MEASI
Institute *of* Management

OPERATIONS MANAGEMENT COURSE MATERIAL-434C2D

VISION & MISSION STATEMENT

Vision: To be an oasis of knowledge to the seeker, to nurture one's creativity and research acumen, and to instil a unique blend of leadership, innovative spirit, and empathy in response to the ever-evolving business ecosystem.

Mission:

- Provide a pedagogy that blends academic rigor and experiential learning.
- Inculcate an entrepreneurial mindset through curated activities.
- Establish a conducive environment for research.
- Foster a culture of innovation and collaboration to progress in a dynamic business landscape.
- Promote humanistic values to produce socially responsible leaders.

Program Educational Objectives (PEOs)

PEO 1 – Employability:

To develop students with industry-specific knowledge & skills to meet the industry requirements, and also join a public sector undertaking through competitive examinations.

PEO 2 – Entrepreneur:

To create effective business service owners with a growth mindset by enhancing their critical thinking, problem-solving, and decision-making skills

PEO3 – Research and Development:

To instil and grow a mindset that focuses efforts towards inculcating and encouraging the students in the field of research and development

PEO 4 – Contribution to Business World

To produce ethical and innovative business professionals to enhance the growth of the business world

PEO 5 – Contribution to the Society:

To work and contribute towards the holistic development of society by producing competent MBA professionals

Program Outcomes

PO1:Problem Solving Skill

Application of tools & techniques relevant to management theories and practices in analysing & solving business problems

PO2: Decision-Making Skill

Fostering analytical and critical thinking abilities for data-based decision making

PO3: Ethical Value

Ability to develop value-based leadership attributes

PO4: Communication Skill

Ability to understand, analyse, and effectively communicate global, economic, legal, and ethical aspects of business

PO5: Individual and Team Leadership Skill

Ability to be self-motivated in leading & driving a team towards the achievement of organizational goals and contributing effectively to establish industrial harmony

PO6: Employability Skill

Foster and enhance employability skills through relevant industry subject knowledge

PO7: Entrepreneurial Skill

Equipped with skills and competencies to become a global entrepreneur

PO8: Contribution to Society

Strive towards becoming a global influencer and motivating future generations towards building a legacy that contributes to the overall growth of humankind

COURSE OBJECTIVES

- C1: To understand the challenges involved in production design & capacity planning and provide insights on make or buy decisions
- C2: To determine multiple plant location decisions and effective utilization of plant layout
- C3: To explain the models, concepts and techniques adopted in the areas of inventory control and maintenance

- C4: To elucidate the importance of work study and quality control tools
- C5: To provide insights on service operations management and waiting line analysis

SYLLABUS

UNIT I - INTRODUCTION (12 Hours)

Operations Management - Nature, Scope, Historical Development, Functions - Long term Vs Short term issues - A Systems Perspective - Challenges - Manufacturing Trends in India - Production Design and Process Planning - Types of Production Processes - Plant Capacity - Capacity Planning - Make or Buy Decisions - Use of Crossover Chart for Selection Processes - Types of Charts used in Operations Management

UNIT II - FACILITY DESIGN (12 Hours)

Plant Location: Factors to be considered in Plant Location - Location Analysis Techniques - Choice of General Region, Particular community and Site - Multiple Plant Location Decision - Plant Location Trends

Layout of Manufacturing Facilities: Principles of a Good Layout - Layout Factors - Basic Types of Layout - Principles of Materials Handling - Materials Handling Equipment's - Role of Ergonomics in Job Design

UNIT III - INVENTORY CONTROL AND MAINTENANCE (12 Hours)

Basic Inventory Models - Economic Order Quantity - Economic Batch Quantity - Reorder Point - Safety Stock - Inventory Costs - Classification and Codification of Stock - ABC Classification - Materials Requirement Planning (MRP) - JIT - Implications of Supply Chain Management

Maintenance: Preventive Vs Breakdown Maintenance - Group Replacement Vs Individual Replacement - Breakdown Time Distribution - Maintenance of Cost Balance - Procedure for Maintenance

UNIT IV - DESIGN OF WORK SYSTEMS AND QUALITY CONTROL (12 Hours)

