SYLLABUS

B.B.A. III SEM

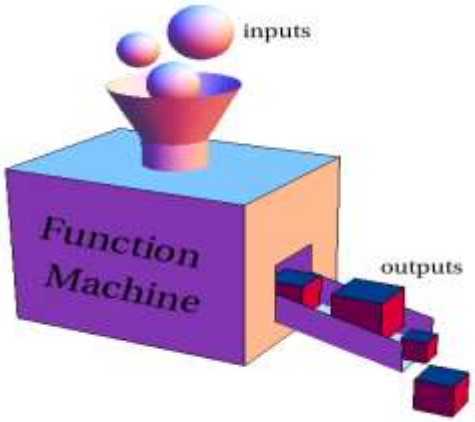
Subject – Operations Management

UNIT – I	**Introduction to productions and operations management: Nature of production, productions and system, production as an organizational function, decision making in production, production management and operations management, Characteristics of modern production and operation management, organization of production function, recent trends in production/operations management.**
UNIT – II	**Production process, manufacturing and service operations: production process, manufacturing operation, service operations, selection of process non manufacturing or service operations, difference between manufacturing and service operations, classification of manufacturing process, manufacturing operations as conversion process, characteristics of modern manufacturing process,**
UNIT – III	**Design of production system: Product, process and production design, factors influencing product design, approaches for product design, process planning and process design, process selection, process management, major process decisions,**
UNIT – IV	**Plant location & Plant layout – Location theories, freedom of locations, errors in selection, steps in location selection, relative importance of location factors, location models, Meaning, definition scope and of facility layout, factors influencing layout, types of layout, importance of layout, layout planning, layout tools and techniques, analysis if layout with computers, criteria for selection and design of layout, layout design procedure.**
UNIT – V	**Materials Management – functions, meaning and operations, – overview of materials planning & material requirement planning, over view of Store management – objectives & functions.**
UNIT – VI	**Quality control – Purpose of inspection and quality control – control charts and acceptance sampling by variable and attributes. Sample plan OC curve, AQL, AOQL, LTPD.**

UNIT – I
Introduction to operations management

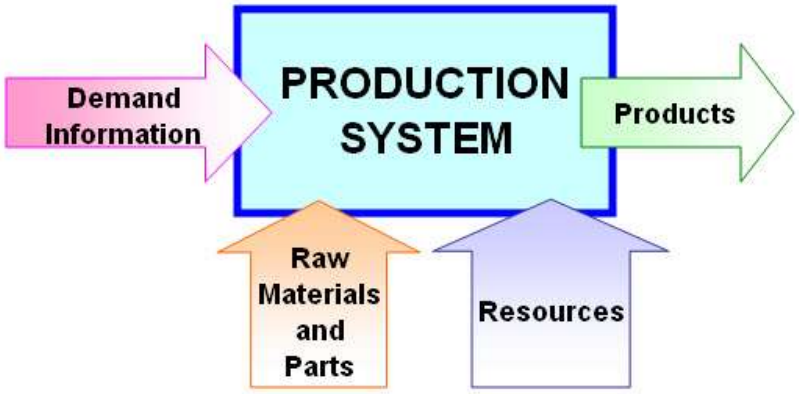
Introduction

Production is the center of all activities of an organization. An organization has many activities such as: Finance, Personnel, Marketing, etc. all of which are dependent on production activity. Hence the position of Production Management in an organization is very important.

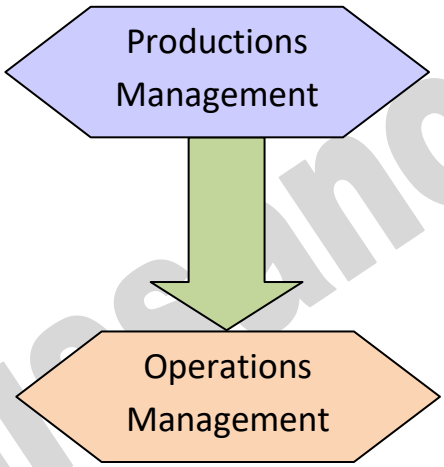


Definitions of Production/Operations Management

1. POM is concerned with that process which converts inputs into outputs. The input are various resources like raw materials, men, machines technology etc. The outputs are goods & services.
2. Production Management: Deals with decision making related to production process so that resulting goods or services are produced according to specifications in amount & by schedules demanded & at minimum cost.
3. Operations management is that activity where by resources are combined and transformed in a controlled manner to add value in accordance with policies communicated by management.
4. POM is multidisciplinary approach which integrates the knowledge of science, technology, engineering & management to convert I/P into O/P's.



Shift from Production Management to Operations Management

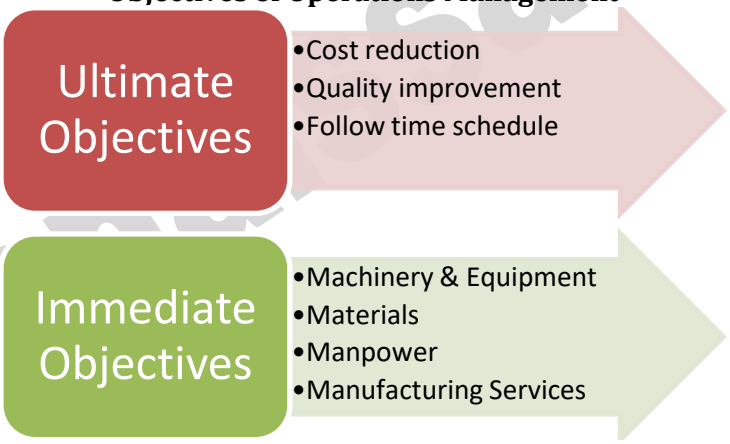


Till the early 1970s, the term 'Production Management' was used but an important change emerged during the 1970s which was reflected in the new name – "Operations Management" which incorporated both production and service related concepts and procedures. As the service sector has become more prominent, the change from 'production' to 'operations' indicates the development of the field to service organization.

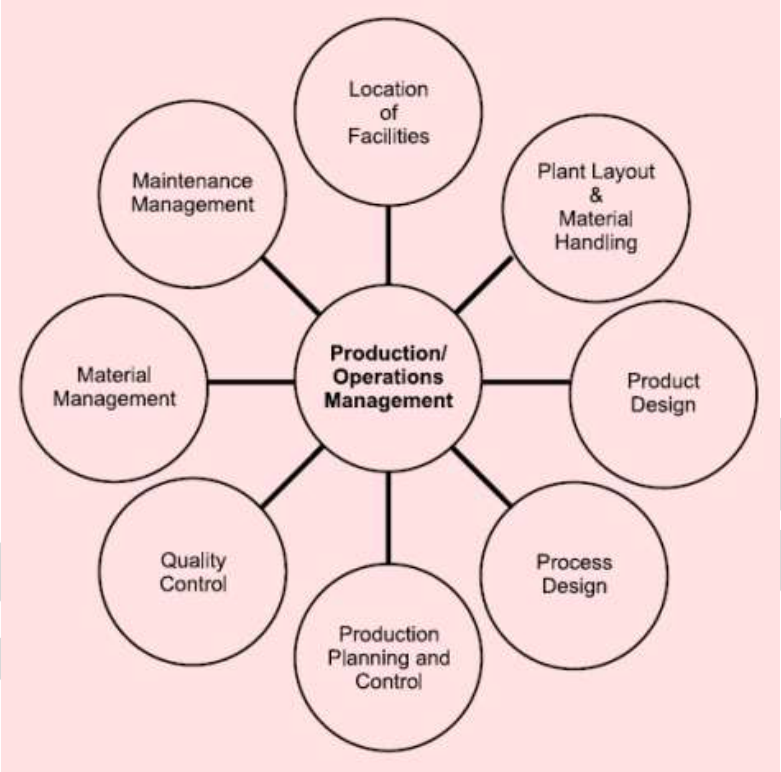
Difference

Base	Production Management	Operations Management
1. Concerned	It is concerned with manufacturing.	**It is concerned with services also.**
2. Nature of output	Output is tangible.	**Output is tangible and intangible also.**
3. Use	In this, job uses less labour and more equipment.	**In this, job uses more labour and less equipment.**
4. Customer participation	**There is no customer participation.**	**Frequent customer participation.**

Objectives of Operations Management



Scope of Operations Management



Functions/Importance of Operations Management

The Important of operations management can be judged by the functions they perform.

