Operations management

Level 5 - 12
Unit introduction

This unit is designed to enable those who work in purchasing to assess the efficiency and effectiveness of an organisation’s operations. This is the process of converting input resources into output products and services and occurs in all types of organisation, whether in manufacturing or services, public or private sector.

Students should be able to understand how operations staff add value to its inputs through the effective management of production and delivery. Operations staff are likely to be the most important internal customers of purchasing and supply chain managers.
Session 1

Operations management in context
The input-transformation-output model for goods and services
Learning objectives

At the end of this session candidates will be able to:

- compare the challenges facing operations managers who operate in increasingly complex global markets for goods and services

- recognise the need for an operations manager with a broad business understanding and an appreciation of technology and its application in business

- define operations management and assess the influences on operations management in the broader competitive environment
Learning objectives

- evaluate the input-transformation-output model and explain how it relates to operations management

- compare the different characteristics of products and service organisations and analyse how they impact on operations management practice.
Operations management – the changing environment

- Deregulation and the EU
- Improvements in communications
- Disparity in global labour rates
- Global sourcing opportunities
- Shortening product life cycle
- Improvements in transport
- More products outsourced – more technological complexity
- Environmental Issues
- Many other business issues in the environment.
5 challenges for operations managers

- Globalisation
- Social responsibility
- Environmental responsibility
- Technology
- Knowledge management

Source: Slack et al
Drivers of globalisation

- Global strategies
  - Global market convergence
    - Similar customer needs
    - Global customers
    - Transferable marketing
  - Global competition
    - Interdependence
    - Global competitors
    - High exports/imports
  - Cost advantages
    - Scale economies
    - Sourcing efficiencies
    - Country-specific costs
    - High product development costs
  - Government influence
    - Trade policies
    - Technical standards
    - Host government policies

Adapted from Johnson & Scholes
The environment for OM

- Competitive environment
- Technological environment
- Globalisation

Operations management
Operations management

- ‘… The direction and control of the processes that transform inputs into finished goods and services.’ (Krajewski and Ritzman)
- ‘… Concerned with creating, operating and controlling a transformation system that takes inputs and a variety resources and produces outputs of goods and services needed by customers.’ (Naylor)
- ‘… The management of any aspect of the production system that transforms inputs into finished goods and services.’ (Jones, George and Hill)
Technological environment

- Use of computer aided systems for design (CAD) and manufacturing (CAM)
- Modern manufacturing machinery – NC controlled machine tools
- Computer-integrated networks
- Automated guided vehicles and inventory picking systems
- Advanced control technologies.
Globalisation

- Increased competition
- Shorter product life cycles
- Management of virtual teams for new product introduction
- Constant review of core competencies versus global outsourcing.
The concept of operations

‘Operations’

- Those activities that take inputs, add value to them and provide an output to customers

- It is about the way organisations produce goods and services.
Input-transformation-output
Product / Service mix

- Objective is to deliver customer satisfaction or, better, customer delight
- All goods must be supplied as a package with a service element.
- It is the service that often leads to competitive advantage.
Operations and supply chains

Supply Chain Management
“The organisation of the overall business processes to enable the profitable transformation of raw materials or products into finished goods and their timely distribution to meet customer needs.”

(Institute of Logistics and Transport)
Supply chain management

- An integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user
- The objective is to improve the total performance of an enterprise by enhancing its responsiveness to the market place and by reducing the overall cost of supply.
Adding value

- By making top and bottom line contributions
- P&S can deliver:
  - Cost advantage
  - Value advantage
Creating superior customer value through enhanced service.
End-to-end supply chain

The Enterprise

Procurement → Materials Control → Production → Distribution → Sales and Marketing

One of P&S’s key roles has always been internal customer service
Integrated supply chain network
Features of services

- Intangible
- Consumed as they are produced
- Cannot be stored
- Difficult to match supply with demand
- People focused
- Subjective quality.
Operations as a mix of product and service

Pure product

Implications for operations
• Tangibility
• Quality
• Capacity management
• Customer services

Pure service

Tangibility
Session 2

The strategic roles, responsibilities and relationships of operations management

Performance objectives for the operations function
Learning objectives

At the end of this session candidates will be able to:

- formulate an operations strategy that will integrate with the product requirements of marketing and other key business functions
- evaluate the strategic relationship between the operations function and the other main functions within the business for example marketing, finance, purchasing and supply chain, human resources (HR) and IT (Information technology)
- analyse the key performance objectives, their relationship with the order winning criteria and how they contribute to the success of the business.
Operations’ decision areas

- Process
- Quality
- Capacity
- Workforce
- Inventory

Source: Schroeder
OM as a key business function

Engineering/technical
Finance/accounting
Human resources
Information technology

Product/service development
Operations
Marketing & sales

Other functions
Porter’s value chain

- Firm Infrastructure
- Human Resources Management
- Inbound Logistics
- Operations
- Outbound Logistics
- Marketing & Sales
- Service
- Technology Management
- Procurement
Operations in the strategic framework

Source: Hahn (1991)
A model for operations

<table>
<thead>
<tr>
<th>Stage</th>
<th>Internal/neutrality</th>
<th>External/neutrality</th>
<th>Internally supportive</th>
<th>Externally supportive</th>
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</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Reactive</td>
<td>Limited contribution</td>
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<td>Stage 2</td>
<td>Benchmarks externally</td>
<td>Adopt practice of competitors</td>
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<tr>
<td>Stage 3</td>
<td>Aspire to be the best</td>
<td>Continual improvement</td>
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<tr>
<td>Stage 4</td>
<td>Operations as a foundation</td>
<td>Goal: to be one step ahead</td>
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</tr>
</tbody>
</table>

Source: Hayes and Wheelwright
Slack’s performance criteria for operations management

- Quality
- Speed
- Dependability
- Flexibility
- Cost.
Conflicts between objectives

- Amazon.com offer same day dispatch of products at lower than high street prices. Customers **depend** on them achieving high **speed** delivery, yet this demands a level of inventory that increases their **costs**

- McDonalds can be **depended** upon to provide **fast**, low **cost** food of consistent **quality**. The speed can only be achieved at some **cost** and there is no attempt to be **flexible** in the range of food supplied.
Session 3

Outsourcing make versus buy
Effective design of products and services
Learning objectives

At the end of this session candidates will be able to:

- advise on the benefits of make or buy/outsourcing decisions associated with specific components and services
- assess the relationship between design and procurement
- analyse the significance of strategic outsourcing decisions in terms of
  - span of control
  - core competencies
  - impact on other functions
- appraise the design process for products and services
- recognise the benefits that arise from thorough design evaluation and improvement
- establish the need for environmentally sensitive design
- argue the case for the contribution that P and S can make to the design of products and services.
Outsourcing is different to

- Subcontracting – the employment of a specialist supplier who does not become fully integrated

- Partnership Sourcing – for example a car assembler partnership with a supplier of wheels

- Make-or-Buy – a tactical decision taken on a case-by-case basis.
Core competencies
(Hamel & Prahalad)

- The set of competencies that differentiate one organisation from another

- In the long run competitiveness derives from an ability to build, at lower cost and more speedily than competitors, the core competencies that spawn unanticipated products.
Core competencies cont

- The real sources of advantage are to be found in manager’s ability to consolidate corporate-wide technologies and production skills into competencies that empower individual businesses to adapt quickly to changing circumstances.

