# CHAPTER-II
# PRODUCTION SYSTEM

## 2.1 Introduction

A "Production System" is a system whose function is to transform an input into a desired output by means of a process (the production process) and of resources. The definition of a production system is thus based on four main elements: the input, the resources, the production process and the output.

**Resources**
**Input-Production Process-Output**

Most of the organizations (including non-profit organization) can be described as production systems.These organizations transform (or convert) a set of inputs (such as materials, labour, equipment, energy etc.) in to one or useful outputs. The outputs of a production system are normally called products. These products may be:

(a)Tangible goods (Steels,chemicals etc.) (b)Intangible services (Teaching,health care etc.) (c)combination of (a) and (b) (fast food,tailoring etc.)

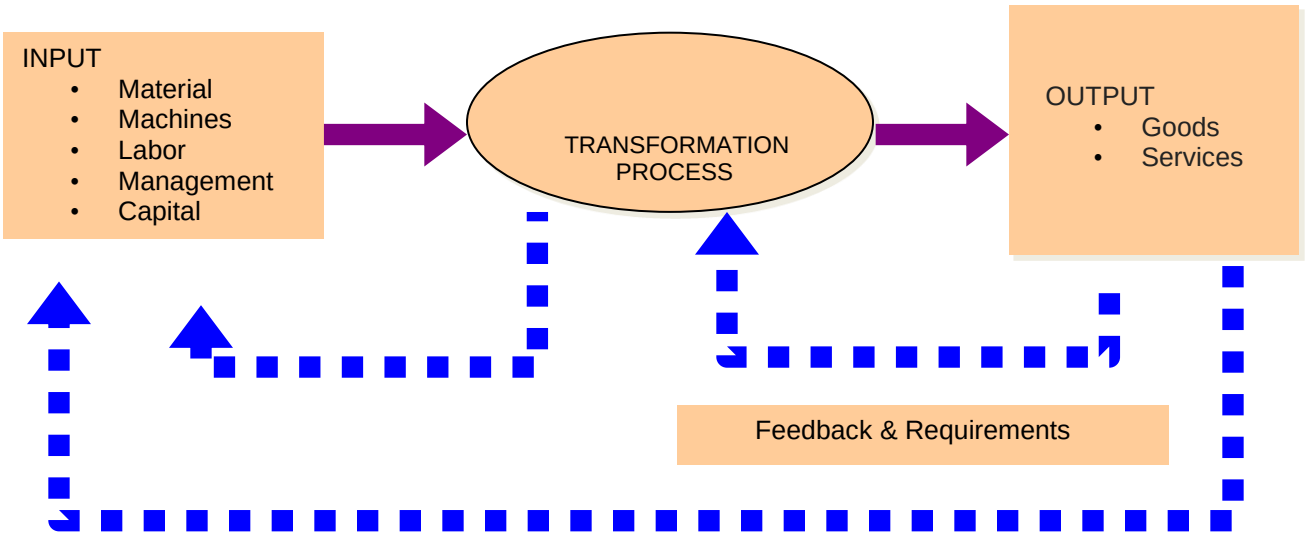


Fig 2.1 A simple block diagram of a production system

Production system refers to manufacturing subsystem that includes all functions required to design, produce, distribute and service a manufactured product. So this system produces goods and/or services on a continuous and/or batch basis with or without profit as a primary objective.

Production is the basic activity of all organizations and all other activities revolve around production activity. The output of production is the creation of goods and services which satisfy the needs of the customers. In some organization the product is physical (tangible) good. For example, refrigerators, motor cars, television, toothpaste etc., while in others it is a service (insurance, healthcare etc.).The production system has the following characteristics:

- Production is an organized activity, so every production system has an objective.
- The system transforms the various inputs (men, material, machines,information,energy) to useful outputs (goods and/or services).
- Production system doesn't oppose in isolation from the other organization system such as marketing, finance etc.
- There exists a feedback about the activities which is essential to control and improve system performance.

  The transformation process involves many activities and operation necessary to change inputs to output. These operations and activities can be mechanical, chemical, inspection and control, material handling operation etc.

**2.2 Models of Production system:**

A model is a representation of reality that captures the essential features of an object/system/process. Three types of models are there such as physical, schematic and mathematical.

*I.* *Physical model:* Replica of a physical object with a change of scale.
a. For big/huge structure of physical object: small scale (Ex. solar system)
b. For microscopic objects: magnified scale(Ex. Atomic model)

*II.* *Schematic model:* These are 2-D models which represents

- Price fluctuations with year.
- Symbolic chart of activities in sequence for a job.
- Maps of routings
- Networks of timed events.

The pictorial aspects are useful for good demonstration purposes.

*III.* *Mathematical model:*

Formulas and equations have long being the servants of physical sciences. One can represent the important aspect of a system/problem in mathematical form using variables, parameters and functions. This is called mathematical model .by analyzing and manipulating the mathematical model, we can learn how the real system will behave under various conditions.

