business in a way that balances economic and environmental needs. The field of operations management has a vital role to play in the long-term sustainability of our economy.

Practices for minimal long-term effect on the environment

- Reduction in the use of toxic substances.
- Reduced reliance on petroleum and other non-renewable energy sources.
- Use of naturally renewable materials.
- Use of biodegradable materials e.g. naturally reabsorbed into the ecosystem.
- Use of organic materials e.g. grown without synthetic fertilizers or pesticides.
- Fair trade e.g. certified policies and standards for a fair living wage and safe work environments. No third world sweatshops!

The organisations’ environmental footprint or environmental impact, is determined by the amount of depleted raw materials and non-renewable resources it consumes to make its products, and the quantity of waste and emissions that is generated in the process. The life cycle of a product should take into consideration the raw materials it uses in production, all other manufacturing processes, all distribution and transportation costs caused by a product’s existence, right through to its final disposal.

To produce 1 ounce of gold creates 30 tonnes of toxic waste because of the compound cyanide used in the process for extracting gold.
1 ounce of gold will make a wedding ring.

Bennett and James ‘areas for environmental responsibility’

- **Production** e.g. minimising waste and toxic emissions.
- **Environmental auditing** e.g. to comply with legislation, but also an issue of integrity to take a more proactive stance.
- **Ecological approach** e.g. minimising waste throughout entire value or supply chain.
- **Quality** e.g. set targets to reduce environmental waste and emissions.
- **Accounting** e.g. account for social costs to society or third parties, for investment appraisal decisions.
- **Economic** e.g. internal economic charges for any social cost created by divisions to encourage its minimisation.

ISO 14001 is an international standard for Environmental Management Systems and offers internationally recognised environmental certification. To gain accreditation a documented and structured approach must be adopted for setting environmental targets and monitoring systems implemented to ensure environmental management systems are effective e.g. meeting targets for minimisation of energy consumption, waste and emissions.
6.5 Modern manufacturing environment

Lean production or the Toyota production system (TPS)

Lean production (also known as the Toyota Production System) is a manufacturing methodology originally developed by Toyota to get the right things to the right place at the right time. Lean production focuses on delivering resources when and where they are needed.

The Toyota Production System (TPS) was built on two main principles: Just In Time (JIT) and Jidoka e.g. continuous improvement of quality within the production system. Underlying the entire Toyota production process is the concept that “good thinking means good product.” Lean production techniques focus on reducing waste, cycle times, defects, inventory, travel time of parts and non value added activities. Lean techniques can also be applied to services e.g. process improvements can be made and sustained, although not always in the same way as manufacturing. A service organisation generally does not hold any inventory, but it can have a backlog of service requests and waiting lists which can impact on customer relations, in contrast to a manufacturer, no warehouse can hold that “service request” backlog.

Lean production tools and techniques

- Getting things right first time (total quality management) e.g. minimisation of internal and external failure cost.
- Minimising inventory e.g. JIT stock control to improve cash-flow management.
- Minimising waste e.g. zero wastage policy.
- Flexible workforce practices e.g. focus factories, cell manufacturing, teamwork, multi-skilled employees and empowerment to shorten lead times.
- High commitment to human resource policy e.g. investment in training and development, quality circles and performance related reward schemes.
- Management and workforce culture of commitment to continuous improvement.

Joseph Juran an early 20th century quality management theorist, suggested a Pareto relationship existed between work systems and quality problems e.g. 85% of quality problems are caused by ineffective work systems. The conclusion is that management should concentrate on work systems more than anything else when it comes to improving quality within an organisation.

Advantages of lean production

- Increased capacity
- Reduced wastage, idle time, reworks and production cost
- Improved flexibility, efficiency and lead times to respond quickly to changes in customer demand
- Higher quality of product or service
- Increased customer satisfaction and brand loyalty e.g. less complaints, warranty claims and returns.
- Economies of scope
Economies of scope is possible when resources such as machinery or labour can be shared to manufacture different products e.g. a condition where fewer inputs can produce a greater variety of outputs (products), using multi skilled staff and multi purpose machinery. A greater business value and lower cost can be achieved by jointly producing different products using the same common inputs e.g. flexibility to diversify production without significant investment required, because scope exists to substitute resources from one process to another. Multi skilled operatives allow greater flexibility and economies of scope. For example rather than just being a ‘miller’ or ‘grinder’ or ‘welder’ operative workers could be trained to do all three jobs. These operatives can also be trained to perform routine maintenance on machines and equipment, in order to diagnose and correct routine problems earlier, rather than relying on a specialised maintenance crews. Such techniques facilitate and support JIT production methods.

Disadvantages of lean production

- Continuous cost of investment in retraining displaced or reassigned operators.
- Learning new skills and strategies to cope with new methods.
- Change management a long-term educational strategy of gaining commitment, trust and support from the workforce e.g. does not happen over night and not just a ‘temporary thing’ management are trying out.
- Poor morale, motivation and resistance from the workforce during changeover.

Total productive maintenance (TPM) is a concept to improve the productivity of an organisations equipment and can contribute towards an effective lean production system. TPM aims to shorten lead times by ensuring production and machine maintenance staff work closer together. Machine operators are empowered and trained in order to speed up routine servicing, fault diagnosis and maintenance of operating machinery.

Benefits of TPM

- Less equipment downtime and major stoppages in production giving greater efficiency of production flow.
- Better understanding by production staff of the performance of their equipment, helping to diagnose and rectify problems quicker and improve production flow.
- Less reworks, scrap and wastage levels through better maintenance.
- More effective teamwork helping to improve flexibility.
- Increased enthusiasm and motivation by involvement of the workforce.
- Improved service to customers by reducing lead times and improving quality.
Just in time

The JIT philosophy requires that products should only be produced if there is an internal or external customer waiting for them. It aims ideally for zero stock e.g. raw materials delivered immediately at the time they are needed, no build up of work-in-progress in production and finished goods only produced if there is a customer waiting for them. This means cash is not tied up unnecessarily within raw material, work-in-progress or finished goods stock, allowing more effective cash flow management for the organisation. JIT is an example of a chase demand strategy for balancing capacity (supply) and demand.

Characteristics of JIT

1. Closer relationships with suppliers maintained
2. Smaller and more frequent deliveries to plan and administrate
3. Higher quality machines with regular maintenance to avoid delays
4. Involvement and training of staff to maintain flexibility

Focus factories

The aim of focus factories is to reduce the cost of 'part finished stock' e.g. work-in-progress. Part finished stock is expensive not only to store, but it also cannot be sold because it is not ready and could be delaying potential sales. Focus factories reorganise traditional factories, which normally take parts of several products and mass produce in anticipation of demand, instead manufacturing is organised into smaller stand alone factories or cells, with each team responsible for making a complete product. In contrast focus factories are 'product' as opposed to 'process' driven. This facilitates expertise to be developed, reduces waiting times, speeds up production and less inventory is held.