Work Study - Objectives - Procedure - Method Study and Motion Study - Work Measurement - Time Study - Performance Rating - Allowance Factors - Standard Time - Work Sampling Techniques - Job Sequencing and Scheduling

Quality Control: Purpose of Inspection and Quality Control - Different Types of Inspection - Acceptance Sampling - The Operating Characteristic Curve - Control Charts for Variables and Attributes

UNIT V - SERVICE OPERATIONS MANAGEMENT (12 Hours)

Introduction to Services Management - Nature of Services - Types of Services - Service Encounter - Designing Service Organizations - Service Facility Location and Layout - Service Blueprinting - Waiting Line Analysis for Service Improvement - Service Processes and Service Delivery

Total Hours: 60

REFERENCE BOOKS

1. Chary, S.N., Production and Operations Management, 5th Edition, Tata McGraw-Hill, 2012
2. Gore, A. and Panizzolo, R., Operations Management, Cengage Learning India, 2012
3. Heizer, J., Render, B. and Rajashekhar, J., Operations Management, 9th Edition, Pearson, 2009
4. Krajewski, L., Operations Management; Processes and Supply Chains, 9th Edition, Pearson, 2011
5. Metters, R., King-Metters, K.H., Pullman, M. and Walton, S., Successful Service Operations Management, Cengage Learning, 2nd Edition 2012
6. Panneerselvam. R, Production and Operations Management, 3rd Edition, PHI Learning, 2012

E-SOURCES

1. lib.mdp.ac.id/ebook/.../Karya%20Umum-Operations%20Management.pdf
2. www.shsu.edu/~mgt_ves/mgt560/ServiceManagement.ppt
3. dl4a.org/uploads/pdf/Ebook%20for%20production%20and%20operations%20management.pdf
4. https://www.mheducation.co.uk/he/chapters/9780077133016.pdf
5. zums.ac.ir/files/research/site/ebooks/strategy/operations-strategy.pdf

ADDITIONAL REFERENCE BOOKS

1. William J Stevenson, Operations Management, Tata McGraw Hill, 12th Edition, 2015
2. Russel and Taylor, Operations Management, Wiley, 9th Edition, 2016
3. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008
4. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007

COURSE OUTCOMES

On completion of this course successfully, the students will:

- C205.1: Be aware on the concepts of production design, capacity planning and make or buy decisions (PO2, PO4)
- C205.2: Possess knowledge on plant location decisions and utilization of plant layout (PO2, PO7)
- C205.3: Have better understanding on Inventory models and maintenance techniques (PO6, PO7)
- C205.4: Be aware about work study procedures and the importance on quality control tools (PO1, PO2, PO6, PO7)
- C205.5: Have insight on service operations, service delivery and waiting line analysis (PO6, PO7)

UNIT I - INTRODUCTION

OPERATIONS

Operations are often defined as a transformation or conversion process wherein inputs such as materials, machines, labour and capital are transformed into outputs (goods and services). Operations are useful actions or activities which are done methodically as part of plan of work by a process that is designed to achieve the pre-decided objectives.

OPERATIONS MANAGEMENT

Operations Management refers to a set of activities that creates value in the form of goods and/or services by transforming inputs into outputs. Operations management designs and operates productive systems or operating systems such as banks, hospitals, hotels, government agencies and manufacturing plants. Operations management includes activities such as organising work, selecting processes, arranging layouts, locating facilities, designing jobs, measuring performance, controlling quality, scheduling work, managing inventory and planning production.

Basic Operations Management Model

INPUT (Land, Material, Labour & Capital) → **PROCESS** (Conversion Process) → **OUTPUT** (Goods & Services)

↑ CONTROL ↓

← FEEDBACK ←

DIFFERENCE BETWEEN GOODS AND SERVICES

1. Services are usually intangible whereas goods are tangible (i.e., can be touched and seen)
2. Services are often produced and consumed simultaneously; services cannot be stored whereas goods can be produced and inventoried before consumption or use
3. Services are often unique, for example insurance policies, medical treatment procedures, haircut styles, etc.
4. Services have high customer interaction; services are often difficult to standardize and automate because customer interaction demands uniqueness. The service product may have to be customized in most of the service offerings
5. Services are often knowledge based, for example educational, healthcare, legal and consultancy services and, therefore, difficult to standardize and automate
6. Services are frequently dispersed because services may have to be delivered to the client/customer at his/her place or office, a retail outlet or even at the residence of the customer/client
7. Goods can be inventoried and can be resold whereas reselling of services is unusual and services cannot be inventoried