## 2.3 Product vs. services

| Product | Services |
|---|---|
| 1-tangible, durable products.<br>2- Output can be inventoried.<br>3-consumption/use takes more time.<br>4-low costumer's involvement.<br>5-long response time.<br>6-available at regional, national and international market.<br>7-Reqire large facilities.<br>8-Capital intensive.<br>9-Quality easily measured.<br>10-Demand variable on weekly, monthly, seasonally. | 1- Intangible, perishable products.<br>2- Output can't be inventoried.<br>3-Immidiate consumption.<br>4- High costumer's involvement.<br>5- Short response time.<br>6-local market.<br>7- Require small facilities.<br>8-Labour intensive.<br>9- Quality not easily measured.<br>10- Demand variable on hourly, daily, weekly basis. |

*Explanations*

Manufacturing organization generally transfer tangible inputs or raw materials into some tangible output (ex: steel, refrigerator, toothpaste, soap etc.) Other inputs such as labour skills, management skills, capitals are used as well. Manufacturing organizations perform some chemical /physical processes (such as blending refining, welding, grinding.etc) to transfer their raw material into tangible products. Service providing organization though transform a set of input into set of output, they don't produce a tangible output.(ex: mail service, library service, restaurant etc.).or provide service(ex: health care, hair care, watch and automobile repair etc.). The service of service providing organization is intangible.

A 2nd distinction is based on inventories .durable goods can be kept for longer time these goods can be stored for longer time and can be transported in anticipation in future demand .Thus with durable goods ,operation manager can co up with the peaks and valleys in demand by creating inventories and smoothing out output levels. Whereas service can't be pre produced. For example: getting fast food from a fast food center, getting treatment from hospital etc.

A 3rd distinction is based on consumption/use of output. The products (goods) generally take longer period for its use, for ex refrigerator, T.V. automobile etc. can be used at least for 10 years. On the other hand, the output produced from a service operation (i.e. service) is consumed within a small time. Ex. consumption of fastfood,taking hair care, enjoying journey by a bus/train/aero plane enjoying entertainment program.

A 4th distinction is based on customer contact. Most of the consumers/customers have little or no contact with production system/organization. Whereas, in many service providing organization

consumers/customers are directly involved. For example: students in an educational institution, patients in hospital.

The 5th distinction is based on lead time/response time to customers demand. Manufacturers take generally some lead time (i.e. time period from placing the order to get the product) in terms of days/week. Whereas the services are offered within few minutes of customers arrival. For ex: ATM Service, getting postal stamps, getting grocery from a retail shop and getting examined by a doctor etc.

The 6th distinction is on availability. Products can be available from regional, national or international markets due to availability of transportations and distribution facilities whereas, service can't shipped to distant locations. Thus service organization requiring direct customer contact must locate very near to the customers.

The 7th distinction is based on liabilities/facilities. Manufacturing unit/organization producing products generally require larger facilities, more automation and greater capital investment than service providing organization.

The 8th distinction is based on capital/labour priority. Generally manufacturing firm producing goods/products require more capital than a service provider. Ex. An automobile firm requires more capital than a post office/Nursing home. The 9th and 10th distinction is based on quality and demand variation.

### 2.4 Various types of Layout:

***Plant layout*** means the disposition of the various facilities (equipment, material, manpower etc.) and services of the plant within the area of site located.

**Objectives**

- Material handling and transportation is minimized and effectively controlled.
- Bottlenecks and points of congestions are eliminated (by line balancing) so that the raw-material and semi-finished goods move fast from one workstation to other.
- Workstations are designed suitable and properly.
- Suitable spaces are allocated to production centers and service centers.
- The movements made by the workers minimized.

Layout can be classified into the following four categories:

a. process layout
b. product layout
c. Group layout(combination layout)
d. Fixed position layout

***a. process layout:***

- It is also known as functional layout.
- Here similar machines and services located together Ex. All the lathe machines will be at one place and all milling machines at another place and so on.
- This type of layout generally employed for industries engaged in job-shop production and non-repetitive kind of production.
- When there variety of products manufactured at low volume we prefer this type of layout.
- Ex. furniture manufacturer company, restaurant etc.