Dedicated cell production

Traditional production has been about the specialisation of workers, machines and mass production lines. In cell production there exists multi-skilled teams, who are responsible for delivering work in progress or finished goods, on to the next production cell. Each team may also be responsible for routine maintenance, quality control and health and safety. Reorganisation production into 'cells' with dedicated teams, can enhance efficiency, synergise worker skills and knowledge and improve motivation of the workforce e.g. team spirit

Total quality management (TQM)

TQM is the process of embracing a quality conscious philosophy or culture within an organisation, it aims towards standards of near perfection and continuous improvement.

Characteristics of TQM

1. Get it right first time philosophy
2. Continuous improvement e.g. aim towards zero defects, idle time, wastage etc
3. Quality assurance procedures and systems
4. Culture of 'quality is everyone's concern'
5. Participation and teamwork encouraged
Quality Control v Quality Assurance

**Quality control** systems include sampling, inspection and testing of raw materials, work-in-progress or finished goods stock. Also the monitoring of customer complaints and analysis of product faults reported from internal testing or customer returns. Quality control systems obtain feedback about historical performance in order to improve performance of the organisation in future (feedback control), it is the control of quality through inspection and appraisal.

**Quality assurance** is a planned and systematic action to provide adequate confidence that an item or product conforms to established technical requirements e.g. training of staff to ensure high standards, or suppliers guarantee high quality through systems and assurance standards (feed forward control). This is more aligned towards a TQM philosophy, QA when contrasted to QC is about the concept of prevention, rather than diagnosis and cure.

**Quality circles** is an American idea, whereby a group of 5 to 8 employees, normally working in the same area, volunteer to meet on a regular basis to identify areas for improvement or analyse work related problems in order to find solutions.
6.6 Information technology and its usefulness to manufacturing operations

Flexible manufacturing systems (FMS) consist of several machines along with part and tool handling devices such as robots, arranged so that it can handle any family of products or parts for which the system has been designed and developed. Such systems aim to achieve greater economies of scale for the manufacturer, the capability of economic production of small batches of a variety of products or parts with minimal set up time. These systems are highly computerised, automated and integrated.

Computer aided design (CAD) automates the development of new product designs faster. When integrated with expert systems CAD can automatically work out the stress and strain of different materials required to support new designs. Through good design it can assure better quality of the product when it is manufactured or assembled e.g. design, drafting and display of graphically oriented information early in the design process aids good production planning.

Computer aided manufacturing (CAM) automates production e.g. robotic and programmable production cycles. This can reduce defects and wastage within the production process due to a reduction in human labour required e.g. human beings careless, clumsy and easily make mistakes.

Optimised production technology (OPT) optimises the use of bottleneck resources (limiting factors) e.g. the binding constraints that limit capacity and throughput. Examples include programmable production cycles to match the speed of non-bottleneck resources to the running of bottleneck resources maintained at full capacity. OPT helps to avoid the build up of unnecessary work in progress and supports a JIT environment.

Materials requirement planning (MRP I) is an inventory control system which provides an automated list of components and materials required for the type and number of products entered. This allows better production planning and accuracy of inventory management.

Manufacturing resource planning (MRP II) Evolved from MRP I. A system that incorporates not only material requirements, but all manufacturing resources such as different labour types, machine types and other manufacturing resources required for the type and number of products entered. It could even produce the budgeted cost for each batch or unit of product entered aiding effective production planning, control and cash-flow management. A useful capability to answer "what-if" questions.

Computer-integrated manufacturing (CIM) means manufacturing supported by computers. The total integration of computer aided design, manufacturing, quality control and purchasing in one centralised system.

Enterprise-wide systems (ERP systems) also referred to as enterprise resource planning (ERP) or enterprise computing. Enterprise-wide systems are information systems that are used throughout a company or enterprise. A company-wide computer software system used to manage and coordinate all the resources, information and functions of a business. To be considered an ERP system, a software package must provide the function of at least two systems e.g. payroll and accounting functions if integrated, could be technically considered an ERP package. ERP is the modern extension of MRP (material requirements planning, then later manufacturing resource planning) systems and CIM (Computer Integrated Manufacturing).
Enterprise-wide systems enable the effect on different enterprise support resources or business processes to be forecast more accurately, when increasing or decreasing volumes sold or produced. Such resources incorporated are not just production related; they include forecasts for other support departments and even entire divisions. Enterprise-wide systems require effective integration of information systems e.g. a central database.

All functional departments are integrated in one holistic information system. As well as integrating manufacturing, warehousing, logistics, and information technology, it would also include accounting, human resources, marketing and strategic management.

SAP Business One is an integrated finance and business management software solution, it includes everything you need to manage a business: e.g. financials, accounts payable/receivable, banking, inventory, customer relationship management, production, service management, human resources and reporting.

Benefits of ERP systems

- Integration of software applications can speed up exception reporting.
- Real-time data capture and reporting of financial results.
- Presents information for all levels of management.
- Can be integrated with customers or suppliers to speed up lead times and improve the quality of supply chain management.
- More effective planning e.g. forecasting the impact changing volumes will have on company wide cost, sales and profitability. A useful capability to answer "what-if" questions.

Limitations of ERP

- Inadequate investment in training for end users.
- Bespoke and expensive to develop and maintain.
- High switching cost.
- Industry standard prescriptions for ERP systems may not gain competitive advantage.
- Too difficult to adopt some business process into an ERP model.
- Only as reliable as the programmers that programmed it.
- Database approach therefore risk of losing information or security breaches.
6.7 Supply chain management

Supply chain management
Strategies to achieve greater integration of the supply chain from raw material to the ultimate final sale and disposal of a finished product or service. Effective supply chain management can be crucial for an organisation to gain competitive advantage e.g. higher quality, lower cost, quicker delivery etc. A supply chain is an example of a supply network, raw materials, components, finished goods and services, are procured as a product passes through a chain of processes that supply one another and at each stage ‘adds value’ to the customer in some way.

Supply chain management involves the movement of products, services, and information between and within businesses, the creation of value, and support of enterprises in the pursuance of a competitive advantage in the market place. (Kilty)

Illustration of a supply chain

Example 6.4
Apply the above stages of the supply chain to a cake industry?