8. Some aspects of quality of goods are measurable whereas many aspects of quantity of services are difficult to measure
9. Selling and production are distinct in case of goods whereas in case of services selling is often a part of the service
10. Goods can be transported whereas service cannot be transported but the service provider can be transported
11. Location of facility to manufacture goods affects costs whereas location of service facility affects customer contact
12. Manufacturing of goods can be easily automated whereas service is often difficult to automate

DISTINCTION BETWEEN PRODUCTION MANAGEMENT AND OPERATIONS MANAGEMENT

Production Management refers to the application of management principles to the production function in a productive system such as a factory or a manufacturing plant (e.g., steel plant, cement plant, etc.). It involves application of planning, organizing, directing and controlling the production processes employed for the conversion of inputs into outputs in a productive system.

Operations Management refers to a set of activities that creates value in the form of goods and/or services by transforming inputs into outputs. Operations management designs and operates productive systems or operating systems such as banks, hospitals, hotels, government agencies and manufacturing plants.

Two Main Differences:

1. The term "production management" is mainly used for a productive system where tangible goods are produced; whereas the term "operations management" is more frequently used where various inputs are transformed into intangible services
2. Operations management is the more recent term used to activities involved in the process of transforming inputs into outputs (goods and/or services) in a productive system, whereas the term "production management" (or manufacturing management) was used earlier to refer to activities related to the process of transforming inputs into outputs (mainly tangible goods)

NATURE AND SCOPE OF OPERATIONS MANAGEMENT

The scope of operations management is very vast and covers the following activities:

- Selection of location
- Forecasting
- Capacity planning
- Scheduling
- Managing inventories
- Assuring quality
- Motivating employees
- Deciding where to locate facilities
- Design of work system
- Operations planning and control
- Resource requirement planning
- Capacity requirement planning
- Project management
- Quality management

HISTORICAL DEVELOPMENT OF OPERATIONS MANAGEMENT

The production of goods for sale and the modern factory system had their roots in the Industrial Revolution (which began in the 1770's in England and spread to other countries in Europe and later to the US in 19th century). However, the substitution of machine power to human power started with the most significant invention of steam engine by James Watt in 1764, followed by invention of spinning jenny (1770) and powerloom (1785).

Key Contributors:

Adam Smith (1776) - Advocated the concept of "division of labour" in his book "The Wealth of Nations"

Charles Babbage (1832) - Recommended the use of scientific methods for analysing production problems

F.W. Taylor (1878-1911) - Studied work methods in great detail to identify the best methods for doing each job. His book "The Principles of Scientific Management" (1911) laid the foundation for the field of production management

Frank and Lillian Gilbreth (1911) - Developed the "Principles of motion economy" and the concept of "Therbligs"

Henry Gantt (1912) - Recognized the value of non-monetary rewards to motivate workers and developed "Gantt chart" for scheduling

Harrington Emerson - Applied Taylor's ideas to develop organisational structure and encouraged the use of experts to improve organisational efficiency

Henry Ford (1913) - Developed the concept of mass production and assembly lines with conveyors in his automobile plant. Also used concepts of "interchangeable parts" and division of labour

F.W. Harris (1915) - Developed the concept of "Economic Order Quantity" for inventory control systems

Dodge, Romig and W. Shewhart (1924-1931) - Developed concepts of sampling inspection, statistical quality control and control charts

Elton Mayo (1930s) - Started the "human relations movement" through his famous Hawthorne experiments

Abraham Maslow (1940s) - Developed "Hierarchy of Needs Theory"

Frederick Herzberg (1950s) - Refined Maslow's theory as "Motivation-Hygiene" theory

Douglas McGregor (1960) - Added "Theory X" and "Theory Y"