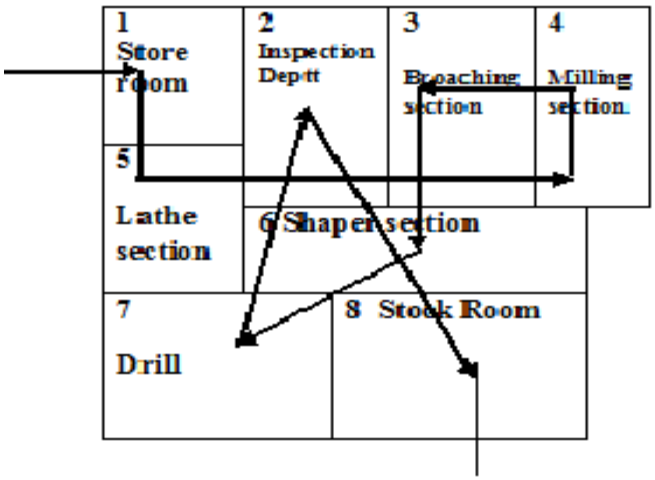


Fig 2.2 process layout

***b. Product layout***

- It is also known as line (type) layout.
- The flow of product will smooth and logical.
- When the machines and auxiliary services are located according to the processing sequence we prefer this layout.
- It implies that various operations raw material are performed in a sequence and the machines are placed along the product flow line.
- The product layout is selected when the volume of production of a product is high such that separate production line to manufacture it can be justified.
- Assembly line production or mass production prefer this type layout. Ex. Assembly of television sets assembly of computer key-board etc.


Fig 2.3 product layout

### *c. Group layout:*

- It is the combination of both process and product layout.
- In this type of layout a set of machinery or equipment is grouped together in a section so that each group of machines or equipment is used to perform similar operations to produce a family of components. These machines grouped in to cells.
- It minimizes the sum of cost of transport and the cost of equipment.

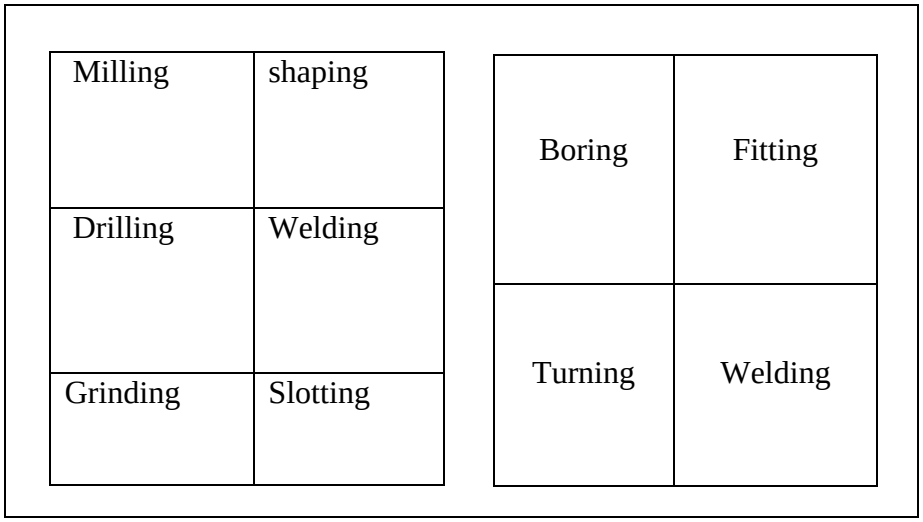


Fig 2.4 Group layout

### *d. Fixed position layout*

- It is also called static product layoutin which the physical characterstics of the product dictate as to which type of machine and men are brought to the product.
- This type layout is inherent in ship building,aircraft manufacture and big pressure vessels fabrication.
- In other type layout the product moves past stationary production equipment where as in this case men and equipment are moved to the material at one place and the product is completed at the place where the material lies.

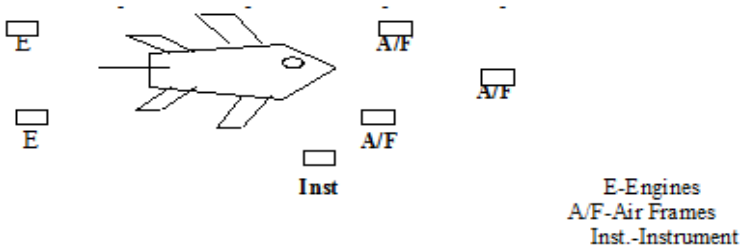


Fig 2.5 Fixed position layout

### 2.5 Process-focused and product-focused system:

In process-focused system the arrangement of facilities is made according to the process layout and in product-focused system the arrangement of facilities is made according to the product layout.

**Comparison of process oriented layout and product oriented layout**

| Sl No. | Different Aspects | Process oriented | Product oriented |
|---|---|---|---|
| 1 | Product | Diversified products using operations, varying rate of output or small batches of many different products | Standardized product, large volume,stable rate of output |
| 2 | Workflow | Variable flow depending on nature of job | Identical flow and same sequence of operations for each unit. |
| 3 | Human skills | Semiskilled craftsman and able to do various/different categories of work | Highly specialized and able to perform repetitive tasks at fixed place |
| 4 | Supporting staffs | Less;scheduling,material handeling,production and inventory control | Large; schedule materials and people, monitor and maintain works |
| **5** | Material handling | Material handling cost high,handeling sometimes duplicated | Less dectble , flow systematized and often automated. |
| **6** | Inventory | In process inventory less | In process inventory high |
| **7** | Space utilization | Space and capital are tied up by work in process | Less space is occupied by work in transit and for temporary storage. |
| **8** | Capital requirement | Comparatively low investment in machines required | Large investment in specialized equipment and processes |
| **9** | Production cost | Relatively low fixed cost, high variable cost(for direct labour,material and material handling) | Relatively high fixed cost, low variable cost (for labour and materials) |
| **10** | Production time | Through time is larger. | Throughput time is lesser. |
| **11** | Flexibility of design change | high | low |
| **12** | Effect of breakdown | Break down of any machine doesn't effect much on the final output | Seriously affected; as all are interrelated system. |