Supply chain terminology
- **Upstream** refers to processes that occur prior to an organisations supply stage.
- **Downstream** refers to processes that occur later to an organisations supply stage.
The three elements of supply chain management

- Responsiveness e.g. how quickly and flexibly supply can meet demand.
- Reliability e.g. deliver consistently and on time.
- Relationships e.g. develop high degree of mutual understanding and trust, often using single supplier sourcing strategies to achieve this.

Linking purchasing to the corporate strategy

According to Professor Paul Cousin’s, supply chain management is about managing the flow of goods and services through the organisation, with the aim of making the organisation more competitive e.g. by streamlining activities or automating billing, ordering and payment. Cousins introduced the following inter-connected factors to strategically influence supply chain management.

The ‘strategic supply wheel’ illustrated by Cousin’s

- **Portfolio of relationships** e.g. build high collaboration and maintain good relations with suppliers.
- **Skills and competences** e.g. develop skills internally for effective supply chain management, through perhaps recruitment and training.
- **Strategic performance measures** e.g. monitor and control supply chain management using performance measures.
- **Cost-benefit analysis** e.g. CB analysis applied to all new strategic approaches or new opportunities, to ensure they are financially justified.
- **Organisational structure** e.g. support effective supply chain management through effective organisation of staff.

The ‘strategic supply wheel’ suggests that it is imperative to maintain an alignment of corporate goals with the organisations supply chain policies. This might sound obvious but many purchasing directors are unaware or not connected in anyway to the corporate policy e.g. the role of the purchasing manager historically has been that of low organisational status and with little management training. Competitive advantage can be gained from developing competencies and capabilities, exploiting information technology and building more collaborative approaches with suppliers.
The strategic positioning tool by Reck and Long

Reck and Long looked at the different positions or approaches to supply chain management a purchasing department could take. Supply management was historically considered to have a passive role in the business organisation, but this position has moved to a more strategic role, as organisations strive to develop competitive advantage. These findings by Reck and Long, along with many other writers in this field of study, are useful for practitioners seeking to improve the performance and standing of the purchasing function.

- **Passive** (clerical and transaction based) purchasing acts only on the requests by other departments, viewed as a clerical function only. A reactive not pre-emptive administration role within the organisation.
- **Independent** (commercial but still at arms length) purchasing takes more of a professional approach e.g. implementing IT systems to facilitate greater speed and accuracy of purchasing. This increases the awareness of its importance within the organisation.
- **Supportive** (proactive purchasing) purchasing is regarded as an essential role and is more pre-emptive at delivering information to departments, it has good procedures and controls over supplier sourcing and selection processes.
- **Integrative** (full partnership, strategic sourcing and collaboration) purchasing is viewed as strategic, core and essential to support the organisation's competitive strategy, fully integrated to align corporate goals with its supply chain policies.

Responsibilities of a purchasing department

**Investigation**

1. Receiving material requisitions
2. Confirming detailed specification of needs
3. Enquiries into potential suppliers
4. Selection of potential suppliers

**Ordering**

1. Negotiating with suppliers
2. Placement of orders
3. Confirming acceptance of orders
4. Keeping other departments informed of progress

**Receipts handling**

1. Shipping and transport arranged
2. Receipt, inspection and handling of goods
3. Acceptance/Rejections of deliveries
4. Receipt of supplier invoices
Supplier sourcing strategies

- **Single sourcing** e.g. the organisation sources a particular material, component or service from one supplier only.
- **Multiple sourcing** e.g. the organisation sources a particular material, component or service from many suppliers simultaneously.
- **Delegated sourcing** e.g. the organisation outsources purchasing decisions to a third party or external organisation, business process outsourcing (BPO).
- **Parallel sourcing** e.g. the organisation uses a combination of two or more of the above typologies.

**Example 6.5**

What could be the advantages or disadvantages of using single, multiple, delegated and parallel sourcing strategies?
IT to facilitate greater integration within the supply chain

The following software applications can support inbound logistics.

- Bar coding for the receipt, handling and movement of stock.
- Electronic tagging of raw materials or components to ensure they are located.
- Materials Requirement Planning (MRP I) systems integrated with suppliers for automatic ordering.
- Route masters for drivers to ensure efficient delivery.
- Electronic Data Interchange (EDI) a computer-to-computer data interchange for electronic invoicing, billing and payment of transactions between the organisation and its suppliers, or use of an extranet e.g. internet based EDI.
- Computer Aided Design (CAD) for new product development and for greater collaboration with suppliers.
- Automated payment methods e.g. Electronic Funds Transfer (EFT) systems.

Business strategies to facilitate greater integration within the supply chain

- **Vertical integration** e.g. merging or acquiring suppliers within the supply chain for greater control and profit margin.
  - **Backwards vertical integration** a firm integrating backwards within its supply chain, the supplier involved in a previous and a different stage of production or supply e.g. Ford Motor Company merging with a car component supplier or manufacturer.
  - **Forwards vertical integration** a firm integrating forwards within its supply chain in the next and a different stage of production or supply, closer to its ultimate customer e.g. Ford Motor Company merging with a car dealership e.g. car retailer.
- **Strategic alliances or joint ventures** can also help to develop new products and features, streamline cost, decrease lead times and share knowledge for the greater benefit of both the organisation and its suppliers.
The role of supply networks

- To support the corporate and competitive strategy
- Speed up ordering, processing and payment e.g. ‘paper less’ administration.
- Reduce lead time for delivery of inventory levels and the final product.
- Innovate and develop new ways to add value to customers.
- Reduce staff overhead.
- Improve quality of the final product or service.
6.8 Managing inventory (stock)

Retailers buy stock or inventory and sell it to customers; manufacturers buy raw material and components, manufacturing or assembling goods and then selling these finished goods downstream e.g. later in the supply chain, towards the ultimate consumer or customer.

Stock

| Raw material | Materials and components used to manufacture or assemble finished goods. |
| Work-in-progress | Incomplete finished goods e.g. finished goods which require further work before they can be sold to customers. |
| Finished goods | Fully completed (manufactured) goods ready for sale. |
| Consumables | Disposable tools or materials used for the production e.g. lubricants or cleaning material for machines, disposable tools or equipment. |

Managing the procurement of raw material and components into the production process of an organisation can be a major and complex process. Many organisations operate within just in time (JIT) environments, attempting to minimise material inventory and handling, this typically requires effective communication and good systems to allow uninterrupted flow of production. The relationship between purchasing and other departments is a very important one, it ensures inventory arrives at the right place, right time, right quality, right quantity and the right price.
### Inventory control systems

<table>
<thead>
<tr>
<th><strong>Periodic (or bin) Inventory Systems</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock levels are reviewed at predetermined intervals of time and an order is placed. Orders are made on a scheduled basis but the reorder level could be for a standard or variable quantity each time.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Continuous (Perpetual) Inventory Systems</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock levels are constantly monitored and reviewed in real-time and orders placed when stock reaches or falls below a predetermined reorder level. The reorder level could be for standard or variable quantity each time but ordering does not occur at predetermined intervals of time.</td>
</tr>
</tbody>
</table>

The physical stock count or audit of inventory levels would be undertaken more frequently when it is uneconomic or very difficult to record each receipt and issue of stock within an inventory control system. High value items are normally monitored more frequently, however a team should ensure all stock items are counted and valued at least once every financial period.

