Chapter

6 Operations Management

6.1 Overview of operations management

Operations Management
Operations management (OM) is any business function responsible for managing the process of making goods and services.

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)

Operations management (OM) is any business function responsible for managing the process of making goods and services and without it there would be no products or services to sell to customers. It is any management function responsible for planning, controlling and coordinating the necessary inputs (resources) such as technology, information, people, equipment, inventory etc. and managing the transformational processes of ómaking goods or servicesô. Organisations heavily rely upon operational processes to produce effective products and efficiently deliver them on time and customers receiving services relative to buying goods, will often participate more extensively in the creation and delivery of services ómore visiblyôseeing operations being performed.

Operational management has a major impact on the cost of producing products or services and how well the products and services are produced and delivered. Operational functions (departments) are the transformational processes required to convert business inputs (resources) in ways that add value (utility) for customers, therefore higher customer willingness to pay and profit margin. Operations management is critical to gaining competitive advantage (órder winnersô) for an organisation.

Examples of operational functions within an organisation

- **Merchandising** ówhere retail occurs, bricks or clicksôe.g. store outlets or websites.
- **Manufacturing, production or processing** e.g. physical manufacturing and assembly.
- **Customer support** e.g. customer call centres, customer service and after sales service, customer complaints and warranty (repair) departments.
- **Warehousing, logistics and transport** e.g. storage, transport and inventory control.

The four Vs of operations strategy

According to Slack, Chambers and Johnston the goal of any organisation is to make the most effective use of its operations while ensuring that its customers are satisfied with the quality, cost, availability and quantity of goods or services. The four Vs of operations according to them can help all types of organisation make the most effective use of their operations. Organisations can make more effective use of their resources (inputs) to make products or services (output) in a number of ways;

- **Volume** e.g. this dimension is key to organisations like McDonalds, where uniformity, standardisation, automation and routine are key to achieving **high volumes (mass production)** of output and therefore low cost per unit. This

dimension works best when operations make a single product or small range of standard products.

- **Variety** e.g. this dimension could be key to financial services or even hairdressing, in either case staff often have to produce a variety of different types of financial advice e.g. tax, insurance, pensions or investment, or in the case of a haircut e.g. hair dye, perm, trim or skinhead. This dimension requires more ófunctional flexibilityô (or multi-skilled) staff and other resources in order to produce a **'diversity of output (variety)'**, otherwise a low cost model can be difficult to achieve.
- **Variation** e.g. this dimension refers to the **'degree of customisation'** to its products or services that an organisation can offer to its customers, for example luxury house building, holidays or cars, can often be tailored specific to unique requirements of each customer. Standard costing and therefore cost control becomes harder to achieve with this type of model because each product could be unique and specific to each customer.
- **Visibility** e.g. this dimension refers to the **'customer's ability to see and experience' operations as a process.** This dimension is more critical to service organisations such as retail or hairdressing, in both cases physical evidence, people and processes are witnessed first-hand by the customer. Royal Mail customers can track and trace their parcels, which also supports the same principle.

Operations strategy is therefore vital. If an organisation can offer certain unique features about their products or services, then customers could be willing to pay extra for this and may remain more loyal to the organisation. Product design incorporates factors such as aesthetics, reliability, durability, product functions and features, novelty, design, colour and even the courtesy, enthusiasm and friendliness of staff involved in supporting customers can all make a massive difference to customer value and brand loyalty.

Performance dimensions for product design

- **Quality** e.g. Marks & Spencer, Thorntonôs, BMW all are synonymous with the image of high quality. Quality means ófitness for the purposeô, so characteristics include how the product functions (what it does), robustness, reliability, taste or features it has.
- **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 guarantee overnight global parcel delivery.
- **Flexibility** e.g. ability to increase or decrease production to meet customer demand, or offer a variety and variation in products or services. Multi-skilled staff and resources can help an organisation achieve greater flexibility and economies of scope (cost savings by using the same resource to make different products or services).
- **Cost** e.g. important if aiming to offer a product or service at the lowest possible price (cost leadership strategy). Cheap and cheerful products like supermarket ówn economy brandsô or the óbasic no frills serviceô of Easy Jet and Ryan Air, often achieved by standardisation of products with inferior features or functions in order to keep the cost of production very low.

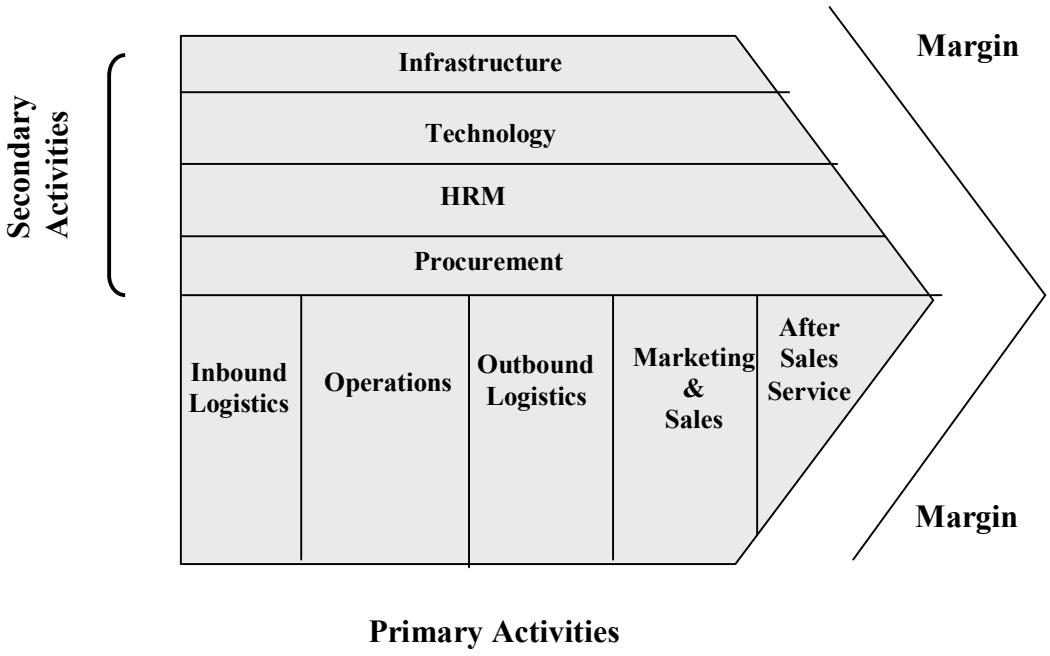
6.2 Porter's value chain analysis

> A value chain is ôthe sequence of business activities by which in the perspective of the end user, value is added to the products or services produced by an organisationõ
>
> **(CIMA)**.

Value chain analysis (VCA) is a position audit tool which examines the current and ôinternalõ 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 resources (inputs) from its environment and converts (processes) these into products or services (outputs), in doing so it creates ôadded valueõ (margin or profit) for the organisation and its customers.

Porter grouped nine business processes or activities of an organisation into what he called the value chain activities classified as either **primary or secondary activities.** Each activity incurs cost but in combination with other activities will provide customer satisfaction and added value. Profit margin is the value created when combining activities.

- **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 ôadd valueõ e.g. the product or service should be worth more than its cost of the individual parts or resources required to make it, allowing profit margin to be earned.



Inbound logistics

Business processes that receive, handle and store inputs (resources) e.g. warehousing, inventory control and inbound transport.

Operations

Business processes which are ótransformationalô and convert inputs to outputs e.g. staff, materials, machines, equipment etc. used to assemble the final product or service.

Outbound logistics

Business processes which deliver the final product (output) when it leaves the organisation e.g. outbound storage and transportation of goods to the customer or another third party intermediary within the supply chain.

Marketing & Sales

Business process of researching customer needs, targeting specific customers, selling to them and designing an effective marketing strategy for the organisations products and services.

After sales service

Business processes that support the product or service (output) when it has left the organisation e.g. departments that deal with product returns, customer complaints, after sales training and product support.

Procurement

Business processes to manage and negotiate the acquisition of resources (inputs) for the other activities e.g. components, raw materials and equipment. Ensures resources required are in the right place at the right time and right cost e.g. purchasing departments.

Technology development

Business processes required for innovation, product design and testing or the invention of new products and processes e.g. product design or research and development (R&D) departments.

Human resource management (HRM)

Business process to procure and look after the organisations most valued asset óits staffô e.g. staff recruitment, selection, training, development, retention and reward. Staff are a vital requirement for all activities.

Infrastructure

Business processes to support the whole of the value chain but not belonging to any of the other eight categories of activity above e.g. head office, legal, finance, IT, buildings maintenance, quality control, staff canteen.

6.3 Business Process Re-engineering (BPR)

BPR

The fundamental redesign of existing business processes to achieve improvements in critical areas such as cost, speed, quality or service.

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."

