



Subject: Production and Operation Management
Module 01
Chapter 01
Nature and Scope of Production and Operation
Management

□ **INTRODUCTION**

- Production and Operations Management (POM) involves managing the various activities, processes, and procedures related to the conversion of numerous production related inputs into outputs.
- It is crucial for manufacturing as well as service organization to implement POM practices effectively.
- Management expects a manager to be equipped with the latest theories and practices of POM.
- A Production and Operation Manager has to decide where to locate new facilities, minimizing overall costs of Operations.
- The capacity and layout of the facility must be so planned that it can fight the local competition effectively.
- Project management skills and techniques have to be applied to facilitate the establishment of operations facilities in time and within given budget.
- In addition, many other techniques such as Material Requirement Planning-MRP, Just-in-Time- JIT, Supply Chain Management-SCM, Aggregate Planning, Work Design, Quality Management, etc. needed to be implemented in order to gain competitive advantage.



□ DEFINITIONS

○ **Production:**

Production is a transformation system where inputs are converted into outputs.

○ **Production Management:**

Step-by-step conversion of the one form of materials into another, either chemically or mechanically.

According to **H. A. Harding**,

“Production Management is concerned with those processes which converts the inputs into outputs.”

According to **E. S. Buffa**,

“Production Management deals with decision-making related to production processes so that the resulting goods is produced according to specifications and by the schedule demanded and at minimum cost”

□ OPERATIONS MANAGEMENT

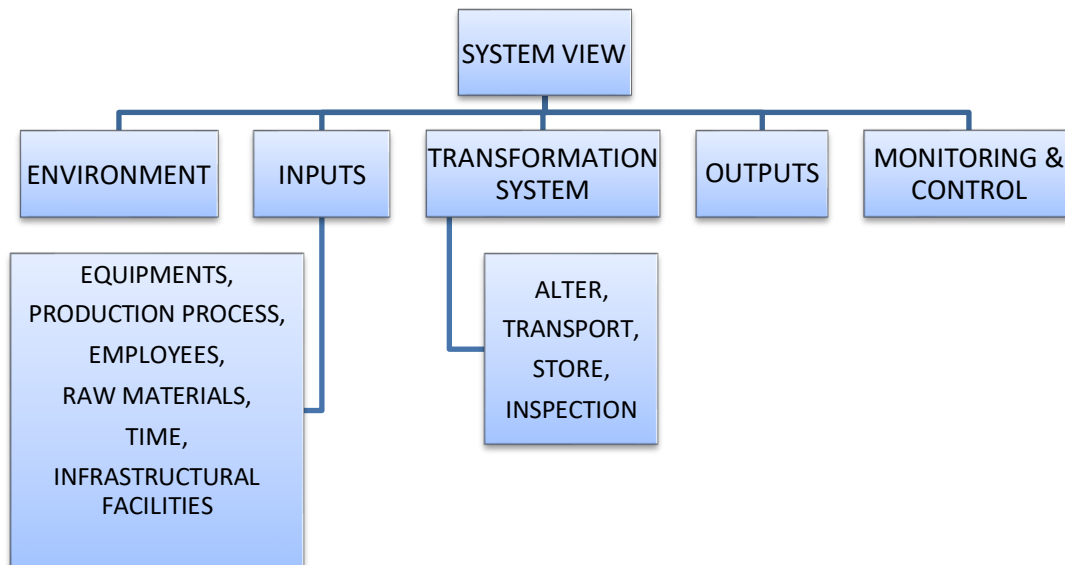
- Inclusion of services into the scope of production management is broadly known as Operations management.
- Non-manufacturing organizations providing services like hospitals, banks, transportations, warehousing are covered by OM.

□ SYSTEM VIEW OF ORGANIZATION

- A Production system can be defined in the terms of the environment, inputs, transformation system, outputs and mechanism used for monitoring and control.
- These are the sub system of production system.



- o There is interaction and interdependence among these sub systems.
- o Various components of the systems view of operation management are given below:



- o **Environment:**

Include those things that are outside the actual production system, but influence it in some way.

- o **Input:**

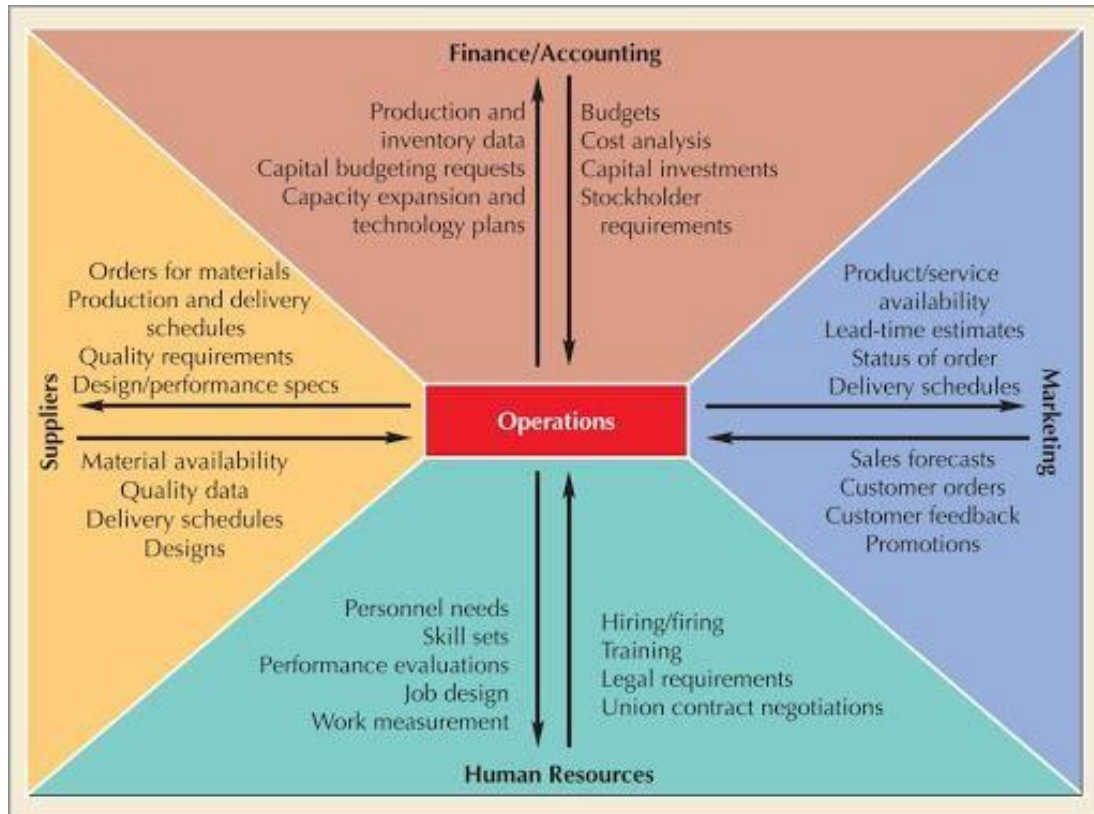
- **Equipment:** Equipment will determine the quality and cost of products.
- **Production Process:** How input will be converted into output using equipment and labor.
- **Employees:** Skill and motivation of employees will determine the quality and cost of products.
- **Time:** All these processes are and assembling take time. The lesser the time taken, the more efficient the production is.



- **Raw Material/Component:** Suppliers who are capable of supplying good quality raw materials/components and maintain an equitable relationship with them.
 - **Infrastructural Facilities:** Production processes are likely to be carried out smoothly if the production area is clean, airy and well-lit.
- **Transformation System:**
- Alter
 - Transport
 - Store
 - Inspection
- **Output:**
- At one level service is intangible offering with little no transfer of physical goods.
 - At another level service is one part of product – service mix being offered to the customer.
 - At third level the main offering is product but supplier also provides some services.
- **Monitoring and Control:**
- Apply corrective measure to alter the input/transformation process and thereby output, if deviation is found in actual than expected.



□ FUNCTION VIEW OF ORGANIZATION



- o The four primary functional areas of a firm are marketing, finance, operations, and human resources.
- o As shown in Figure, for most firms, operation is the technical core or hub of the organization, interacting with the other functional areas and suppliers to produce goods and provide services for customers.
- o For example, to obtain monetary resources for production, operations provide....
- o Finance and accounting with production and inventory data, capital budgeting requests, and capacity expansion and technology plans.



SHREE H.N.SHUKLA COLLEGE OF MANAGEMENT STUDIES, RAJKOT
AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY

Lalpari Campus,
Near Lalpari Lake,
B/H Marketing Yard,
Amargadh (Bhichri), Rajkot
Ph. No. 9727753360

3 – Vaishalinagar
Nr. Amrapali Railway Crossing
Raiya Road,
Rajkot - 360001
Ph.No–(0281)2471645

- o Finance pays workers and suppliers, performs cost analyses, approves capital investments, and communicates requirements of shareholders and financial markets.
- o Marketing provides operations with sales forecasts, customer orders, customer feedback, and information on promotions and product development.
- o Operations, in turn, provides marketing with information on product or service availability, lead-time estimates, order status, and delivery schedules.
- o For personnel needs, operations rely on human resources to recruit, train, evaluate, and compensate workers and to assist with legal issues, job design, and union activities.
- o Outside the organization operations interacts with suppliers to order materials or services, communicate production and delivery requirements, certify quality, negotiate contracts, and finalize design specifications.