William Ouchi (1970) - Added "Theory Z" combining Japanese and Western approaches

Post World War II - Operations research and quantitative techniques were applied to production management

1980s onwards - Widespread use of personal computers, MIS, DSS, CAD, CAM, CNC machines, Robots, CIM, FMS in production management

Japanese Management Practices - Emphasis on TQM, continuous improvement (Kaizen), worker teams, empowerment, and Just-In-Time (JIT) production system

OBJECTIVES OF OPERATIONS MANAGEMENT

1. Maximum customer satisfaction through quality, reliability, cost and delivery time
2. Minimum scrap/rework resulting in better product quality
3. Minimum possible inventory levels (i.e., optimum inventory levels)
4. Maximum utilization of all kinds of resources needed
5. Minimum cash outflow
6. Maximum employee satisfaction
7. Maximum possible production (i.e., outputs)
8. Higher operating efficiency
9. Minimum production cycle time
10. Maximum possible profit or return on investment
11. Concern for protection of environment
12. Maximum possible productivity

FUNCTIONS OF OPERATIONS MANAGEMENT

Operations Management is a branch that deals with managing operations and processes within the organisation. Operation managers are required to perform various functions as a part of their job responsibilities:

Key Functions:

1. Managing Finance Finance plays a chief role in operations management. It is essential to ensure that the organization's finance has been utilized properly to carry out major functions such as the creation of goods or services so that the customer's needs could be satisfied.

2. Operation This function is mainly concerned with planning, organizing, directing and controlling all the activities of an organisation which helps in converting the raw materials and human efforts into valuable goods and services for satisfying customer needs.

3. Strategy Strategy in operation management refers to planning tactics that could help them to optimize the resources and have a competitive edge over others. Business strategies imply to supply chain configuration, sales, capacity to hold money, optimum utilization of human resources and many more.

4. Design of the Product Incorporating innovative technologies play a crucial role in the selling of a product. The operation managers focus on producing top-notch quality products.

5. Forecasting Forecasting refers to the process of making an estimation regarding certain events that might occur in the future. In operation management, forecasting refers to the estimation of customer's demand so that production can be done accordingly.

6. Supply Chain Configuration The main motive of Supply Chain Configuration is to ensure effective management, monitoring and controlling of all the main activities that are held in a firm.

7. Managing the Quality Quality management plays an imperative role in selling a product. The operation manager allocate the task of quality management to a team and then supervise their task.

ISSUES RELATED TO DECISIONS

The problems involved in production management require two major types of decisions relating to:

1. Design of the production system
2. Operation and control of the production system

Decisions related to the design of production system are **long-run decisions** whereas, decisions related to operations and control of the production system are **short-run decisions**.

LONG-RUN DECISIONS

Long-run decisions related to the design of the production system are:

1. **Selection and Design of Products:** Product selections and designs with productive capability are interdependent
2. **Selection of Equipment and Processes:** Selection of the most economic equipment and processes among the various alternatives
3. **Production Design of Parts Processed:** Production design aims at selection of equipment, processes, and tools for economic production
4. **Job Design:** Involves basic organisation of work as well as matching workers to their jobs

5. **Location of the System:** A trade-off decision since there is no one best location for a productive system
6. **Facility Layout:** Decisions related to design capacity, basic modes of production, shifts of working, use of overtime and subcontracting

SHORT-RUN DECISIONS

Short-run decisions related to the operations and control of the system are:

1. **Inventory and Production Control:** Allocation of productive capacity consistent with demand and inventory policy
2. **Maintenance and Reliability of the System:** Decisions regarding maintenance effort, maintenance policy and practice
3. **Quality Control:** Setting permissible levels of risk and balancing inspection costs with probable losses
4. **Labour Control:** Work measurement and wage incentive systems to control labour costs
5. **Cost Control and Improvement:** Day-to-day decisions involving the balance of labour, material and overhead costs

A SYSTEMS PERSPECTIVE - OPERATIONS MANAGEMENT

Systems Approach To Operations Management

An organized enterprise does not exist in a vacuum. Rather, it is dependent on its external environment; it is a part of larger systems such as the industry to which it belongs, the economic system, and society. Thus, the enterprise receives inputs, transforms them, and exports the outputs to the environment.