## 2.6 Product life cycle

A product life cycle consist of 5 stages through which a product passes that is *introduction *growth*maturity*decline. the figure shown previously represent sales and profit associated with each stage and some practical example of products are also shown on it.

### 1. Introduction

At this stage, sales begin and profit goes from –ve to +ve. In this stage ,the demand is low .because the costumer don't know much about the product. The organization has to invest heavily in advertisement to make the product familiar to the costumers. the volume sales are low,and if proper care is not taken, there is chances to product failure.

### 2.Growth

The product next enters a stage at rapid growth. Early in this stage (due to acceptability of the product by the costumer) there is drastic jump in sales and profit rise. It is because of limited or no competition. During this stage the mandate for operation is somehow to keep up with demand; efficiency is less of concern.

### 3.Maturity

During this stage, sales level off and profit begins to decline. New competition create to cut costs and ultimately on unit profit margin. Now operation must stress on efficiency, although marketing can ease the pressure by intensifying to differentiate the product.

### 4.Decline

At last the existing product enters to a declining stage and becomes obsolete. Either demand despisers or a better less expensive product.

Life cycle suggest when to eliminate the existing product and introduce a new one. This life cycle varies greatly from product to product. For example it took 15 years for "Xerox" to introduce electrostatic copy m/c .in contrast and computer and microchip industry, products become obsolete in months.

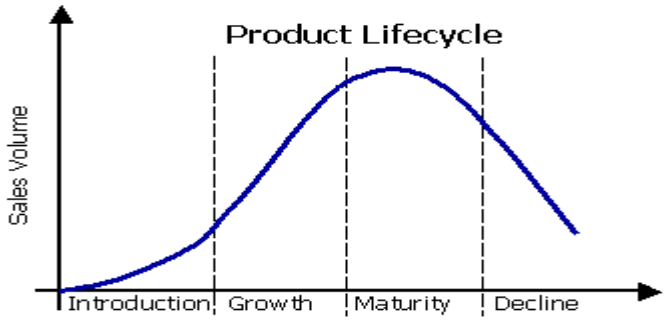


Fig 2.6. product life cycle

**2.7 Production function**

**(a) Functions of industrial enterprise**

**(b) Functions of process**

(a)Functions of industrial enterprise

The major functions of a relatively large industrial firm is represented by the following figure