A business system, function or process takes inputs such as resources and processes (transforms) them in some way to achieve an output of some kind. Anything that hinders this efficient and effective delivery should be reengineered. Re-engineering existing business processes can shorten lead-times, improve customer service or add value to the product or service being sold. Information technology is primarily viewed as the enabling factor today for BPR e.g. automation of processes, however, computerised processes do not necessarily mean re-engineering, it has to produce a better-desired outcome.

Characteristics of BPR

1. Fundamental rethinking
2. Re-design of existing business processes
3. Dramatic improvements in existing business processes

BPR identifies and analyses existing processes in order to innovate them, it attempts to rationalise, eliminate or add value to a process by redesigning and reassembling it to operate as efficiently and as effectively as possible.

BPR programmes could include

- Combining jobs e.g. breaking down functional specialisation for greater flexibility.
- Greater empowerment and training of staff to improve performance.
- Re-designing systems to rationalise and improve efficiency.

Ford Motor Company

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.

Benefits of BPR

- ✓ Competitive advantage e.g. cost, lead time, efficiency.
- ✓ Added value to customers e.g. quality and satisfaction.
- ✓ Reduction in staff headcount and paper flow when automating.
- ✓ Improvement in staff morale and motivation when using new technology.
- ✓ Regular projects keep pace with new technology and change.

The stages in a BPR exercise

1. Identify processes to be re-engineered e.g. those suitable for innovation
2. Understand, break down and analyse the process
3. Identify óchange leversô e.g. look at new or existing technology to improve it
4. Rationalise or eliminate process if it does not add value
5. Redesign process to operate in the most efficient cost effective way
6. Reassemble, implement process and manage change
7. Monitor and review to ensure the expected benefits are realised

Process innovation

Process innovation is more transformational or óstep changeô for an organisation, process innovation is radical change or large scale change to the operations or processes of an organisation. Often this type of change involves major restructuring, reorganisation and cultural change often necessary, perhaps a completely new way of thinking. A good example would be e-commerce first introduced by an organisation as an entirely new medium for selling its products or services.

Examples of process innovation

- Henry Fordôs first use of the mass production line within the car industry.
- Lithography method used to manufacture microchips within the computer industry.
- Internet, barcodes and scanners within the retail industry.

BPR contrasted with process innovation

BPR fundamentally redesigns <u>existing</u> business processes.

- Identifies and analyses existing processes to innovate.
- Rationalises or eliminates if it does not add value.
- Redesigns and reassembles existing processes to operate efficiently and effectively.

Process innovation takes a process view of an organisation, as does BPR, but with the application of transformational innovation to a process, it creates an entirely new processes and therefore considered more radical than BPR.

- Creates new processes
- May involve cultural change and major restructuring
- Greater chance of adding value

6.4 Process mapping

Process design is the activity of determining workflow, equipment and other resource needs, for a process (activity) to work effectively. Good process design typically uses flowcharting as a tool for a process to be improved, it is normally a good idea to first illustrate the process in order to undertand it, communicate this to others óvisuallyô and then work on its improvement. Process mapping is the use of flow charts or diagrams e.g. arrows, symbols and shapes in order to facilitate the understanding of a process. It is a tool which assists with good process design. Each symbol in a process map is used 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 flow charts will help to communicate understanding of a process.

- 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.

Benefits of process mapping

- ✓ Management understanding of processes better when mapping is used.
- ✓ Supports other tools such as benchmarking, business process re-engineering and lean management (or waste elimination) to achieve dramatic improvements in customer satisfaction or cost reduction.
- ✓ Worker understanding of where their roles and responsibilities are linked within a process and how this integrates with other processes.
- ✓ Diagrammatically can highlight process inefficiencies or lack of value and help focus on where improvement is needed.
- ✓ Can be used for structured ówalk throughô testing to confirm logic of a process.
- ✓ Can be used to set up prototype designs for new processes.
- ✓ Step-by-step flow without being overwhelmed by the bigger picture.

Mapping processes can be complex, long winded and awkward and getting everyone to agree with what a new process óshould be likeô may take many redrafts. Microsoft Visio is an example of a ready-to-use software package for process mapping, which can be used to minimise work effort for professionally designing process maps.

Work study

Work study means the systematic examination of methods or processes that carry out activities, in order to improve the efficient and effective use of resources that support work flow. Work study can also help design standards of performance in order to monitor an activity better. Work study could include examining a job in order to make it more efficient or time motion studies undertaken to determine standard performance for how long a job or different elements of a process should take. Process mapping is a useful tool to support work studies and so is BPR when trying to re-engineer work processes for better performance.

6.5 Capacity planning

Capacity

The maximum limit to the volume of a product or service an organisation can produce within a given timescale and bound by its current constraints such as existing technology, resources and efficiency of business processes.

The ability of an operation to perform and produce (capacity) is often quantified by using productivity, efficiency and utilisation measures.

Terminology for capacity

- **Over capacity (spare capacity)** means that resources e.g. staff, machines and equipment are not being fully utilised (ôidleô) and the organisation is not operating at full capacity, there is insufficient demand for the organisations products.
- **Under capacity (full capacity)** means that customer demand is greater than the maximum capacity the organisation can make or sell e.g. full order book, customer queuing and waiting lists.

Forecasting demand can be complex and unreliable within uncertain environments today so a balance needs to be struck between capacity available and meeting customer expectations and demand. If an organisation does not manage its operations effectively it may either be tying up money unnecessarily e.g. idle labour or holding large inventory levels, or not able to supply products or services flexibly enough to meet surges in customer demand during ôpeakô moments and therefore lose orders.

Market forecasting methods for predicting demand levels

- **Survey or sample of buyer 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 ôpopulationô forecast of likely demand.
- **Composite of sales force opinions** where human judgement is applied by sales staff within the organisation that have good understanding of customers, market demand and likely growth levels.
- **Expert opinions** industry experts or consultants and ôwhat they sayô, but this method is often hampered by a lack of expertise available.
- **Past-sales analysis** projections (trend and forecasting models) using a mathematical

study of past (historical) performance e.g. high low method, time series, regression analysis, or scatter graphs. The major limitation of these methods is that past performance may not be a good indication of the future.

- **Market test methods** could include consumer trials and testing of new products or product features for consumers to give their direct and often qualitative opinions and feedback to ascertain likely popularity. Testing provides valuable assistance in determining future ópotentialô for customer demand, providing the research is not flawed or poorly designed.
- **Queuing theory** e.g. a mathematical study of the formation of waiting lines or queues (electronic or physical), for when customer ócustomer arrivalsô 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 to monitor 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.

Queuing theory enables a series of performance measures to be monitored.

- ✓ Performance measures can be calculated to help improve operations. Ratios such as average waiting times can be monitored for the impact on customer satisfaction.
- ✓ Expected number of customers can be determined in advance for more effective staff and resource planning.
- ✓ Can be used to respond to variations in demand for products or services e.g. marketing promotion can help 'smooth' peaks and troughs in demand.
- ✓ Internal benchmarking e.g. ratios of different sales outlets compared to identify where improvement in customer throughput is required.

Factors that influence capacity

- **Resources available** e.g. quantity of labour and skills, quantity of machines and times available. óBottlenecksô restrict an organisations resource capacity to supply. Flexibility from staff and other resources can help achieve quicker lead times.
- **Physical space** e.g. maximum seating in a stadium or restaurant, or maximum production space to manufacture goods.
- **Efficiency and waste** e.g. time taken to convert inputs (resources) into the product or service (output). The minimisation of staff idle time (or other resources) and wastage levels from inputs is vital to maximise efficiency, increase throughput and reduce cost.
- **Lead time (responsiveness)** e.g. high set up time for production or long production cycles can make supply very unresponsive (inelastic) to changes in customer demand.

6.6 Achieving workforce flexibility

Types of staff flexibility

- **Functional flexibility** (task flexibility or ómulti-skilledô employees) is achieved by breaking down traditional occupational boundaries and specialisation. Manufacturing workers for example may be required to take on other indirect tasks such as quality control, cleaning of work area, routine machine maintenance and learn new production processes and skills. This enables staff (or their skills) to be used more flexibly by being moved around the organisation in order to save cost or cover absenteeism. Functional flexibility can be achieved by staff secondments, training and job rotation to learn new skills.
- **Financial flexibility** is achieved by using performance related pay systems e.g. staff paid per unit of product they make or sell, this helps achieve better cash-flow management when production is slack. Financial flexibility converts staff cost from fixed to variable therefore supporting better cash-flow management.
- **Numerical flexibility** enables a firm to rapidly adjust the number of staff it has to changing levels of customer demand. This can be achieved by reducing permanent full-time staff and recruiting instead more subcontractors, temps or part-time workers.
- **Temporal flexibility** can be achieved by varying the time of day or days in the week an employee is willing to work e.g. time off in lieu after working longer shifts to accommodate a surge in demand, or covering for other staff shifts at a momentôs notice. It can be achieved by staff contract terms or culturally accepted by staff.
- **Location flexibility** is to do with the ógeographical mobilityô of the organisations staff such as the ability to move staff between offices, branches or outlets within other parts of the country and even internationally. It can be achieved by staff contract terms or culturally accepted by staff.