Key Components:

1. Inputs and Claimants The inputs from the external environment may include people, capital, managerial skills, technical knowledge and skills. Various groups make demands on the enterprise:

- Employees want higher pay, more benefits, job security
- Consumers demand safe and reliable products at reasonable prices
- Suppliers want assurance that their products will be bought
- Stockholders want high return and security
- Government depends on taxes and compliance with laws

- Community demands good citizenship, jobs, minimum pollution

2. The Managerial Transformation Process It is the task of managers to transform the inputs, in an effective and efficient manner, into outputs. The managerial functions of planning, organizing, staffing, leading, and controlling provide a framework for organizing managerial knowledge.

3. The Communication System Communication is essential to all phases of the managerial process for two reasons:

- It integrates the managerial functions
- It links the enterprise with its external environment

4. External Variables Effective managers will regularly scan the external environment. While managers may have little or no power to change the external environment, they have no alternative but to respond to it.

5. Outputs Outputs usually include products, services, profits, satisfaction, and integration of the goals of various claimants to the enterprise.

CHALLENGES IN OPERATIONS MANAGEMENT

The key challenges facing service operations managers are:

1. Managing Multiple Customers Many service organizations serve heterogeneous groups of customers in different ways. Understanding customer needs, developing relationships, and managing various customers are key tasks.

2. Understanding the Service Concepts There may be differing views about what service an organisation is selling and/or the customer is buying. Articulating and communicating the service concept is critical.

3. Managing the Outcome and Experience For many services, there is no clear boundary between experience and the outcome. The intangible nature of the experience provides particular problems for both specification and control.

4. Managing the Real Time Many services happen in real time. They cannot be delayed or put-off. During a service encounter, it is not possible to undo what is done.

5. Knowing, Implementing and Influencing Strategy Service operations managers must understand their role, not only in implementing strategy but also in contributing to it or influencing the strategy.

6. Continually Improving Operations Service operations managers face the challenge of how to continually improve and develop their operations while managing the increased complexity resulting from change.

7. Encouraging Innovations Innovation looks for what is new rather than improving the existing service operations. This usually requires elements of financial risk and personal risk for service managers.

8. Managing Short Term and Long Term Issues Simultaneously Organizations are under pressure to perform in the short term which leaves little time for medium term operational improvement or long term strategic planning.

RECENT TRENDS IN OPERATIONS MANAGEMENT

1. **Global Market Place:** Globalisation of business has compelled many manufacturing firms to have operations in many countries
2. **Production/Operations Strategy:** More firms are recognizing the importance of production/operations strategy for overall business success
3. **Total Quality Management (TQM):** TQM approach has been adopted by many firms to achieve customer satisfaction
4. **Flexibility:** The ability to adapt quickly to changes in volume of demand, product mix, and product design (agile manufacturing)
5. **Time Reduction:** Reduction of manufacturing cycle time and speed to market provide competitive edge
6. **Technology:** Advances in technology have led to automation, computerization, information and communication technologies
7. **Worker Involvement:** Assigning responsibility for decision making to lower levels (employee involvement and empowerment)
8. **Re-engineering:** Involves drastic measures or break-through improvements to improve performance
9. **Environmental Issues:** Increasing emphasis on pollution control, waste disposal, reducing waste, recycling
10. **Corporate Downsizing (Right Sizing):** Forced on firms to improve profitability and efficiency

11. **Supply-Chain Management:** Management of supply-chain reduces costs throughout the chain
12. **Lean Production:** Use minimal amounts of resources to produce high volume of high quality goods with variety

MANUFACTURING TRENDS IN INDIA

Today many sections of the Indian manufacturing sector are extremely innovative, including the automotive sector, auto-components sector, assembly lines, IT manufacturing sector, and small components manufacturing sector.

Key Points:

- The Indian government has aimed to increase domestic manufacturing sector's share to 25% of GDP by 2022
- Growth driven by use of innovative technology and greater willingness to spend on R&D
- India's expenditure in science has increased three-fold over the past decade
- India's share of global patents has been increasing

Benefits of Increased R&D Spending

Greater spending on R&D leads to innovation visible among private Indian companies in various sectors including PPE manufacturing, truck manufacturing, and small components manufacturing.