- For a competence to be core it should:
  - provide access to wide a variety of markets
  - contribute significantly to end-user value
  - be difficult to imitate.
A company’s build up to manufacturing and evaluating routes to objectives

- Decision to make or buy
- Identification of technology alternatives
- Process choice

Must know ‘How’ to manufacture a component before deciding whether to buy or make in house.
Process positioning

In simple terms process positioning can be thought of as make or buy decision

In systems theory process positioning is concerned with boundaries or span of process or vertical integration and sourcing decisions.
Vertical integration

A definition of vertical integration is as follows

When a company decides to manufacture and control all the raw materials and components it needs in order to assemble and make its products

Examples from the past are Ford and Raleigh bicycles.
The make or buy decision

- What boundaries should a firm establish over its activities such as the span of process?

- How should it construct its relationship with suppliers, distributors and customers?

- Under what conditions should it change its relationships and what will be the effect on its competitive position?
Choice of process

Decide how much to purchase from external suppliers which in turn determines the make-in task

Choose the engineering alternatives that will allow the made in components to be brought together with the bought out items

Choose the methods of manufacture which reflects the market place and volumes in which these products compete.
Make or buy is the centre of the company’s manufacturing strategy
Levels of make or buy

- Strategic make or buy - long term capability requirement and decisions about investment

- Tactical make or buy - deals with temporary capacity imbalance

- Components make or buy – usually carried out at the design stage, important to take into account own manufacturing capability.
Factors to be taken into account in a make or buy review

- Market position and trends
- Company product and process capability
- Customers, competitors and suppliers – their characteristics, requirements and capabilities
- Cost analysis and comparison with the outside world
- Projection of financial results and sensitivity analysis.
Maintaining the make versus buy strategy and monitoring for changes in the business environment

- A change in business strategy
- Internal load changes
- Major new design projects
- New production equipment investment plans
- Supplier quality and delivery ratings
- Supplier capacity changes
- Supplier price changes.
Outsourcing decision matrix

Hi

Core’ness’ ranking

Lo

In-house

Partner

Supplier development

Outsource

Supplier competence
Definition

Design, *di-zīn’, n*

- A plan or scheme conceived in the mind of something to be done
- The preliminary conception of an idea that is to be carried into effect by action
- A project.
Generic Customer Expectations

- Low price
- High quality
- Quick service
- Many features
- Customisable to their unique needs
- Ethical
- Environmentally sound
- Traceable (for example food)
Demands of competitive advantage

- Forecasts for new or improved products and services
- Faster launch – to beat competitors
- Faster, lower cost production
- Increased focus on.
Demands of competitive advantage

The demands
- Faster time-to-market to beat competitors
- Faster, lower cost production
- Forecasts for new or improved products and services

Mean a greater focus on …
- Production methods & processes
- Value/supply chains
- Design
- Value engineering
- Consumer research
- Concurrent engineering
- Rapid prototyping
The design process

- Design brief
- Research
- Preliminary designs
- Design selection
- Prototype
- Production
- Internal evaluation
The design process

- Prepare brief
- Research
- Outline designs
- Select preferred design
- Detailed design
- Construct and test
- Put into production
- Evaluate
- Improve.
Customer satisfaction

Customers are becoming increasingly demanding. They typically want and expect:

- low prices
- high quality
- quick service
- many features
- customisable to their unique needs.
Delivering improved products

- Market research to forecast customer requirements
- Keep up investment in R and D
- Reduce time to market by using concurrent engineering
- Minimise waste and add value.
Unique contribution of purchasing and supply to design

- Harness the expertise available in the supply chain
- Avoid ‘Not Invented Here’
- Develop relationships (partnering etc)
  
  ....... Practice early buyer and supplier involvement (EBI & ESI)
Purchasing supports design

- Defect prevention (→ quality)
- Value analysis/engineering
- Information on materials availability
- Provision of alternatives when specified materials not available
- Reduction of vertical integration
- Focus on systems or assemblies, rather than components
- Evaluation of alternative materials
- Building ‘designership’ relationships
- Creation of information centre for joint use

(Lysons)
Session 4

Design and disposal of environmentally friendly products and services
Design improvement tools
Learning objectives

At the end of this session candidates will be able to:

- assess the relationship between design and procurement and propose design tools that will ensure cost effective development of new products and services
- analyse the design process for products and services
- understand the full design business process
- evaluate the benefits that arise from thorough design evaluation and environmentally sensitive design with respect to the product life cycle
- analyse the contribution that purchasing and supply can make to the design of products and services by the application of certain tools.
Design
(Compton & Jessop)

The process of task recognition and problem solving with the object of fulfilling needs by the creation of products and services.
Environmentally sensitive design

The triple bottom line:

- cost
- social responsibility
- environmental impact.
Techniques

- The over-riding principle behind environmental procurement is that environmental impact must be minimised.
- Already considered the strategic advantages of Early Buyer Involvement in product design.
- Regulation is continually increasing.
- There are several techniques that can be used to ensure minimise environmental impact.
Life cycle analysis

- Consider the product’s environment impact from sourcing, through production, distribution, use and disposal
- How would this be applied to the use of nuclear power?
Whole life costing

- Buy
  - Price
  - Delivery
  - Specification
  - Tendering
  - Quality
  - Install
  - Commissioning
  - Visits

- Own
  - Opportunity cost
  - Depreciation
  - Taxes

- Use
  - Fuel / Energy
  - Consumables
  - Spares
  - Break Fix
  - Maintenance
  - Operators
  - Training
  - Upgrades

- Dispose
  - Removal
  - Transport
  - Decommissioning
  - Waste disposal
  - Capital Gains Tax
Design for disassembly (DFD)

The 4Rs:
- reduce
- reuse
- recycle
- recover

DDF addresses 3 of the Rs by ensuring that assemblies, components and Materials can be reused, recycled or recovered.
Environmentally preferred materials and methods

For example:

- the selection of timber for furniture from sustainable sources
- incinerating glossy magazines rather than recycling them.
Benefits of environment procurement

- Reduce waste and improve resource efficiency
- Secure the supply of goods and services
- Minimise business risks
- Provide cost savings
- Provide added value
- Enhance corporate image
- Create markets for new products and services.
Environmental management standards

- ISO 14000 (reference www.iso.org)

- The EU Eco-Management and Audit Scheme (EMAS)  
  (reference www.europa.eu.int)
Waste electrical and electronic equipment

- The WEEE Directive aims to conserve landfill and support more sustainable development by providing an impetus to boost recycling
- Electronic and electrical manufacturers and importers will be most affected by the Directive and will be required to take responsibility for treating and recycling their products when they become waste.
Restriction of hazardous substances

- RoHS legislation aims to reduce environmental impacts of waste and improve recyclability
- The Directive restricts the use of a range of potentially hazardous materials in products manufactured for sale in the UK market
- WEEE & RoHS link: www.environwise.gov.uk
Technology and the environment (ISO 14000 family)