□ MAIN OBJECTIVES OF THE PRODUCTION MANAGEMENT

1. **Efficiency-** increased output for a given input.
2. **Productivity-** increased production using given resources.
3. **Reduce Cost-** production is more economical (reduce cost)
4. **Quality-** good quality products at reduced cost.
5. **Reduced processing time-** increased production within a given amount of time.
6. **Utilization of resources-** Utilization of 5M (Machinery, Material, Money, Manpower, Manufacturing service)

□ SCOPE OF THE PRODUCTION MANAGEMENT

- Product Selection and Design
- Process Selection and Planning
- Facilities Location
- Facilities Layout and Material Handling
- Capacity Planning

□ HISTORICAL EVOLUTION OF OM

□ Industrial Revolution

- Began in the 1770s in England and spread to the rest of Europe and to the United States during the 19th century.
- Substituted machine power for human power.
- The revolution first took place in textile mills, grain mills, and machine making facilities.
- **Division of Labor:**
 - Around the same time, Adam Smith's Wealth of Nations (1776) proposed the division of labor, in which the production process was broken down into a series of small tasks, each performed by a different worker.
- **Interchangeable Parts:**



- The concept behind interchangeable parts lies in creating nearly identical parts that can be easily mass produced and replaced.
- These parts are then fitted together to create various products.

□ SCIENTIFIC MANAGEMENT

- It widely changed the management of factories.
- It was developed by **Frederick Winslow Taylor**, the father of Scientific Management.
- Based on observation, measurement, analysis and improvement of work methods and economic incentives.
- Studied to identify the best method for doing each job.
- **Mass Production:**
 - The high-volume production of a standardized product for a mass market.
 - Henry Ford practically adopted the scientific management principles for Taylor.
 - Introduced the moving assembly line, which affected many industries.
 - Introduced mass production to the automotive industry.
- **Quality Revolution:**
 - An emphasis on quality and the strategic role of operations.
- **Lean Production:**
 - An adaptation of mass production that prizes quality and flexibility.
 - Using the concept of Just-in-Time Japanese manufacturer changed the rules of production from mass production to lean production.
 - Lean production prizes flexibility (rather than efficiency) and quality (rather than quantity).
 - Renewed emphasis on Quality and the strategic importance of operations made companies competitive again.
 - Technology together with changing political and economic condition, has promote an era of industrial globalization.



FUTURE CHALLENGES OF OM

Service Sector

- More people work in the service sector than the manufacturing, but productivity is low in comparison to the manufacturing.
- Service facilities which are visited by customers used only for parts of the days/ weeks/ year.
- It is important that service providers make concerned efforts to apply all principles of operation management as they are being applied by manufacturers of product.

Protecting the environment

- There are two challenges: production process should emit (Release) less or no effluents, and material used to make products should be non-toxic (Harmless) and recycled.
- Companies should not lose their competitiveness while doing so. They should expand resources to invent production process and material that less damage environment.

ROLE OF OPERATION MANAGEMENT IN FUTURE

- To understand customers' needs, measure their satisfaction with company's product and use this information to develop new and improved products.
- To exploit technology to respond rapidly and flexibly to customers' needs.
- To exploit technology to improve productivity.
- Use fewer resources to produce product or produce of high value with same amount of resources.
- To continually improve products and process to reduce defects and waste.
- To develop skill of employees and keep them motivated.
- To continually learn from customer and competitor.

Module-1

Chapter 02

PROCESS



DESIGN

□ PRODUCTION SYSTEM

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

□ CHARACTERISTICS OF PRODUCTION SYSTEM

1. Production is an organized activity, so every production system has an objective.
2. The system transforms the various inputs to useful outputs.
3. It does not operate in isolation from the other organization system.
4. There exists a feedback about the activities, which is essential to control and improve system performance.

□ TYPES OF PRODUCTION PROCESS / SYSTEM

- **The types of production processes/systems are classified on the basis of**
 - Product / Output Variety and
 - Product / Operations / Output Volume
- **They are broadly classified as:**
 - Continuous Production Process
 - Process / Flow Production
 - Mass Production
 - Intermittent Production Process
 - Batch Production
 - Job Shop Production
 - Project Production Process

□ Process classification by type of customer order

- **Made to Stock Production Process**
 - These firms make items that are completed and placed in stock before customer order.



- **Made to Order Production Process**

- These complete the end item only after receiving a customer order.
- Because manufacturer cannot anticipate what each customer wants.

- **The third type of production process is one where**

- The company produces standard modules and
- Assembles these modules
- According to the specifications of customer order
- **This type of production process is *Assemble-to-Order Production Process***

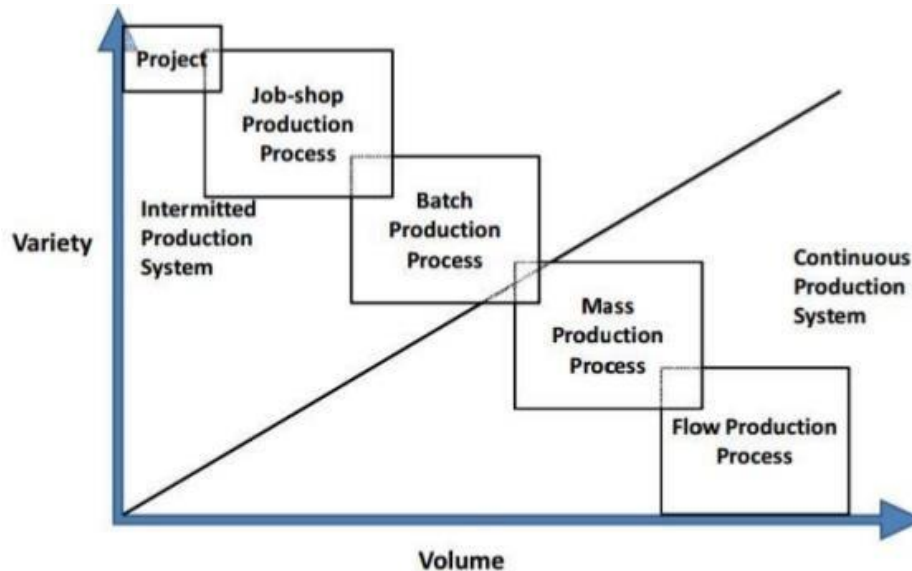
- Ex. PVC window assemblers,
- Modular kitchen board assemblers, etc.
- This is a hybrid method, since components are made to stock and finished products are made to order.

- **FEATURES OF MAKE TO ORDER PROCESS**

- The processing activities begins as customer order receives.
- Materials have to be purchased for a customized product order.
- Nothing is done until the order is received, and the product is designed and manufactured entirely according to the customer's specification.

- **FEATURES OF MAKE TO STOCK PROCESS**

- Must have a standard product line.
- Builds inventory in advance of demand.
- Forecasting, inventory management and capacity planning are most important processes.
- Begins with manufacturer rather customer order.
- Purpose is to meet the desired level of customer service at minimum cost.
- Also used when demand is seasonal.



□ Continuous Manufacturing System

- These are also referred to as Repetitive Manufacturing Systems.
- These are mass production facilities that produce high volumes of the same products.
- They are usually make-to-stock producers.
- The manufacturing happens in Automated, special-purpose equipment.

Repetitive Manufacturing

- WIP is low because the items move quickly in the plant.
- Examples are television, radio, and telephone producers.
- Product(s) follow the same path.

□ Continuous Flow (Flow Shop)

- Some products flow continuously through a linear process.
- These types of operations are called Continuous Flow Operations.
- Usually the products are not discrete.
- Continuous flow operations are sometimes also called process type operations
— (as opposed to discrete operations).
- Examples are
 - Chemical plant,
 - Oil and Gas,
 - Petroleum refineries,

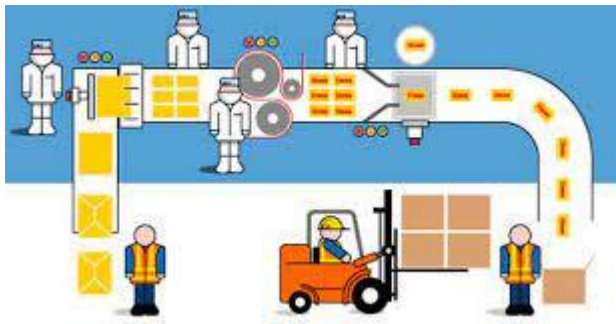


— Sugar mills, etc.

□ Process Production / Flow Production

When is it used:

- Dedicated plant and equipment with zero flexibility.
- Material handling is fully automated.
- Process follows a predetermined sequence of operations.
- Planning and scheduling are a routine action.
- Product differentiation is limited.
- Involves high initial investments.



□ Advantages:

- Standardization of product and process sequence.
- Higher rate of production with reduced cycle time.
- Highest capacity utilization due to line balancing.
- Manpower is not required for material handling.
- Persons with limited skills can be used for production process.
- Unit cost is low due to high volume of production.
-

□ Disadvantages:

- The main disadvantage is that the work is quite repetitive for workers and can cause demotivation (imagine sitting at a conveyor belt all day tightening the same screw!) which leads to a poor quality/productivity.
- Also, opposite to batch production, the company is only producing one type



of product therefore it's concentrating all of its risk on one good.