Automation in Domestic Manufacturing

- Industrial robots are working alongside human workers in numerous assembly lines
- Use of automation in India is growing, though not as widespread as in developed economies
- Gradual increase in automation expected, which will raise living standards through increased productivity

AI and Technology Driven Innovation

The potential for AI in the manufacturing sector is immense. Technologies such as Digital Supply Chains, Big Data, Internet of Things (IoT), AI, and robotics will have significant impact on the Indian manufacturing sector.

India climbed 3 spots to the 57th position on the Global Innovation Index (GII) in 2018, indicating significant progress in innovation.

PRODUCT DESIGN

Product design is the process of deciding on the unique characteristics and features of the company's product. Process selection is the development of the process necessary to produce the designed product. Product design must support product manufacturability.

Product Design Defines:

- Appearance
- Materials
- Dimensions
- Tolerances
- Performance standards

Features of Good Product Design:

1. **Utility:** The product should provide steady performance through its life
2. **Aesthetics:** Product aesthetics is important in success of the product
3. **Producible:** Product design should enable effective production through available methods
4. **Profitability:** Product design should deliver value to customer and sustainability to organization
5. **Differentiable:** A good product design should enable product to be differentiated among competition

PRODUCT DESIGN PROCESS

The product design process typically involves three main aspects:

1. ANALYSIS

Accept Situation: Designers commit to the project and pool resources to solve the task efficiently

Analyze: Research begins. Team gathers general and specific materials including statistics, questionnaires, and articles

2. CONCEPT

Define: The key issue is defined. Conditions become objectives, and restraints become parameters for the new design

3. SYNTHESIS

Ideate: Designers brainstorm different ideas and solutions without bias or judgment

Select: Designers narrow down ideas to select few guaranteed successes and outline the plan

Implement: Prototypes are built, the plan is realized, and the product becomes an actual object

Evaluate: The product is tested and improvements are made. This is an ongoing process

FACTORS AFFECTING PRODUCT DESIGN

1. **Correct Team Selection:** Expert designers who understand technology and customer expectations
2. **Customer Involvement:** Involving customers in product design and testing provides insight
3. **Prototyping and Testing:** Essential to reduce risk before committing capital and manpower
4. **Raw Material:** Must meet quality standards and have reliable procurement system
5. **Production Method and Process Layout:** Feasibility determines future success
6. **External Factors:** Environmental and government regulations must be considered

PRODUCT DEVELOPMENT

A successful product development requires a total-company effort. The process consists of eight major steps:

1. Idea generation
2. Idea screening
3. Concept development and testing
4. Marketing Strategy Development
5. Business analysis

6. Product Development
7. Test marketing
8. Commercialization

PROCESS PLANNING

Process planning is concerned with planning the conversion or transformation processes needed to convert materials into finished products. It consists of two parts:

1. PROCESS DESIGN

Process design is concerned with the overall sequence of operations required to achieve product specifications. It specifies:

- Type of work stations to be used
- Machines and equipment necessary
- Quantities required

The sequence is determined by:

- Nature of the product
- Materials used
- Quantities being produced
- Existing physical layout

A route sheet specifies the sequence of operations by name and numbers for each component.

2. OPERATIONS DESIGN

Operations design is concerned with the design of individual manufacturing operations. It examines the man-machine relationship in the manufacturing process. It specifies:

- Work content constituting the operation
- Method of performing the work
- Man and machine time required per unit

An operation sheet specifies the steps and elements of work for each operation in proper sequence.

PRINCIPLES OF PROCESS PLANNING

1. Define outputs first, then look toward inputs needed
2. Describe and assess goals frequently to ensure appropriateness

3. Process should appear as logical flow without loops back to earlier steps
4. Any step executed needs to be documented
5. Consult people involved in the process for current information

PROCESS PLANNING ACTIVITIES

1. Selection of raw-stock
2. Determination of machining methods
3. Selection of machine tools
4. Selection of cutting tools
5. Selection or design of fixtures and jigs
6. Determination of set-up
7. Determination of machining sequences
8. Calculations of cutting conditions
9. Calculation and planning of tool paths
10. Processing the process plan

BREAK-EVEN ANALYSIS

Break-even analysis is a technique widely used in production management. It is based on categorizing production costs between:

- **Variable costs:** Costs that change when production output changes
- **Fixed costs:** Costs not directly related to volume of production

The variable and fixed costs are compared with sales revenue to determine the level at which the business makes neither profit nor loss (the "break-even point").