- Waste generation, management and disposal
- Energy and fuel usage
- Transport issues and emissions
- Recycling of materials (including packaging and end-of-life products)
- Noise pollution
- Hazardous materials
- Over-production
- Health and safety issues.
Need for environmentally sensitive design

- Minimisation of:
  - pollution
  - nuisances, for example, noise and smell
  - potential safety hazards
- ‘Life cycle’ analysis:
  - efficiency and economy in use of inputs in production
  - planned life appropriate for need
  - minimum harm to environment during product use
  - end-of-life disposal (design for disassembly)
- Guidance by ISO (14000 family)
Tools to improve design

- Standardisation
- Modularisation
- Quality function deployment (QFD)
- Value analysis and value engineering
- Taguchi methods
- Computer-aided design (CAD)
- Rapid prototyping
- Simultaneous/concurrent engineering.
Session 5

Design and management of the operations management network
Process types and layouts in manufacturing and service industries
Learning objectives

At the end of this session candidates will be able to:

- design, plan and manage an operations network and advise on the optimum layout for specific types of product and process work flows
- formulate effective resource plans and schedules that will deliver products in a cost effective manner
- analyse the critical features of an operations network and explain how they contribute to the management of supply and demand
- distinguish between the different process types in manufacturing and service industries.
Characteristics of operations

- **Volume**: Low → High
- **Variety**: Low → High
- **Variation in demand**: Low → High
- **Visibility**: Low → High
Supply network decisions

Strategic network decisions consist of (Slack):
- integration decisions
- operation location decisions
- long-term capacity decisions

Feasibility factors –
- technical
- operational
- economic
- schedule

Benefit factors –
- tangible
- intangible

Financial factors –
- profitability
- cash flow.
Other network considerations

Organisation structure dimensions –
- Degree of formalisation
- Degree of complexity
- Degree of automation
- Stable ↔ dynamic

Integration –
- Horizontal integration (competitors)
- Vertical integration (supply chain)

Make/do vs buy and outsourcing –
- Pros include flexibility and lower capital requirements
- Cons include reduced control, dependence on others and potential to breed future competitors.
Definition of technology

- Technology – the machines, equipment and devices which help the operation transform materials, information and customers on order to add value and fulfil the operation’s strategic objectives

- Dimensions of technology –
  - degree of automation
  - scale of technology
  - degree of integration.
Production process types

Operations systems

Manufacturing
- Project
- Job shop
- Batch
- Mass
- Continuous

Service
- Professional services
- Service organisations
- Mass services
Basic layout types

Fixed position layouts
The product built in situ

Product layout
Product moves in sequential stages

Process layout
Activities are arranged by sequence of operation

Hybrid layouts
Activities are arranged by cell which completes a part or assembly
# Layout design

<table>
<thead>
<tr>
<th>Layout decisions</th>
<th>Layout design factors</th>
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<td>Process type</td>
<td>Safety</td>
</tr>
<tr>
<td>Layout type</td>
<td>Length of flow</td>
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<tr>
<td>Detailed design of layout</td>
<td>Clarity of flow</td>
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<td>Staff conditions</td>
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<td>Management coordination</td>
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<td>Accessibility</td>
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<td>Use of space</td>
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<td>Long-term flexibility</td>
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</table>
Chain or network?
(Christopher)

‘Individual businesses no longer compete as stand-alone entities, but rather as supply chains. We are now entering the era of ‘network competition’ where the prizes will go to those organisations who can better structure, co-ordinate and manage the relationships with their partners in a network committed to better, faster and closer relationships with their final customers’.
Operations network

Strategic design of the network depends:
- degree of integration
- location of facilities
- capacity to be made available

Agreement on Strategy needed between organisations in the network.
Process choice

Depends on:
Volume
  - how much of a particular design of the product or service is required?
Variety
  - how many different designs of the product or service are required?
Examples

- The gas supply network deals in very large volumes of a single product
- The railway network offers a single product (personal transport) to a multitude of destinations
- The ship building industry produces vessels to numerous designs which are often never repeated
- An architectural practice designs numerous buildings which are often individual.
Process technologies

Technology
- a knowledge of using tools and machines to do tasks efficiently

Process technology
- methods and equipment used to manufacture a product or deliver a service

May process material, information or people.
Manufacturing processes

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
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<tbody>
<tr>
<td>Project</td>
<td>Ship building</td>
</tr>
<tr>
<td>Job shop</td>
<td>Small printer</td>
</tr>
<tr>
<td>Batch</td>
<td>Glass bottles</td>
</tr>
<tr>
<td>Mass</td>
<td>Car assembly</td>
</tr>
<tr>
<td>Continuous</td>
<td>Gas supply</td>
</tr>
</tbody>
</table>
Manufacturing

Variety
- Project
- Job shop
- Batch
- Mass
- Continuous

Volume
- High
- Low

Volume: High - Low
Variety: High - Low
Service processes

Type                  | Example
---                   | ---
Professional          | Architect
Service shops         | High street bank
Mass                  | Railways
Services

Variety

Professional

Service shop

Mass

Volume

Low  high

High  Low
Process Layouts

Basic options

- Fixed
  - People, materials and services are brought to the site
- Process
  - Driven by technology and work piece is taken to the machine
- Product
  - The stages of the process are laid out so that the materials being transformed progress step-by-step in a pre-arranged sequence.
Hybrid or cell layout

- All the operations and services required to undertake certain activities are clustered together.
- In a manufacturing organisation, cells may contain a mixture of machine types which together produce finished product without moving the work piece around the factory and with greater flexibility than in a product layout.
- In a hospital there may be a maternity ‘cell’ where all related activities can be performed within one unit.
Volume-variety characteristics

- Low VOLUME - Fixed position layout
- Low VOLUME - Process layout
- Low VOLUME - Cell layout
- Low VOLUME - Product layout
Process and layout

- Project
- Fixed
- Batch
- Mass
- Continuous
- Jobbing
- Process
- Cell
- Product
Session 6

Work study and work measurement
The planning and control of quality
Learning objectives

At the end of this session candidates will be able to:

- design, plan and manage an operations function and advise on the optimum layout for specific types of product and process work flows
- formulate effective resource plans and schedules that will deliver products in a cost effective manner
- evaluate the use and techniques of work study and work measurement
- compare and contrast different approaches to job design
- appraise the cultural implications around empowerment and self managed teams
- evaluate the techniques used to plan and control quality.
Definitions

- ‘Job’ –
  - the sum of a series of tasks carried out by one person
  - a group of similar positions in an organisation
- ‘Job design’ – the specification of the content and methods of jobs.
What makes up a job?