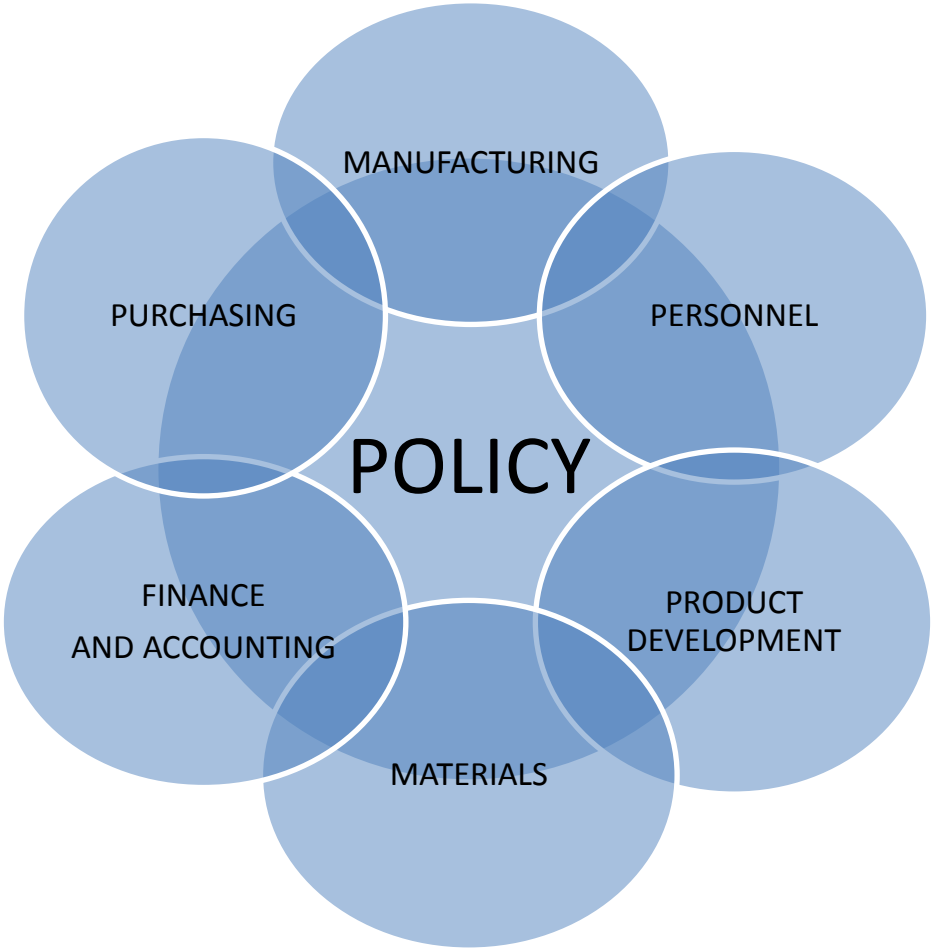


Fig 2.6 of production function a enterprise

The core area of the diagram represents the organization's policy making group. In a hierarchic triangle, this group would occupy the apex. The overlapping portions of the circle denote the co-operation needed from the two groups in order to establish overall policy. The slope of each function and its relationship to the production process are briefly discussed in the following.

**(i)Manufacturing**

A fundamental function of much production system is to produce a physical output. Manufacturing includes the operations and direct support services for making the product operation management is concerned with production scheduling, performance standards, method improvement, quality control, plant layout and material handling. A plant service section handles shipping receiving, storing and transporting raw material parts and tools. The plant engineering group is usually responsible for in-plant construction, maintenance, design of tools and equipment and other problems of mechanical, hydraulic or electrical nature.

**(ii) personnel**

The recruitment and training of the personnel needed to operate the production system are the traditional responsibilities of the personnel function. Along with it, this department takes care health, safety, wage administration of the employees. Labour relation and employee services and benefits are increasingly important.

**(iii) Product development**

Many organizations give major emphasis on product development because the ultimate profit of any organization depends primarily on the nature/quality of product. The product must be customized. A separate section is responsible for this task.

**(iv)Marketing**

Many ideas of product development comes through the marketing function. Selling is the primary interest of marketing. Sales forecasts and estimate of the nature of future demands is also performed by this department. Contact with customers provide feedback about the quality expected from the firm and opinion on how well the products meet quality standard.

**(v) Finance and accounting**

Internal financing includes reviewing the budgets for operating sections, evaluating of proposed investments for production facilities and preparing balance sheet. Besides these the other responsibilities is to see how well the firm is scoring in the business competition game.

In this business game analogy the accounting functions are collection of cost data for materials direct labour and overhead. Special reports are prepared regarding scarp, parts and finished goods inventories, pattern of labour hours and similar data applicable to production activities.

### (vi) Purchasing

In a narrow sense, purchasing is limited to accounting materials from outside sources. But while carrying out this activity, it requires to investigate the reliability of vendors, type of materials needed, co-ordinating material purchase volume with the requirement as per schedule, discovering new material and process. The purchasing function serves the other functional areas, overlap sometimes with inventory control, material inspection, shipping and receiving, sub-contracting and internal transportation.

## (b)Functions of production process

Another was to group functions is according to their relative position in a production process. the sequential arrangement is shown in the following