### Example 6.6

What could be the disadvantages of periodic when compared to continuous systems for controlling inventory?
Holding inventory

Holding large levels of inventory enables an organisation to be more flexible to meet surges in demand e.g. offer customers a large variety of goods and immediately however holding large levels of inventory can be very expensive.

Advantages of holding inventory

✓ Discounts for bulk buying e.g. order higher volumes but less frequently
✓ Reduction in transaction costs if buying higher volume but less frequently
✓ Continuity of production e.g. avoids stock-outs and costly hold ups
✓ Flexibility to meet surges in customer demand
✓ Avoidance of price rises e.g. buy larger quantities when the price is lower

Disadvantages of holding inventory

☒ Higher risk of damage, deterioration and theft
☒ Higher risk of stock obsolescence
☒ Opportunity cost of money or cash tied up
☒ Subsequent price reductions maybe be missed
☒ Storage and administration cost of support e.g. warehousing, staff and systems

Examples of inventory control systems

<table>
<thead>
<tr>
<th>Reorder level systems</th>
<th>Periodic review systems</th>
<th>Economic order quantity (EOQ)</th>
<th>ABC system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whenever the current stock level falls below a standard reorder level, a new order is placed for a fixed amount in order to replenish stock.</td>
<td>Stock levels are reviewed at predetermined intervals of time e.g. 1st day of each month. Orders for stock will be placed after review.</td>
<td>The EOQ model determines a fixed quantity of stock to order which would minimise the total of holding and ordering cost.</td>
<td>High value (A) Medium value (B) Low value (C)</td>
</tr>
<tr>
<td>A fixed quantity is ordered at variable intervals of time.</td>
<td>A variable or fixed quantity is ordered at a fixed intervals of time.</td>
<td>A fixed quantity is ordered at variable intervals of time.</td>
<td>Higher value items are reviewed more frequently and controlled by a greater extent than low value items.</td>
</tr>
</tbody>
</table>
The ABC system of inventory management

Different stock items are classified as either

- High value (A)
- Medium value (B)
- Low value (C)

Higher value items are reviewed more frequently and controlled by a greater extent than low value items. This is because better stock control of high value items will minimise cash tied up unnecessarily within high value raw material or finished goods stock, supporting more effective cash flow management for the organisation. ABC is an example of a periodic inventory system.

Economic Order Quantity (EOQ)

A mathematical calculation for a fixed quantity of inventory ordered each time (the EOQ), that would minimise the total of holding and ordering cost. EOQ is an example of a continuous inventory system.

Assumptions of EOQ

- The level of customer demand is known
- The level of customer demand occurs at an even rate over time
- Constant purchase price of inventory
- A fixed cost exists for each order placed
- The lead time for inventory is constant e.g. how long it takes for inventory to be delivered once an order has been placed

The formula for EOQ

\[ EOQ = \sqrt{\frac{2 \times C_O \times D}{C_H}} \]

Where

\( D \) = Annual demand (units)

\( C_O \) = Fixed cost for each order placed

\( C_H \) = Cost of holding one unit in stock for one year (this may include a cost of capital for money tied up in the value inventory)
Note: At the EOQ point, the stock holding cost and ordering cost will be equal.

- **Holding cost rises when the size of order increases.** This is because a higher level of average stock will be kept throughout the year. The holding cost would include the cost of warehousing, staff and systems to support and maintain inventory, also the cost of insurance, obsolescence, damage, deterioration and theft, even the cost of money or cash tied up e.g. cost of capital, which is the opportunity cost of investing in inventory.

- **Ordering cost falls when the size of order increases.** This is because if the size of order increases for the same quantity of inventory purchased annually, then less orders and therefore administration cost would be required e.g. staff, paperwork, phone calls etc.
Example 6.7

Saffy Ltd manufactures a product called whatzits, which are made using material X. Every year 3000 units of material X are required. The cost of placing an order for material X is £200 and the cost of holding one unit of material X for one year is £42. The purchase price of one unit of material X is £20.

What is the economic order quantity for material X assuming a 52-week period?

What will be the average frequency for purchase orders are placed?
6.9 Process mapping

For processes to be improved they must first be illustrated. Flow charts can facilitate the use of process mapping e.g. diagrams using arrows, symbols and shapes. Within each symbol you write down what the symbol represents e.g. the start, or finish of a process, short description of action to be taken or decision to be made. Symbols are connected to one another by using arrows to demonstrate the flow of a process from start to finish. There are many other flowchart symbols that can also be used, but more importantly the use of flow charts is to communicate understanding, this is more important, so keep things simple. Most flow charts are made up of three main types of symbol.

- Oval shapes or elongated circles signify the start or termination of a process

- Rectangles signify processes, instructions or actions

- Diamonds show decisions that need to be made

Advantages of process mapping

- They can be used for structured ‘walk through’ testing to confirm understanding of workflow, information flow, compliance to regulations.
- They can be used to set up prototype designs for new processes to add value to business processes e.g. shorten lead times, increase efficiency or minimise waste.
- Easier to confirm logic and understanding e.g. visual communication.
- Step-by-step flow without being overwhelmed by the bigger picture.

Mapping processes can be long winded, awkward and a complex process e.g. getting everyone to agree what the process looks like with many redrafts. Microsoft Visio is an example of a ready-to-use software package for process mapping, fully customisable to minimise work effort and produce professionally designed process maps.
Key summary of chapter

**Operations strategy**
The total pattern of decisions which shape the long-term capabilities of any type of operations and their contribution to the overall strategy, through the reconciliation of market requirements with operations resources.
*(Definition: Slack and Lewis)*

**Performance dimensions for operational strategy**
- Quality e.g. effectiveness
- Speed e.g. efficiency
- Flexibility e.g. lead time
- Cost e.g. economy

**Capacity**
The ability of an operation to perform and produce. The maximum limit to the volume of product or service an organisation can produce, in a given timescale and bound by its constraints such as existing of technology, resources and business processes.

- **Over capacity** e.g. spare capacity and idle resources
- **Under capacity** e.g. full order book, customer queuing, waiting lists etc.