(1) Planning: - Planning means defining objective, goals strategies, policies & programs & procedures for production activities & supporting activities.

(2) Organizing: - Organizing means arranging necessary inputs such as materials, machines, Man/labour, location etc for production activities. The concepts involved are –

- Facility Location
- Layout Planning
- Material Resource Planning etc.

(3) Controlling: - Operations Manager exercise control by measuring actual output & comparing them with planned output. Controlling activity includes –

- Quality Control
- Cost Control
- Preparing Produce/Operation Schedules

Decision making in Operation Management

1) **Strategic planning** : Strategic (or long-range) decisions of relevance to the production area (but with important interactions with other functional areas) included which products to produce, on which of the dimensions of cost, quality, delivery and flexibility to compete; where to locate facilities; what production equipment to use; and long-range choices concerning raw materials, energy and labour skills.
2) **Tactical planning** :Tactical (medium-range) plans, with a planning horizon from six months to two years into the future, take the basic physical production capacity constraints and projected demand pattern, established by a long-range plan, and ration available resources to meet demand as effectively and as profitable as possible. Even though basic production capacity is essentially fixed by long-range considerations, production capacity can be increased or decreased within limits in the medium term. A decision can be made to vary one or more of the following: the size of the work force, the amount of overtime worked, the number of shifts worked, the rate of production, the amount of inventory, the shipping modes and possible the amount of subcontracting utilized by the company. These plans, in turn, constrain but provide stability to what can be done at the operational level.
3) **Operational planning :** Operational (short-term) activities provide the day-to-day flexibility needed to meet customer requirements on a daily basis within the guidelines established by the more aggregate plans discussed above. Short-range operating schedules take the orders directly from customers, or as generated by the inventory system and plan in detail how the products should be processed through a plant. In most cases detailed schedules are drawn up for one week, then one day and finally one shift in advance. The schedules involve the assignment of products to machines, the sequencing and routing of orders through the plant, the determination of replenishment quantities for each stock keeping unit and so on.

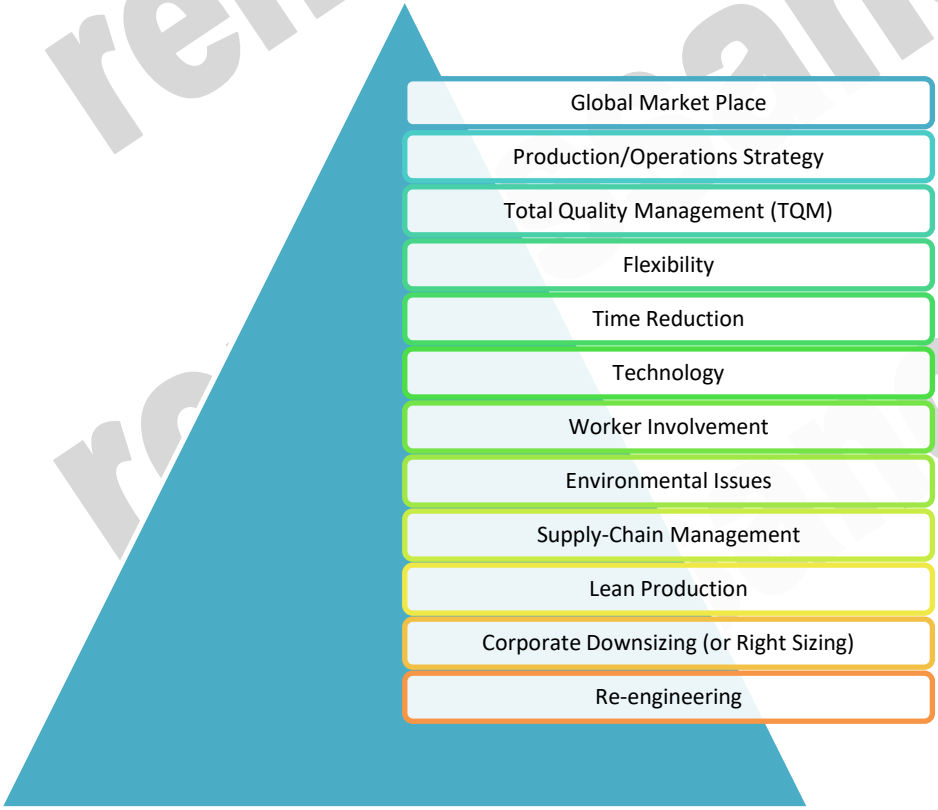
Characteristics of Modern production and operation management

Nature or features or characteristics of production and operation management

1) **It's a transformational process:** The production and operation management is concerned with the conversion of raw material.
2) **Its result into value addition:** In this at every successive level some value is added to the previous one. Example sand at sea shore does not ass any value but sand used in construction adds to the value.

3) **It's a system itself:** It's a complete step wise process i.e. a proper well defined sequence is followed in production and operation management.
4) **It exists for certain objective:** First there is an objective and to meet that particular objective a complete procedure is followed.
5) **It's carried out in part of organization:** Its meaning is that production is not alone in the organization rather there are certain other acts also like finance, research and development etc.
6) **Inter relationship among the system:** No system can ever work in isolation and depends on others for certain help. So, there exists an interrelationship among different system.
7) **Stratum formulation:** A production system consists of various strata of corporate hierarchy in which every stratum has a role to play depending upon the size of the firm. Every stratum enjoys certain benefits as a result of stratum performance.
8) **Specialization of function:** As different functions are performed separately, due to this they are repetitively performed by same people and there is specialization of functions.
9) **Increase in productivity:** As there is specialization in functions so the speed of doing a task increases as a result there is increase in productivity.
10) **Decrease in cost:** Specialization leads to less wastage.

Recent Trends in Production/Operations management



UNIT – 2
Production Process, Manufacturing & Service Organizations

Meaning of Process
A series of stages involving man, machine, method, materials and others resources is known as process through which organizational inputs are transformed into value added output to satisfy customer needs.

Production Process
Also known as 'conversion process' or 'transformation process'.

Manufacturing Operations
Manufacturing operations by which inputs are converted into some tangible outputs.

Service Operations
Service operations are also known as non-manufacturing operations. They are used to transform a set of inputs into a set of outputs which are not tangible. Service operation can be classified into standard services and custom services according to the degree of standardization.

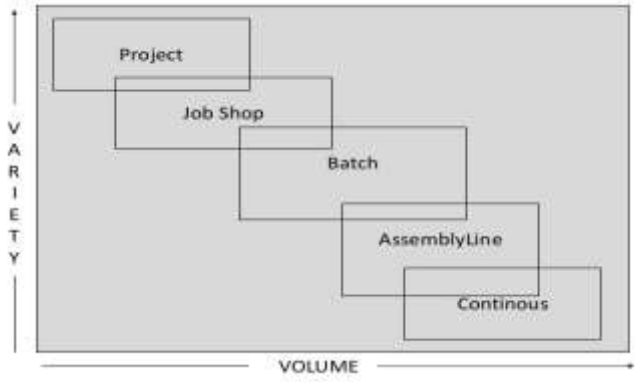
Manufacturing and Services
Common Characteristics of Manufacturing & Service organization:
- Entail customer satisfaction as a key measure of effectiveness
- Require demand forecasting
- Require design of both the product and the process
- Involve purchase of materials, supplies, and services
- Require equipment, tools, buildings, and skills, etc.

Differences between Manufacturing & Service organization:
- **Customer contact**: Service involves a much higher degree of customer contact than manufacturing does. The performance of a service typically occurs at the point of consumption. Manufacturing allows a separation between production and consumption.
- **Uniformity of input** Service operations are subject to more variability of inputs than manufacturing operations are. Each patient, each lawn, each TV presents a specific problem.
- **Labor content of jobs** Manufacturing ---capital –intensive .Service ---a higher labor content.
- **Uniformity of output Products**--standardization, low variability, smooth, efficient. **Service**--customization, variable, slow.
- **Storage of output -** In manufacturing Store Goods may be stored. Services are consumed during delivery, cannot be stored.
- **Measurement of productivity** In manufacturing, measurement is more straightforward In service operation, measurement is more difficult due to variations in demand intensity.