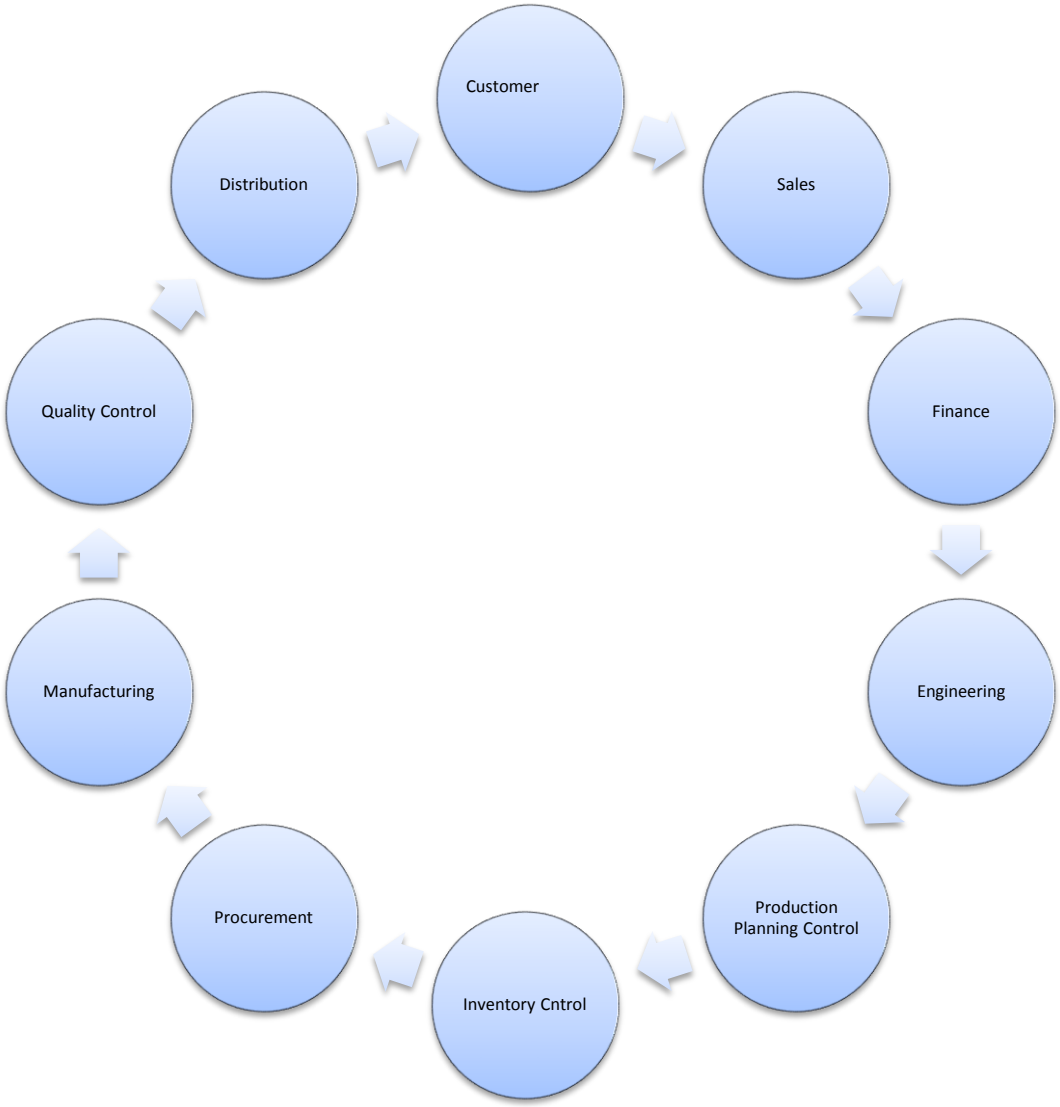


Fig 2.7 functions of production process

## 2.8 Types of production system:

The production system of a company mainly uses facilities, equipments and operating methods(called the production system) to produce goods that satisfy customers' demand.The above requirements of a production system depend on the type of product that the company offers and the strategy that it employs to serve its customers. The classification of production system is explained in the table.

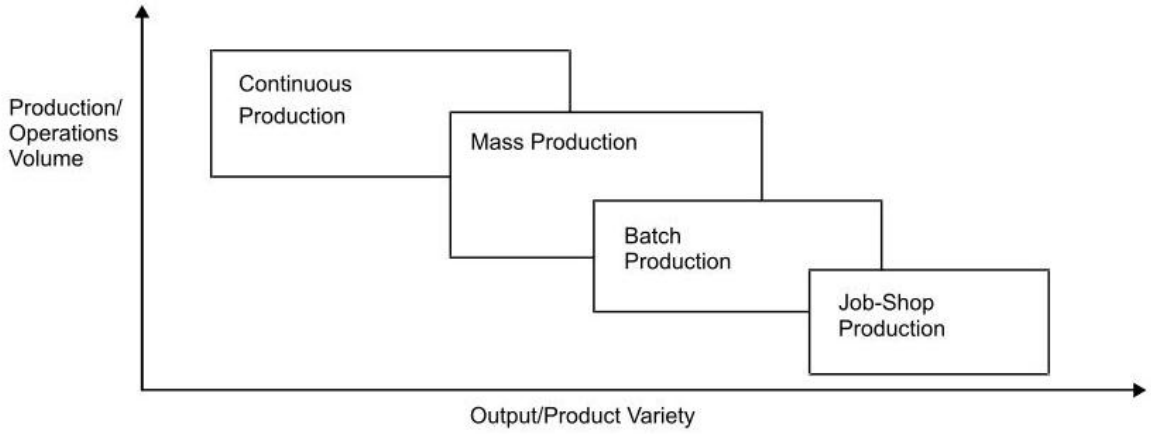


Fig 2.6 Classification of production systems

***Job shop production***

- Job shop is appropriate for manufactures of small batches of many different products, each of which is custom designed and requires its own unique set of processing steps or routing through production process.
- The production system in which different types of product follow different sequences through different shops. Ex. Furniture manufacturing company, restaurant, prototype industry.
- Much time is spent waiting for access to equipment. Some equipment overloaded.
- A process technology suitable for a variety of custom designed products in some volume.
- This production system adopts process layout as by this production system we manufacture more variety of products at low product volume.

***Batch production***

- A process technology suitable for variety of products in varying volumes.
- Here limited product variety which is fixed for one batch of product. Ex. Bakery shop, medicine shop.

- Within the wide range of products in the facility, several are demanded repeatedly and in large volume.
- This type of production system should be preferred when there is wide variety of products in wide variety of volumes.