□ **Mass Production Process:**

When is it used:

- Standardization of product and process sequence
- Dedicated special purpose machines having high production capacities and output rates
- Large volume of products
- Shorter cycle time
- Lower in process inventory
- Balanced production lines
- Material and parts flow are continuous without back-tracking
- Production planning and control is easy
- Material handling can be completely automatic



➤ **Advantages:**

- Higher rate of production with reduced cycle time.
- Higher capacity utilization due to line balancing
- Less skilled operators are required.
- Low process inventory
- Manufacturing cost per unit is low.

➤ **Limitations:**

- Break-down of one machine may stop entire production line.
- Line layout needs major changes with changes in product design.
- Higher investment in production facilities.

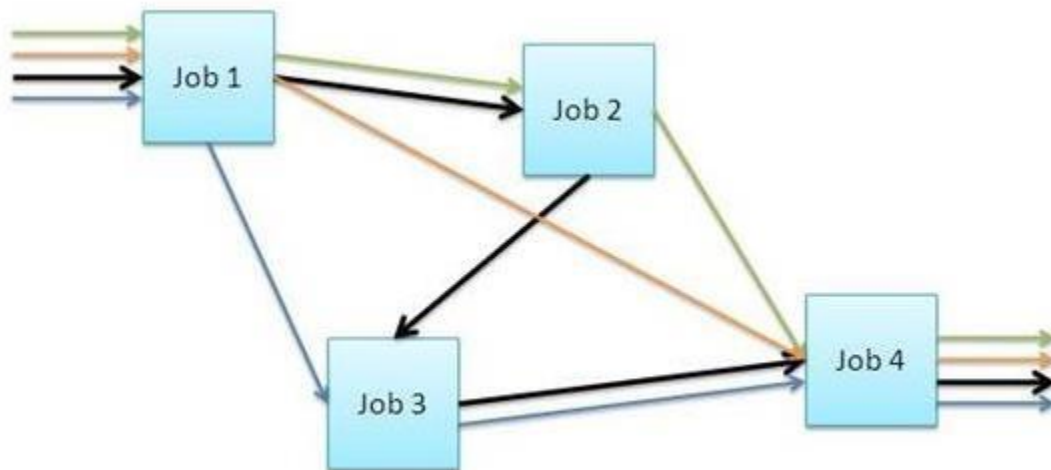


□ Intermitted Production Process:

In this type of production process:

- The volume of each product is low.
- Generally, produces make-to-order, custom products in accordance with design supplied by the customer.
- Each job may be unique and may require a special set of production steps.
- Further, each job may require a particular routing.
- There are no standard routings.
- Products may follow different paths.
- Needs general-purpose production equipment

□ Job Shop Production Process





➤ **Job shop production process are used in**

- woodworking shops,
- metal fabrication shops, etc.
- May require an inventory of a few type of the raw materials.
- BUT, here the largest percentage of the inventory is Work in Process (WIP).
- Work in Process is the inventory that accumulates in between process stages.

➤ **When is it used:**

- High variety of products with low volume
- Use of general-purpose machines and facilities
- Highly Skilled Operators who take up each job as a challenge
- Large inventory of materials, tools and parts
- Detailed planning is essential for sequencing of each product Capacities for each work centers and order priority

➤ **Advantages:**

- A large variety of products can be produced with the general-purpose machines
- Operators become more skilled and competent with each job
- Full potential of operators can be utilized
- Opportunity exists for creative methods and innovative ideas.

➤ **Limitations:**

- Production planning is complicated
- Larger space requirement.



□ **Batch Manufacturing:**

- Many manufacturing operations fall between job shops and repetitive manufacturing. These are called batch manufacturing.
- Batch means a single production run
- Batch size means the quantity produced in a single production run.
- It may be less than 100 units OR up to a few 1000 units.
- The batch manufacturing company makes a batch of one product, then may switch over (set up) the equipment and make a batch of another item.
- Production equipment should be more flexible than repetitive manufacturing and it is generally less flexible than job shops.

- Here, products having same or similar processes may be grouped into a product family.
- Examples are small hand tools (e.g., drill, screw driver), and hand mixers.

➤ **When is it used:**

- There is a shorter production run
- Plant and machinery are flexible
- Every batch of production requires changes in the plant and machinery set-up.

➤ **Limitations:**

- Material handling is complex
- Production planning & control is complex
- High set-up cost due to frequent changes in set ups.
- WIP inventory is higher than continuous production process.



➤ **Advantages:**

- Lower manufacturing lead time and cost as compared to job order production process.
- Better utilization of plant and machinery
- Promotes functional specialization
- Lower investment in plant and machinery
- Flexibility to accommodate and process number of products
- Job Satisfaction to operators.

□ **Project Production Process**

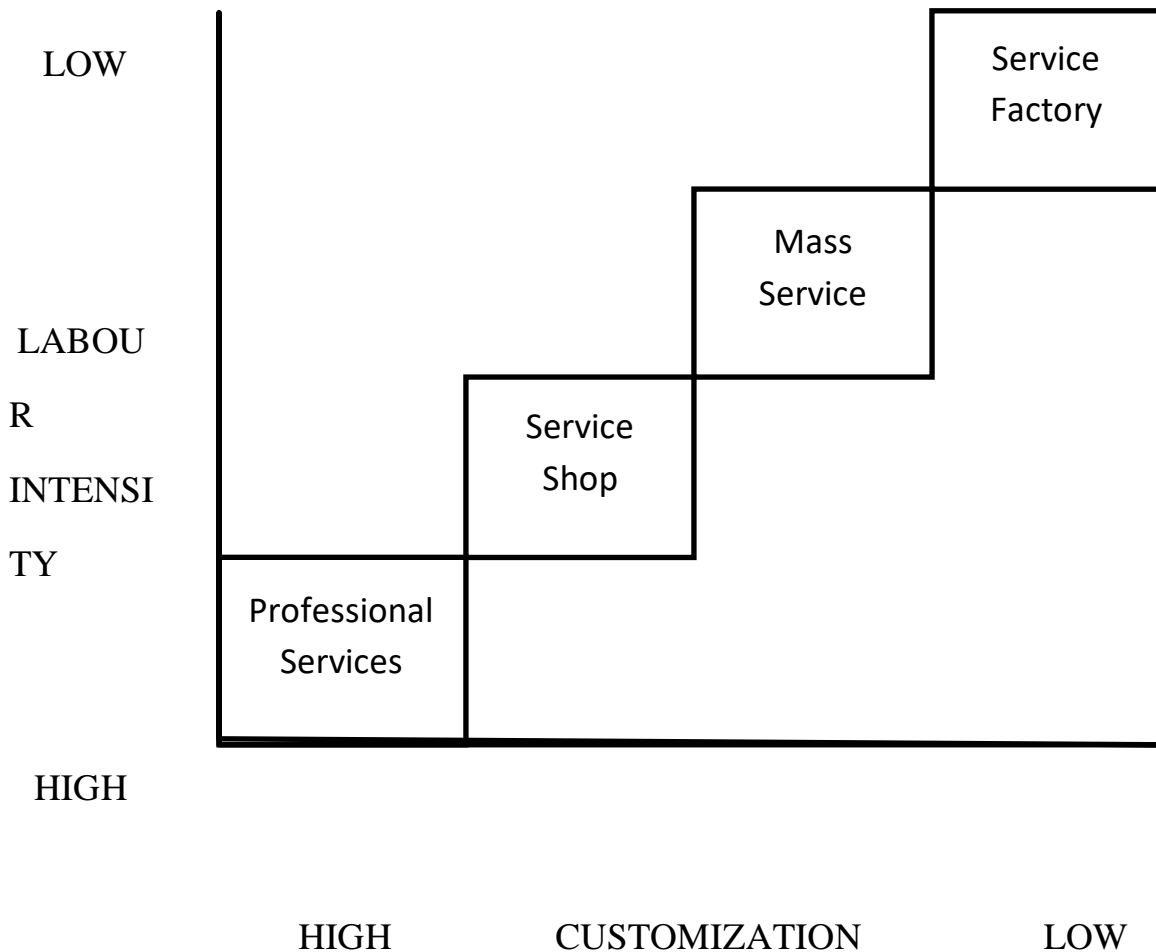
- A project is a highly flexible and low volume type operation.
- Usually the item to be produced stays in a fixed place and all the resources come to it.
- At the end of production, resources leave the place.
- Examples are:
 - ship construction,
 - bridge construction,
 - buildings and
 - large machines
- Some types of service operations may also be called as Projects.
- These involve a team of people over a period of time and then the people leave the project.
- Example:
 - Developing a software package may be a project type of service operation.



□ **SERVICE SYSTEMS**

1. Professional Services
2. Service Shop
3. Mass Services
4. Service Factory

□ **SERVICE PROCESS MATRIX**



Less labor intensive (involvement of the customer in service design and the delivery), less customized (involvement of the service provider in service design and delivery)



1. PROFESSIONAL SERVICES

- Highly customized, very labor intensive
- Ex. accountants, lawyers, doctors

2. SERVICE SHOP

- Less customized and less labor intensive but still attentive to individual customers
- Ex. schools, hospitals

3. MASS SERVICES

- Offers same basic services to all customers and allows less interaction with service provider
- Ex. retailing, banking

4. SERVICE FACTORY

- Services with least degree of customization and labor intensity
- Ex. electricity, transportation

□ PROCESS SELECTION

- Process planning is to select a production process for those items we will produce in-house.
- The process chosen to create the product or service must be consistent with product and service characteristics.
- The most important product characteristics (in terms of process choice) are degree of standardization and demand volume.