- Work content
- Methods content
- Structural content
- Personal content
- Reward content

... So, we need to understand the organisational, technical AND personal aspects when designing a job.
Job design

- The application of motivational theories to improve productivity and job satisfaction of employees

- From our current point of view we can consider job design to involve the specification of the content and methods of jobs.
Rationales for job design

Approaches to Job Design

Scientific management approach
Good job design eliminates wasted effort and motion

Socio-technical systems approach
Good job design reflects the social aspects of the job as well as the technical

Ergonomic approach
Good job design fits the job (physically) to the worker

Motivational approaches
Good job design increases job satisfaction by increasing variety and challenge

Human factors approach
Good job design takes into account the environment in which the job is carried out
Work study

Method study
(FW Taylor)

The systematic recording and critical examination of ways of working in order to develop easier, more effective and cheaper methods

Work measurement
(F&L Gilbreth)

Application of techniques such as time study and work sampling to establish the time for a qualified worker to carry out a specified job at a defined level of performance
Work measurement techniques

Work Measurement Techniques

Direct

- Time study
- Activity sampling
- Work sampling

Indirect

- Predetermined motion time systems (PMTS)
Scientific management approach
(Taylor)

Break tasks down to their simplest level and train people to undertake very limited roles. This de-skills jobs and was applied in early mass production.

- Advantages – easy to control; easy to introduce new staff.
- Disadvantages – discourages people from thinking; leads to boredom.
Motivational approach

- Encourage people to think and commit themselves
- Fits with Herzberg’s theory which suggests that the job itself can be a source of satisfaction.
Some techniques

- Job rotation
  - variation

- Job enlargement
  - more of the same

- Job enrichment
  - more demands.
Ergonomics approach

Looks at the interaction of the individual and the work place
The key is to fit the job to the person and not the person to the job

- For example, the use of carefully designed computer work stations and the insistence on operators taking breaks both of which protect against repetitive strain injury.
Application

For the past thirty years the emphasis has been on applying motivational approaches and encouraging people to bring their brains to work.

The importance of ergonomics is in the emphasis on designing jobs to protect people from injury.
Flexibility

- Multi-skilling – offers greater interest in return for reduction / elimination of demarcation
- Alternative working patterns – for example, mixture of stable core group with temporary / short-term / ad hoc support; annualised hours; flexitime; shift-working.
Empowerment

- Puts responsibility for decision making at the most appropriate level in an organisation
- A form of job enrichment offering greater responsibility and authority
- Must be accompanied by strong leadership and clear communication of company objectives.
Work study

Key people:

- Taylor (1856-1917)
- Gilbreth (1868-1924)

..... so it’s really quite modern
Work study has two aspects:

1. Method study
   - Systematic recording and examination of methods as a means to developing improvements
   - Can be key to the operational aspects of job design.
Work study has two aspects:

2. Work measurement:
   - Establishing the time taken for a qualified worker to carry out task to defined level of performance
   - Can be useful in establishing the standard cost for a task and hence setting operational budgets.
Work study

Method study
- Select tasks to be studied
- Record facts
- Critically appraise how task is done
- Develop effective method
- Implement new method
- Seek further improvements.

Work measurement
- Select the tasks
- Record the facts
- Analyse them
- Calculate basic and standard times
- Agree method and its related time.
The importance of quality in operations
Definitions of Quality

- Transcendent approach
  - Quality as something you know when you see it!
- Product-based approach
  - Quality $\equiv$ quantity of one or more attributes
- User-based approach
  - Quality as meeting user needs/wants
- Manufacturing-based approach
  - Quality as conformance to requirements
- Value-based approach
  - Quality as a balance of excellence, control of variability and price.
Dimensions of product quality

- Performance
- Features
- Reliability
- Conformance
- Durability
- Serviceability
- Aesthetics
- Perceived quality
Dimensions of service quality

- Access
- Communication
- Competence
- Courtesy
- Credibility
- Reliability
- Responsiveness
- Security
- Understanding
- Tangibles

(Parusuruman, Zeithaml & Berry)
Cost of quality

The optimal cost level occurs at the zero defects point.
Quality management principles

- Customer focus
- Leadership
- Involvement of people
- Process approach
- Systems approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial supplier relationship

ISO 9000:2000
Techniques for planning and controlling quality

- Reactive approaches
  - Inspection
    - Receiving inspection
    - Classification inspection
    - Control inspection
    - Audit inspection
  - Statistical process control (SPC)

- Proactive approaches
  - Taguchi methods
  - Quality function deployment (QFD)
  - Failure mode and effects analysis (FMEA)
Cost of quality

- Failure costs
  - waste; rework; repair
- Appraisal costs
  - inspection; test
- Prevention costs
  - planning; systems; procedures

- What is the cost of ignoring quality?
Minimising the cost

- Target is to achieve zero defects (whether product or service)
- Cost then = Appraisal + Prevention
- Excellent systems, procedures and culture can reduce the appraisal cost
  - A virtuous circle.
Quality management

A hierarchy of techniques

- Quality Control (QC)
  - detection and correction of defects
- Quality assurance (QA)
  - systems and procedures to ensure conformance with specification
- Quality management (QM)
  - broader than quality assurance and encompassing the whole organisation.
ISO 9000:2000 Principles

(www.iso.ch)

- Customer focus
- Leadership
- Involvement of people
- Process approach
- System approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial
Why ISO 9000?

- Forces organisations to do it right

- Customers increasingly demand accreditation as a prerequisite for doing business
  - Do they always know what it means?

- Loosing accreditation is damaging.
Some techniques

Process oriented

- Inspection
- Statistical process control (SPC)
- Taguchi loss function

Product oriented

- Failure mode and effect analysis (FMEA)
- Quality function deployment (QFD)
SPC

- A technique for ensuring product consistency
- Key attributes are measured, continuously or at a pre-defined sampling frequency, and the measurements are plotted against the target measurement and upper (UCL) and lower (LCL) control limits
- The control limits are set ±3 standard deviations from the target (Re 6 Sigma!!)
SPC – sample charts

Statistical process control

- Alternating and erratic behaviour - investigate
- Two points near control limit - investigate
- Apparent trend in one direction - investigate
- Suspiciously average behaviour - investigate
- Five points one side of centre line - investigate
- Sudden change in level - investigate
Using SPC

- The key is to recognise that if the measurement is drifting outside the control limits, then something needs attention, for example the settings of the production machine.

- The problem with SPC is that while it can indicate that something needs attention, the overriding principle is that all measurement within the control limits are acceptable. It does not drive continuous improvement.
Session 7

Asset maintenance, replacement strategy and location decisions
The planning and control of operations and managing capacity
Learning objectives

At the end of this session candidates will be able to:

- design, plan and manage an operations function and advise on the optimum layout for specific types of product and process work flows
- formulate effective resource plans and schedules that will deliver products in a cost effective manner
- develop an asset and replacement strategy
- identify the different approaches to maintenance
- develop strategies for the planning and management of capacity
- appraise appropriate strategies for managing and smoothing capacity.
Maintenance

- Maintenance –
  - those activities that relate to keeping capital assets in good working order so as to anticipate and prevent interruption in operations and to do so at the least cost commensurate with effectiveness

- Objectives –
  - to enable quality and customer satisfaction to be achieved
  - to maximise the useful life of the equipment
  - to ensure safe operation
  - to minimise total production/operating costs
  - to maximise capacity

- Failure –
  - an inability to produce outputs in the appropriate manner (rather than the inability to produce any output)
Repair verses preventive maintenance

Optimum level of productive maintenance

Preventive maintenance cost

Breakdown maintenance and repair cost

Total cost

Amount of preventive maintenance
When is it time to replace an asset?