***Assembly line (mass) Production***

- A process technology suitable for a narrow range of standardized products in high volumes.
- The successive units of output undergo the same sequence of operation using specialized equipment usually positioned along a production line.
- The product variety is fixed here. Ex. Assembly of television sets, assembly of auto, assembly of computer keyboard, cold drinks factory etc.

***Continuous production***

- A process technology suitable for producing a continuous flow of products.
- The product is highly standardized.
- Material and products are produced in continuous, endless flows, rather than in batches or discrete units.
- Continuous flow technology affords high volume, around-the clock operation with capital intensive, specialized automation.

**2.9 Dimensions of Product Strategies:**

- **Product-Positioning.**
- **Product-Repositioning.**
- **Product-Overlap.**
- **Product Scope.**
- **Product-Design.**
- **Product Elimination.**
- **New Product.**
- **Diversification.**
- **Value-Marketing.**

***Product Positioning***: The Procedure

1. **Analyze** product attributes that are salient to Customers.
2. **Examine** the distribution of these attributes among different segments.

3. **Determine** the optimal position for the product in regard to each attribute, taking into consideration the position occupied by existing brands.
4. Choose an overall position for the product (based on overall match between product attributes and their distribution in the population and the position of existing brands)

Product Positioning Strategy

- **Definition**: Placing a brand in that part of the market where it will have a favorable reception compared with competing brands.
- For Ex The marketers of "Liril" soap wants the people to think "Liril" when they think soap. The marketers of "Colgate" want the consumers to think "Colgate" when they think toothpaste etc.
- **Objective**
  - To position the product in the market so that it stands apart from competing brands. (b) To position the product so that it tells customers what you stand for, what you are, and how you would like customers to evaluate you. In the case of positioning multiple brands:
    - (a) To seek growth by offering varied products in differing segments of the market.
    - (b) To avoid competitive threats to a single brand
- **Requirements**: Use of marketing mix variables, especially design and communication efforts.
  - Successful management of a single brand requires positioning the brand in the market so that it can stand competition from the toughest rival and maintaining its unique position by creating the aura of a distinctive product.
  - Successful management of multiple brands requires careful positioning in the market so that multiple brands do not compete with nor cannibalize each other. Thus it is important to be careful in segmenting the market and to position an individual product as uniquely suited to a particular segment through design and promotion.
  - Expected Results:
  - Short term success
  - Meet as much as possible the needs of specific segments of the market

- Limit sudden changes in sales.
- Make customers faithful to the brands.

***Product Re-positioning Strategy***

- **Definition**: Reviewing the current positioning of the product and its marketing mix and seeking a new position for it that seems more appropriate.
- **Objectives**: (a) To increase the life of the product. (b) To correct an original positioning mistake.
- **Requirements:**
  - If this strategy is directed toward existing customers, repositioning is sought through promotion of more varied uses of the product.
  - If the business unit wants to reach new users, this strategy requires that the product be presented with a different twist to the people who have not been favorably inclined toward it. In doing so, care should be taken to see that, in the process of enticing new customers, current ones are not alienated.
  - If this strategy aims at presenting new uses of the product, it requires searching for latent uses of the product, if any. Although all products may not have latent uses, there are products that may be used for purposes not originally intended.
- **Expected Results:**
  - Among existing customers: increase in sales growth and profitability.
  - Among new users: enlargement of the overall market, thus putting the product on a growth route, and increased profitability.
  - New product uses: increased sales, market share, and profitability.

***Product Overlap Strategy***

- **Definition**: Competing against one's own brand through introduction of competing products, use of private labeling, and selling to original-equipment manufacturers.
- **Objectives:** Product overlap strategies can include selling similar goods in different markets, regions or international countries. For example, a company may sell widgets and cogs; both offer extremely similar consumer benefits. However, the company may sell widgets in the United States and cogs in Canada.
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- **(a)** To attract more customers to the product and thereby increase the overall market.
- (b) To work at full capacity and spread overhead.
- (c) To sell to competitors; to realize economies of scale and cost reduction.

- **Requirements:**
  - (a) Each competing product must have its own marketing organization to compete in the market.
  - (b) Private brands should not become profit drains.
  - (c) Each brand should find its special niche in the market. If that doesn't happen, it will create confusion among customers and sales will be hurt.
  - (d) In the long run, one of the brands may be withdrawn, yielding its position to the other brand
- **Expected Results:**
  - Increased market share.
  - Increased growth.

***Product Scope Strategy***

- **Definition**: The product-scope strategy deals with the perspectives of the product mix of a company. The product-scope strategy is determined by taking into account the overall mission of the business unit. The company may adopt a single-product strategy, a multiple-product strategy, or a system-of-products strategy.
- **Objectives:**
  - Single product: to increase economies of scale by developing specialization.
  - Multiple products: to cover the risk of potential obsolescence of the single product by adding additional products.
  - System of products: to increase the dependence of the customer on the company's products as well as to prevent competitors from moving into the market.
- **Requirements:**
  - (a) Single product: company must stay up-to-date on the product and even become the technology leader to avoid obsolescence.
  - (b) Multiple products: products must complement one another in a portfolio of products.