The Break-Even Chart

A graphical representation showing the relationship between various costs of production and volume of production. The point where neither profit nor loss is made is the "break-even point" (BEP), represented by the intersection of total cost and total revenue lines.

Break-Even Point (BEP) = Fixed Cost / Contribution per unit

Where: Contribution per unit = Selling price - Variable cost per unit

Alternatively: **BEP = Fixed cost / PV Ratio**

Where: PV Ratio = Contribution / Sales

As output increases, variable costs increase, meaning total costs (fixed + variable) also increase. At low output levels, costs exceed revenue. At BEP, total costs equal total revenue.

PRODUCTION SYSTEM

The production system of an organization is that part which produces products. It is an activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with policies communicated by management.

Characteristics of Production System:

1. Production is an organized activity with an objective
2. System transforms various inputs to useful outputs
3. Does not operate in isolation from other organization systems
4. Feedback about activities is essential to control and improve system performance

CLASSIFICATION OF PRODUCTION SYSTEM

1. INTERMITTENT PRODUCTION

Intermittent means something that starts and stops at irregular intervals. Features:

- Goods produced based on customer orders
- Small scale production
- Production flow is not continuous
- Large varieties of products of different sizes
- Design changes according to customer specifications
- Very flexible system

a. JOB SHOP PRODUCTION

Characteristics:

- Manufacturing of one or few quantity of products per customer specifications
- Low volume and high variety
- General purpose machines arranged in departments
- Unique technological requirements for each job

Advantages:

- Variety of products can be produced

- Operators become more skilled
- Full potential of operators utilized
- Opportunities for creative methods

Limitations:

- Higher cost due to frequent setups
- Higher inventory levels and costs
- Complicated production planning
- Larger space requirements

b. BATCH PRODUCTION

Defined as "a form of manufacturing in which the job passes through functional departments in lots or batches and each lot may have a different routing."

Characteristics:

- Shorter production runs
- Flexible plant and machinery
- Setup changes between batches
- Lower manufacturing lead time and cost than job order

Advantages:

- Better utilization of plant and machinery
- Promotes functional specialisation
- Lower cost per unit than job order production
- Lower investment in plant and machinery
- Flexibility to process multiple products
- Job satisfaction for operators

Limitations:

- Complex material handling
- Complex production planning and control

2. CONTINUOUS PRODUCTION

Production facilities arranged as per sequence of operations. Items flow through sequence using material handling devices like conveyors.

Characteristics:

- Dedicated plant and equipment with zero flexibility

- Fully automated material handling
- Predetermined sequence of operations
- Component materials not readily identifiable with final product
- Routine planning and scheduling

Advantages:

- Standardization of product and process
- Higher production rate with reduced cycle time
- Higher capacity utilization due to line balancing
- Automatic material handling
- Limited skills required
- Lower unit cost due to high volume

Limitations:

- No flexibility for multiple products
- Very high investment
- Limited product differentiation

a) MASS PRODUCTION

Manufacture of discrete parts or assemblies using continuous process.

Characteristics:

- Standardization of product and process
- Dedicated special purpose machines
- Large volume of products
- Shorter cycle time
- Lower in-process inventory
- Perfectly balanced production lines
- Continuous flow of materials
- Easy production planning and control
- Automatic material handling

Advantages:

- Higher production rate with reduced cycle time

- Higher capacity utilization
- Less skilled operators required
- Low process inventory
- Low manufacturing cost per unit

Limitations:

- Breakdown of one machine stops entire line
- Major changes needed for product design changes
- High investment in production facilities
- Cycle time determined by slowest operation

b) FLOW PROCESS PRODUCTION

Homogeneous products are produced continuously. This approach reduces cost and increases efficiency. Systems are highly automated with workers as monitors.