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

The **shamrock organisation** proposed by Charles Handy, divides employees into three categories: **core, contractual and flexible labour**.

Both models explain how organisations can achieve greater flexibility.

The "flexible firm"

The concept of the ñflexible firmò 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, this helps achieve greater cost-effectiveness for the organisation. The ñflexible firmò model suggests that we can design flexible staff arrangements to proactively meet business needs. For example more numerical flexibility can be achieved by the use of peripheral workers (part-time or temporary staff) or external labour (freelancers, sub-contractors, or self-employed). Core workers (full-time permanent employees) are not as easy to reduce in number when business contraction is required however can 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 are used to symbolise an organisations 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 ôexternalô labour) e.g. self-employed, subcontractors or outsourcers who are engaged to provide services as and when needed by the organisation.
- The **flexible** (or peripheral labour) workforce e.g. temporary, casual or part-time employees on short-term contracts and like the contractual fringe taken on as and when needed by the organisation.

The three parts of the shamrock (types of labour) all have advantages and disadvantages. The inner core are often well paid with superior reward and recognition packages but often do work by comparison that is stressful, work longer hours (sometimes unpaid) and are more committed. The flexible workforce such as temp or casual workers have less job security and offer greater numerical flexibility for the organisation, however can work out more expensive in the short-term. The contractual fringe (or external labour) also offer numerical flexibility and more effective cost control, however being ôexternalô and often with no sense of belonging to the organisation, may not care very much about it or have their own priorities. The inner core and contractual fringe can often perform identical jobs, side by side, often on different wage or recognition packages.

Achieving greater flexibility

- Increased use of outsourcing will according to Handy attempt to shrink the organisations ôinner coreô leaf (downsize) and enlarge its ôcontractual fringeô leaf as a basis of improving both numerical and financial flexibility.
- Short-term staff contracts can achieve numerical flexibility.
- Use of performance related pay systems can achieve a lower composite of fixed staff wages and salaries and achieve greater financial flexibility.
- Job enlargement, multi skilling and empowerment of the organisations full-time and part-time staff can achieve greater functional flexibility.

6.7 Capacity planning and control

Capacity planning and control is about how an organisation responds to variations in demand for its products in order to balance capacity (supply) with demand by its customers.

Level capacity strategy

The organisation manufactures (produces or makes) its products at a ôconstant rateô of output, ignoring any fluctuation in customer demand levels. This means óstockpilingô during periods when customer demand is low and then the running down of inventory levels to fulfil customer demand during peak times e.g. when demand outstrips capacity.

- ✓ Full utilisation of operational resources at all times.
- ✓ Efficient mass production levels can be held at a constant rate.
- ✓ Lowers average unit cost of products e.g. mass production drives down cost.
- ✘ High risk of stock obsolescence if customer preferences or needs change.
- ✘ High cost in service industries when assets are under-utilised e.g. idle in off-peak.

Chase demand strategies

The opposite to a level capacity strategy. The organisation continually óchasesô customer demand and extends or contracts its supply (output or capacity) to match existing customer demand levels e.g. a Just In Time (JIT) system, or ópull demand strategyô. This strategy will require flexible utilisation of operational resources e.g. constant adjustment to resource and workforce capacity using methods such as óquick hiring and then lay-offsô using part-time and casual labour, or the use of overtime working from permanent staff during moments of ópeak demandô.

- ✓ Flexible utilisation of resources for better economies of scope e.g. cost savings by utilising the ósame staff or machinesôto make a óvarietyôor óvariationôof products.
- ✓ Minimisation of inventory levels e.g. aim of JIT is óstockless productionô, so materials or finished goods are ordered or made only when there is a customer order, less cash-flow is tied up within inventory when resources are under-utilised.
- ✘ Over reliance on flexible staff during ópeakô periods of time e.g. overtime, temps or sub-contractors can hinder responsiveness to surges in customer demand.
- ✘ High risk of disruption given the organisation does not store inventory, so it may fail to deliver on time and respond to surges in customer demand.

Demand management strategies

The aim of this strategy is to influence customer demand levels, in order to match demand closer to the organisations most ôefficientô operating capacity. It is a strategy to ósmooth outô customer demand during ópeakô and óoff peakô periods. Continual adjustments are made to the ómarketing mixô of products to influence demand levels such as product pricing adjustment or promotional activities to help 'smooth' demand peaks and troughs.

- ✓ Helps maintain full capacity to avoid layoffs or under-utilised resources.
- ✓ Maintains a constant level of production and activity for greater cost efficiency.
- ✘ Not always effective e.g. promotion to encourage demand óoff peakô may not work.
- ✘ Offer of price discounts during óoff peakôperiods can financially harm profitability.
- ✘ Surges in customer demand during ópeakôperiods can harm customer satisfaction.

Outsourcing

Another way an organisation can respond to variations in demand for its products is by using subcontracting or outsourcing for operational work performed in order to meet temporary fluctuations in demand. But this is not always a possible strategy and can work out more expensive as a long-term strategy.

Demand management strategies further explained

As an illustration, a car manufacturer in times of óover capacityô could attempt to stimulate more demand from customers during these times e.g. cash back offers, 0% finance deals, discounted price reductions, more attractive warranties, free insurance and aggressive advertising. During times of óunder capacityô they could attempt to stimulate less customer demand e.g. óorder next yearôs model todayô, reduction in advertising expenditure and waiting lists, however this can make the organisation appear to be ignoring its customer needs and lead to customer dissatisfaction during such times.

A service organisation like 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, they also offer óearly birdô discounts to encourage customers to book earlier before peak season. Service organisations too can have the effect of dissatisfying customerôs e.g. high prices charged during school (ópeak seasonô) holidays when attempting to discourage customer demand.

Another issue with services and capacity management is that services are not physical goods and therefore cannot be stored; they are labour intensive to deliver and have instant perishability. It is therefore less likely that service organisations would use a level demand strategy especially if demand levels are volatile.

Contrasting 'services' with 'goods'

- **Intangibility** e.g. services have no material or physical substance and it's difficult for a customer to tell in advance what they will be getting.
- **Legal ownership** e.g. little physical evidence exists for services performed and so it's difficult to return a service if it is faulty or the customer is dissatisfied.
- **Instant perishability** e.g. unlike physical goods, 'services cannot be stored', so any unused or idle capacity cannot be stored for future sale as inventory for the customer.
- **Heterogeneity** e.g. each time a service (output) is performed it is 'never perfectly identical' and can depend on the time of day or member of staff it is delivered by. Physical goods tend to be homogenous (perfectly identical) when factory made.
- **Inseparability** e.g. services normally cannot be separated from a person who is required to provide it.

Example 6.1

Explain why a level capacity strategy could be difficult to adopt for an organisation operating in 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?

6.8 The concept of sustainability in operations management

Sustainability within operations management is about preserving natural resources for future generations e.g. minimisation of carbon footprint. A fully sustainable operation is one that has a zero impact or positive impact on the ecological environment. Organisations in recent decades have begun to consider how their operations affects the environment and future generations and are beginning to acknowledge new practices of doing business in a way that balances economic and environmental needs for better sustainability. The field of operations management has a vital role to play in the long-term sustainability of our economy.

Sustainability is a business ethical responsibility concerning the organisations duties or responsibilities towards the wider environment, community or society as a whole. Being socially irresponsible can create a bad image through the adverse public image and media coverage it can cause e.g. BP Deep Water Horizon oil spill.

Practices for better sustainability

- Reduction in the production of toxic substances, carbon emissions and other greenhouse gasses (GHGs) from the organisations activities.
- Reduced reliance on fossil fuel such as petroleum and other non-renewable energy.
- Use of natural, renewable and biodegradable materials e.g. naturally reabsorbed into the ecosystem.
- Redesigning packaging and products to use less material or energy.
- Reducing energy and pollution from transportation, logistics and manufacturing.

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 as well as the quantity of waste and emissions it generates in this process. The life cycle of a product should take into consideration not just the raw materials it consumes in its production, but all other manufacturing processes, distribution and transportation caused by the products existence, right through to its final disposal. It is important to consider sustainability not just within the organsiation but throughout its entire supply chain.

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 ‘dimensions or areas for environmental responsibility’

- **Production** e.g. minimising waste and carbon emissions.
- **Environmental auditing** e.g. to comply with legislation and take a more proactive stance towards sustainability by reporting and being transparent about it.
- **Ecological approach** e.g. minimising waste throughout entire value and supply chain.
- **Quality** e.g. set targets to reduce environment waste and emissions.
- **Accounting** e.g. account for ‘social costs’ to society or third parties within decision making such as carbon footprint from the organisations activities.
- **Economic** e.g. internal economic charges for any ‘social cost’ created by divisions or departments to discourage pollution and carbon emissions.