**Capacity planning**
- **Survey or sample of buyers intentions** e.g. customer sample taken
- **Composite of sales force opinions** e.g. human judgement applied by staff
- **Expert opinions** e.g. opinions from industry experts or consultants
- **Past-sales analysis** e.g. projections (trends) using a study of past performance
- **Market test methods** e.g. consumer trials and testing
- **Queuing theory** e.g. mathematical study of waiting lines or queues
The flexible firm ‘achieving workforce flexibility’

The **shamrock organisation** (a concept by Charles Handy), divided employees into three categories: **core, contractual and flexible labour**.

The flexible firm model proposed by **John Atkinson**, divides employees into three categories: **core, peripheral and external labour**.

Both models are similar and can be used to explain how an organisation might achieve greater flexibility.

**The shamrock organisation**

- The inner core e.g. permanent key employees.
- The flexible workforce (or peripheral labour) e.g. temporary, casual and/or part-time employees on short-term contracts.
- The contractual fringe (or external labour) e.g. self-employed subcontractors or freelancers, who are engaged to provide services as and when needed and often paid by results.

**Types of workforce flexibility**

- **Functional flexibility** (task flexibility/multi-skilled employees) concerns breaking down traditional occupational boundaries and avoidance of over-specialisation.
- **Financial flexibility** aims to convert staff cost from fixed to variable cost.
- **Numerical flexibility** enables a firm to adjust rapidly to changing levels of demand by increasing or decreasing the number of employees.
- **Temporal flexibility** can be achieved by varying the hours worked by employees in response to changes in demand.
## Strategies for balancing capacity (supply) and demand

### Level capacity strategies

- e.g. produces at a constant rate of output ignoring any changes or fluctuations in customer demand levels
  - Efficient production levels at all times
  - Supports mass production of uniform products.
  - High risk of stock obsolescence when customer needs change.

### Chase demand strategies

- e.g. a Just In Time (JIT) system, the opposite to a level capacity strategy.
  - Economies of scope from flexible resources
  - Minimisation of stock levels
  - Problems of no surplus inventory to run down during peak periods
  - High risk of disruption to production e.g. stock outs

### Demand management strategies

- e.g. influence customer demand levels to match to an efficient operating capacity (supply).
  - When off peak make the customer come to you
  - Maintain efficient levels of production and inventory
  - Marketing strategies not always effective.
  - Offers of discounts can be financially harmful

## The characteristics of service organisations

- **Intangibility** e.g. no material substance or physical existence
- **Legal ownership** e.g. cannot be returned if faulty.
- **Instant perishability** e.g. cannot be stored
- **Heterogeneity** e.g. service performed is different each time
- **Inseparability** e.g. the service cannot be separated from the person who provides it
The concept of sustainability in operations management

Sustainability within operations management is about preserving natural resources for future generations. A fully sustainable operation is one that has a zero impact, or a positive impact on the ecological environment.

Practices for sustainability

- Reduction in the use of toxic substances.
- Reduced reliance on petroleum and other non-renewable energy sources.
- Use of naturally renewable materials.
- Use of biodegradable materials
- Use of organic materials
- Fair trade

The organisations’ environmental footprint or environmental impact, is determined by the amount of depleted raw materials and non-renewable resources it consumes to make its products, and the quantity of waste and emissions that is generated in the process. The life cycle of a product should take into consideration the raw materials it uses in production, all other manufacturing processes, all distribution and transportation costs caused by a products existence, right through to its final disposal.

Lean production or the Toyota production system (TPS)

Lean production (also known as the Toyota Production System) is a manufacturing methodology originally developed by Toyota.

"good thinking means good product"

Toyota Production System (TPS) was built on two main principles: Just In Time (JIT) and Jidoka e.g. continuous improvement of quality within the production system.

Lean production focuses on delivering resources when and where they are needed.

Lean production tools and techniques

- Getting things right first time
- Minimising inventory e.g. JIT stock control
- Minimising waste
- Flexible workforce practices
- High commitment to human resource policies
- Culture of commitment to continuous improvement
Concepts that support lean production

**Total productive maintenance (TPM)** aims to shorten lead times by ensuring production and machine maintenance staff work closer together. Machine operators are empowered and trained in order to speed up routine servicing, fault diagnosis and maintenance of operating machinery.

**Just in time (JIT)** requires that products should only be produced if there is an internal or external customer waiting for them. It aims ideally for zero stock e.g. raw materials delivered immediately at the time they are needed, no build up of work-in-progress in production and finished goods only produced if there is a customer waiting for them.

**Total quality management (TQM)** is the process of embracing a quality conscious philosophy or culture within an organisation, it aims towards standards of near perfection and continuous improvement.

**Quality circles** is an American idea, whereby a group of 5 to 8 employees, normally working in the same area, volunteer to meet on a regular basis to identify areas for improvement or analyse work related problems in order to find solutions.

Information technology to support capacity planning

**Flexible manufacturing systems (FMS)** consist of several machines along with part and tool handling devices such as robots, arranged so that it can handle any family of products or parts for which the system has been designed and developed. These systems are highly computerised, automated and integrated.

**Computer aided design (CAD)** automates the design, drafting and display of graphically oriented information early in the design process aids good production planning.

**Computer aided manufacturing (CAM)** automates production e.g. robotic and programmable production cycles.

**Optimised production technology (OPT)** helps to avoid the build up of unnecessary work in progress and supports a JIT environment e.g. resource planning centred around bottleneck resources (limiting factors) or the binding constraints that limit capacity.

**Materials requirement planning (MRP I)** is an inventory control system which provides an automated list of components and materials required for the type and number of products entered. This allows better production planning and accuracy of inventory management.

**Manufacturing resource planning (MRP II)** Evolved from MRP I. A system that incorporates not only material requirements, but all manufacturing resources such as different labour types, machine types and other manufacturing resources required for the type and number of products entered.

**Computer-integrated manufacturing (CIM)** is manufacturing supported by computers. The total integration of computer aided design, manufacturing, quality control and purchasing in one centralised system.

**Enterprise-wide systems (ERP systems)** also referred to as enterprise resource planning (ERP) or enterprise computing. Enterprise-wide systems are information systems that are used throughout a company or enterprise. A company-wide computer software system used to manage and coordinate all the resources, information and functions of a business.
**Supply chain management**

Strategies to achieve greater integration of the supply chain from raw material to the ultimate final sale and disposal of a finished product or service. Effective supply chain management can be crucial for an organisation to gain competitive advantage e.g. higher quality, lower cost, quicker delivery etc. A supply chain is an example of a supply network, raw materials, components, finished goods and services, are procured as a product passes through a chain of processes that supply one another and at each stage ‘adds value’ to the customer in some way.