Key Differences Between Service and Manufacturing Operations

Characteristic	Manufacturing	Service
Output	Tangible	Intangible
Customer contact	Low	High
Uniformity of input	High	Low
Labor content	Low	High
Uniformity of output	High	Low
Measurement of productivity	Easy	Difficult
Opportunity to correct quality problems	High	Low

Classification of Manufacturing Process/Types of production system



(A) Job Shop Production: In this system Products are manufactured to meet the requirements of a specific order. The quality involved is small and the manufacturing of the product will take place as per the specifications given by the customer. This system may be further classified as:

(i**) The Job produced only once**: Here the customer visit the firm and book his order. After the completion of the product, he takes delivery of the product and leaves the firm. He may not visit the firm to book the order for the same product. The firm has to plan for material, process and manpower only after receiving the order from the customer. The firms have no scope for pre-planning the production of the product.

(ii) **The job produced at irregular intervals**: Here the customer visits the firm to place orders for the same type of the product at irregular intervals. The firm will not have any idea of customer's visit. Here also planning for materials, process and manpower will start only after taking the order from the customer. In case the firm maintains the record of the Jobs Produced by it, it can refer to the previous plans, when the customer arrives at the firm to book the order.

(iii) **The Jobs Produced periodically at regular intervals**: In this system, the customer arrives at the firm to place orders for the same type of product at regular intervals. Here firm knows very well that the customer visits at regular intervals, it can plan for materials, and process and manpower and have them in a master file. As soon as the customer visits and books the order, the firm can start production. If the volume of the order is considerably large and the number of regularly visiting customers are large in number, the Job Production system slowly transform into Batch Production system.

(B) Batch Production: Batch Production is the manufacture of number of identical products either to meet the specific order or to satisfy the demand. When the Production of plant and equipment is terminated, the plant and equipment can be used for producing similar products. This system also can be classified under three categories.

(i) A batch produced only once: Here customer places order with the firm for the product of his specification. The size of the order is greater than that of job production order. The firm has to plan for the resources after taking the order from the customer.

(ii) **A Batch produced at irregular intervals as per Customer order or when the need arises:** As the frequency is irregular, the firm can maintain a file of its detailed plans and it can refer to its previous files and start production A Batch Produced periodically at known Intervals: Here the firm either receives order from the customer at regular intervals or it may produce the product to satisfy the demand. It can have well designed file of its plans, material requirement and instructions for the ready reference. It can also purchase materials required in bulk in advance. As the frequency of regular orders goes on increasing the Batch Production system becomes Mass Production System. Here also, in case the demand for a particular product ceases, the plant and machinery can be used for producing other products with slight modification in layout or in machinery and equipment.

(C) Continuous Production: Continuous Production system is the specialized manufacture of identical products on which the machinery and equipment is fully engaged. The continuous production is normally associated with large quantities and with high rate of demand. Hence the advantage of automatic production is taken. This system is classified as:

(i) Mass Production: Here same type of product is produced to meet the demand of an assembly line or the market. This system needs good planning for material, process, maintenance of machines and instruction to operators. Purchase of materials in bulk quantities is advisable.

(ii) Flow Production: The difference between Mass and Flow Production is the type of product and its relation to the plant. In Mass Production identical products are produced in large numbers. If the demand falls or ceases, the machinery and equipment, after slight modification be used for manufacturing products of similar nature. In flow production, the plant and equipment is designed for a specified product. Hence if the demand falls for the product or ceases, the plant cannot be used for manufacturing other products. It is to be scraped.

The examples for the above discussed production system are

(i) **Job Production Shop**: Tailors shop; cycle and vehicles repair shops, Job typing shops, small Workshops.

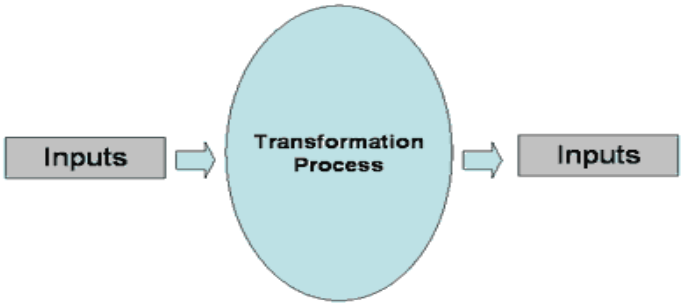
(ii**) Batch Production Shop:** Tyre Production Shops, Readymade dress companies, Cosmetic Manufacturing companies...etc.

(iii) **Mass Production**: Components of industrial products,

(iv) **Flow Production**: Cement Factory, Sugar factory, Oil refineries...etc.

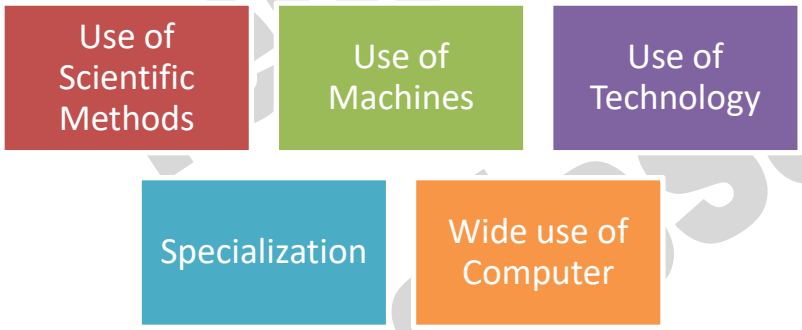
Manufacturing operations as conversion Process

Production and Operations Management ("POM") is about the transformation of production and operational inputs into "outputs" that, when distributed, meet the needs of customers.



The process in the above diagram is often referred to as the **"Conversion Process".**

Characteristics of Modern Manufacturing Process –



UNIT – 3
DESIGN OF PRODUCTION PROCESS

Product Design

Before a product can embark on its journey through the four product life cycle stages, it has to be developed. New product development is typically a huge part of any manufacturing process. Most organizations realize that all products have a limited lifespan, and so new products need to be developed to replace them and keep the company in business. For developing a product, product design is must.

Product Design:

Design has a great impact on the quality of a product or service. If the design of product or service is poor, it may not satisfy needs of the customers.

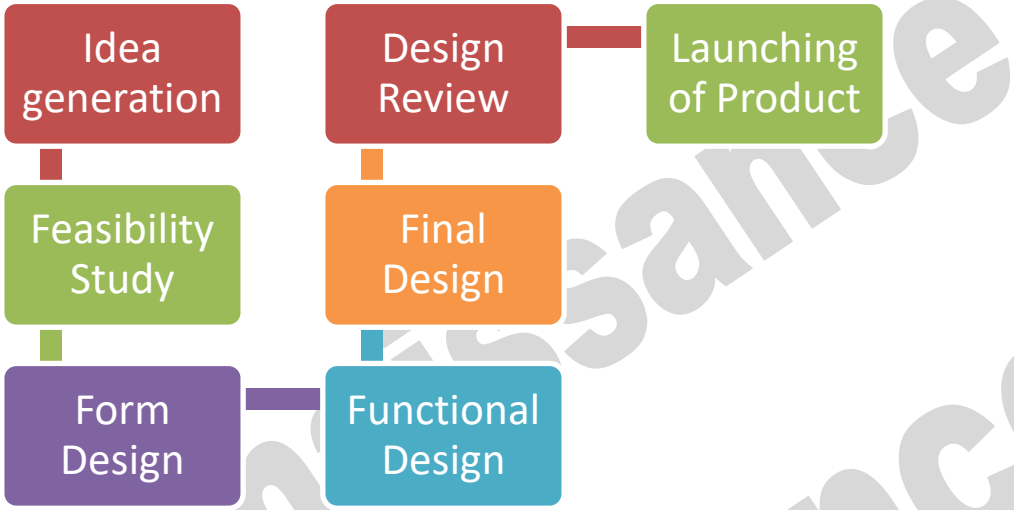
Definition:

"Product design is concerned with the determination of what a product would look like, how it will be made, what function the product will perform and how it will perform."