Characteristics:

- Fully automated material handling
- Very less work in process inventory
- Component materials cannot be readily identified with final product
- Production planning and scheduling can be predefined

PLANT CAPACITY

Plant Capacity is the rate of productive capability of a facility. The operating unit might be a plant, department, machine, store, or worker. Capacity can be specified in terms of inputs or outputs.

Capacity Measures:

Capability: Airlines measure capacity in Available Seat Miles (ASMs); hospitals in beds (though this doesn't consider outpatients)

Input Capacity: Machine processes 120 pounds of raw materials per hour (120 pounds/hour)

Output Capacity: Machine produces 20 units of finished goods per hour (20 units/hour)

CAPACITY PLANNING

Capacity Planning is the process of determining the production capacity needed by an organisation to meet changing demands for its products. It is central to the long-term success of an organisation.

Time Horizons:

1. Long Range Capacity Planning (>1-2 years) For productive resources that take long time to acquire or dispose of:

- Buildings
- Equipment
- Facilities
- Machinery
- Materials handling equipment
- Transportation vehicles

2. Intermediate Range Capacity Planning (6-18 months) Capacity varied by:

- Hiring or laying off labour
- Purchasing new tools and minor equipment
- Outsourcing/subcontracting

3. Short Range Planning (<1 month) Concerned with day-to-day planning:

- Daily scheduling of activities
- Machine loading
- Weekly scheduling
- Making adjustments to eliminate variance between planned and actual output
- Overtime
- Transfer of personnel
- Changing production routings

ESTIMATING THE CAPACITIES OF EXISTING FACILITIES

Types of Capacity:

Production Capacity: Maximum rate of production/output of an organisation. Must account for absenteeism, equipment breakdowns, vacations, holidays, delays, work schedules, overtime, temporary workers, outsourcing.

Design Capacity: Maximum output that can possibly be attained under ideal conditions.

Effective Capacity: Maximum possible output given product mix, scheduling difficulties, machine maintenance, quality factors, absenteeism. Usually less than design capacity.

Maximum Capacity (Peak Capacity): Maximum output facility can achieve under ideal conditions.

Measures of Capacity:

Different measures apply in different situations:

- Automobile plant: number of automobiles per unit time
- Hospital: number of patients treated per day

Capacity Utilization Rate = (Capacity used / Best operating level)

Best operating level is the volume at which average unit cost is minimum.

Efficiency = (Actual Output / Effective Capacity)

DETERMINANTS OF EFFECTIVE CAPACITY

a) Facilities Factors:

- Design (size, provision for expansion)
- Location (transportation costs, distance to market, labor supply, energy sources)

b) Product/Service Factors:

- Design
- Product or service mix
- Similar items enable higher production rates

c) Process Factors:

- Quantity capabilities
- Quality capabilities

d) Human Factors:

- Job content
- Job Design
- Training and experience
- Motivation
- Compensation
- Learning rates

- Absenteeism and labor turnover

e) Operations Factors:

- Scheduling
- Materials management
- Quality assurance
- Maintenance policies

f) External Factors:

- Product Standards
- Safety regulations
- Unions
- Pollution control standards

STEPS IN CAPACITY PLANNING

1. Assessment of Existing Capacity Capacity measured in terms of output (manufacturing) or inputs (services).

2. Forecasting Future Capacity Needs

- Short term requirements estimated by forecasting product demand at different product life cycle stages
- Long-term capacity requirements difficult to anticipate due to market and technology uncertainties
- Capacity forecast determines gap between existing and estimated capacity

3. Identifying Alternative Ways of Modifying Capacity

- When existing capacity is inadequate: expand capacity through additional shifts
- When existing capacity exceeds forecast: develop new products, sell facilities, lay off workers, get work from other firms

4. Evaluation of Alternatives Evaluate alternatives from economic, technical and other viewpoints. Use:

- Cost Benefit analysis
- Decision theory
- Queuing theory

5. Choice of Suitable Course of Action Select most appropriate alternative considering:

- Level of demand
- Cost of production
- Availability of funds
- Management policy