Factors
- Nature of the asset
- Obsolescence
- Changes in operating processes

Checklist questions by Carson et al
- Is it worn out?
- Can its operations be done on an automatic machine?
- Can it handle other work?
- Will a new machine have other advantages?
- Is it obsolete?
- Is it fit for purpose?
- Does it lack necessary features?
- Has it been made unsuitable?
Asset maintenance

- The best quality system will fail if the buildings, plant and machinery (called ‘assets’) are inadequate or poorly maintained.

- The aim of maintenance is to keep equipment and facilities in effective and safe working order.

- Objectives are to minimise interruptions to operations at minimum cost.
Maintenance

- Repair/breakdown – reactive
- Preventive maintenance – proactive
- Total Productive Maintenance (TPM)
- Equipment monitoring
- There will always be breakdowns.
5 goals of TPM

- Improve equipment effectiveness
- Achieve autonomous maintenance
- Plan maintenance
- Train all staff in relevant maintenance
- Achieve early equipment management.
Time to replace an asset

- Assuming like-for-like replacement (very unlikely)
  - calculate cost per unit of output over life of machine
  - replace when coast per unit is minimised
- More generally – consider reasons to replace and apply investment appraisal techniques (payback; DFC)
Asset replacement

Why?

- Worn out
- New process required
- Different output required
- Opportunity to reduce operating costs
- Opportunity to improve quality of output
- Unsafe
Facility location

- PEST analysis to broaden perspective
- Demand side factors
  - those that encourage sales / increase revenues
- Supply side factors
  - those that reduce costs
Analysis

- A cost based analysis of possible locations is likely to give insufficient weight to the demand side factors.
- For example, a supply side analysis of a suitable location for a designer clothing outlet might put it in a retail park near the M25; a demand side analysis might put it in Bond Street.
Complexity of location decisions

Complexity of location decisions is increasing location factors to consider:

- labour/workforce
- transportation
- utilities/services
- environment
- community/social
- economic/financial.
Methods of analysis

- Factor rating
- Centre of Gravity
- Linear programming
- Simulation

… Remember the constraints imposed on an established organisation.
Factor analysis

- Scores each factor identified on a scale (say 0 -10) and then weights it by its perceived importance.
- Has the elegance of producing one ‘best’ solution from the various options.
- But the solution is only as good as the subjective judgements on which the model is based.
Centre of gravity

- Most applicable to, for example, the siteing of a distribution warehouse
- The total vehicle-miles are calculated for each possible location based on the known demand of every customer
- The site chosen is the one that minimises the vehicle-miles figure
- A useful technique, but depends on an accurate estimate of the demand pattern.
Factors in location decisions

Demand side
- Aim – To enhance revenue and reputation by improving services and convenience and reducing costs
  1. Skill and reputation of the workforce
  2. Prestige and attractiveness of the location
  3. Customer convenience.

Supply side
- Aim – To minimise operating costs while increasing speed and efficiency of delivery
  1. Labour costs
  2. Logistics factors
  3. Utility costs
  4. Environmental costs
  5. Community factors.
Operations Planning and Control (OPC)

- Planning – deciding what to do and when to do it to meet the organisation’s goals
- Control – monitoring progress towards the goals and if necessary taking corrective action to get back on track.
Stages in OPC

- Estimate demand
- Aggregate capacity planning  Master operations schedule (MOS)
- Rough-cut capacity planning (iterate)
- Detailed operations schedule (DOS)
- Short-term rescheduling. Prioritising and control.
What is planning and control?

Supply of products and services

The operation’s resources

Planning and control

The activities which reconcile supply and demand

Demand for products and services

The operation’s customers
Planning is deciding

- what activities \textbf{should} take place in the operation
- when they should take place
- what resources should be allocated to them

Control is

- understanding what is actually happening in the operation
- deciding whether there is a significant deviation from what \textbf{should} be happening
- (if there is deviation) changing resources in order to affect the operation’s activities
Significance of planning or control

Long-term Planning and Control
- Uses aggregated demand forecasts
- Determines resources and contingencies
- Objectives set in largely financial terms

Medium-term Planning and Control
- Uses partially disaggregated demand forecasts
- Determines resources and contingencies
- Objectives set in both financial and operations terms

Short-term Planning and Control
- Uses totally disaggregated forecasts or actual demand
- Makes interventions to resources to correct deviations from plans
- Ad hoc consideration of operations objectives
Planning and control needs

- Information on demand levels
- Information on resources.
Capacity

- A measure of the organisation’s ability to meet customer expectations
- Input measures – for example hospital beds available
- Output measures – for example barrels of beer per week.
Capacity strategies

- Demand is variable
- Capacity is fixed in the immediate-term
- Strategic decision required to invest in long-term internal capacity and ensure external capacity (via supply chain) is available.
Capacity management

In the short-term capacity can be expanded by:

- increasing efficiency
- working overtime
- subcontracting or outsourcing.
Capacity

Definition –
- a measure of an organisation’s ability to provide customers with the goods or services they demand in the required quantities at the required time

Dimensions of capacity –
- utilisation – proportion of capacity used
- production – volume produced
- productivity – ratio of output to input(s)
- efficiency – ratio of actual to possible

Measuring capacity –
- unit output per period (with given inputs)
Strategic capacity planning

- Capacity limits the possible rate of output (or volume over a period)
- It is important to get capacity ‘right’:
  - under-capacity can reduce potential sales and profits
  - over-capacity can increase overhead costs and reduce profits
- To avoid investing in ‘uncertain’ or unwanted capacity, companies try to flex their capacity by:
  - subcontracting
  - outsourcing
  - partnerships, joint ventures or co-ownership
  - alliances
  - mergers or vertical/horizontal integration.
## Capacity expansion and smoothing

<table>
<thead>
<tr>
<th>Utilisation</th>
<th>Production</th>
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<tbody>
<tr>
<td></td>
<td>Changing the product/service mix</td>
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<td></td>
<td>Improving design to eliminate operations</td>
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<tr>
<td></td>
<td>Enhanced automation/mechanisation</td>
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<td></td>
<td>Subcontracting and outsourcing</td>
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<td>Working overtime or additional shifts</td>
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<td>Increased preventive maintenance</td>
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<table>
<thead>
<tr>
<th>Productivity</th>
<th>Efficiency</th>
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<td>Employee incentives</td>
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<td>Improving design to eliminate operations</td>
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<td>Eliminating bottlenecks</td>
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<td>Increasing product yield</td>
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<td>Changing the product/service mix</td>
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<td></td>
<td>Increased preventive maintenance</td>
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Session 8

Forecasting
MRP and MRPII and ERP
Learning objectives

At the end of this session candidates will be able to:

- design, plan and manage an operations function and advise on the approaches for managing and controlling supply and demand within the operations network
- formulate effective resource plans and schedules that will deliver products in a cost effective manner
- explain the objectives of operations planning and control (OPC) and the actions necessary to control operations
- analyse, select and use basic techniques to forecast demand
- analyse and explain the mechanics of materials requirements planning (MRP), manufacturing resource planning (MRPII) and enterprise resource planning (ERP)
Independent demand

- Demand cannot be precisely forecast
  - for example finished goods
- Inventory control by ABC analysis/fixed reorder quantities/continuous & periodic review.
Dependent demand

- Demand can be derived from finished product numbers
  - for example components/sub-assemblies
- Inventory control by MRP/MRPII/ERP/OPT.
Forecasting demand

- Independent demand is variable and unpredictable, so it is necessary to make forecasts to guide the operations planning process.