ISO 14001 is an international standard for ñEnvironmental Management Systemsò 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 the minimisation of energy consumption, waste and emissions.

Benefits of sustainable practices

- ✓ Competitive performance can be improved by the organisation by differentiating itself relative to the competition on the basis of sustainability. M&S launched ñPlan A" in January 2007, there is no ñPlan Bò, setting out commitments with the ultimate goal of becoming the world's most sustainable major retailer. This in itself drew huge publicity to the brand and reputation of M&S.
- ✓ Socially responsible (ógreenô) customers often are willing to pay premium prices, which can be a big boost to sales revenue and profits.
- ✓ Green investors can bolster up the share price of more sustainable organisations e.g. recycling or renewable energy companies.
- ✓ Sustainable business practices can reduce cost and play a valuable role when supporting ôlean productionô or waste elimination as a principle.

6.9 The 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
ñto get the right things to the right place at the right time.ò

Lean production focuses on delivering resources when and where they are needed, it is based on the principle of ówaste eliminationô

The Toyota Production System (TPS) was built on two main principles: Just In Time (stockless production) and Jidoka (automation with human intelligence). Underlying the entire Toyota Production System was the concept that "good thinking means good productò. Lean production techniques focus on reducing waste, cycle times, defects, inventory holding and movement and any other non-value added activity. Lean production can also be applied to service organisations although not always in the same way as manufacturing.

Lean production tools and techniques

- Getting things right first time and continuous improvement (total quality management).
- Minimising inventory e.g. JIT stock control to reduce holding cost.
- Minimising waste e.g. zero wastage policies.
- Flexible workforce practices e.g. focus factories, cell manufacturing, teamwork, multi-skilled employees and empowerment to staff to shorten lead times.
- High commitment to human resources e.g. investment in training and development, quality circles and performance related reward schemes.
- Management and workforce culture of collaboration for continuous improvement.

Advantages of lean production

- ✓ Increased capacity as less wastage increases throughput of products.
- ✓ Reduced wastage, idle time, reworks and therefore production cost.
- ✓ Improved flexibility, efficiency and lead times to respond quickly to changes in customer demand.
- ✓ Higher quality of product or service which satisfies customers e.g. fewer complaints, warranty claims and product returns.
- ✓ Multi skilled operatives give greater flexibility and economies of scope.

Disadvantages of lean production

- ✘ Continuous cost of investment in training of workforce.
- ✘ Change management problems of learning new skills and strategies to cope with new technology or working methods.
- ✘ Poor morale, motivation and resistance from the workforce during changeover.

Example 6.4

Identify FIVE examples where waste elimination principles can be applied to a service organisation such as a hairdresser and also for a manufacturer, such as one that makes household electrical products.

Total productive maintenance (TPM)

TPM aims to shorten lead times in production by ensuring production and maintenance staff work closer together. Machine operators and assembly workers are empowered and trained to undertake routine servicing, fault diagnosis and maintenance of their own operating machinery in order to speed up throughput or potential hold ups in production flow due to machine down time. Total productive maintenance (TPM) is a concept to improve productivity of the organisations equipment and contribute towards a leaner production system.

Benefits of TPM

- ✓ Less equipment downtime and major stoppages in production therefore greater efficiency of production flow.
- ✓ A better understanding by production workers of the performance of their equipment and machines therefore can diagnose and rectify problems quicker.
- ✓ Less reworks, scrap and wastage levels through better maintenance of machines and equipment.
- ✓ More effective teamwork and job rotation can help to improve flexibility for who can respond to routine problems.
- ✓ Increased enthusiasm and motivation of the workforce e.g. job enrichment due to new skills and challenges.
- ✓ Improved service to customers by reducing lead times and improving the quality of products made.

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 within the production cycle and finished goods only produced when there is a customer waiting for them. This means cash is not tied up unnecessarily within raw material, work-in-progress or finished goods, 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 and diversity of skills.

Total quality management (TQM)

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

Characteristics of TQM

1. Get it right first time as an organisational philosophy.
2. Continuous improvement aims towards zero defects, idle time and wastage.
3. Quality assurance procedures and systems for the prevention of poor quality.
4. Organisational culture developed that óquality is everyoneôs concernô.
5. Participation and teamwork encouraged for continuous improvement.

Layout and flow

Layout and flow is about how production processes and inventory movement is designed within operations management. Layout and flow has an impact on how materials, components, work-in-progress and finished goods travel through a manufacturing or service operation. The main advantages of good layout and flow is the minimisation of distance travelled for inventory, better maintenance of the quality of production flow and minimisation of wastage, it can also save money by reducing physical space required.

Focus factories (product layouts)

Focus factories are organised into smaller standalone factories with each team responsible for making a complete product (or small range of products). This enables product expertise to be developed, reduces movement of raw material and work-in-progress, reduces customer waiting times and speeds up production. Traditional factories produced many products for many customers in many markets, but focus factories ófocusô on a limited and more manageable set of products or markets. The manufacturing operations of most multi-national car manufacturers are built around this principle.

Dedicated cell production (cellular manufacturing or process layouts)

Workers and machines are organised into manufacturing cells to undertake common and standardised processes e.g. just milling, or just grinding, or just assembly, in order to make a common set of family parts or components for the final products. Reorganisation of production into ócellsô with dedicated teams can enhance efficiency and synergise worker skills and knowledge, Cellular manufacturing supports lean production by lowering cost because of the similarities in processing different products and therefore the specialisation and standardisation of processes can achieve better economies of scope.

Lean Synchronisation

Lean Synchronisation means ôthe flow of products or services is delivered exactly to what customers require (good quality) and with zero waste in this process. Lean Synchronisation supports a customer ñpullò or chase demand (JIT) strategies, where demand determines when raw material is pulled through operational systems and production commences. Key to the definition is ôleanõ; therefore the flow of production and delivery must use precious resources as efficiently and effectively as possible with no waste tolerated. JIT systems, lean production (waste elimination) methods and TQM are all concepts which support the term lean synchronisation; such concepts focus on flexibility, customer values and quality.

6.10 The role of technology and its usefulness to manufacturing operations

Process technology plays a valuable role in supporting the manufacturer today, the below includes a long list of different manufacturing technologies that exist.

Flexible manufacturing systems (FMS) consist of several machines 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 to produce. Such systems aim to achieve greater economies of scope 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, integrated and capital intensive.

Computer aided design (CAD) automates the development of new product designs faster and when integrated with expert systems can work out the stress and strain of different materials to support more robust designs. Through automated design CAD helps with visual design, drafting and display of graphical and 3D information early in the design stage to aid good production planning. Design specifications can also be exported to other manufacturing systems for quicker set up time and more accurate production.

Computer aided manufacturing (CAM) means the automation of production using robots, computerisation and programmable production cycles. This can reduce defects and wastage in the production process and speed up flow, due to a reduction in labour intensity required, human beings compared to robots are careless, clumsy, easily make mistakes and also less productive.

Computer-integrated manufacturing (CIM) is manufacturing supported by computers. The total integration of computer aided design (CAD), manufacturing (CIM), statistical quality control and purchasing systems in one integrated system. CIM is an example of a closed loop control system and fully computerised.

Optimised production technology (OPT) optimises the use of ôbottleneck resourcesõ (limiting factors) which are binding constraints that limit capacity and throughput when making products. Examples include programmable production cycles to match the speed of non-bottleneck resources to the running of bottleneck resources to maintain efficient flow of production and avoid build-up of work-in-progress. OPT can support production planning also by calculating optimal production plans that maximise contribution. OPT supports a JIT environment by helping to avoid the build-up of work-in-progress.

Materials requirement planning (MRP I) supports inventory control by ôautomatingõ a list of components and materials (material inputs) required based on production volumes entered. This allows more accurate and timely planning information to support inventory management.

Manufacturing resource planning (MRP II) evolved from MRP I. A system that incorporates not only automated calculations for material and component requirements (MRP I) based on production volumes entered, but also for other manufacturing resources required such as different labour and machine types and there hourly requirements. MRP II can also help plan for manufacturing support resources e.g. set-up, maintenance and quality control resources. This technology is useful for more accurate inventory management, production planning, control and cash-flow management.

Automatic Guided Vehicles (AGV) means automated and mobile robots which can follow floor markings, wires or lasers in order to automate and move themselves around without human intervention. They still take the form of normal vehicles such as forklifts or carts but are fully automated. Kelloggôs (the food manufacturer) has implemented AGVs for pallet movement throughout its manufacturing plants and this technology is used extensively within the car industry for automated movement of vehicle parts and components around a factory. Problems with AGVs include costly floor area and space they take up, they are not as fast as human driven vehicles and can be expensive when designing and building them to work effectively and move around obstacles. However unlike humans, AGVs can work 24/7 and they donôt get tired.