- As we move from projects to continuous production, demand volume increases; products become more standardized; systems become more capital-intensive, more automated, and less flexible; and customers become less involved.

□ PROCESS PERFORMANCE

- The performance of process is determined by the following factors:
- **Run time:** It is the time required to produce a batch or products. It is calculated by multiplying the time required to produce each unit by the batch size.

Runtime = time required to produce each unit * batch size

- **Setup time:** It is the time to prepare machine to make particular product. Machines that have high set up times will produce products in batches.
- **Operation time:** It is the sum of the set-up time and the run time for batch of products that are run on machine.

Operation time = setup time + run time

- **Cycle time:** Average time for completion of a unit at a production step.

Cycle time = setup time + batch size * time per unit / batch size

- **Throughput time:** It is a combination of process time and waiting time. (Processtime + Waiting time)
- **Throughput rate:** It is the output rate that the process produces over a period of time. For example, 100 units per hour.
- **Value-added time:** It is the process time, i.e., the time during which useful work



is being done on a product.

- **Efficiency:** It is a ratio of the actual output of a process relative to some standard.

Efficiency = actual output / standard output

- **Productivity:** It is a ratio of output to input.

Productivity = output / input

□ PROCESS EVALUATION

1. Break Even Analysis
2. Product Process Matrix
3. Present Value Analysis

□ PROCESS SELECTION WITH

1. BREAKEVEN ANALYSIS

- Several quantitative techniques are available for selecting a process.
- One that bases its decision on the cost tradeoffs associated with demand volume is **Breakeven Analysis**.
- The **components** of breakeven analysis are volume, cost, revenue, and profit.
- **Volume** is the level of production, usually expressed as the number of units produced and sold. We assume that the number of units produced can be sold.
- **Cost** is divided into two categories: fixed and variable.
- **Revenue** on a per-unit basis is simply the price at which an item is sold. Total revenue is price times volume sold.
- **Profit** is the difference between total revenue and total cost.
- These components can be expressed mathematically as follows:

- Total cost = fixed cost + total variable cost

$$TC = C_f + VC_v$$



- Total revenue = volume * price

$$TR = Vp$$

- Profit = total revenue - total cost

$$Z = TR - TC$$
$$= Vp - (Cf + VCv)$$

- In selecting a process, it is useful to know at what volume of sales and production we can expect to earn a profit.
- We want to make sure that the cost of producing a product does not exceed the revenue.
- By equating total revenue with total cost and solving for V, we can find the volume at which profit is zero. This is called the **breakeven point**.

- A mathematical formula for the breakeven point can be determined as follows:

$$TR = TC$$

$$Vp = Cf +$$

$$VCvVp - VCv =$$

$$Cf$$

$$V(p - Cv) = cf$$

$$V = Cf / p - Cv$$

- For ex: manufacturing a board will occur following costs and selling price.
- Fixed cost = Cf = Rs. 2,000, Variable cost = Cv = Rs. 50 per board, Price = p = Rs.100per board
- $V = cf / p - cv$
 $= 2000 / 100 - 50 = 40$ units

- Breakeven analysis is especially useful when evaluating different degrees of automation.
- More automated processes have higher fixed costs but lower variable costs.
- The “best” process depends on the anticipated volume of demand for the product and the tradeoffs between fixed and variable costs.

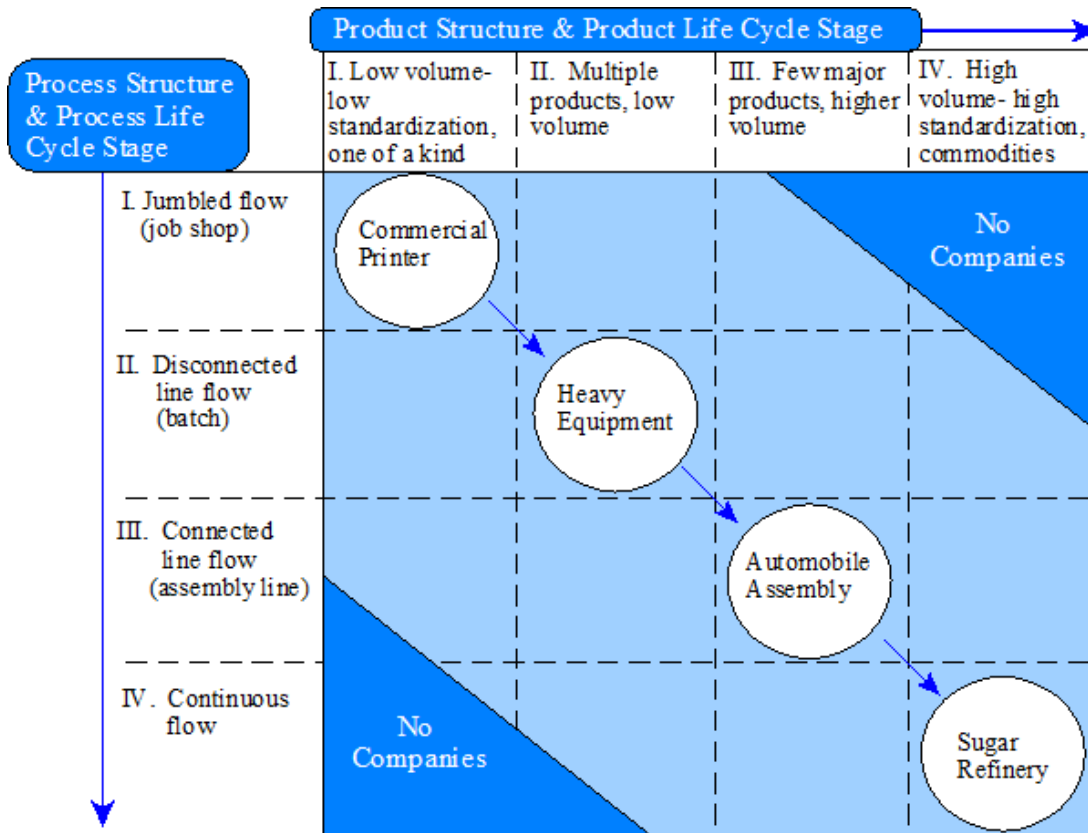


1. Formulate a total cost equation for each process considered.
 2. Calculate the point of indifference between two alternative processes (i.e., the volume at which the total cost of manufacturing is the same for the two processes) by setting their total cost equations equal to each other and solving for v , demand volume.
 3. Above the point of indifference, choose the alternative with the lowest variable cost.
 4. Below the point of indifference, choose the alternative with the lowest fixed cost.
2. Suppose in the above example if the demand for the board will exceed the break-even point i.e. 40 units then to buy automated machinery will occur fixed cost of Rs.10000 and reduce variable cost to Rs. 30 per unit. The boards would sell for Rs.100, regardless of which manufacturing process is chosen.

$$\begin{aligned} \text{Process A} &= \text{Process B} \\ \text{Rs. } 2,000 + \text{Rs. } 50V &= \text{Rs. } 10,000 + \text{Rs. } \\ & 30V \\ \text{RS. } 20V &= \text{Rs. } 8,000 \\ V &= 400 \text{ units} \end{aligned}$$



2. Product Process Matrix



- The product process lifecycle matrix shows that the processes which are best for an organization go through several stages of progress just like the product or service involved.
- The job shop process is generally good for initial stage when quantity produce are low as well as the customization is higher.
- With the product becoming more standard and there is increase in the production volume, the newer tools such as batch production is introduced.
- After that continuous flow process is introduced.



- The diagonal part on the product/process life cycle matrix is known as **Product Possibility Frontier**. This frontier signifies the optimal possible combination of product and process.
- The diagonal part shows two types of organization which are popular to each other.
- The **first type** is shown on the left-hand side. Which makes customized equipment. Each product is unique and used at introduction stage of production life cycle. Job shop process is recommended.
- The **second type** is shown on the right-hand side. Which makes mass production of its product or service. It is used at maturity stage of product life cycle and use continuous flow process.

3. Present Value Analysis: Net Present Value

- When company wants to evaluate one machine over another, present value of its future cash flow can be helpful for evaluating the same.
- If an investment is expected to earn a rate of return 'r' per year, then any cash flow 'n' years in future will be discounted by a factor of $1/(1+r)^n$.
- For Ex:
 - Investment of Rs.10000 and expect to earn Rs.3000, Rs.4000, Rs.5000 for next three years. The rate of return is 10%.
- The discounted value of benefits
$$= 3000/(1+0.1)^1 + 4000/(1+0.1)^2 + 5000/(1+0.1)^3$$
$$= 2727+3306+3757$$
$$= \text{Rs.9790,}$$
which is lesser than the investment of Rs.10000.