- All forecasts are wrong.
Dependent and independent demand

- **Dependent demand**
  - e.g. input tyre store in car plant
  - Demand for tyres is governed by the number of cars planned to be made

- **Independent demand**
  - e.g. tyre fitting service
  - Demand for tyres is largely governed by random factors
Forecasting techniques

- Qualitative
  - Based on opinion or survey data
- Quantitative
  - Mathematical analysis.
Demand forecasting techniques

Forecasting Techniques

Qualitative

Use of ‘soft’ information that provides insights and information not obtainable by quantitative methods

• Expert opinion
• Market research
• Test marketing
• Delphi method
• Jury method

Quantitative

Use of ‘hard’ information that eliminates personal biases and subjectivity associated with qualitative approaches

• Time series
• Casual models

Use of ‘hard’ information that
Qualitative techniques

- **Expert opinion**
  - take judgements from experts in the field and average their views
- **Market surveys**
  - which may be primary - carried out in the field
  - Secondary - desk based research
- **Delphi method**
  - A variant of the expert opinion method
  - A panel of experts are asked for a forecast of (say) demand for a product
  - Views are then circulated and compared and until a consensus view emerges.
Quantitative techniques

- Time series
  - extrapolating historical data to generate a forecast
  - Considers: trends (for example rising over time); cyclical effects (for example related to the cyclical variations in an industry); seasonal effects; irregular elements

- Causal models
  - looking for a predictor, for example looking at the pattern of births to predict pram sales.
Push and pull operations

- Production focus – ‘push’ product through the system to the customer
- Customer focus – ‘pull’ product through the system when the customer wants it.
Pull and push philosophies of planning and control

**PUSH CONTROL**

- Central OPS. Planning and Control System
  - Instruction on what to make and where to send it
  - Work centre
  - Work centre
  - Work centre
  - Work centre
  - Forecast
  - Demand

**PULL CONTROL**

- Work centre
  - Request
  - Delivery
  - Demand
  - Request
  - Delivery
  - Request
  - Delivery
  - Request
  - Delivery
  - Request
  - Delivery
Push and pull – inventory control

Push systems
- Independent demand
- Control with re-order point or periodic review

Some push; some pull
- Dependent demand
- Control with MRP or derivatives

Pull systems
- JIT.
Inventory control

Inventory Control Systems

‘Push’ systems (independent demand)

- Continuous review (using pre-determined re-order levels)
  - FOQ
  - EOQ
- Periodic review systems

Elements of ‘push’ and ‘pull’ (dependent demand)

- MRP
- MRP II
- OPT

‘Pull’ systems (independent and dependent demand)

- JIT systems
Materials requirements planning

- Orders
- Forecasts
- Bill of materials (BOM)
- Master production schedule
- MRP software
- Inventory file
- Reports
  - Operating reports
  - Control reports
  - Inventory transactions
MRP – MRPII and how it works

MRP - Materials requirements planning looks at the materials requirements based on the MPS

Used for repetitive manufacturing with some common parts in many different products

MRPII - Manufacturing resource planning so called because it has the ability to calculate the capacity of the system; can be closed loop due to matching capacity information for work centres.
MRP – with inputs and outputs

- Forecasts
- Customer orders
- Master production schedule (MPS)
  (indicates products to produce and when they are needed)
- Inventory transactions
  (inventory status records)
- Engineering changes
- Material requirements planning
  (explodes BOM per MPS requirements, nets out inventory levels, lead times and:
  1. what to order and how many
  2. when to order
  3. what orders to expedite)
- Product structure records
  (contains bills of materials and shows how product is produced)
MRP and how it works

Central to all MRP systems is the generation of five pieces of information about every item in the BOM(*), for each period (or time bucket) within the planning horizon:

• gross requirements planned for each period
• number and timing of planned receipts
• planned orders
• planned quantity available in stock
• net requirement planned for each period

Time buckets chosen might be days, weeks or months

(*)Note the need to separate in-house and bought out items.
MRPII

Principal stages in operations planning and control

- Orders and sales
- Master scheduling
- Requirements planning
- Inventory control
- Purchasing management
- Scheduling
- Monitoring and control
- Bill of materials
- Capacity management
- Routings
- Maintenance management
- Cost accounting
- Monitoring and control
Data integrity

The strength of MRP systems depends on the perceived reliability of the information they produce. High reliability can be achieved only if care is taken to ensure accuracy and continuing integrity of input data.

Need to have regular physical stock counts and information audit checks.

Data needs to be available in real time if MRP is run on a daily basis.
Advantages of MRP

- Reduced stock levels
- Higher stock turnover
- Better customer service
- More reliable and faster quoted delivery times
- Improved utilisation
- Less time spent on expediting.
Problems of MRP

- Implementation can take years
- Off the shelf packages can be used but bespoke has its own problems (SAP)
- Data entry and maintenance can take a long time
- Reports can be difficult to generate on some systems
- Data integrity is essential from all areas of the business. There needs to be a real focus on forecasting in order to manage the MPS
- Can alienate people – lose sense of control.
MRP II

The extension of a computerised MRP to create an integrated-decision support system linking:

- production planning and control
- engineering
- purchasing
- marketing
- accounting
- human resources management

Key interface point: Master Production Schedule.
MRP II advantages

- Coordinates efforts of multiple departments to the achievement of a common plan
- ‘What if’ analysis of potential decisions
- Improved utilisation of other resources
- Flexibility to cope with changes
- Resources can be expressed in money terms for budgeting and control.
ERP - Enterprise Resource Planning

ERP is a significant development from MRP. It is a fully integrated business system that covers

- MRPII
- Sales and marketing
- Finance
- HR
- CRM
- Installation
- Logistics.
Enterprise resource planning

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>▪ Information is entered only once</td>
<td>▪ Implementation is lengthy and expensive</td>
</tr>
<tr>
<td>▪ Faster inventory turnover</td>
<td>▪ Maintenance costs are high</td>
</tr>
<tr>
<td>▪ Improved customer service</td>
<td>▪ Any data errors are replicated throughout system</td>
</tr>
<tr>
<td>▪ Reduced set-up times</td>
<td>▪ Depends on complete trust between organisations and free flow of information.</td>
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<tr>
<td>▪ Coordination throughout supply chain</td>
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<tr>
<td>▪ Focus on best practice</td>
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<tr>
<td>▪ Higher quality with fewer reworks</td>
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<tr>
<td>▪ Improved revenue collection and cash flow.</td>
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</table>
Enterprise Resource Planning (ERP)

- ERP is the logical extension of MRP II throughout the organisation and out into the supply chain
- It provides real-time information and provides analytical functionality.
Session 9

Project Management and TQM
Learning objectives

At the end of this session candidates will be able to:

- design, plan and manage an operations function and advise on the optimum layout for specific types of product and process work flows with specific focus on projects and project management
- appraise effective methods of developing a continuous improvement culture within an operations management environment
- identify and analyse the key roles and objectives of project management
- distinguish the key roles and objectives of project management
- explain the use of project management techniques
- explain the cultural change required to implement Total Quality Management (TQM)
Project

A unique set of co-ordinated activities, with definite starting and finishing points, undertaken by an individual or organisation to meet specific objectives within defined time, cost and performance parameters.
Some types of project

- Designing and constructing a new building
- Setting-up a new manufacturing facility
- Designing and implementing new business processes
- Undertaking the research and development for a new product.
Project life cycle

- Conception/definition
- Planning, resourcing and scheduling
- Implementation
- Termination and hand-over
- Review.
Project management

- Planning, monitoring and control of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance.