Computer Numerical Control (CNC) means the use of industrial robots or machines which use computer programmes to fully automate operations e.g. a machine tool which will follow precise paths, motions and actions based on a machine code or numerical program given to it. CNC offers increased productivity, flexibility and reduced waste due to programming and automation of machine tools to work in a precise way. Computers and automation play an integral part within CNC. Computer aided design (CAD) software can also transfer programmable data for quicker set up times and greater accuracy of product information to ónumerically controlledô machines.

6.11 Supply chain management

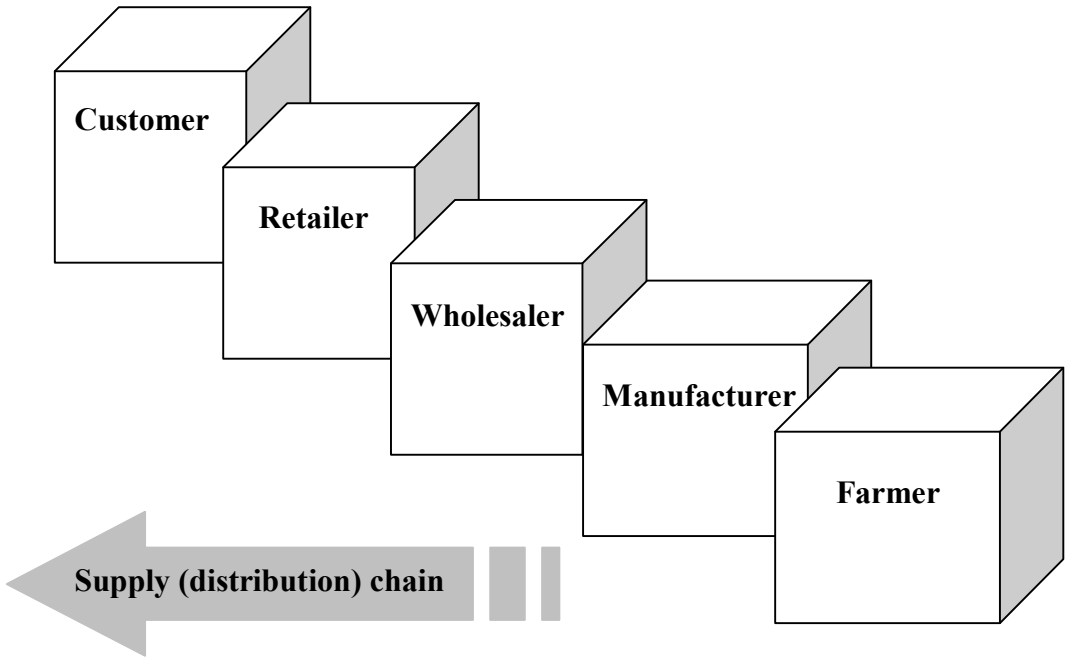
Supply chain management

Supply chain management (SCM) aims to achieve greater integration of the organisations supply chain from its receipt of raw materials to the ultimate final sale and disposal of is finished products or services.

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)**

Effective supply chain management is about ôintegration of the organisations flow of goodsô, which can be crucial for an organisation to gain competitive advantage e.g. increase quality, lower cost of inventory, storage, transportation or achieve quicker delivery and production cycles. A supply chain is an example of a ôsupply networkô, whereby raw materials, components, and ultimately finished products are procured (or made) and pass through a chain of different organisations (intermediaries) that supply one another. As goods pass through each stage of a supply chain this normally ôadds valueô in some way to the customer and therefore increases willingness to pay at each stage.

Illustration of a supply chain



Supply chain terminology

- **Upstream** refers to activities that occur **before** the organisations stage of supply.
- **Downstream** refers activities that occur **after** the organisations stage of supply.

Example 6.5

Apply some stages of a supply chain to a cake industry?

Three elements of supply chain management

- Responsiveness e.g. how quickly (flexibly) can the organisation obtain supplies.
- Reliability e.g. can the organisation obtain supplies consistently and on time.
- Relationships e.g. does the organisation build a high degree of mutual trust and understanding in order to collaborate with suppliers or other intermediaries within its supply chain. Single supplier sourcing strategies are often adopted to achieve this.

Contrasting 'traditional purchasing' with 'supply chain management'

The modern thought today is about supply chain management ('supply') rather than the traditional approach of 'purchasing'. Strategic procurement directors have become a significant role for a board of directors today, as opposed to the traditional passive view of at best a tactical purchasing manager as the highest ranked job title.

- Purchasing is less strategic as a function compared with supply.
- Purchasing is more routine, operational and ópriceô based, concentrating day to day on buying material or inputs at the órightô price, right time and right quality.
- Purchasing does not implement supply chain strategies e.g. make decisions concerning outsourcing, new technology, strategic partnerships or sustainable sourcing strategies to enhance value within the organisations supply chain.

Advantages of 'supply' rather than 'purchasing' approaches

- ✓ Works in partnership with suppliers e.g. interaction, trust and relationships are viewed as important, which can add value to the organisation and its products. Goodwill and loyalty from suppliers is more likely to exist under the supply approach when compared to traditional purchasing approaches of shopping around and aggressive negotiation, supply is more about órelationship rather than transaction based effortô.
- ✓ Supply approaches do not compromise on quality, whereas traditional purchasing tended to concentrate on the lowest price possible, which often came with a trade-off e.g. more inferior materials, which effects the quality of the final product or service.
- ✓ Supply approaches view ósustainable strategiesô as important within decision making e.g. recycled materials and suppliers with good track record for corporate social responsibility. Supply tends to include environmental and social criteria within procurement decisions.

- ✓ Traditional purchasing approaches tend to increase their cost of existence due to the additional administration they create due to continual shopping around e.g. complexity of systems to deal with multiple supplier sourcing strategies, higher risk of inaccurate orders and suppliers cooperating less effectively.

Paul Cousin's, supply chain management

According to Professor Paul Cousinôs, supply chain management is about managing the flow of goods and services through the organisation, with the aim of making the organisation more competitive. Cousins introduced the following inter-connected factors to strategically influence supply chain management.

The ó**strategic supply wheel'** illustrated by Cousin

- **Portfolio of relationships** e.g. keep the very best óportfolioô of suppliers and build high trust and maintain good relations in order to collaborate with them. Relational approaches work on mutual understanding and trust between two parities for behaviour expected rather than just explicit terms agreed by way of a contract.
- **Skills and competences** e.g. develop core competences and skills internally for effective management of supply chain using recruitment and training.
- **Strategic performance measures** e.g. monitor and control supply chain management using performance measures.
- **Cost-benefit analysis** e.g. cost benefit analysis applied to all new strategic approaches or supply chain opportunities to ensure their justification.
- **Organisational structure** e.g. effective óorganisation of staffôto support supply chain management.

The óstrategic supply wheelô suggests that it is imperative to maintain an alignment of organisations strategic aims with its supply chain policies. This might sound obvious but many purchasing directors are unaware or not connected in anyway with the corporate policies. The role of the purchasing manager traditionally 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 role of the purchasing function

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/Rejection of deliveries
4. Receipt of supplier invoices

The strategic positioning tool by Reck and Long

Reck and Long and other writers in this field of study are useful for organisations seeking to improve the performance and standing of their purchasing function. Reck and Long looked at different positions or approaches an organisation could adopt to manage its purchasing function, the four views or stages of the óstrategic extent of purchasingô. An organisation can also use Reck and Longôs tool to ópositionô their existing purchasing function and analyse what needs to be done to achieve a greater strategic view. Purchasing was historically considered to be a passive role within the organisation; however it has moved more towards a strategic role as organisations have strived to develop competitive advantage.

- **Passive (Stage 1)** (clerical and transaction based) purchasing acts only on the request of other departments and viewed as a clerical function with little legitimate authority in the organisation. A reactive not pre-emptive administration role within the organisation.
- **Independent (Stage 2)** (commercial but still óat arms lengthô) purchasing takes more of a professional approach implementing its own administration systems to facilitate greater speed and accuracy of purchasing. Awareness of its importance as a function within the organisation increases.
- **Supportive (Stage 3)** (proactive purchasing) purchasing is regarded as an essential function and is more pre-emptive at delivering information to support other departments, it maintains good procedures and controls over supplier sourcing and selection processes.
- **Integrative (Stage 4)** (full partnership, strategic sourcing and collaboration) purchasing is viewed as strategic and essential to support the organisations strategic aims and competitive strategy. Fully integrated to align corporate aims with supply chain policies.