### Strategic supply chain management

The **strategic supply wheel** illustrated by Cousin’s:

- **Portfolio of relationships** e.g. high collaboration with suppliers
- **Skills and competences** e.g. develop skills internally
- **Strategic performance measures** e.g. monitor and control supply chain
- **Cost-benefit analysis** e.g. over strategic approaches
- **Organisational structure** e.g. support effective supply chain management

### The strategic positioning tool by Reck and Long

- **Passive** (clerical and transaction based) purchasing viewed as a clerical function.
- **Independent** (arms length purchasing but commercial) purchasing takes more of a professional approach.
- **Supportive** (proactive purchasing) purchasing is regarded as essential and more pre-emptive in the information it delivers.
- **Integrative** (full partnership, strategic sourcing and collaboration) purchasing is viewed as strategic, core, essential and therefore fully integrated.

### Supplier sourcing strategies

- **Single sourcing** e.g. source from one supplier only.
- **Multiple sourcing** e.g. source service from many suppliers simultaneously.
- **Delegated sourcing** e.g. purchasing decisions are outsourced.
- **Parallel sourcing** e.g. a combination of two or more of the above.
**IT to facilitate greater integration of supply chain**

- Bar coding
- Electronic tagging
- Materials Requirement Planning (MRP I)
- Route masters
- Electronic Data Interchange (EDI)
- Extranet e.g. internet based EDI.
- Computer Aided Design (CAD)
- Electronic Funds Transfer (EFT) systems.

**Business strategies to facilitate greater integration of supply chain**

- Vertical integration
- Strategic alliances or joint ventures

**Process mapping**

For processes to be improved they must first be illustrated. Flow charts can facilitate the use of process mapping e.g. diagrams using arrows, symbols and shapes.

**Advantages of process mapping**

- Visual communication
- Structured walk through testing
- Prototype designs
**Periodic Inventory Systems**
Stock levels are reviewed at predetermined intervals of time and an order is placed. Orders are made on a scheduled basis but the reorder level could be for a standard or variable quantity each time. A simpler and less complex system to maintain but problems of periodic systems for controlling inventory include:

- Missing or obsolete items may not be identified quickly enough.
- Larger errors or discrepancies between physical counted and stock records maintained when stock is periodically verified.
- Higher risk of stock outs occurring if stock levels are not reviewed frequently.

**Continuous (Perpetual) Inventory Systems**
Stock levels are constantly monitored and reviewed in *real-time* and orders placed when stock reaches or falls below a predetermined reorder level. The reorder level could be for standard or variable quantity each time but ordering does not occur at predetermined intervals of time.

**The ABC system**
An example of a periodic review system, where different stock items are classified as either.

- High value (A)
- Medium value (B)
- Low value (C)

Higher value items are reviewed more frequently than low value items.
Further question practice

Question 1 (CIMA P4 November 2005)

You are a researcher employed by a topical business discussion television show "Round The Table". Next week's discussion is about managing supply to achieve quality and customer satisfaction. Invited guests will be a leading academic, public and private sector senior managers and the chief executive of a car producer. You have been asked to prepare an outline briefing that will give some background information to the show's presenter.

Your research shows that the automobile industry is highly competitive and globally suffers from "overcapacity". In certain countries however, there is unfulfilled demand for specialist makes and models, implying some under capacity "hot spots". You understand that for any organisation, whether producing goods or services, effective capacity management is vital. It ensures that customers' needs are more fully met and that there are fewer unfulfilled delivery date promises. There are several ways of dealing with variations in demand and matching production capacity including:

- concentrating on inventory levels (a "Level capacity" strategy).
- concentrating on demand (a "Demand" strategy).
- adjusting levels of activity (a "Chase" strategy).

As part of your investigation you note that distinctive issues exist for service organisations (such as those found in the public sector) compared with manufacturing organisations (such as car producers).

Required:
As the show's researcher you are required to produce guidance notes to support the show's presenter which:

(a) discuss why a level capacity strategy might be difficult for a firm wishing to adopt a just-in-time (JIT) philosophy;
(5 marks)

(b) discuss the impact of demand strategies on an organisation's marketing practices;
(5 marks)

(c) discuss the relationship between chase strategies and the flexible organisation;
(5 marks)

(d) identify the ways that service organisations differ from manufacturing organisations when considering capacity management;
(5 marks)

(e) describe the types of software applications a manufacturing firm might introduce to improve its inbound logistics;
(5 marks)

(f) describe the types of computerised assistance that could be used by those involved in selling cars and wanting to improve demand.
(5 marks)

Notes (a) to (d) should have particular regard to quality, capacity and other organisational issues.

(Total = 30 marks)
Suggested solution to Question 1 (CIMA P4 November 2005)

Guidance Notes

Question 1 Part (a)

Level capacity strategy

With a level capacity strategy of inventory management the organisation manufactures at a constant output ignoring any changes in demand. This often means stockpiling for a manufacturer or higher holdings of stock if demand levels fall.

Just in time

JIT requires that products should only be produced if there is an internal or external customer waiting for them. It aims ideally for zero stock e.g. raw materials delivered immediately at the time they are needed, no build up of work-in-progress during production and finished goods only produced if there is a customer waiting for them e.g. a chase management strategy.

Contrast

The two concepts do not support one another because the former involves stock piling which conflicts with the latter’s aim of zero stock.

Car manufacturers could improve customer satisfaction by using a level capacity strategy especially for the specialist models which have current unfilled demand e.g. quicker deliveries fulfilled. Level capacity strategies are also cost efficient, however could result in high stock obsolescence if the market needs of customers change e.g. where over capacity exists and does not recover.
Guidance Notes

Question 1 Part (b)

Demand management strategies

Demand management strategies aim to influence demand levels at certain times e.g. peak and off-peak, in order to match demand closer to the organisations capacity. It is a strategy in order to smooth demand. This will affect the organisations marketing practices e.g. Thomas Cook slashing holiday resort prices over winter to encourage customers to switch the time they go on holiday. Although this can have the affect of dissatisfying customers e.g. during school holidays where under capacity exists, excessive prices are charged to customers.

During times of over capacity

For the car manufacture where over capacity exists, the marketing department should attempt to stimulate more demand from customers during these times e.g. cash back offers, 0% finance, price reductions, attractive warranties, free insurance and aggressive advertising.