Objectives of Product Design:

Following are the basic objectives of product design:

Steps of Product Design



1. **Idea Generation**
   Ideas for new products or improvements to existing products can be generated from many sources like complaints or suggestions of cutomers, sales persons in the field, factory workers, marketing research, company's own R&D and new technological developments. Competitors are also a source of ideas for new products and services.

2. **Feasibbility Study**
   Feasibility study means whether the concept is suitable as well as practically possible or not. Different types of ideas may generate from the first stage or product design. Alternative product and service concepts undergo a feasibility study.
   Several type of analysis are performed for this purpose like market analyiss, economic anlysis, techical analysis and strategic analysis. They are described below:
   i) Market analysis determines whether there is eough demand for the proposed product.
   ii) Economic analysis estimates production and development costs and compares them to estimated sales volume.
   iii) Technical analysis determines whether the new product require new technology and whether the company have sufficient labour and management skills to support the required technology.
   iv) Strategic analysis anwer such questions as: Does the new product provide a competitive advantage for the company? Does it draw on corporate strenghts? Is it compatible with the core business of the firm?

3. **Form Design**
   Form design refers to the physical apopearence of a product – its colour, size, shape and style. Other features like image, market appeal and personal identification are also arto of form design.

4. **Functional Deisgn**
   Functional design is concerned with how the product performs. Three performance characteristics are considered during this phase are reliability, maintainbility and usability.

i) **Reliabiity** is the probability that a given product will peform its inended function for a specified length of time under normal conditions of use.
ii) **Maintainability** refers to the cost of maintaining or reparing a product or sevice.
iii) **Usability** means whether the produt or service is good fit for its targeted customer.

5. Production Design

Production design is concerned with how the product will be made. When the designs are difficult to make, they often result in poor quality products. Lack of knowledge about manufacturing capacities may result in designs which are not possible to make. The approaches used to production design are simplifciation, standardization, modularity and design for manufacture (DFM).

6. Final Design

The final design consists of detailed drawing and specifications for the new product or service. Many companies known for creativity and innovation in product desing are slow in getting new products to the market. In order to reduce time-to-market, there is a need for change in the decision making process and the particpants in that process.

7. Design Review

Before finalizing a design, the value of every component and the possibility of its failure should be reviewed.

8. Launching of Product

After assessing the product design on the basis of above criteria, the product may be finally launched. When a product is launched, there is a need for coordinating the supply chain and rolling out marketing plans. These are the areas in which marketing and production department must work together very closely.

Factors Influencing Product design

1. Customers' requirements: The product designers must consider and study the requirements of their targeted customers. The designed product must satisfy customers in terms of good product requirements like quality, performance, reliability, durability, etc. The product must create confidence among customers so that they become loyal to it and start entrusting its company. This will lead to repeated cycle of sales for the company, thus boosting its profits.

2. Production facilities: The product designers must check that production department has got all necessary facilities to produce a product. Simple product design requires minimum production facilities. This will make the job of production department easy, and it will also minimize the cost of production. The machines and tools which are used to produce the product must give comfort and convenience to the employees of production department.

3. Raw-materials to be used: The type and quality of the raw-materials to be used, greatly influence the design and making of a product. The designer must have proper knowledge about latest materials, which are required to produce the product. He must collect information about required materials from primary and secondary sources. He must also find out what materials are used by the competitors for their products.

4. Cost to price ratio: Cost is one of the main factors, which influences the design of a product. Sometimes the product designer is informed about the maximum cost of the product. So he has to design the product within this cost. In such a case, he has no freedom to over-design the product. The product designer is also guided by the cost of competitor's products. It may happen that the designer first designs the product and then the final price of the product is decided. In this case, the designer gets a freedom to design the products. However, he must never over design the product.

5. Quality policy: The design of the product is guided by quality policy, which is fixed by the top level of management. This policy gives, guidelines for quality standard. It sets the design trend for the future. It also builds a particular quality image of the company's products. Some companies prefer to have the 'prestige image' for their products. For e.g. Mercedes-Benz, Rolls Royce, Rolex Watches, etc. Other companies prefer the 'popular image' for their products.

6. Plant and machineries: The product design depends on the availability of plant and machinery. The designer must not design a product which cannot be manufactured by the machines available in the company. The machines to be used for production should be of good quality and in a better condition (well maintained) to meet the needs of the product designers and the quality standards.

7. Effect on existing products: The product designer must consider the impact or effect of the product design on the existing products of the company. An upcoming new product may badly affect the sale of existing products. The designer must avoid this situation. For e.g. a company may design a low-quality product, but it may badly affect the sale of its high quality existing product. Secondly, if a new product is going to replace a former product, then it must be able to use the same manufacturing and distribution strategies of the existing product.

8. Reputation of the company: The product designer must consider the reputation of the company in the

market. Companies which have a good name and goodwill in the market will want their new product designs to match or keep up their positive image.

PROCESS PLANNING AND PROCESS DESIGN

Meaning of Process

A process is a sequence of activities which are performed to achieve some result e.g. creating value for the customers. A process converts inputs into outputs in a production system.

Process Planning

For survival and success of a product or service, it should possess the desired quality standards. It should be produced at the right time (when the customers need it) and the total costs associated with it should be within the budgeted limits. Process planning refers to complete description of the specific stages in the production process. It determines how a product will be produced or a service will be provided. It decides which components will be made in-house and which will be purchased from a supplier.

Process planning is required mostly for new products or services. However, it is also necessary when business or market conditions change, when equipments with better technology are introduced in the market or when the production capacity of the organization is to change.

Process planning is the base for designing factory building, facility layouts and selecting production equipments. It also affects job design and quality control of the organization. Hence, it is important for operations managers to determine how products will be produced or service will be provided.

Process Design

Process design includes choice of process and technology, analysis of flows through operations and the associated job design in operations. Process design is said to be effective for an organization only when it is able to accommodate the product/service design.

Factors Affecting Process Design Decisions

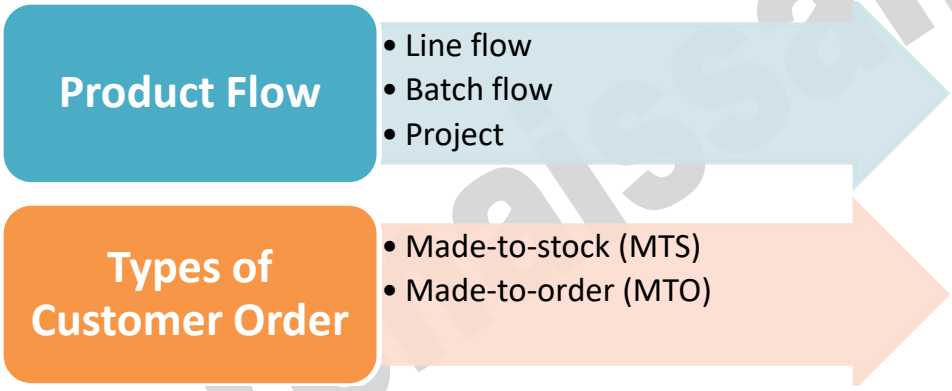
1. **Nature of Demand**:
   The basic objective of any production system is to produce goods or services according to the requirements of customers. It is essential for an organization to schedule its production in such a way that it can always fulfill estimated future demand levels.

The demand for a product does not follow a fixed pattern overtime. The rise or fall of demand is influenced by several factors like seasonal fluctuations, change in fashion and technology etc. The process should be flexible enough to change the production level as per the fluctuations in demand.