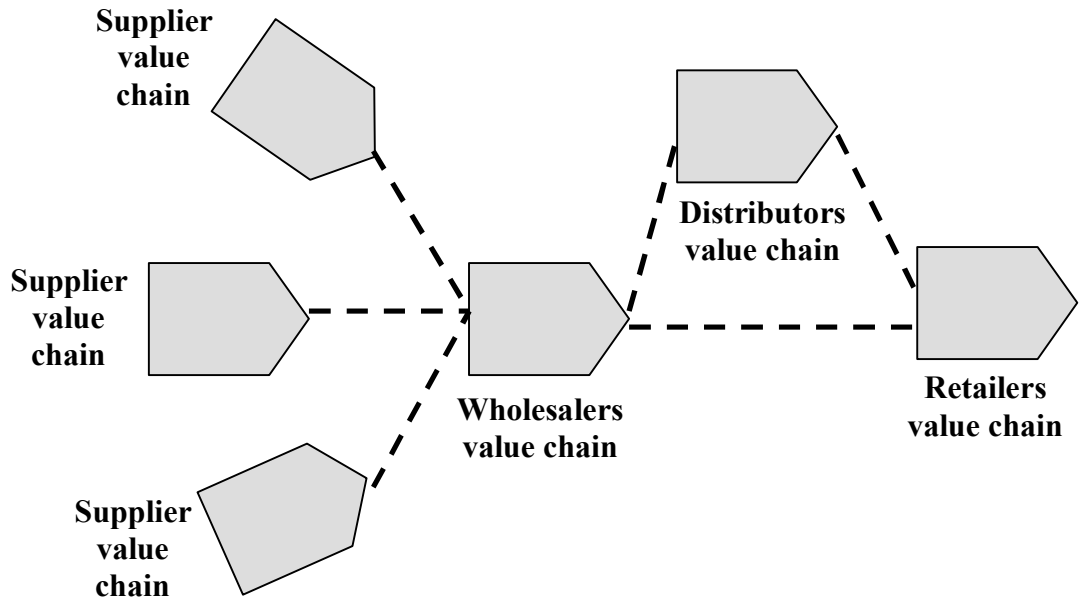
Supplier sourcing strategies

- **Single sourcing** e.g. the organisation sources a material, component or service from óone single preferred supplier onlyô.
- **Multiple sourcing** e.g. the organisation sources a material, component or service from ómany different suppliersô.
- **Delegated sourcing** e.g. the organisation óoutsourcesô its purchasing function and decision making to a third party external organisation.
- **Parallel sourcing** e.g. the organisation uses a combination of two or more of the above supplier sourcing strategies.

Example 6.6

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

Strategies to support integration within the supply chain



The following technology can support supply chain management

- Bar coding for more accurate receipt, handling and movement of inventory.
- Electronic tagging of inventory to aid automated tracking.
- Materials Requirement Planning (MRP I) to support inventory management.
- Route masters for delivery drivers to ensure efficient delivery and tracking vehicles.
- Electronic Data Interchange (EDI) or extranets (internet based versions of EDI) for more accurate and faster invoicing, billing and payment of transactions between the organisation and its suppliers.
- Computer Aided Design (CAD) to support greater collaboration with supplierôs e.g. new product development designs fed back to manufacturers in quicker lead times.
- Automated on-line payment e.g. Electronic Funds Transfer (EFT) systems.

The following business strategies can support supply chain management

- Vertical integration e.g. merging with or acquiring other organisations at ótherstages of the organisations supply chainôfor greater control and lower cost.
    - Backwards vertical integration e.g. integrating backwards with a supplier involved in a previous stage of the organisations stage of supply chain, such as Ford Motor Company acquiring a car component manufacturer.
    - Forwards vertical integration e.g. integrating forwards with a supplier involved in the next stage after the organisations stage of supply chain and therefore closer to the organisations ultimate customer, such as Ford Motor Company (manufacturer) acquiring a car dealership (retailer).
- Strategic alliances or joint ventures e.g. informal or formal agreements between an organisation and other organisations in its supply chain in order to collaborate develop new products and features, streamline supply cost, decrease lead time or share knowledge and research for the benefit of both organisations. Shell Oil Company often works in joint venture with other national and international energy companies.

The role of supply networks

- To support the corporate aims and competitive strategy of the organisation.
- To speed up ordering, processing and payment e.g. ópaper lessô administration.
- To reduce lead time of delivery for inventory.
- To be innovative and develop new ways that adds value.
- To reduce cost such as staff overhead and administration.
- To improve the quality of the final product or service.

Reverse Logistics

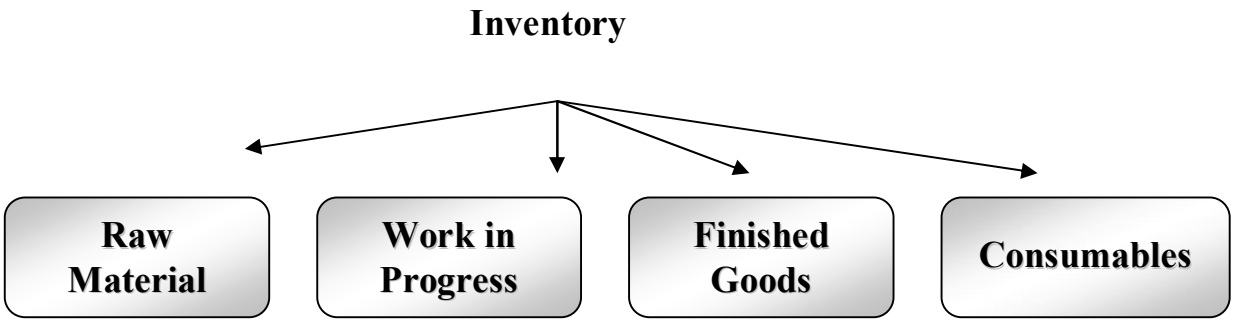
Reverse logistics is any process which manages the flow of ósurplusô and unwanted product returns from their final destination back to the organisation. Returned products could be repaired, resold, dismantled, recycled, or sent for landfill, all examples of processes which are reverse logistics. Reverse logistics could also include processes to manage product recalls, recycling programs, hazardous material or asset recovery.

Logistics is about managing the flow (movement) of raw materials, work-in-progress and finished goods from the point of origin to consumption. Reverse logistics includes all of the activities of logistics, but in reverse and back through the supply chain network. Quick, efficient and cost effective returns are essential to supporting the management of reverse logistics, óan average of 4% to 6% of all retail purchases are returned, costing the industry about $40 billion per yearô (Source: Forbes Magazine, December 2005).

Retailers can use reverse logistics in order to reduce the huge cost of product returns and refunds from damaged merchandise. Centralising customer complaints and returns handling policies could lead to significant benefits. Manufacturers could also manage reverse logistics in order to reduce product returns by retailers, by implementing JIT and delivering more responsively but in lower batches of products to match retailer demand more precisely.

6.12 Managing inventory

Retailers buy inventory (or stock) and sell this to customers; manufacturers instead buy raw material and components, manufacture and assemble (make) goods, then sell these finished products downstream within the supply chain, towards the customer or final consumer. In either case a service or manufacturing organisation needs to manage and control its inventory.



Raw material	Materials and components (inputs) required by the organisation to make its finished products.
Work-in-progress	Incomplete finished goods e.g. further processing by the organisation before the finished product can be sold to customers.
Finished goods	Fully completed (manufactured) products ready for sale to the organisations customers.
Consumables	Disposable tools or materials used in production of a product but do not form part of the product itself e.g. lubricants, cleaning materials, disposable tools and equipment.

Managing the procurement of raw material and components into the production process can be a major and complex process. Within a just in time (JIT) environment, an organisation attempts to minimise material inventory and handling, thereby increasing the need for effective communication and good systems for uninterrupted flow of production.

Holding inventory

Holding large amounts of inventory enables an organisation to be more flexible and respond better to surges in customer demand, however holding large levels of inventory can be very expensive.

Advantages of holding inventory

- ✓ Discounts for bulk buying e.g. higher volumes ordered but less frequently.
- ✓ Reduction in transaction costs e.g. higher volumes ordered but less frequently.
- ✓ Continuity of production e.g. avoid costly hold ups in ordering and production.
- ✓ Avoid customer dissatisfaction from óstock outsô
- ✓ Avoid price rises e.g. buy larger quantities when prices are lower.

Disadvantages of holding inventory

- Higher risk of damage, deterioration and theft of inventory.
- Higher risk of stock obsolescence due to changing customer trends or preferences.
- Opportunity cost of money (cash) tied up within working capital.
- Subsequent price reductions maybe missed due to substantial holdings already.
- Storage and administration cost e.g. warehousing, staff and systems

Inventory control systems

Periodic (or bin) 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 (fixed) or variable quantity each time. Stock levels are reviewed at predetermined intervals of time e.g. 1st day of the month and orders then placed after review for a variable or fixed quantity.