Chapter 03

PRODUCT

DESIGN

- New products and services are the lifeblood of an organization.
- Designs can provide a competitive edge by bringing new ideas to the market quickly, doing a better job of satisfying customer needs, or being easier to manufacture, use, and repair.
- it defines a firm's customers, as well as its competitors.
- The design process itself is beneficial because it encourages companies to look outside their boundaries, bring in new ideas and experiment.

□ THE DESIGN PROCESS

- Design has a tremendous impact on the quality of a product or service.
 - Poor designs may not meet customer needs or may be so difficult to make that quality suffers.
 - Costly designs can result in overpriced products that lose market share.
 - If the design process is too lengthy, a competitor may capture the market by being the first to introduce new products, services, or features.
- An effective design process:
- Matches product or service characteristics with customer requirements,
 - Reduces the time required to design a new product or service,
 - Ensures that customer requirements are met in the simplest and least costly manner, and
 - Minimizes the revisions necessary to make a design workable.



➤ **Product Design**

Defines the appearance of product, sets standards for performance, specifies which materials are to be used and determines dimensions and tolerances.

➤ **Service Design**

Specifies what physical items, sensual benefits and psychological benefits, the customer is to receive from the service and defines the environment in which the service will take place.

➤ **TYPES OF PRODUCT**

1. Customized Product

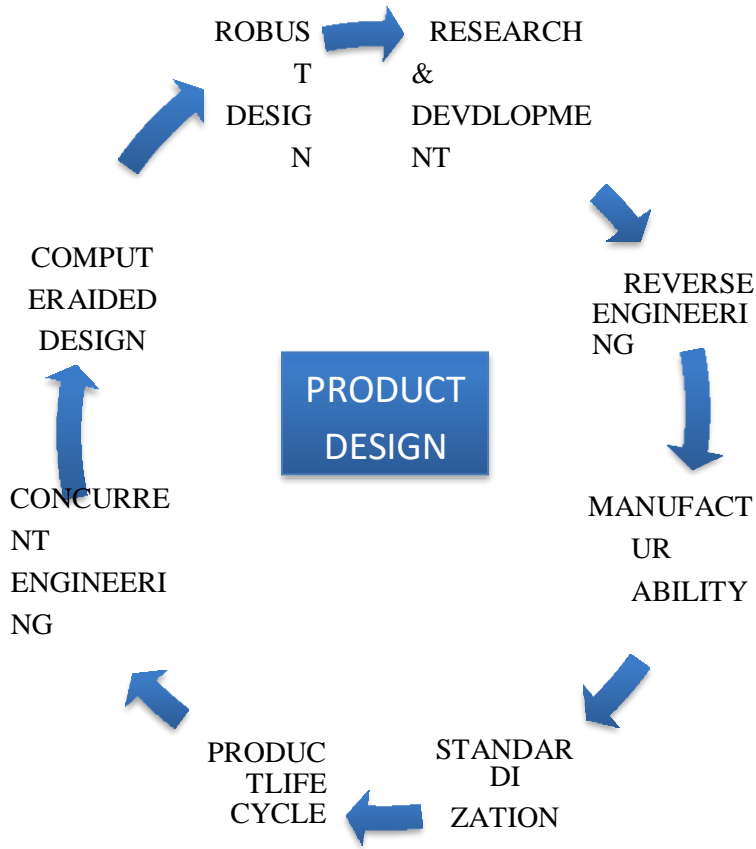
- These products are manufactured to meet customer's specification.
- These products are produced in small numbers hence are expensive.
- Every item in manufacturing process is manufactured carefully hence the delivery time is high.

2. Modular products

- These products are assembled from the standard components according to customer's specification.
- Components are made in large quantity and hence are inexpensive
- The company assembles product after order is received and hence customer has to wait for delivery of the product.

3. Standard Product

- These products are designed and produced by a company.
- These products are made in large number and hence inexpensive.
- These products are sold from inventory and hence are immediately delivered to customer.





➤ **Research & Development:**

- The design of new products is done by the Research and Development department of the organization with the help of many other departments.
- In R&D, fundamental knowledge is the advancement of the state of knowledge in a subject, though it may not be practically converted into commercial applications.
- Applied research has the objective of developing commercial applications.
- Development is the process of converting the results of applied research into useful commercial application.

➤ **Reverse Engineering:**

- Reverse Engineering is the process of carefully dismantling an existing product (of a competitor) step by step in order to understand the unique underlying concepts.
- It helps in designing new products, which are better than those of the competitors.
- In the field of consumer electronics, Sony Corp. is on the forefront in designing new innovative items such as the Walkman, handy cam, digital camera etc.
- Many other companies have to follow the reverse engineering approach in order to break Sony's monopoly of new products in the shortest possible time.

➤ **Manufacturability:**

- Manufacturability implies designing a product in such a way that its manufacturing/assembling can be done easily.
- While designing a new product, the manufacturing capabilities of the organizations have to be kept in mind.
- If the required capabilities do not exist, the management can be consider enhancing the production capabilities by making more investment.

➤ **Standardization:**



- Standardization refers to less variety in the design of products. New products are designed such that there is no major variation from the existing products.
- Lack of standardization creates problem, while it presents benefit such as lower design costs.
- Modular design is another type of standardization, which means designing a product in parts or modules.
- Modules are sub-assemblies of different components and parts.
- This approach reduces a lot of effort and time required to design the product.
- The inventory management of module also is simple in comparison to that of large number of different components in a non-modular design.

➤ **Robust Design:**

- Robust design means designing a product that is operational in varying environmental conditions.
- It is easier to create a product with robust design rather than making changes in the environment to suit the product.

➤ **Concurrent Engineering:**

- Concurrent engineering is the product design approach in which the design team includes personnel from the marketing, engineering, production, materials department, finance department, etc.
- This approach is radically opposite to the classical sequential product design approach in which the design process takes place in stages, moving from one department to the other.
- Concurrent engineering saves a lot of time and effort unlike the sequential approach in which feedback between departments, at times leading to rejections of the suggested designs at later stages, results in the wastage of a lot of time and effort.

➤ **Life Cycle of a Product:**

- The product life cycle has five stages throughout the life of a product, namely,



incubation, growth, maturity, saturation, and decline.

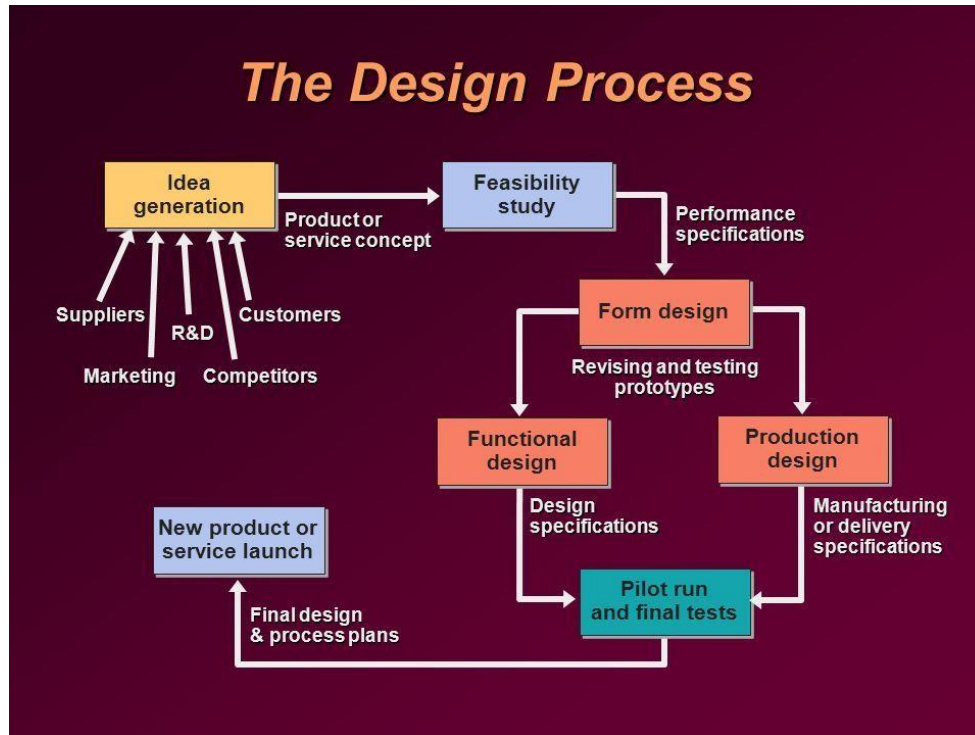
- The duration of life cycle of a product depends upon the type of product
- Incubation witnesses a low demand of product due to less awareness about the product.
- As the awareness increases the demand tends to increase, this stage is called the growth phase.
- Next follows the maturity stage, when the demand tends to become stable and even new features do not appeal much to the masses.
- It leads to a saturation phase and eventually to decline phase.

➤ **Computer-Aided Design:**

- Computer-aided design is a software which helps the designer to make the three-dimensional design of a product on the computer and visualize the design from various angles.
- In the earlier times, when CAD software were not available, design engineers had to make designs from various angles on paper charts which was tedious and time consuming.
- The designs made on CAD can be transmitted to distant location using the sources say internet and can be seen simultaneously through intranet.

□ **THE DESIGN PROCESS**

Following figure outlines the design process from idea generation to product launch.