OR

- The controlled implementation of defined change.
The project management triangle
Project control

- Developing targets and plans
- Measuring actual performance
- Comparing it against planned performance
- Analysing the differences
- Taking effective action to correct the situation.
Control charts

Gantt charts
  - Bar chart showing when tasks are planned to take place

Network analysis
  - Break down project into tasks and arrange into a logical sequence
  - The critical path determines the minimum duration of the project.
Post-implementation review

Assess if objectives have been met:

- cost
- time
- quality

Assess the process – what would we do differently next time?
Project management

- ‘Project’ – A one-off job which consists of a number of tasks

- Characteristics of projects
  - Unique – each is different in some way
  - Uncertain – risk arises from complexity and uncertainty of work involved
  - Impermanence – project will end

- Types of projects:
  - Civil engineering – for example Wembley stadium
  - Manufacturing projects – for example Queen Mary 2
  - R&D projects – for example a new pharmaceutical drug
  - Management projects – for example installing a new MIS.
The project life cycle

1. Conception/definition
   - Business case made and objectives set
2. Planning, resourcing and scheduling
   - Activities identified using work breakdown structure
   - Activities planned and scheduled (network/Gantt)
   - Resource requirements identified
   - Detailed schedules and budgets prepared
3. Implementation
   - Project activities undertaken
   - Project managed through matrix structure
   - Progress measured against milestones
4. Termination and handover
   - Project and supporting documentation completed
5. Operations and maintenance
   - Ongoing support to the deliverable(s).
Networks and critical path analysis

CPM and PERT calculate –
- Total time required
- Start and finish times for each activity
- The ‘critical path’
- Slack available in non-critical activities

To reduce the time to complete an activity by adding resources (‘crashing’) –
- Identify activities that may be ‘crashed’
- For each activity, establish cost
- Estimate activity duration with resources added
- Determine revised completion date and cost
- Recalculate critical path and costs
- Compare various options to determine most effective solution.
Juran’s TQM definition

The set of management processes and systems that create delighted customers through empowered employees leading to higher revenue and lower cost.
Total Quality Management (TQM)

- ‘TQM is a way of managing an organisation so that every job, every process, is carried out right first time and every time’ (DTI)
- ‘Attention is paid to systems, procedures & processes rather than the focus being on the goods or services being supplied ’ (Bailey & Farmer)

......... a philosophy which underpins ISO 9000:2000
Pre-requisites for TQM

- Competitive advantage could be achieved through ensuring customers were delighted by high quality and reliability
- TQM is a philosophical approach to delighting customers
- It needs to be embodied in the culture, mission and objectives of all staff from the top down
- Anything less and an attempt to apply TQM is doomed to failure.
Overview of TQM

‘TQM’ –
- A philosophy that has far wider implications than just products and services. TQM enables an organisation to manage its processes and people to ensure complete customer satisfaction.

Perspectives on TQM –
- TQM as an approach, philosophy or attitude
- TQM as an end product
- TQM as a system
- TQM as what it is about.
Development of TQM

- The early Americans – post-1945
  - Deming – PDCA cycle, 14 points for management, 7 deadly diseases of management, 7 point action plan
  - Juran – categories for quality, quality planning map, formula for results
  - Feigenbaum – quality ethic (10 benchmarks of quality), total quality control, classification of quality cost
- The Japanese – 1960s →
  - Ishikawa – fishbone diagram, 6 steps version of PDCA
  - Taguchi – quality loss function, concept of robust design
  - Shingo – ‘poka-yoke’ (mistake proofing)
- The new wave of ‘gurus’ – 1980s →
  - Peters – MBWA, 12 traits of success in quality improvement
  - Crosby – 5 absolutes of quality, 14 step process
  - Moller – focus on administrative processes and the individual (productivity, relationships and quality)
Corporate strategy
(Johnson & Scholes)

Concerned with the overall purpose and scope of the organisation to meet the expectations of major stakeholders and add value to the different parts of the enterprise.
Vision

An image of the future

- Products and services to be delivered
- How the enterprise will operate
- What the values will be.
Mission

‘Describes the organisations basic function in society, in terms of the products and services it produces for its clients’ (Mintzberg)

Four elements:

- purpose
- strategy
- policies and performance standards
- Values.
Mission statement

- A formal declaration of underlying purpose. It says what an organisation exists to do
- Should be brief, flexible and distinctive.
Mission and vision

- Must be developed in the context within which the organisation exists
- In particular, consideration must be given to:
  - the cultural context
  - the political context.
Cultural context
- internally and externally

- Culture in society is set by, for example, people’s attitudes, beliefs, practices, customs, values, art and amusements.
- Organisational culture may be defined as the sum of beliefs, attitudes, practices and customs held by people in the organisation – ‘it’s the way we do things around here’. 
Components of culture

- Underlying assumptions about how we operate
- Overt beliefs about what we are
- Visible artefacts – office style; dress code; and so on.
Stakeholders

- Internal – for example, staff and managers
- Connected – for example, shareholders, customers, suppliers and financiers
- External – for example, community, government and pressure groups.
Stakeholder conflict

The goals of the various stakeholders may be different, one key area of potential conflict being between managers and shareholders.
## Assessment model
(Hayes & Wheelwright)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Internal neutrality</td>
<td>1. Avoid mistakes</td>
</tr>
<tr>
<td>2. External neutrality</td>
<td>2. Benchmark</td>
</tr>
<tr>
<td>3. Internally supportive</td>
<td>3. Creative reaction to business strategy</td>
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</tbody>
</table>
Pros and cons of TQM

Benefits
- Improved customer satisfaction
- Enhanced quality of goods and services
- Reduced waste and inventory (↓ costs)
- Improved productivity
- Reduced product development time
- Increased flexibility in meeting market demands
- Reduced WIP
- Improved customer service and delivery times
- Better utilisation of human resources.

Limitations
- Potential for a strong internal focus and disregarding the market
- Raises customer expectations
- Incumbent bureaucracy of councils and documentation
- Delegates determination for quality to ‘experts’
- Its call for cultural transformation creates a cult that only total commitment can save the organisation.
Session 10

The philosophy of JIT
Approaches to continuous improvement
Learning objectives

At the end of this session candidates will be able to:

- propose philosophies, tools and techniques for continuous improvement and be able to apply these approaches within an operations function in order to improve the overall competitiveness of the business.