2. **Degree of Automation**:
   Automation has become essential for the organization to compete the market. Automation helps an organization to produce goods and services of better quality at reasonable cost within shorter period of time. However, it is not always advisable for a producer to automate all processes completely because savings in labour costs may not justify always the huge investment required for automation. Therefore, operations managers should decide on the degree of automation required for their production processes.
3. **Desired Quality Level**:
   Decision about the desired quality level of products/services affects the design of production process at all stages. The quality level of a product or service decides whether it can compete in the market. The desired level of quality has a direct implication on the degree of automation in he production process.
4. **Flexibility:**
   An organization is said to be flexible when it responds quickly to the changing customers needs or market conditions. Flexibility is essential for organization to increase or maintain their market share. The production processes for organizations must be designed such that the production level may be increased or decreased as per the changes. The flexibility required in a system affects the designs of its production process significantly.
5. **Degree of Customers Contact**:
   For many products and services, the extent of customer contact affects the design of production process. For example, in systems like clinics and schools, the customer is actively involved and the service is directly performed on the customer. In such systems, equipment and employee training should be designed keeping in view the customer. In other systems where customer interaction is negligible like production of steel or cement, the price and speed of delivery are the matter of operations strategies.

Process Selection

There are various types of processes that can be selected and the corresponding situations where a particular process is preferred. Broadly, there are two main types of process classification:



Selection of the Process

The major considerations in any process selection are capacity, flexibility, lead time and efficiency in using resources.

Process selection decision is also influenced by the environment. When new materials become available, different transformation process may become more appropriate. For example, plastic containers have become very popular in place of metal containers.

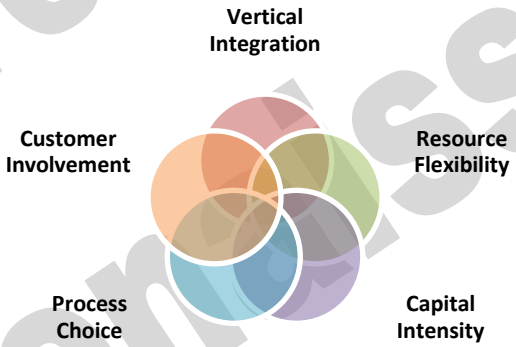
Development of new technology may render a process obsolete because the new technology is more economical, uses cheaper material and produces goods with a high quality level. Previously, the bolts wre made of hexagonal rods.

The competitions also affect the selection of process. If the competitors can deliver the product or service much faster than us, it may lead us to review the form of process selected for our operations functions.

Process Management

Process Management is concerned with the selection of inputs, operations and methods which transform inputs into outputs. It includes process definition, documentation, statistical process control and the tools of quality improvement. "Process management is the application of knowledge, skills, tools, techniques and systems to define, visualize, measure, control, report and improve processes with the goal to meet customer requirements profitability.

Major Process Decisions



The production/operations managers consider five common process decision which are discussed below:

1. **Process Choice:**
   It helps to determine whether the resources are organized around products or processes so that the flow strategy can be implemented. It depends on the volume and degree of customization to be provided.
   The five basic process types which are choosen by production manager are:
   i) Job shop process
   ii) Batch process
   iii) Repetitive process
   iv) Continuous process
   v) Project process
2. **Vertical Integration:**
   When the production and distribution chain, from suppliers of components to the delivery of products and services to customers is brought under the ownership of a firm, it is known as vertical integration. The degree of integration is decided by the management keeping in view all the

activities performed from the acquisition of raw material to the delivery of finished products to customary.

There are two directions of vertical integration:

i) Forward integration

ii) Backward integration

If a manufacturer decides to buy a wholesale firm and distribute its products only through that wholesaler, the integration is 'forward' toward the market. On the other hand, if the manufacturer buys a supplier company, the integration is 'backward'.

3. **Resource Flexibility:**

Flexibility is desired by a firm about its resources i.e. employees, facilities and equipments. The degree of flexibility depends on the competitive priorities of management. Production managers must decide whether they should maintain flexible workforce which will provide reliable customer service and adjustment is capacity. Flexible workforce is useful if there is fluctuations in workloads. However, it is better to have certain amount of permanent workforce having multiple skills. It will help in movement of surplus workforce from a work center to another work center.

4. **Customer Involvement:**

The level of customers interaction with the process is known as customer involvement. Now a days, the involvement of customers is increasing due to growing competition on customization. Companies are allowing customers to specify their requirement or even to be involved in the designing process for the product.

5. **Capital Intensity:**

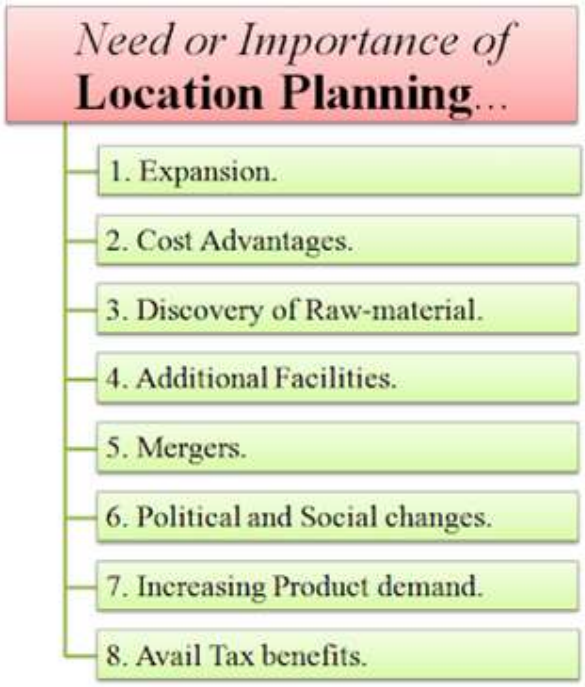
The level of capital resources used in manufacturing like equipments and machines is known as capital intensity. Decision about the amount of capital investment required for equipments and machines is important for designing a new process. Capital intensity is important for increasing productivity and quality but there is a risk of high investment cost for low volume operations.

Unit – 4
Plant Location & Plant Layout

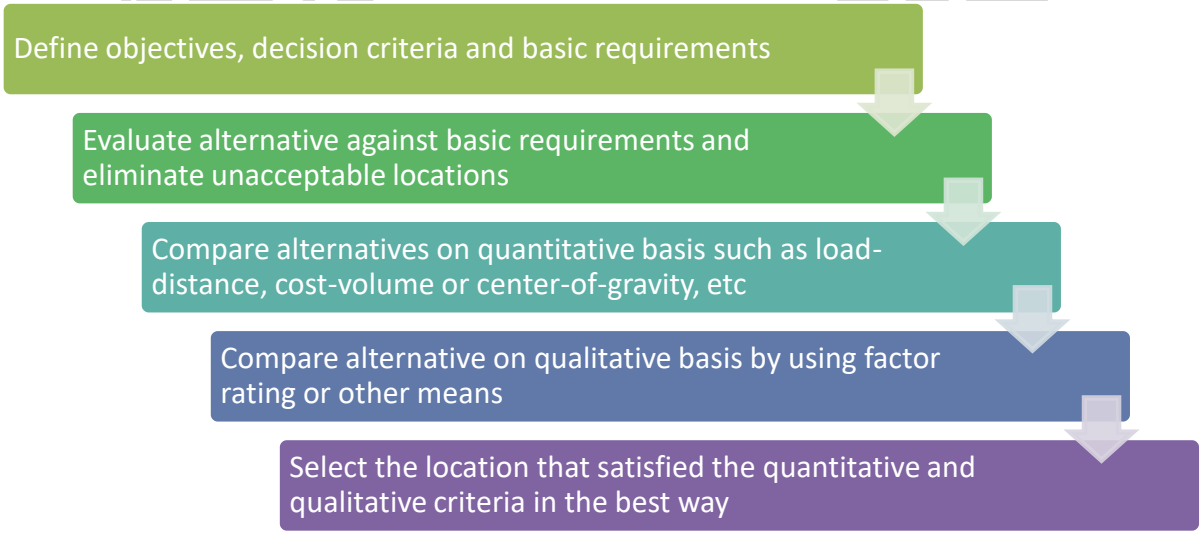
Introduction:

Every firm must use location planning techniques. There are many options for location planning. Corporations choose from expanding an existing location, shutting down one location and moving to another, adding new locations while retaining existing facilities. There are a variety of methods used to decide the best location from alternatives for the corporation.