1. IDEA GENERATION

- o The design process begins with understanding the customer and actively identifying customer needs.
- o Ideas for new product or improvements existing products can be generated from many sources.
- o Perceptual Maps, Benchmarking and Reverse Engineering can be helpful to companies to learn from their competitors.
- o **Perceptual Maps** compare customer perception to companies' product with competitor's product.
- o **Benchmarking** refers to finding the best in class product or process, measuring the performance of your product or process against it and making recommendations for improvement based on results.
- o **Reverse Engineering** refers to carefully dismantling and inspecting a competitor's product to look for design features that can be incorporated into your own product.

2. FEASIBILITY STUDY

- a. A feasibility study consists of market analysis, economic analysis and technical and strategic analysis.



- b. The market analysis assesses whether there is enough demand for the proposed product to invest in developing it further.
- c. Economic analysis looks at estimated production and development cost and compare them to estimated sales volume: Cost/Benefit analysis, Net present value or internal rate of return.
- d. Decision regarding new technology, sufficient capacity for production, products competitive advantage for the company.
- e. Performance specification are written for the product concept that passed the feasibility study and are approved for development.

3. RAPID PROTOTYPING

- a. Testing and revising a preliminary design model.
- b. The interactive process involves form, functional as well as production design.
 - Form a design: How the product will look.
 - Functional design: How the product will perform.

Three criteria are considered:

Reliability, Maintainability & Usability.

1. Reliability:

The probability is that the product will perform its intended function for a specific period of time.

2. Maintainability:

The ease with which a product is maintained or repaired.

Products can be made easier to assemble them into modules like computers.

3. Usability:

Easy use of product or service. Standardized designs are usually easier to use.

PRODUCTION DESIGN:

1. Simplification:

Reduces the number of parts, Assemblies or options in a product.

2. Standardization:



How the product will be made. When commonly available and interchangeable parts are used.

3. Modular Design:

Combines standardized building blocks or modules to create unique finished products.

4. PILOT RUN AND FINAL TEST

- Design specifications, manufacturing and delivery specifications
- Final design consists of detailed drawing and specifications for the new product, accompanying with process plan including component and tooling, description and procedure for workers and computer program for automated machines.

5. NEW PRODUCT LAUNCH

- Launching of new product ramping up production, coordinating supply chain and rolling out marketing plans.

6. EVALUATION OF DESIGN

- A company's design process is effective if its product serves customers' requirement better than those of competitors and if it can be easily and economically.
- The following metrics are helpful in evaluating the effectiveness of company's design process:

1. What percentage of the company's revenue is derived from the products launched in last five years?
2. How many of the company's products have market share of 50%?
3. What percentage of company's suppliers are involved in the product design process?
4. What percentage of company's components are being used in multiple products?
5. What is average number of components per product?



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Ph.No–(0281)2471645

6. What percentage of the product's components can be recycled?



ONE WORD QUESTION-ANSWER (MCQ)

Sr.No.	Question	Answer
1.	Production and Operations Management (POM) involves what?	Production and Operations Management (POM) involves managing the various activities, processes, and procedures related to the conversion of numerous production related inputs into outputs.
2.	It is crucial for manufacturing as well as service organization to implement POM practices effectively. True/False?	True
3.	Who expects a manager to be equipped with the latest theories and practices of POM?	Management
4.	A Production and Operation Manager has to decide what kind of Decision?	Where to locate new facilities, minimizing overall costs of Operations.
5.	The capacity and layout of the facility why must be so planned?	It can fight the local competition effectively.
6.	Why Project management skills and techniques have to be applied?	To facilitate the establishment the of operations facilities in time and within given budget.
7.	What is Production?	Production is a process where input are converted into a desirable output or finished goods.
8	What is Production Management?	Step-by-step conversion of the one form of materials into another, either chemically or mechanically



9	What is Production Management as per H. A. Harding?	“Production Management is concerned with those processes which converts the inputs into outputs.”
10	What is Production Management as per E. S. Buffa?	“Production Management deals with decision-making related to production processes so that the resulting goods is produced according to specifications and by the schedule demanded and at minimum cost”
11	What is OPERATIONS MANAGEMENT?	Inclusion of services into the scope of production management is broadly known as Operations management.
12	Which sectors are covered by OM?	Non-manufacturing organizations providing services like hospitals, banks, transportations, warehousing are covered by OM.
13	How A Production system can be defined in the terms?	A Production system can be defined in the terms of the environment, inputs, transformation system, outputs and mechanism used for monitoring and control.
14	What are the sub system of production system?	There are Two types of sub system in production system. (i) Control sub-system; (ii) Conversion sub-system
15	What is Control sub-system?	Control Sub-system is a sub system of larger production system where inputs are converted into output.
16	What is Conversion sub-system?	Conversion Sub-system is a sub system of larger production system where portion of output is taken for monitoring the feedback



		of a product.
17	What is Environmental component in POM?	Include those things that are outside the actual production system, but influence it in some way.
18	Who will determine the quality and cost of products?	Equipment will determine the quality and cost of products
19	What is Production Process?	How input will be converted into output using equipment and labor.
20	Who is determining the quality and cost of products?	Skill and motivation of employees will determine the quality and cost of products
21	The lesser the time taken, the more efficient the production is. True/False?	True
22	Suppliers who are capable of supplying good quality raw materials/components and maintain an equitable relationship with them. True/False?	True
23	When the Production processes are likely to be carried out smoothly?	If the production area is clean, airy and well-lit.



24	What comes under Transformation System?	<ul style="list-style-type: none"> • Alter • Transport • Store • Inspection
25	At one level service is intangible offering with little no transfer of physical goods. True/False?	True
26	At Second level service is one part of product True/False?	True
27	At which level service mix being offered to the customer?	Second level.
28	At which level main offering is product but supplier also provides some services?	Third Level
29	Apply corrective measure to altering the input/transformation process and thereby output is possible. True/False?	True



30	What are the primary functional areas of a firm?	Marketing, finance, operations, and human resources.
31	For most firms, what is the technical core or hub of the organization?	Operation
32	What is Finance and accounting with production domain?	Production and inventory data, capital budgeting requests, and capacity expansion and technology plans
33	What do Finance do in a firm?	Finance pays workers and suppliers, performs cost analyses, approves capital investments, and communicates requirements of shareholders and financial markets.
34	What do Marketing do in a Firm?	Marketing provides operations with sales forecasts, customer orders, customer feedback, and information on promotions and product development.
35	What do Operation do in a Firm?	Operations, in turn, provides marketing with information on product or service availability, lead-time estimates, order status, and delivery schedules.
36	Do operations rely on human resources to recruit, train, evaluate, and compensate workers and to assist with legal issues, job design, and union activities?	Yes



37	Where operations interacts with suppliers to order materials or services, communicate production and delivery requirements, certify quality, negotiate contracts, and finalize design specifications?	Outside the Organization
38	Which are the pure service industries?	Such as banks, hospitals provide product like, loan schemes, diagnosis, reports etc.
39	Where we get a tangible, identifiable product which is a result of a transformation process?	In Manufacturing
40	In services, the end product is often intangible but as just real. True/False?	True
41	We can put various organizations on a continuum, having extreme limits as product orientation & process orientation . True/False?	True
42	Who are Providing both service and product to the	Restaurants



	customer?	
43	Product is Tangible or Intangible?	Tangible
44	Service is Tangible or Intangible?	Intangible
45	Do product makes Minimum contact with ultimate consumer with firm?	Yes
46	Service makes High contact with clients or customers.True/False?	True
47	What are the inputs?	Input can be various resources like raw materials,men, machines, methods
48	Which manufacturing organizations also provide services?	Car manufacturer also provides after sales services. A service organization also deals in products . Bank other than safe keeping of money also offer Loan.
49	What are the MAIN OBJECTIVES OF THE PRODUCTION MANAGEMENT?	Efficiency- increased output for a given input. Productivity- increased production using given resources. Reduce Cost- production is more economical (reduce cost) Quality- good quality products at reduced cost.
50	What are the 5Ms in Production?	5M (Machinery, Material, Money, Manpower, Manufacturing service)
51	What are the SCOPE OF THE PRODUCTION	1.Product Selection and Design; 2.Process Selection and Planning;



	MANAGEMENT?	3.Facilities Location; 4.Facilities Layout and Material Handling; 5.Capacity Planning;
52	Operations management is a broad term which includes manufacturing as well as service organization. True/False?	True
53	Where the Operations management highlights?	Operations management highlights the increasing importance of the service industry in the overall business environment.
54	Is There a growing need for the application of the principles of operationsmanagement in the service industry?	Yes
55	Where the Industrial revolution started?	The revolution first took place in textile mills, grain mills, and machine making facilities.
56	Which continent started industrial revolution first?	Began in the 1770s in England and spread to the rest of Europe and to the United States during the 19th century.
57	What is the concept behind interchangeable parts?	Creating nearly identical parts that can be easily mass produced and replaced. These parts are then fitted together to create various products.