- examine and evaluate the philosophy of just in time (JIT) and continuous improvement in the context of lean manufacturing.

- analyse and explain the different approaches to continuous improvement.
Just in Time (JIT)

- ‘JIT aims to meet demand instantaneously, with perfect quality and no waste’ (Bicheno)
- Reduce non-value adding activities:
  - achieve zero defects
  - eliminate inventory
  - minimise set-up times
  - smooth product mix.
The meaning of just-in-time

Traditional approach
- Focus on high capacity utilisation
- More stoppages because of problems
- More production at each stage
- Extra production goes into inventory because of continuing stoppages at earlier stages

JIT approach
- Focus on producing only when needed
- Fewer stoppages
- Lower capacity utilization, but
- No surplus production goes into inventory
- Low inventory so problems are exposed and solved

High inventory reduces the chance of the problems being exposed and solved

Extra production goes into inventory because of continuing stoppages at earlier stages
The JIT philosophy

JIT as a philosophy

• Eliminate waste
• Involve everyone
• Continuous improvement
Techniques associated with JIT

JIT as a philosophy
- Eliminate waste
- Involve everyone
- Continuous improvement

JIT as a set of techniques for managing operations
- Basic working practices
- Design for manufacture
- Operational focus
- Small simple machines
- Layout and flow
- TPM
- Set-up reduction
- Total people involvement
- Visibility
- JIT supply
JIT planning and control

JIT as a philosophy
- Eliminate waste
- Involve everyone
- Continuous improvement

JIT as a set of techniques for managing operations
- Basic working practices
- Design for manufacture
- Operational focus
- Small simple machines
- Layout and flow
- TPM
- Set-up reduction
- Total people involvement
- Visibility
- JIT supply

JIT as a method of planning and control
- Pull scheduling
- Kanban control
- Levelled scheduling
- Mixed modelling
- Synchronization
JIT and MRP together

- JIT concepts can co-exist with MRP but the techniques have different objectives
- MRP/ERP II aim to coordinate ordering, scheduling and inventory to meet production demands
- JIT aims to reduce inventory
Lean operations

- A system of work organisation that strives to deliver high quality, low cost products through the efficient use of resources and the elimination of waste
- Elements
  - Eliminate waste
  - Continuous production
  - Continuous improvement.
Eliminate waste (muda)

- Any activity that does not add value
- Type 1 – unavoidable with current technology
- Type 2 – avoidable, for example waiting time; double handling.
Seven sins of muda (Waste)

1. Overproduction
2. Waiting
3. Transportation
4. Inappropriate processing
5. Excess inventory
6. Unnecessary motion
7. Defects
8. Unused knowledge of employees!!
Why go lean?

- Reduce costs
- Improve quality

But

- Not the answer to the world, the universe and everything
- Best suited to the steady state.
World class performance

What it takes to be a world beater:
- reduce operational cost
- increase visibility to business performance
- reduce time-to-market
- satisfy customer expectations
- streamline outsourcing processes
- manage multiple locations and global operations.
Introduction to Just-in-time

- ‘Making what the customer needs, when it is needed and in the quantity needed using minimum resources of people, materials and machinery’
- Distinction:
  - ‘Big JIT’ (lean production) – focus on all sources of waste
  - ‘Little JIT’ (JIT production) – focus on scheduling goods inventories and providing services resources where needed
- Objectives of JIT:
  - zero defects
  - zero set-up time
  - zero inventories
  - zero handling
  - zero lead time
  - lot size of one.
## JIT and MRP

<table>
<thead>
<tr>
<th>System characteristics</th>
<th>JIT</th>
<th>MRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>‘Pull’</td>
<td>‘Push’</td>
</tr>
<tr>
<td>Focus</td>
<td>Quality</td>
<td>Bottlenecks</td>
</tr>
<tr>
<td>Rates of output</td>
<td>Level schedule</td>
<td>Variable production plan</td>
</tr>
<tr>
<td>Work authorisation</td>
<td>Kanban</td>
<td>MPS</td>
</tr>
<tr>
<td>Inventory status</td>
<td>Reducing to zero</td>
<td>The less the better</td>
</tr>
<tr>
<td>Admin personnel</td>
<td>Fewer</td>
<td>More</td>
</tr>
<tr>
<td>Forms of control</td>
<td>Shop floor, visual, workers</td>
<td>Supervisors, reports</td>
</tr>
<tr>
<td>Capacity adjustment</td>
<td>Visual, immediate</td>
<td>Capital planning</td>
</tr>
<tr>
<td>Scheduling</td>
<td>Kanban says ‘market now’</td>
<td>MRP says, ‘Which job next?’</td>
</tr>
</tbody>
</table>
Advantages and disadvantages of JIT

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in stocks</td>
<td>Without safety stocks, organisations vulnerable</td>
</tr>
<tr>
<td>Enhanced product quality; reduced scrap and rework</td>
<td>Less suitable for ‘batch’; more suitable for ‘flow’</td>
</tr>
<tr>
<td>Shorter manufacturing lead times</td>
<td>Faulty forecast and slow supplier response can reduce JITs effectiveness</td>
</tr>
<tr>
<td>Greater flexibility in changing production mix</td>
<td>Long-term commitment to a single supplier required</td>
</tr>
<tr>
<td>Smoother production flow</td>
<td>Considerable time and cost of conversion to JIT</td>
</tr>
<tr>
<td>Potential for integrating with MRP</td>
<td>Small lot sizes can result in increased transport costs and traffic congestion.</td>
</tr>
<tr>
<td>Greater workforce participation</td>
<td></td>
</tr>
<tr>
<td>Higher productivity</td>
<td></td>
</tr>
<tr>
<td>Reduced space relationships</td>
<td></td>
</tr>
<tr>
<td>Improved relationships with suppliers.</td>
<td></td>
</tr>
</tbody>
</table>
Approaches to continuous improvement

- Process or value stream mapping
- FMEA
- The PDCA cycle
- Inventory management methods
Process mapping

Process mapping is the mapping of different activities in the production of goods and services in order to identify those that do and don’t add value.

Timing the different activities and having an indication of the actual throughout time.

Based on this information eliminating or reducing throughout time

See Slack: Operations Management.
Value stream mapping

The value stream map helps identify every process within the value stream, pulls them out from the background clutter of the organization, and identifies the steps needed to build a lean value stream. VSM is a tool that should be used every time major changes are planned within a value stream. The road to a lean value stream includes lasting, systemic improvements that not only remove waste, but also remove the sources of the waste so that they never come back.
FMEA- Failure Mode and Effect Analysis

Is a controlled system for predicting what may go wrong. It takes into account the design, manufacture and working life of parts and processes and tries to envisage every potential failure. It asks three questions:

- what might go wrong?
- what effect would it have?
- what might cause it to go wrong?
The PDCA cycle

- Plan
- Do
- Check
- Act
Inventory management methods

- Kanban
- Consignment stocks
- VMI vendor managed inventory
- JIT.