Continuous (Perpetual) Inventory Systems

Stock levels are constantly monitored and reviewed in ôreal-timeõ and orders placed when stock reaches or falls below a predetermined reorder level. The reorder level could be for a standard (fixed) or variable quantity each time. In contrast to a periodic system, ordering of inventory does not occur at predetermined intervals of time.

Example 6.7

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

The ABC system

Different stock items are classified as either

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

Higher value items are reviewed more frequently and controlled by a greater extent than lower value items. This is because better stock control of higher value items will minimise cash tied up unnecessarily within working capital. ABC is an example of a periodic inventory system its main advantage is more effective cash flow management for the organisation. Higher value items are normally monitored more frequently, however a team should ensure that all stock items are counted and valued at least once every financial period.

Just in time (zero inventory policy)

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 within the production cycle and finished goods only produced when there is a customer waiting for them. This means cash is not tied up unnecessarily within raw material, work-in-progress or finished goods, allowing more effective cash flow management for the organisation. JIT is an example of a chase demand strategy for balancing capacity (supply) and demand.

Economic Order Quantity (EOQ)

The EOQ model determines a fixed quantity of stock to order which would minimise the total of all holding and ordering cost for it. A fixed quantity is ordered at variable intervals of time, so the EOQ model is an example of a ófixed continuous inventory systemô. The EOQ is a mathematical calculation for a ófixed quantity of inventory to be ordered each timeô in order to minimise the total of holding and ordering cost.

Assumptions of EOQ

- The level of annual 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. the length of time inventory takes to be delivered after an order has been placed.

The formula for EOQ

$$\textbf{EOQ} = \sqrt{\frac{2 \times C_O \times D}{C_H}}$$

Where

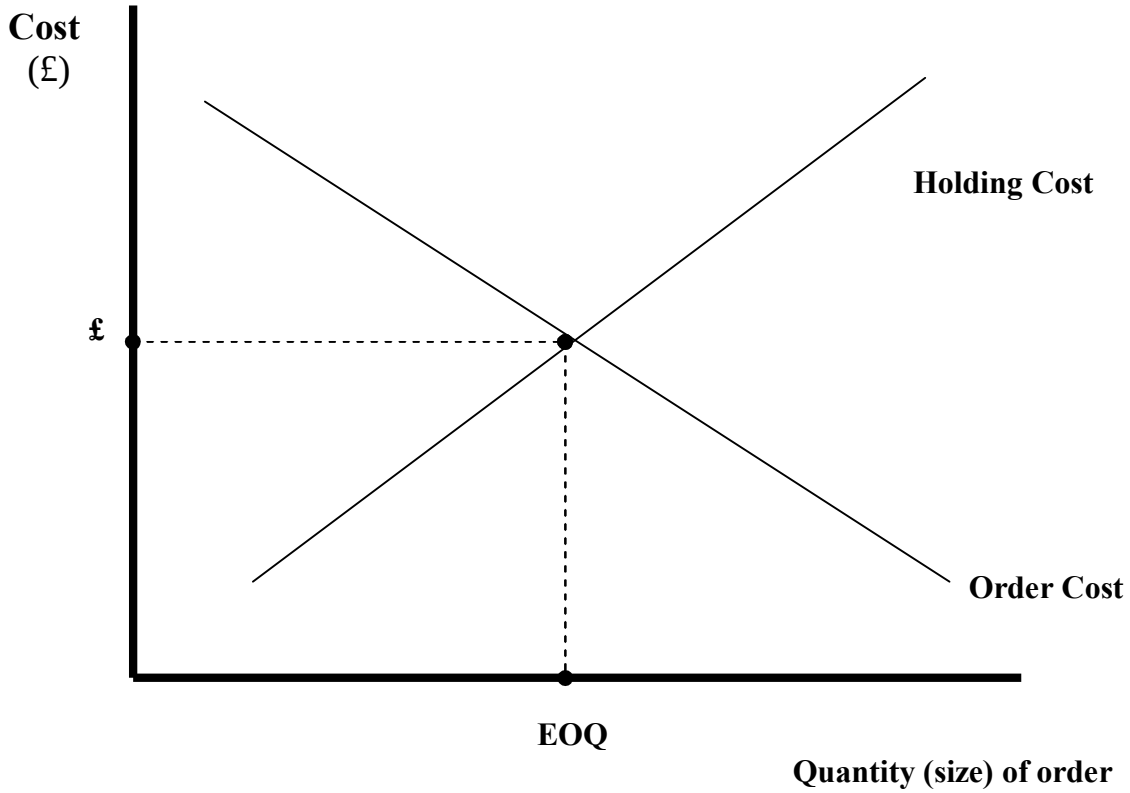
D = Annual demand (units).

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 moneyô tied upô in working capital).

Tutor Note: EOQ is the square root of 2 Cod ($2 \times C_O \times D$) and Chips (C_H).

At the EOQ point, stock holding cost and ordering cost will be equal.



- **Holding cost rises if the size of order increases.** This is because a higher level of average stock will be kept throughout the year. Holding cost would include warehousing (storage), staff, systems, insurance, obsolescence, damage, deterioration and theft, and even the cost of money tied up in working capital. Holding cost is required to support and maintain inventory,
- **Ordering cost falls if the size of order increases.** This is because a higher size of order decreases the need to order as many times throughout the year. If fewer orders then less administration cost for the organisation e.g. staff, paperwork, phone calls.

Example 6.8

Saffy Ltd manufactures a product called ówhatzitsô which are made using material X. Every year 3000 units of material X is required. The cost of placing an order for material X is £200 each time 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 and what would be the average frequency for a purchase orders being placed?

Tutor Note: It is unlikely any EOQ calculations will be expected in your exam the example is for demonstration only.

Key summary of chapter

Operations Management

Operations management (OM) is any business function responsible for managing the process of making goods and services.

The four Vs help an organisation make the most effective use of their operations.

- **Volume** e.g. high volumes of standardised product(s).
- **Variety** e.g. diversity of products (output).
- **Variation** e.g. degree of customisation to products.
- **Visibility** e.g. the customerôs ability to see and experience operations.

Porter's value chain analysis

According to Professor Michael Porter, an organisation receives resources (inputs) from its environment and converts (processes) these into products or services (outputs), in doing so it creates óadded valueô (margin or profit) for the organisation and its customers.

Porter grouped nine business processes or activities of an organisation into what he called the value chain activities classified as either primary or secondary activities.

- **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.

Business Process Re-engineering (BPR)

The fundamental redesign of existing business processes to achieve improvements in critical areas such as cost, speed, quality or service.

Characteristics of BPR

1. Fundamental rethinking
2. Re-design of existing business processes
3. Dramatic improvements in existing business processes

Process mapping

For a process to be improved it is normally a good idea to first illustrate it in order to undertand the process, communicate this to others óvisuallyô and then work on improvement. Process mapping is the use of diagrams e.g. arrows, symbols and shapes in order to facilitate this process.

Work study

Work study means the systematic examination of methods or processes that carry out activities, in order to improve the efficient and effective use of resources that support them.

Capacity planning

Terminology

- **Over capacity (spare capacity)** means that resources e.g. staff, machines and equipment are not being fully utilised (óidleô).
- **Under capacity (full capacity)** means that customer demand is greater than the maximum capacity.

Factors that influence capacity

- Resources available
- Physical space
- Efficiency and waste
- Lead time (responsiveness)

Market forecasting methods for predicting demand levels

- **Survey or sample of buyer intentions** e.g. surveys or interviews undertaken.
- **Composite of sales force opinions** e.g. sales staff within the organisation.
- **Expert opinions** industry experts or consultants and ówhat they sayô.
- **Past-sales analysis** e.g. mathematical trend and forecasting models.
- **Market test methods** e.g. consumer trials and testing of new products.
- **Queuing theory** e.g. a mathematical study of the formation of queues.

Capacity planning and control

- **Level capacity strategy** e.g. organisation manufactures (produces or makes) its products at a óconstant rateô of output, ignoring any fluctuation in customer demand levels.
- **Chase demand strategies** e.g. the opposite to a level capacity strategy, the organisation continually óchasesô customer demand using a Just In Time (JIT) system.
- **Demand management strategies** e.g. to influence customer demand levels, in order to match demand closer to the organisations most éfficientô operating capacity.

Achieving workforce flexibility

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

The **shamrock organisation** proposed by Charles Handy, divides employees into three categories: **core, contractual and flexible labour**.

Both models explain how organisations can achieve greater flexibility.

Types of staff flexibility

- Functional flexibility
- Financial flexibility
- Numerical flexibility
- Temporal flexibility
- Location flexibility

Contrasting 'services with goods'

- Intangibility
- Legal ownership.
- Instant perishability
- Heterogeneity
- Inseparability

The concept of sustainability in operations management

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

Sustainability is a business ethical responsibility concerning the organisations duties or responsibilities towards the wider environment, community or society as a whole. Being socially irresponsible can create a bad image through the adverse public image and media coverage it can cause e.g. BP Deep Water Horizon oil spill.