58	Who is the the father of Scientific Management?	Frederick Winslow Taylor
59	Scientific Management is based on what?	Based on observation, measurement, analysis and improvement of work methods and economic incentives
60	The high-volume production of a standardized product for a mass market.True/False?	True
61	Who practically adopted the scientific management principles for Taylor?	Henry Ford practically adopted the scientific management principles for Taylor.
62	What comes under Quality Revolution?	An emphasis on quality and the strategic role of operations.
63	What is Lean Production?	An adaptation of mass production that prizes quality and flexibility.
64	By using which concept Japanese manufacturer changed therules of production from mass production to lean production?	Using the concept of Just-in-Time Japanese manufacturer changed therules of production from mass production to lean production.
65	Lean production	Lean production prizes flexibility (rather than efficiency) and quality(rather than



	prizes what?	quantity).
66	What made companies competitive again?	Renewed emphasis on Quality and the strategic importance of operations.
67	What has promoted an era of industrial globalization?	Technology together with changing political and economic condition
68	What are the modern Factors effecting OM?	<ol style="list-style-type: none"> 1.Global Competition; 2.Quality, Customer Services and Cost Challenges; 3.Rapid Expansion of Advanced Technologies; 4.Continued Growth of the Service Sector; 5. Scarcity of Operations Resources; 6.Social Responsibility Issues
69	More people work in the service sector than the manufacturing, but productivity is low in comparison to the manufacturing. True /False?	True
70	It is important that service providers make concerned efforts to apply all principles of operation management as they are being applied by manufacturers of product. True/False?	True



71	Production process should emit less or no effluents, and material used to make products should be non-toxic and recycled. True/False?	True
72	Companies should expand resources to invent production process and material that less damage environment. True/False?	True
73	What is ROLE OF OPERATION MANAGEMENT IN FUTURE?	To understand customers' needs, measure their satisfaction with company's product and use this information to develop new and improved products
74	What is Production system?	The production system of an organization is that part, which produces products of an organization.
75	What is Production system?	It is activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with the policies communicated by management.
76	Production is what kind of activity?	Production is an organized activity
77	The types of production processes/systems are classified on the basis of	1.Product / Output Variety ; and 2.Product / Operations / Output Volume;



	what?	
78	What comes under Continuous Production Process?	1.Process / Flow Production 2. Mass Production
79	What comes under Intermittent Production Process?	1. Batch Production; 2. Job Shop Production Project Production Process;
80	What is Made to Stock Production Process?	These firms make items that are completed and placed in stock before customer order.
81	What is Made to Order Production Process?	These complete the end item only after receiving a customer order.Because manufacturer cannot anticipate what each customer wants.
82	What is <i>Assemble-to-Order</i> Production Process?	This is a hybrid method, since components are made to stock and finished products are made to order.
83	What is Continuous Manufacturing System?	These are also referred to as Repetitive Manufacturing Systems. These are mass production facilities that produce high volumes of the sameproducts. usually make-to-stock producers.The manufacturing happens in Automated, special-purpose equipment.
84	What is Continuous Flow (Flow Shop)?	Some products flow continuously through a linear process.These types of operations are called Continuous Flow Operations. Usually the products are not



		discrete.Continuous flow operations are sometimes also called process typeoperations.
85	What is Process Production / Flow Production?	Dedicated plant and equipment with zero flexibility.Material handling is fully automated.Process follows a predetermined sequence of operations.Planning and scheduling are a routine action.Product differentiation is limited.Involves high initial investments.
86	Do Process Production / Flow Production Product differentiation is limited. Involves high initial investments?	Yes
87	When to use Mass Production Process?	When Dedicated special purpose machines having high production capacities andoutput rates,Large volume of products,Shorter cycle time,Lower in process inventory.
88	What is Intermitted Production Process?	Generally, produces make-to-order, custom products in accordance withdesign supplied by the customer. The volume of each product is low.
89	Where job Shop Production Process are used?	Woodworking shops, Metal fabrication shops.
90	What is Batch manufacturing?	Many manufacturing operations fall between job shops and repetitive manufacturing. These are called batch



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		manufacturing.
91	Batch means what?	Batch means a single production run.
92	Batch size means what?	Batch size means the quantity produced in a single production run.
93	Production equipment should be more flexible than repetitive manufacturing and it is generally less flexible than job shops. True/False?	True
94	A project is a highly flexible and low volume type operation. True/False?	True
95	At the end of production, resources leave the place. True/False?	True
96	Do Some types of service operations may also be called as Projects?	Yes
97	What are the SERVICE SYSTEMS?	<ol style="list-style-type: none"> 5. Professional Services 6. Service Shop 7. Mass Services 8. Service Factory
98	What is PROFESSIONAL SERVICE?	Highly customized, very labor intensive. Accountants, lawyers, doctors.



99	What is a SERVICE SHOP?	Less customized and less labor intensive but still attentive to individual customers. Ex. schools, hospitals
100	What do you know by MASS SERVICES?	Offers same basic services to all customers and allows less interaction with service provider. Ex. retailing, banking
101	What do you know by SERVICE FACTORS?	Services with least degree of customization and labor intensity. Ex. electricity, transportation
102	The process chosen to create the product or service must be consistent with product and service characteristics. True/False?	True
103	As we move from projects to continuous production, demand volume increases or Decreases?	Increases
104	As we move from projects to continuous production systems become more capital-intensive, more automated, and less flexible. True/False?	True



105	One that bases its decision on the cost tradeoffs associated with demand volume is Breakeven Analysis. True /False?	True
106	What The components of breakeven analysis?	Volume, Cost, Revenue, and Profit
107	What is Volume?	Volume is the level of production, usually expressed as the number of units produced and sold
108	How Cost is divided?	Cost is divided into two categories: fixed and variable.
109	What is Revenue?	Revenue on a per-unit basis is simply the price at which an item is sold. Total revenue is price times volume sold.
110	What do you mean by Profit?	Profit is the difference between total revenue and total cost.
111	How to calculate Total cost?	Total cost = fixed cost + total variable cost TC = Cf + VCv
112	How to calculate Total revenue?	Total revenue = volume*price TR = Vp
113	How to calculate Profit?	Profit = total revenue - total cost Z = TR – TC = Vp - (Cf + VCv)
114	Cost of producing a product does not exceed therevenue. True/False?	True



115	What is Breakeven point?	By equating total revenue with total cost and solving for V, we can find the volume at which profit is zero. This is called the breakeven point.
116	What is the mathematical formula for the breakeven point?	$TR = TC$ $Vp = Cf + VCv$ $Vp - VCv = Cf$ $V(p - Cv) = cf$ $V = Cf / p - Cv$
117	When Breakeven analysis is especially useful?	When evaluating different degrees of automation.
118	What do product process lifecycle matrix shows?	The processes which are best for an organization go through several stages of progress just like the product or service involved.
119	The job shop process is generally good for initial stage when quantity produce are low as well as the customization is higher. True/False?	True
120	With the product becoming more standard and there is increase in the production volume. True/False?	True
121	The diagonal part on the product/process life	Product Possibility Frontier



	cycle matrix is known as what?	
122	What do The frontier signifies?	The optimal possible combination of product and process.
123	The diagonal part shows how many types of organization?	Two
124	What do left hand side diagonal part elaborate?	It makes customized equipment Each product is unique and used at introduction stage of production life cycle. Job shop process is recommended
125	What do Right hand side diagonal part elaborate?	It makes mass production of its product or service. It is used at maturity stage of product life cycle and use continuous flow process.
126	What are Process plans?	Process plans are a set of documents that detail manufacturing and service delivery specifications
127	They begin with detailed drawings of product design. True/False?	True
128	What do you know by assembly charts or bills of material?	showing the parts and materials needed and how they are to be assembled together.
129	What is operations sheets or routing sheets?	listing the operations to be performed with details on equipment, tools, skills, etc
130	What do you mean by quality-control check sheets ?	specifying quality standards and quality data to be recorded



131	Do Process plans are used in both manufacturing and service settings?	Yes
132	What is Process analysis?	Process analysis is the systematic examination of all aspects of a process to improve its operation — to make it faster, more efficient, less costly, or more responsive to the customer.
133	What are the basic tools of process analysis?	The basic tools of process analysis are process flowcharts, diagrams, and maps.
134	The classic process flowchart looks at the manufacture of a product or delivery of a service from a broad perspective. True /False?	True
135	What do ‘O’ mean in Process flowchart?	Operations
136	What do ‘□’ mean in Process flowchart?	Inspections
137	What do ‘⇒’ mean in Process flowchart?	Transportation
138	What do ‘D’ mean in Process flowchart?	Delay
139	What do ‘∇’ mean in Process flowchart?	Storage
140	Process flowcharts may be used to analyze the efficiency of a series of	True



	processes and to suggest improvements. True/False?	
142	Process flowcharts are used in both manufacturing and service operations. They are a basic tool for process innovation, as well as for job design. True/False?	True
143	Flowcharts can take many forms, from freehand drawings to animated simulations. True/False?	True
144	What is PROCESS INNOVATION?	Process innovation projects are typically chartered in response to a breakthrough goal for rapid, dramatic improvement in process performance. (Process innovation is also known as business process reengineering (BPR))
145	Processes should be analyzed for improvement on a continuous basis. True/False?	True
146	When its time to completely redesign or innovate the process?	When continual improvement efforts have been exhausted and performance expectations still cannot be reached with an existing process.
147	Continuous improvement is about	True



	<p>many, small improvements initiated and implemented by anyone and everyone in the organization to improve the quality of their working processes and practices. True/False?</p>	
148	<p>In an environment of rapid change, the ability to learn faster, reconfigure processes faster, and execute processes faster is a competitive advantage. True/False?</p>	True
149	<p>How Data from the existing process are used?</p>	Used as a baseline to which benchmarking data on best industry practices, customer requirements data, and strategic directives are compared.
150	<p>How Analyzing the gap between current and desired performance helps?</p>	To determine whether the process needs to be redesigned.
151	<p>How a project team manages If redesign is necessary?</p>	If redesign is necessary, a project team is chartered and provided with the preliminary analysis and resulting goals and specifications for process performance.