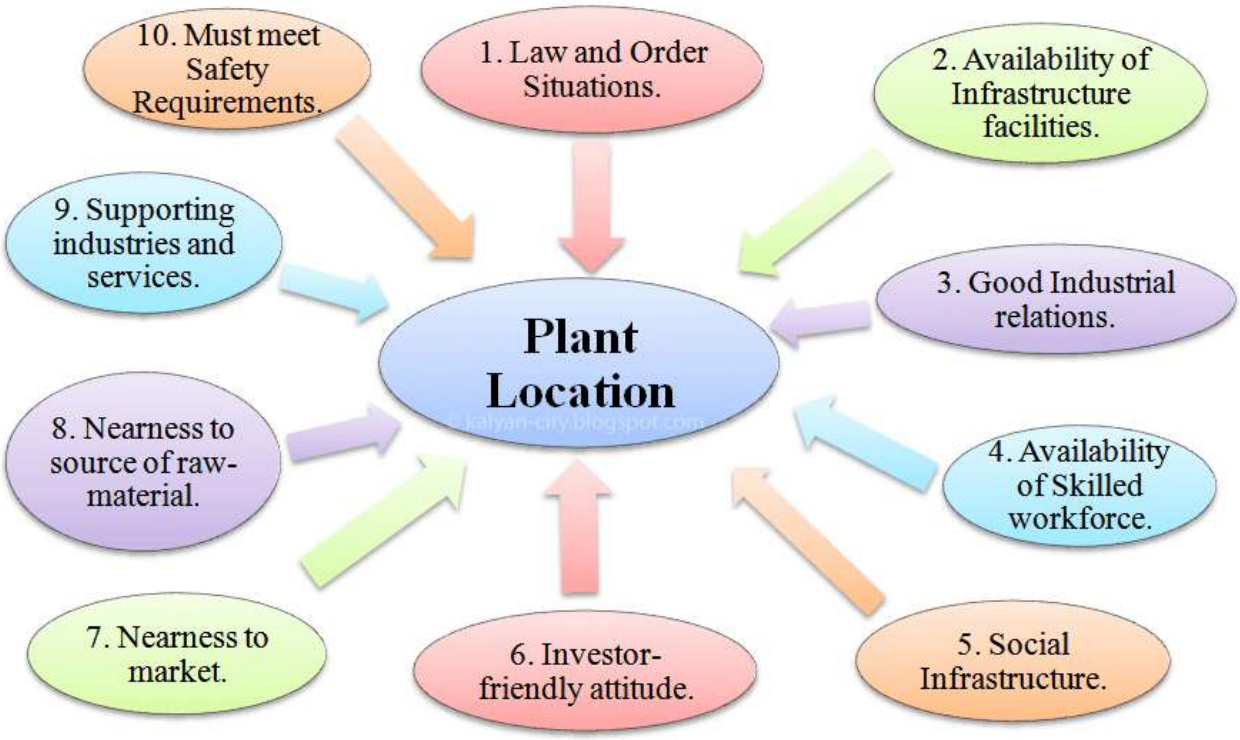
The Need for Location Decisions



Steps in Location Decision



Factors Influencing Facility Location



Factors affecting plant location

Other factors which also affect plant location are availability and cost of land, suitability of land - soil and topography, climatic conditions, location of a similar unit, etc.

(A) Primary factors -
Raw Materials
A Plant location or a manufacturing unit is in the conversion of the raw materials into finished goods, it is very essential that the transport of raw material is at minimum cost. In industries like, sugar, paper, iron and steel are engaged in solvent extraction of oil from rice bran, the china clay washery, factories manufacturing low tension porcelain insulators, and the like should be located near the sources of their raw materials.

Nearness to raw materials offers such advantages as:
1.Reduced cost of transportation
2.Regular and proper supply of materials uninterrupted by transportation breakdowns
3.Saving in the cost of storage of materials.
Raw materials in this context may be classified into two types, viz.

(i)Weight-losing or gross materials
(ii) Non-weight losing or pure materials

Weight-losing materials lose their weight during the manufacturing process. The cost of transporting these raw materials from the source of supply to the place of manufacture is more than the cost of transporting the finished products from the factory to the market. Examples of these raw materials are iron ore, sugarcane, coal, timber etc. Industries using such materials tend to be located at the source to save on the cost of transportation.
The Non-weight losing materials, they grow in weight after they are converted into finished goods. The cost of transporting the finished goods is more than that of raw materials. Examples of such non-weight-losing materials are cotton and woolens

Nearness to the Market
Since the goods are produced for sale they should be near the market. The cost of reduction in the cost of transporting finished goods depends upon the likes and dislikes of the consumers. The Consumer should get some advantages such as:
(i)The Consumer should get or render prompt service.
(ii)Consumer should be provided with after-sales service
(iii)Consumers should get replacement orders without delay.
Industries like non-weight-losing raw materials, industries producing perishable or bulky products and servicing units tend to be located near their market.

Transport Facilities
Transport facilities are essential for bringing raw materials and men to the factory and also for carrying the finished products from the factory to the market. A place which is well connected by rail, road, and sea is ideal for a plant location. In extreme cases, transport may follow the industries. If a public sector unit has been started in a remote place, the government has to provide transport facilities and also cater to the requirements of the product.

Availability of Skill Labor: Education, experience and skill of available labor are another important, which determines facility location.

Availability of Power
Power is essential to move the wheels of an industry. Coal, electricity, oil and natural gas are the sources of power. Industries using electricity have to be located at a place where electric power is available regularly and at cheap rates.

Supply of capital

(B) Secondary Factors
1) Facilities
Business Area: Presence of other similar manufacturing units around makes business area conducive for facility establishment.

2) Natural Factors
Suitability of Climate

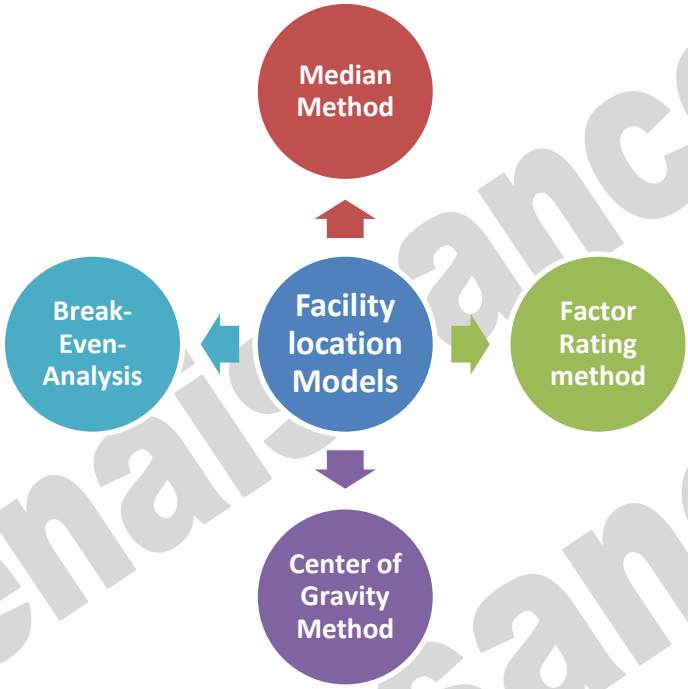
The climate has its own importance with regard to the location of the plant. The nature of production depends upon the climatic conditions. Some industries are placed where humid conditions may be required for the product like the cotton textile which is in Mumbai, the jute industry in Calcutta etc. The scientific and technological developments have enabled us to create artificial conditions. The entrepreneur would do well to take advantage of a natural climate because the cost of providing an artificial climate is quite exorbitant.
Extreme climatic conditions adversely affect labor efficiency. There is heavy industrial concentration in the cool and temperate regions rather than in the tropical and polar regions.