During times of under capacity

For the car manufacture where under capacity exists, the marketing department should attempt to stimulate less demand e.g. the creation of orders from customers at a future point in time (buy next years models now), reduction in advertising or the restriction of availability of certain makes or models. It could make the organisation appear to be ignoring its customers needs when restricting availability and is unlikely to lead to high customer satisfaction during such times.
Guidance Notes

Question 1 Part (c)

Chase demand strategies

Chase demand strategies are the complete opposite of level capacity in that the organisation continually wishes to match levels of demand to volume produced within the organisation e.g. JIT systems. This strategy will require the flexible utilisation of resources in order to do achieve this e.g. minimisation of resources when over capacity and the swift procurement of resources when under capacity.

Flexible organisations

Workforce flexibility will be required due to uncertain market conditions or seasonal changes in demand. It will help achieve cost-effectiveness for an organisation. Numerical flexibility enables a firm to adjust rapidly to changing levels of demand by increasing or decreasing the hours worked by its employees or by the use of subcontractors, temps or part-time workers to meet periods of increased demand.

- Production workers may be required to take on indirect tasks e.g. quality control, cleaning of the work area, maintenance, or adjust to different production processes.
- Swapping employees between different tasks on a regular basis e.g. job rotation, can make the organisations staff more flexible, helping to obtain the maximum contribution from the workforce.
- Training to operate different machines and processes over a period of time can widen the job activities or role of the employee.
- Team working can help obtain a flexible culture and work practices e.g. by empowerment and multi-skilling of team members.

Organisational flexibility will help the organisation achieve short lead times required when meeting customer demands, helping to satisfy customers and improve quality. This therefore supports a chase management strategy.
Guidance Notes

Question 1 Part (d)

Capacity management

Capacity management is a process that seeks to ensure that the organisation can operate at optimum capacity whilst maintaining customer satisfaction levels. Two major differences when trying to manage capacity exist for a service organisation when contrasted to a manufacturer.

Unlike physical goods, services cannot be stored therefore it is more likely the service organisation will be using chase or demand management strategies rather than level demand strategies. For chase management strategies Tesco have installed automated scanning and payment machines for customers to pay for goods themselves, rather than human operated checkouts, this helps to avoid queuing during peak times. Thomas Cook use demand management approaches such as heavily discounted prices over winter to encourage customers to switch the time they go on holiday.

Tesco could use level demand strategies, as they can stockpile e.g. during Christmas, and in the case of Thomas Cook e-commerce can reduce demand on staff for the processing of customer details from during peak season. However in the case of a hair dresser this will be unlikely and will lead to long queues or waiting lists and therefore dissatisfaction of customers during peak demand.

Services often cannot be separated from the person who provides the service.

- Each time the service is performed even to the same customer it can be different each time, manufactured goods tend to be homogenous or perfectly identical when produced.
- It relies heavily on staff (people) to effectively deliver customer satisfaction and quality of service, people being very important within the marketing mix.
- The customer participates heavily in the delivery of services e.g. to determine their exact needs more specifically than a manufactured good.

Manufactures in contrast are often more capital than labour intensive; however this does not mean service organisations cannot embrace new technology as a way of meeting customer demand more flexibly.
Guidance Notes

Question 1 Part (e)

According to Michael Porter inbound logistics are activities associated with receiving, storing, and disseminating inputs necessary to build the product or provide the service. In the case of a car manufacture the activities of managing central and regional warehousing, stock control systems and inbound transport e.g. lorries.

The following software applications could support a manufactures inbound logistics.

- Bar coding for the receipt, handling and movement of stock for greater accuracy.
- Electronic tagging of raw materials or components to ensure they can be located efficiently.
- Stock control systems linked to capacity planning systems such as enterprise resource planning (ERP) systems.
- Materials requirement planning (MRP I) which provides an automated list of components and materials required for the type and number of products entered e.g. make and models of cars. This will facilitate better production planning and stock management.
- Route masters for drivers to ensure efficient delivery of inventory.
- EDI a computer-to-computer data interchange (fixed point to point system) for sending and receiving information e.g. electronic invoicing, billing and payment of transactions between the organisation and its suppliers. Or the use of an extranet which is a form of internet based EDI.

Guidance Notes

Question 1 Part (f)

The types of computerised assistance that could be used by those involved in selling cars and wanting to improve demand would be as follows.

- Laptops with a feature that allows different colours, interiors or optional extras fitted for different models to be created and displayed to a customer in the showroom.
- Database of customer details and addresses e.g. to inform them of new models, shows, exhibitions or customer evenings. Also for automatic reminders that servicing or an MOT is due.
- E-commerce could be used as a process of selling cars electronically using website technology. WebPages can be tailor made specific to customer groups as well as offering graphical features for viewing pleasure and 24/7 access for customers to browse and perhaps order a car on-line.
- M-marketing of new products or promotional offers by automatic text to customers. This can also be used by sales agents or staff employed to send invitations and reminders to customers. Customers can access information about different cars using wireless application protocol (WAP) a technology designed to provide users of mobile terminals with limited access to the internet. It can offer information in text form on the screen of a mobile phone.
- E-mails informing customers of interesting offers based upon analysis of their past transactions e.g. offers of a test drive for new models or guaranteed trade in values for a period of time.
Solutions to lecture examples
Example 6.1

Explain why a level capacity strategy could be difficult to adopt for an organisation operating a just in time system (JIT)?

Level capacity strategy

With a level capacity strategy of inventory management the organisation manufactures at a constant output ignoring any changes in demand. This often means stockpiling for a manufacturer or higher holdings of stock if demand levels fall.

Just in time

JIT requires that products should only be produced if there is an internal or external customer waiting for them. It aims ideally for zero stock e.g. raw materials delivered immediately at the time they are needed, no build up of work-in-progress during production and finished goods only produced if there is a customer waiting for them e.g. a chase management strategy.

Contrast

The two concepts do not support one another because the former involves stock piling which conflicts with the latter’s aim of zero stock.
Example 6.2

Explain the relationship that exists between a chase demand strategy and a flexible organisation?

**Chase demand strategies**

Chase demand strategies are the complete opposite of level capacity in that the organisation continually wishes to match levels of customer demand to its production volume e.g. JIT systems. This strategy will require the flexible utilisation of resources in order to do achieve this e.g. minimisation of resources when over capacity exists and the swift procurement of resources when under capacity.

**Flexible organisations**

Workforce flexibility will be required due to uncertain market conditions or seasonal changes in demand. It will help achieve cost-effectiveness for an organisation. Numerical flexibility enables a firm to adjust rapidly to changing levels of demand by increasing or decreasing the hours worked by its employees or by the use of subcontractors, temps or part-time workers to meet periods of increased demand.