The modern manufacturing environment

Lean production or the Toyota production system (TPS)

Lean production focuses on delivering resources when and where they are needed, it is principle based on ówaste eliminationô

Total productive maintenance (TPM)

TPM aims to shorten lead times in production by ensuring production and maintenance staff work closer together.

Just in time (zero stock policy)

The JIT philosophy requires that products should only be produced if there is an internal or external customer waiting for them.

Characteristics of JIT

Closer relationships with suppliers maintained.
Smaller and more frequent deliveries to plan and administrate.

Total quality management (TQM)

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

Characteristics of TQM

Get it right first time as an organisational philosophy.
Continuous improvement aims towards zero defects, idle time and wastage.

Layout and flow

Layout and flow is about how production processes and inventory movement is designed within operations management. This could include product or process layouts.

Focus factories (product layouts)

Focus factories are organised into smaller standalone factories with each team responsible for making a complete product (or small range of products).

Cellular manufacturing (process layouts)

Workers and machines are organised into manufacturing cells to undertake common and standardised processes.

Lean synchronisation

The flow of products or services delivered exactly to what customers require (good quality) and with zero waste in this process.

The role of technology and its usefulness to manufacturing operations

- **Flexible manufacturing systems (FMS)** are highly computerised, automated and integrated manufacturing systems.
- **Computer aided design (CAD)** automates the development of new designs.
- **Computer aided manufacturing (CAM)** means the automation of production using robots, computerisation and programmable production cycles.
- **Computer-integrated manufacturing (CIM)** is manufacturing supported by computers.
- **Computer Numerical Control (CNC)** industrial robots or machines which use computer programmes to fully automate operations e.g. a machine tool follows precise paths, motions and actions based on a machine code or numerical program given to it.
- **Automatic Guided Vehicles (AGV)** automated and mobile robots which can follow floor markings, wires or lasers in order to automate and move themselves around without human intervention.
- **Optimised production technology (OPT)** optimises the use of ôbottleneck resourcesô (limiting factors) which are binding constraints that limit capacity and throughput when making products.
- **Materials <u>requirement</u> planning (MRP I)** supports inventory control by óautomatingô a list of components and materials (material inputs) required based on production volumes entered.
- **Manufacturing <u>resource</u> planning (MRP II)** evolved from MRP I. A system that incorporates material (MRP I) and other manufacturing resources required to make products. This technology is useful for more accurate inventory management, production planning, control and cash-flow management.

Supply chain management

Supply chain management (SCM) aims to achieve greater integration of the organisations supply chain from its receipt of raw materials to the ultimate final sale and disposal of is finished products or services.

Supply chain terminology

- **Upstream** refers to activities that occur **before** the organisations stage of supply.
- **Downstream** refers activities that occur **after** the organisations stage of supply.

Three elements of supply chain management

- Responsiveness
- Reliability
- Relationships

Contrasting 'traditional purchasing' with 'supply chain management'

- Purchasing is less strategic as a function compared with supply.
- Purchasing is more routine, operational and ópriceô based.
- Purchasing does not implement supply chain strategies.

Reverse Logistics

Reverse logistics is any process which manages the flow of ósurplusô and unwanted product returns from their final destination through the supply chain network and back to the organisation.

Cousin's 'strategic supply wheel'

The óstrategic supply wheelô suggests that it is imperative to maintain an alignment of organisations strategic aims with its supply chain policies.

- Portfolio of relationships
- Skills and competences
- Strategic performance measures
- Cost-benefit analysis
- Organisational structure

Reck and Long

The óstrategic extent of purchasingô.

- **Passive (Stage 1)** (clerical and transaction based) purchasing acts only on the request of other departments.
- **Independent (Stage 2)** (commercial but still óat armôs lengthô) purchasing takes more of a professional approach.
- **Supportive (Stage 3)** (proactive purchasing) purchasing is regarded as an essential function and is more pre-emptive at delivering information.
- **Integrative (Stage 4)** (full partnership, strategic sourcing and collaboration) purchasing is viewed as strategic and essential to support the organisations strategic aims and competitive strategy.

Supplier sourcing strategies

- **Single sourcing** e.g. the organisation sources a material, component or service from óone single preferred supplier onlyô.
- **Multiple sourcing** e.g. the organisation sources a material, component or service from ómany different suppliersô.
- **Delegated sourcing** e.g. the organisation óoutsourcesô its purchasing function and decision making to a third party external organisation.
- **Parallel sourcing** e.g. the organisation uses a combination of two or more of the above supplier sourcing strategies.

Inventory control systems

Periodic (or bin) 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 (fixed) or variable quantity each time.

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 a standard (fixed) or variable quantity each time.

The ABC system

Different stock items are classified;

High value (**A**) items
Medium value (**B**) items
Low value (**C**) items

Higher value items are reviewed more frequently and controlled by a greater extent than lower value items.

Economic Order Quantity (EOQ)

The EOQ model determines a fixed quantity of stock to order which would minimise the total of all holding and ordering cost for it. A fixed quantity is ordered at variable intervals of time, so the EOQ model is an example of a fixed continuous inventory system.

Just in time (zero inventory policy)

The JIT philosophy requires that products should only be produced if there is an internal or external customer waiting for them.

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 latterôs 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 hair dressers 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

Explain FIVE examples where waste elimination principles can be applied to a service organisation such as a hairdresser and also for a manufacturer, such as one that makes household electrical products.

Hair dresser

1. Measurement of liquid ingredients by hair dressers upon application to ensure hair products or treatments are not overused. Perishable items also kept stored to prolong useful life.
2. Temporal flexibility of staff required to ótake leaveô when off-peak and be prepared to work longer hours during peak periods, this will ensure less idle time.
3. Energy efficient heating and lighting within the store.
4. Policies to not leave taps running or electrical equipment e.g. hair dryers, running for longer than is necessary.
5. More efficient scheduling of customers to utilise floor capacity and fixed overhead more effectively,
6. High quality service by training staff will ensure administration of customer service and complaints are kept to a minimum e.g. no expensive recuts or re-treatments if a customer is dissatisfied. Lean production principles can therefore reduce and cut down customer support resources required.
7. More efficient processes involved for the order, administration, sales transaction and delivery of the service can reduce customer queues times and maximise customer throughput, thereby reducing idle time and improving capacity utilisation of floor space.

Manufacturer of household electrical products

1. High quality inputs such as materials and components as well as training for the workforce, can reduce reworks, scrap, product returns, repair and warranty claims, they all consume precious resources.
2. Functional flexibility of assembly workers can utilise different skills to reduce staff idle time.
3. Higher quality machines and total productive maintenance by workers can lower machine down times and help reduce scrap and wasteage during machine processing.
4. Higher quality of final product or service which satisfies customers will give fewer complaints, warranty claims, replacements and product returns.
5. Minimisation of the movement of parts and inventory can reduce unnecessary cost e.g. more efficient processes for ordering and handling.
6. JIT system can reduce holding cost for inventory and parts.
7. More fuel efficient vehicles and route masters can cut down on lead times and reduce inefficiency and cost of delivery.

Example 6.5

Apply some stages of a 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 bulkô and sells to independent retail outlets.
- **Retailer** e.g. larger supermarkets may bypass the ówholesalingô stages and deal directly with the manufacturer when buying cakes and biscuits.
- **Customer** e.g. the ultimate consumer of cakes and biscuits.

In the context of the 'retailer', the customer would be 'downstream' and the farmer, manufacturer and wholesaler would be 'upstream' within the supply chain.

Example 6.6

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 suppler 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 óshops aroundô
- ✓ 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 ómiddle manô
- ✘ 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 6.7

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 6.8

The formula for EOQ

$$\textbf{EOQ} = \sqrt{\frac{2 \times C_O \times D}{C_H}}$$

Where

D = Annual demand (units) = 3000 units

C_O = Fixed cost for each order placed = £200

C_H = Cost of holding one unit in stock for one year = £42

$$\textbf{EOQ} = \sqrt{\frac{2 \times 200 \times 3000}{42}}$$

$$\textbf{EOQ} = \sqrt{28571}$$

EOQ = 169 units

Weekly demand for material X

= 3,000 / 52 weeks = 57 units.

So each order of 169 units will last 169 / 57 = about 3 weeks.

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

Continued ….

Example 6.8 – 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 = {D x Co}/EOQ = {3,000 x £200}/ 169 = £3,550

Annual Holding costs = {1/2 x EOQ x Ch} = ½ x 169 x £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 = Annual ordering cost + Annual holding cost + Purchase cost

= £3,550 + £3,550 + (3,000 x £20)

= £67,100