3) Political Factors

4) Government Subsidies & Facilities
Government Policy
The influence of Government policies and programs on plant locations is apparent in every country, particularly in planned economies like ours. In India, there are several backward regions, which are selected for the location of the plant, which would generate the economy of the region and on a larger scale canvas, the national economy.
The Government of India has been influencing plant location in a number of ways. Some of these are:
1.Licensing policy;
2.Freight rate policy;
3.Establishing a unit in the public sector in a remote area and developing it to attract other industries;
4.Institutional finance and government subsidies.
The influencing of government policy was only after the Independence. Before the Independence, purely commercial considerations were decided as per industrial locations. Such has been the case with TISCO and IISCO. It was because there was no over solicitous government which was ready to come to the rescue of a sick unit to save it from bankruptcy, no ideologue anxious to give a face-lift to the losing public sector concerns by allowing them to jack up prices, give protection and capitalize losses by converting them into equity.
Free Trade Zone/Agreement: Free-trade zones promote the establishment of manufacturing facility by providing incentives in custom duties and levies. On another hand free trade agreement is among countries providing an incentive to establish business, in particular, country.

5) Historical and Religious Factors
6) Initial start and goodwill
7) Personal factors
8) Miscellaneous factors
Environmental Policy: In current globalized world pollution, control is very important; therefore understanding of environmental policy for the facility location is another critical factor.

Facility location Models



Location Cost-Volume-Profit Analysis/Break-Even-Analysis:
The Cost-Volume-Profit (CVP) Analysis can be represented either mathematically or graphically. It involves three steps:
1) For each location alternative, determine the fixed and variable costs,
2) Plot the cost for each location, with cost on the vertical axis of the graph and the annual volume on the horizontal axis.
3) Select the location that has the lowest total cost for the expected production volume.

Additionally, there are four assumptions/Limitations one must keep in mind when using this method:
1. Fixed costs are constant.
2. Variable costs are linear.
3. Required level of output can be closely estimated.
4. There is only one product involved.

Formulae for calculating Break-Even-Point

1. Total variable cost (TVC) = Variable cost per unit x Number of units.
2. Total Costs (TC) = (TFC + TVC)
3. Break-Even Volume = Fixed Cost (Revenue per unit – Variable cost per unit)
4. Expected Profit = Total Revenue – Total Cost
5. Break-Even Point (in units) = $\frac{Fixed\ Cost}{S.P.Per\ Unt - V.C.\ per\ unit}$

Median Method
Median model is a simple model which helps to find out the most suitable location for a new plant to minimize annual transportation costs.

This model considers the volume of loads transported on 'rectangular paths'. All movements are made in east-west or north south directions, diagonal moves are not considered.

Steps:

1. Identify the median load.
2. Find the x-coordinate of the median load.
3. Find the y-coordinate of the median load.

Disadvantages of Median Model

The median model is very simple to operate. However, it suffers from some major disadvantages such as:

i) It assumes that only one single new facility is to be located.
ii) Every point in the (x,y) plane has been assumed to be an eligible point for the location of the new facility.
iii) The median model is valid when the movement is based on a rectilinear mode only.

Factor Rating method

Factor rating is a method of assigning quantitative values to all the factors related to each decision alternative and deriving a composite score that can be used for composition. It can accommodate both quantitative and qualitative factors and allows the decision maker to inject his/her own preferences into a location decision.

Factor Rating consists of six steps:

1. Determine relevant and important factors.
2. Assign a weight to each factor, with all weights totaling 1.00.
3. Determine common scale for all factors, usually 0 to 100 and designate any minimums.
4. Score each alternative.
5. Adjust score using weights (multiply factor weight by score factor); add up scores for each alternative.
6. The alternative with the highest score is considered the best option.

Center of Gravity Method:

The Centre of Gravity method is a mathematical technique used for finding the location of distribution centre that will minimize distribution cost. The centre of gravity method takes into account the locations of plant and markets, the volume of goods moved and transportation cost in arriving at the best location for a single intermediate warehouse. Distance alone should not be the criteria, since the volume shipped from one location to another will also affect the cost.

FACILITY LAYOUT

Introduction to Facility layout

Layout refers to the configuration of departments, work centres and equipments with particular emphasis on movement of customers and materials. Facility layout means an optimum arrangement of different facilities including man, machine, material, equipment, etc.

For an organization to have an effective and efficient manufacturing unit, it is important that special attention is given to facility layout. Facility layout is an arrangement of different aspects of manufacturing in an appropriate manner as to achieve desired production results. Facility layout considers available space, final product, safety of users and facility and convenience of operations.

An effective facility layout ensures that there is a smooth and steady flow of production material, equipment and manpower at minimum cost. Facility layout looks at physical allocation of space for economic activity in the plant. Therefore, main objective of the facility layout planning is to design effective workflow as to make equipment and workers more productive

Objectives of an Ideal Facility Layout

A model facility layout should be able to provide an ideal relationship between raw material, equipment, manpower and final product at minimal cost under safe and comfortable environment. An efficient and effective facility layout can cover following objectives:

- To provide optimum space to organize equipment and facilitate movement of goods and to create safe and comfortable work environment.
- To promote order in production towards a single objective
- To reduce movement of workers, raw material and equipment
- To promote safety of plant as well as its workers
- To facilitate extension or change in the layout to accommodate new product line or technology upgradation
- To increase production capacity of the organization

An organization can achieve the above-mentioned objective by ensuring the following:

- Better training of the workers and supervisors.
- Creating awareness about of health hazard and safety standards
- Optimum utilization of workforce and equipment
- Encouraging empowerment and reducing administrative and other indirect work

Factors Affecting Plant Layout

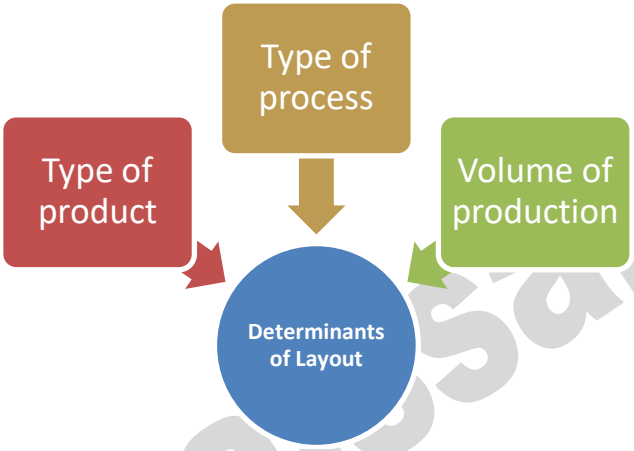
External Factors

- External transportation
- Receiving operations (unloading, storing, etc.)
- Packaging operations
- Storage operations
- Dispatching operations

Internal Factors

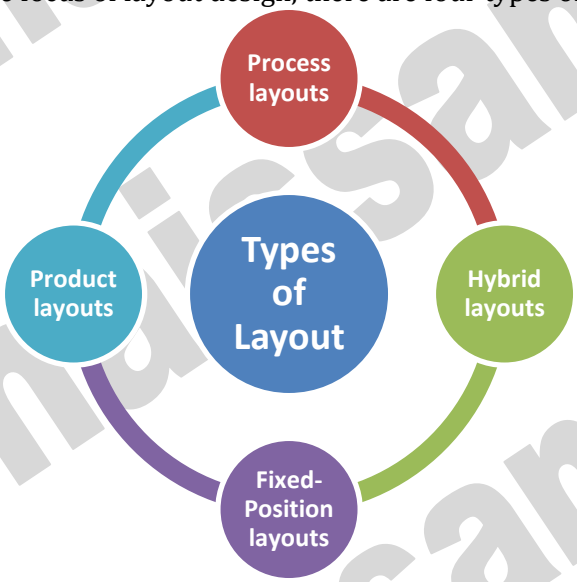
- Type of product and process
- Volume of production
- Quality
- Types of operation
- Design of building
- Material handling equipment
- Personnel (type, number, level of education, nature of work etc.)

Determinants of Layout



Types of Layout

Depending upon the focus of layout design, there are four types of layouts.