- Production workers may be required to take on indirect tasks e.g. quality control, cleaning of the work area, maintenance, or adjust to different production processes.
- Swapping employees between different tasks on a regular basis e.g. job rotation, can make the organisations staff more flexible, helping to obtain the maximum contribution from the workforce.
- Training to operate different machines and processes over a period of time can widen the job activities or role of the employee.
- Team working can help obtain a flexible culture and work practices e.g. by empowerment and multi-skilling of team members.

Organisational flexibility will help the organisation achieve short lead times required when meeting customer demands, helping to satisfy customers and improve quality. This therefore supports a chase management strategy.
Example 6.3

Explain how a service organisation differs from a manufacturer when considering capacity planning?

**Capacity management**

Capacity management is a process that seeks to ensure that the organisation can operate at optimum capacity whilst maintaining customer satisfaction levels. Two major differences when trying to manage capacity exist for a service organisation when contrasted to a manufacturer.

Unlike physical goods, services cannot be stored therefore it is more likely the service organisation will be using chase or demand management strategy rather than a level demand strategy, especially if volatile customer demand exists e.g. high cost of idle resources of hairdressers waiting around for hair cuts, because if no customer demand exists, hair cuts cannot be stored.

As an example of chase management strategies applied to retailing, Tesco have installed automated scanning and payment machines for customers to pay for goods themselves, rather than human operated checkouts, this helps to avoid queuing during peak times. Tesco could also use level demand strategies, as they can stockpile products, unlike service e.g. stockpiling prior to Christmas rush.

Thomas Cook use demand management approaches such as heavily discounted prices over the winter season (off-peak) to encourage customers to switch the time they go on holiday. Thomas Cook also use e-commerce to reduce demand on physical staff requirements and call centres for the processing of customer details during peak season.

Services often cannot be separated from the person who provides the service.

- Each time the service is performed even to the same customer it can be different each time, manufactured goods tend to be homogenous or perfectly identical when produced.
- Services rely heavily on staff (people) to effectively deliver customer satisfaction and quality of service, people being very important within the marketing mix.
- The customer generally participates heavily over the process of delivering a service e.g. to determine their exact needs more specifically than a manufactured good.

Manufactures in contrast are often more capital than labour intensive; however this does not mean service organisations cannot embrace new technology as a way of meeting customer demand more flexibly.
Example 6.4

Apply the above stages of the supply chain to a cake industry?

- **Farmer** e.g. producer of commodities such as wheat, milk, eggs, sugar etc.
- **Manufacturer** e.g. bakes (manufactures) and packages cakes and biscuits.
- **Wholesaler** e.g. ‘buys in bulk’ and sells to independent retail outlets.
- **Retailer** e.g. larger supermarkets may bypass the ‘wholesaling’ stages and deal directly with the manufacturer when buying cakes and biscuits.
- **Customer** e.g. the ultimate consumer of cakes and biscuits.
Example 6.5

What could be the advantages or disadvantages of using single, multiple, delegated and parallel sourcing strategies?

Single sourcing

- Easier to maintain relations with only one supplier
- Easier to facilitate quality assurance procedures with only one supplier
- Could lower cost per unit due to higher volume ordered with only one supplier
- Possibility of competitive advantage e.g. allegiance to one supplier could be more collaborative

- Could only one single supplier in the industry e.g. high bargaining power
- Over reliance on one supplier can increase risk e.g. supplier may fail to deliver

Multiple sourcing

- May help negotiate and drive down prices when more suppliers exist
- More environmentally aware as the organisation shops around
- Lower risk if a supplier fails to deliver

- Not easy to facilitate quality assurance procedures when many suppliers exist
- Higher cost if not bulk buying from one single supplier
- Less commitment from suppliers if supplier hopping is frequent

Delegated sourcing

- Expertise of outsourcer e.g. core skills the organisation does not have
- Can reduce cost of purchasing administration and supplier management

- Can be a complex relationship to manage an outsourcer e.g. could be just another middle man
- Strategic control over purchasing function could be lost
- Confidentiality of information breached

In 2005, Gate Gourmet an outsourcer, that provided British Airways with in-flight meals, dismissed 800 staff over an unofficial strike. This industrial action caused BA to cancel flights because of a lack of food. Passengers were being given food bags and vouchers to get food before boarding flights, but queues meant some check-in desks had to be closed. This disruption at the time cost BA an estimated £40 million.

Parallel sourcing

- Best of both worlds e.g. have your cake and eat it too for all the different goods or services being sourced, once a preferred option has been evaluated

- Complexity of coding, administration and systems
- Duplication of time and cost for running different systems e.g. more staff and IT
Example 6.6

What could be the disadvantages of periodic when compared to continuous systems for controlling inventory?

- Could be huge disruption at certain intervals e.g. at the financial year end to production flow, everything may need to stop to ensure a good cut off point for stock to be physically verified.
- Less control over stock because missing or obsolete items may not be identified frequently enough.
- More likely that larger errors or discrepancies will be discovered when physical stock is counted and compared with any stock records maintained.
- Higher risk of stock outs occurring if stock levels are not reviewed frequently.

However periodic can be allot simpler and less complex as a system to maintain.
Example 6.7

The formula for EOQ

$$EOQ = \sqrt{\frac{2 \times CO \times D}{CH}}$$

Where

\[
\begin{align*}
D & = \text{Annual demand (units)} = 3000 \text{ units} \\
CO & = \text{Fixed cost for each order placed} = £200 \\
CH & = \text{Cost of holding one unit in stock for one year} = £42
\end{align*}
\]

$$\begin{align*}
EOQ &= \sqrt{\frac{2 \times 200 \times 3000}{42}} \\
EOQ &= \sqrt{28571} \\
EOQ &= 169 \text{ units}
\end{align*}$$

Weekly demand for material X

\[
= \frac{3000}{52 \text{ weeks}} = 57 \text{ units}.
\]

So each order of 169 units will last \(\frac{169}{57} = \text{about 3 weeks.}\)

Every 3 weeks will be the average frequency to place an order.

Continued ....
Example 6.7 – continued

The below calculations may help you understand the mathematics better for EOQ.

The ordering costs and holding costs for the whole year above are as follows:

Annual Ordering costs \[= \frac{D \times Co}{EOQ} = \frac{3,000 \times £200}{169} = £3,550\]

Annual Holding costs \[= \frac{1}{2} \times EOQ \times Ch = \frac{1}{2} \times 169 \times £42 = £3,550\]

For the holding cost an average stock is calculated (EOQ is halved) which assumes a constant rate of usage. The holding and ordering cost is equal at the EOQ and the combined cost of both have been minimised.

The total Annual costs \[= \text{Annual ordering cost} + \text{Annual holding cost} + \text{Purchase cost}\]

\[= £3,550 + £3,550 + (3,000 \times £20)\]

\[= £67,100\]