152	It is important that the project team be convinced that total redesign of the process is absolutely necessary to achieve the performance objectives. True/ False?	True
153	What is A useful tool in beginning the redesign of a process ?	A high-level process map.
154	A high-level map contains what kind of things?	Pared to its simplest form, a high-level map contains only the essential building blocks of a process.
155	To guarantee that the detailed map will produce the desired results, key performance measures are determined and set in place. True/False?	True
156	Is it guarantee that the detailed map will produce the desired results, key performance measures are determined and set in place?	Yes
157	When a full-scale implementation can	After a successful pilot study,



	begin?	
158	What a redesigned process may involve?	The redesigned process may involve changing the way executives manage, the way employees think about their work, or how workers interact.
159	What is Run time?	It is the time required to produce a batch or products. It is calculated by multiplying the time required to produce each unit by the batch size.
160	What is the formula of RunTime?	Runtime = time required to produce each unit * batch size
161	What is Setup time?	It is the time to prepare machine to make particular product. Machines that have high set up times will produce products in batches
162	What is Operation time?	It is the sum of the set-up time and the run time for batch of products that are run on machine.
163	What is the mathematical formula of Operation time?	Operation time = setup time + run time
164	What is Cycle time?	Average time for completion of a unit at a production step.
165	What is the mathematical formula of Cycle time?	Cycle time = setup time + batch size * time per unit / batch size
166	What is Throughput	It is a combination of process time and



	time?	waiting time.
167	What is the mathematical formula of Throughput time?	(Processtime + Waiting time
168	What is Throughput rate?	It is the output rate that the process produces over a periodof time. For example, 100 units per hour.
169	What is Value-added time?	It is the process time, i.e., the time during which useful workis being done on a product.
170	Wht is Efficiency?	It is a ratio of the actual output of a process relative to somestandard.
171	What is the mathematical formula of Efficiency?	Efficiency = actual output / standard output
172	What is Productivity?	It is a ratio of output to input.
173	What is the mathematical formula of Productivity?	Productivity = output / input
174	New products and services are the lifeblood of an organization. True/False?	True
175	What do you know by Designs?	Designs can provide a competitive edge by bringing new ideas to the market quickly, doing a better job of satisfying customer needs, or being easier to manufacture, use,



		and repair
176	What defines a firm’s customers, as well as its competitors?	Product design.
177	The design process itself is beneficial because it encourages companies to look outside their boundaries, bring in new ideas and experiment. True/False?	True
178	Do Design has any impact on the quality of a product or service?	Yes
179	Poor designs may not meet customer needs or may be so difficult to make that quality suffers. True/False?	True
180	Do costly designs can result in overpriced products that lose market share?	Yes
181	What will happen If the design process is too lengthy?	If the design process is too lengthy, a competitor may capture the market by being the first to introduce new products, services, or features.
182	What do An effective design process do?	Matches product or service characteristics with customer requirements, Reduces the time required to design a new



		product or service.
183	What is Service Design?	Specifies what physical items, sensual benefits and psychological benefits, the customer is to receive from the service and defines the environment in which the service will take place.
184	What is Customized Product?	These products are manufactured to meet customers specification. These products are produced in small numbers hence are expensive.
185	Every item in manufacturing process is manufactured carefully hence the delivery time is high. True/False?	True
186	What is Modular product?	These products are assembled from the standard components according to customer's specification. Components are made in large quantity and hence are inexpensive
187	The company assembles modular product after order is received and hence customer has to wait for delivery of the product. True/False?	True



188	What do you know by Standard Product?	These products are designed and produced by a company. These products are made in large number and hence inexpensive.
189	Do Standard Product are sold from inventory and hence are immediately delivered to customer?	Yes
190	The design of new products is done by whom?	Research and Development department of the organization with the help of many other departments.
191	In R&D, fundamental knowledge is the advancement of the state of knowledge in a subject, though it may not be practically converted into commercial applications. True/False?	True
192	What is Development?	Development is the process of converting the results of applied research into useful commercial application.
193	What is Reverse Engineering?	Reverse Engineering is the process of carefully dismantling an existing product (of a competitor) step by step in order to understand the unique underlying concepts.



194	How do Reverse Engineering helps?	It helps in designing new products, which are better than those of the competitors.
195	What is Manufacturability?	Manufacturability implies designing a product in such a way that its manufacturing/assembling can be done easily
196	While designing a new product, the manufacturing capabilities of the organizations have to be kept in mind. True/False?	True
197	If the required capabilities do not exist, the management can be considerenhancing the production capabilities by making more investment. True/False?	True
198	What is standardization?	Standardization refers to less variety in the design of products. New productsare designed such that there is no major variation from the existing products.
199	Do Lack of standardization creates problem, while it presents benefit such as lower design costs?	Yes
200	modules are sub-assemblies of different components and part. True/False?	True



201	Do Modular design is another type of standardization, which means designing a product in parts or modules?	Yes
202	What do you know by Modules?	Modules are sub-assemblies of different components and part Modules are sub-assemblies of different components and part
203	Do standardization approach reduces a lot of effort and time required to design the product?	Yes
204	The inventory management of module also is simple in comparison to that of large number of different components in a non-modular design. True/False?	True
205	What is Robust design?	Robust design means designing a product that is operational in varying environmental conditions.
206	Is it easier to create a product with robust design rather than making changes in the environment to suit the product?	Yes



207	What is Concurrent engineering?	Concurrent engineering is the product design approach in which the design team includes personnel from the marketing, engineering, production, materials department, finance department, etc.
208	What is classical sequential product design approach?	The classical sequential product design approach in which the design process takes place in stages, moving from one department to the other.
209	Concurrent engineering saves a lot of time and effort unlike the sequential approach in which feedback between departments, at times leading to rejections of the suggested designs at later stages, results in the wastage of a lot of time and effort. True/False?	True
210	What are the stages of Product life cycle?	The product life cycle has five stages throughout the life of a product, namely, incubation, growth, maturity, saturation, and decline.
211	The duration of life cycle of a product depends upon what?	The duration of life cycle of a product depends upon the type of product.
212	Why Incubation witnesses a low demand of product ?	Incubation witnesses a low demand of product due to less awareness about the product.



213	What is growth phase?	As the awareness increases the demand tends to increase, this stage is called the growth phase.
214	What is maturity stage?	when the demand tends to become stable and even new features do not appeal much to the masses.
215	What is CAD?	Computer-aided design is a software which helps the designer to make the three-dimensional design of a product on the computer and visualize the design from various angles.
216	when CAD software were not available, how design engineers had to make designs?	when CAD software were not available, design engineers had to make designs from various angles on paper charts which was tedious and time consuming.
217	The designs made on CAD can be transmitted to distant location using the sources say internet and can be seen simultaneously through intranet. True/False?	True
218	When IDEA GENERATION begin?	The design process begins with understanding the customer and actively identifying customer needs.



219	What is helping the companies to learn from their competitors	Perceptual Maps, Benchmarking and Reverse Engineering can be helpful to companies to learn from their competitors.
220	What do Perceptual Maps do?	Perceptual Maps compare customer perception to companies' product with competitor's product.
221	What is Benchmarking?	It refers to finding the best in class product or process, measuring the performance of your product or process against it and making recommendations for improvement based on results
222	What do you mean by Reverse Engineering?	Reverse Engineering refers to carefully dismantling and inspecting a competitor's product to look for design features that can be incorporated into your own product.
223	A feasibility study consists of what?	A feasibility study consists of market analysis, economic analysis and technical and strategic analysis
224	The market analysis assesses whether there is enough demand for the proposed product to invest in developing it further. True/False?	True
225	What is Reliability?	The probability is that the product will perform its intended function for a specific period of time.



226	What is Maintainability?	The ease with which a product is maintained or repaired. Products can be made easier to assemble them into modules like computers.
227	What is Pilot Run and Final Test?	Final design consists of detailed drawing and specifications for the new product, accompanying with process plan including component and tooling, description and procedure for workers and computer program for automated machines
228	Do many brands of cars use exactly same brand of tires?	Yes
229	Designer should always bear in mind that specifications do not have a life of their own; they are there to provide functionalities to customer. True/False?	True
230	A company's design process is effective if its product serves customers' requirement better than those of competitors and if it can be easily and economically. True/False?	True
231	How do Simplification helps in Product design?	By Reducing the number of parts, Assemblies or options in a product.



**SHREE H.N.SHUKLA COLLEGE OF MANAGEMENT STUDIES, RAJKOT
AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY**

Lalpari Campus,
Near Lalpari Lake,
B/H Marketing Yard,
Amargadh (Bhichri), Rajkot
Ph. No. 9727753360

3 – Vaishalinagar
Nr. Amrapali Railway Crossing
Raiya Road,
Rajkot - 360001
Ph.No–(0281)2471645

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