- (c) System of products: company must have a close understanding of customer needs and uses of the products.

- **Expected Results:** Increased growth, market share, and profits with all three strategies. With system-of-products strategy, the company achieves monopolistic control over the market, which may lead to some problems with the Justice Department, and enlarges the concept of its product/market opportunities.

***Product Design Strategy***

- **Definition**: The product-design strategy deals with the degree of standardization of a product. The company has a choice among the following strategic options: standard product, customized product, and standard product with modifications.
- **Objectives:**
  - Standard product: to increase economies of scale of the company.
  - Customized product: to compete against mass producers of standardized products through product-design flexibility.
  - Standard product with modifications: to combine the benefits of the two previous strategies.
  - Requirements:
  - Close analysis of product/market perspectives and environmental
  - Changes, especially technological changes.
- **Expected Results:**
  - Increase in growth, market share, and profits. In addition, the
  - third strategy allows the company to keep close contacts with the market and
  - Gain experience in developing new standard products.

***Product Elimination Strategy***

- **Definition**: Cuts in the composition of a company's business unit product portfolio by pruning the number of products within a line or by totally divesting a division or business.
- **Objectives:**
  - To eliminate undesirable products because their contribution to fixed cost and profit is too low,

- Eliminate Products that its future performance looks grim, or because they do not fit in the business's overall strategy.
- The product elimination strategy aims at shaping the best possible mix of products and balancing the total business.
- Requirements:
- No special resources are required to eliminate a product or a division.
- However, because it is impossible to reverse the decision once the elimination

- **Requirements:**
  - No special resources are required to eliminate a product or a division.
  - An in-depth analysis must be done to determine
    - (a) the causes of current problems;
    - (b) The possible alternatives, other than elimination, that may solve problems (e.g., Are any improvements in the marketing mix possible?);
    - (c) The repercussions that elimination may have on remaining products or units.
    - Expected Results:
  - In the short run, cost savings from production runs, reduced
  - inventories, and in some cases an improved return on investment can be
  - Expected. In the long run, the sales of the remaining products may increase because more efforts are now concentrated on them.

***New Product Strategy***

- **Definition:** A set of operations that introduces (a) within the business, a product new to its previous line of products; (b) on the market, a product that provides a new type of satisfaction. Three alternatives emerge from the above: product improvement/modification, product imitation, and product innovation.
- **Objectives**: To meet new needs and to sustain competitive pressures on existing products. In the first case, the new-product strategy is an offensive one; in the second case, it is a defensive one.
- **Requirements:** A new-product strategy is difficult to implement if a "new product development system" does not exist within a company. Five components of this system should be assessed:

- Corporate aspirations toward new products,
- Organizational openness to creativity.

- **Requirements:** A new-product strategy is difficult to implement if a "new product development system" does not exist within a company. Five components of this system should be assessed:
  - Environmental favor toward creativity
  - Screening method for new ideas, and Evaluation process
- **Expected Results:** Increased market share and profitability.
  - are now concentrated on them.

***Diversification Strategy***

- **Definition**: Developing unfamiliar products and markets through:
  - Concentric diversification (products introduced are related to existing ones in terms of marketing or technology),
  - Horizontal diversification (new products are unrelated to existing ones but are sold to the same customers)
  - Conglomerate diversification (products are entirely new).
- **Objectives:** Diversification strategies respond to the desire for:
  - Growth when current products/markets have reached maturity,
  - Stability by spreading the risks of fluctuations in earnings,
  - Security when the company may fear backward integration from one of its major customers,
  - Credibility to have more weight in capital markets.
- **Requirements:** In order to reduce the risks inherent in a diversification strategy, a business unit should:
  - Diversify its activities only if current product/market opportunities are limited.
  - Have good knowledge of the area in which it diversifies.
  - Provide the products introduced with adequate support.
  - Forecast the effects of diversification on existing lines of products.
  - Expected Results:
  - Increase in sales.
  - Greater profitability and flexibility

***Value Marketing Strategy***

- **Definition**: The value-marketing strategy concerns delivering on promises made for the product or service. These promises involve product quality, customer service, and meeting time commitments.
- **Objectives:** Value-marketing strategies are directed toward seeking total customer satisfaction. It means striving for excellence to meet customer expectations.
- **Requirements:**
  - (a) Examine customer value perspectives.
  - (b) Design programs to meet customer quality, service, and time requirements.
  - (c) Train employees and distributors to deliver on promises.
  - Expected Results: This strategy enhances customer satisfaction, which leads to customer loyalty, and, hence, to higher market share. This strategy makes the firm less vulnerable to price wars, permitting the firm to charge higher prices and, thus, earn higher profits.