- **Process layouts - Group similar resources together**
- **Product layouts - Designed to produce a specific product efficiently**
- **Hybrid layouts - Combine aspects of both process and product layouts**
- **Fixed-Position layouts - Product is too large to move; e.g. a building**

(A) Product or Line Layout:

- Product or Line Layout is the arrangement of machines in a line (not always straight) or a sequence in which they would be used in the process of manufacture of the product. This type of layout is most appropriate in case of continuous type of industries where raw materials is fed at one end and taken out as finished product at the other end. For each type of product a separate line of production will have to be maintained.

- This type of layout is most suitable in case of metal extraction industry, chemical industry, soap manufacturing industry, sugar industry and electric industry. It should be noted that this method is most suitable in case of mass production industries.
- product layout is suitable where:
  (i) large quantity of standardized products are produced;
  (ii) the standardized products are to be processed repetitively or continuously on the given production facilities;
  (iii) there must be sufficient volume of goods processed to keep the production line actively occupied,
  (iv) there should be greater interchangeability of the parts; and
  (v) to maintain good equipment balance each work station must employ machines or equipment's of approximately equal capacities. Similarly to maintain good labour balance, each work station must require an equal amount of work to be performed.

Advantages of Product Layout:

(1) Removal of obstacles in production:
Product layout ensures unrestricted and continuous production thereby minimising bottlenecks in the process of production, this is because work stoppages are minimum under this method.

(2) Economies in material handling:
Under this method there are direct channels for the flow of materials requiring lesser time which considerably eliminate back-tracking of materials. On account of this, cost of material handling is considerably reduced. This is greatly helpful in achieving desired quality of the end product.

(3) Lesser manufacturing time:
Under this method (as already pointed), backward and forward handling of materials is not involved, it leads to considerable saving in manufacturing time.

(4) Lesser work in progress:
On account of continuous uninterrupted mass production, there is lesser accumulation of work in progress or semi-finished goods.

(5) Proper use of floor space:
This method facilitates proper and optimum use of available floor space. This is due to non-accumulation of work in progress and overstocking of raw materials.

(6) Economy in inspection:
Inspection can be easily and conveniently undertaken under this method and any defect in production operations can be easily located in production operations. The need for inspection under this method is much less and can be confined at some crucial points only.

(7) Lesser manufacturing cost:
On account of lesser material handling, inspection costs and fullest utilisation of available space, production costs are considerably reduced under this method.

(8) Lesser labour costs:
Due to specialisation and simplification of operations and use of automatic simple machines, employment of unskilled and semi-skilled workers can carry on the work. The workers are required to carry routine tasks under this method. This leads to lesser labour costs.

(9) Introduction of effective production control:
Effective production control on account of simple operation of this method can be employed successfully. Production control refers to the adoption of measures to achieve production planning.

Disadvantages of Product Layout:

(1) Lesser flexibility:

As work is carried in sequence and process arranged in a line, it is very difficult to make adjustments in production of operations. Sometimes, certain changes under this method become very costly and impractical. On account of this drawback, this method is not suitable in the production of goods which are subject to quick style and design changes.

(2) Large investment:

Under this method, machines are not arranged in accordance with functions as such similar type of machines and equipment is fixed at various lines of production. This leads to unavoidable machinery duplication resulting in idle capacity and large capital investment on the part of the entrepreneur.

(3) Higher overhead charges:

Higher capital investment leads to higher overheads (fixed overheads) under this method. This leads to excessive financial burden.

(4) Interruption due to breakdown:

If one machine in the sequence stops on account of breakdown, other machines cannot operate and work will be stopped. The work stoppage may also take place on account of irregular supply of material, poor production scheduling and employee absenteeism etc.

(5) Difficulties in expanding production:

Production cannot be expanded beyond certain limits under this method.

(6) Lack of specialisation in supervision:

Supervision of different production jobs becomes difficult under this method as there is absence of specialised supervision as the work is carried on in one line having different processes and not on the basis of different departments for different specialised jobs. Under this method a supervisor is supposed to have detailed knowledge of all the machines and processes which leads to absence of specialisation in the process of supervision.

(7) Under-utilisation of machines:

As has already been pointed out, separate set of one type of machines is fixed at different lines of production. Usually, these machines are not properly and fully utilised and there remains idle capacity in the form of under utilised equipment.

(B) Functional or Process Layout:

It is just the reverse of product layout. There is a functional division of work under this method. For example, lathes are fixed in one department and welding activities are carried in another department of the factory. The salient features of this type of layout are based on Frederick W. Taylor's concept of 'functional organisation'.

This method is generally adopted for producing different varieties of unlike products. This is particularly adopted tor job order industries like engineering, ship building and printing etc.

Advantages of Process Layout:

(1) Maximum utilisation of machines:

This method ensures fuller and effective utilisation of machines and consequently investment in equipment and machines becomes economical.

(2) Greater flexibility:

Changes in the sequence of machines and operations can be made without much difficulty. This is because the machines are arranged in different departments in accordance with the nature of functions performed by them.

(3) Scope for expansion:

Production can be increased by installing additional machines without much difficulty.

(4) Specialisation:

As has already been pointed out that under this method, specialised machines are used for performing different production operations. This leads to specialisation.

(5) Effective utilisation of workers:

Specialised workers are appointed to carry different type of work in different departments. This leads to effective and efficient use of their talent and capabilities.

(6) More effective supervision:

As the machines are arranged on the basis of functions, performed by them, the specialised and effective supervision is ensured by the specialised knowledge of supervisors. Each supervisor can perform his task of supervision effectively as he has to supervise limited number machines operating in his department.

(7) Lesser work stoppages:

Unlike the product method, if a machine fails, it does not lead to complete work stoppage and production schedules are not seriously affected. Due to breakdown in one machine, the work can be easily transferred to the other machines.

Disadvantages of Process Layout:

(1) Coverage of more floor area:

Under this method, more floor space is needed for the same quantum of work as compared to product layout.

(2) Higher cost of material handling:

Material moves from one department to another under this method, leading to the higher cost of material handling. The mechanical devices of material handling cannot be conveniently employed under this method on account of functional division of work. Material has to be carried by applying other methods from one department to another, resulting into higher cost of material handling.

(3) Higher labour costs:

As there is functional division of work, specialised workers are to be appointed in different departments for carrying specialised operations. The appointment of skilled worker leads to higher labour costs.

(4) Longer production time:

Production takes longer time for completion under this method and this leads to higher inventories of work-in-progress.

(5) Difficulties in production, planning and control:

Due to large variety of products and increased size of the plant, there are practical difficulties in bringing about proper coordination among various areas (departments) and processes of production. The process of production, planning and control becomes more complex and costly.

(6) Increased inspection costs:

Under this type of layout more supervisors are needed and work is to be checked after every operation which makes the process of supervision costlier.

(C) Fixed Position Layout:
This type of layout is undertaken for the manufacture of large parts and assemblies. In this case, material remains fixed or stationary at one place, men and equipment are taken to the site of material. This is suitable in case of ship building, locomotives and heavy machinery industries etc.

Advantages:

(a) Economies in transformation:
As the work is carried at one place and material is not taken from one place to another, this leads to savings in transformation costs.

(b) Different jobs with same layout:
Different projects can be undertaken with the help of same layout.

(c) Production in accordance with specifications:
The jobs can be performed in accordance with the specifications given by the customers.

(d) Scope for flexibility:
It provides maximum flexibility for various changes in production processes and designs of the products.

Disadvantages:

(a) Immobility of material:
As material is fixed at one place, this leads to certain difficulties in arranging specialized workers, machines and equipment for the job.

(b) Large investment:
This method is time consuming and costlier as compared to first two methods.

(c) Unsuitable for small products:
This method is not suitable for producing and assembling small products in large quantities. In actual practice, it has been observed that a judicious combination of three types' viz., product, process and stationary material layout is undertaken by different organizations. This is done with the view to enjoy the advantages of all the methods.

Process Layouts	Product Layouts
Able to produce a large number of different products.	Able to produce a small number of products efficiently.
Resources used are general purpose.	Resources used are specialized.
Facilities are more labor intensive.	Facilities are more capital intensive.
Greater flexibility relative to the market.	Low flexibility relative to the market.
Slower processing rates.	Processing rates are faster.
High material handling costs.	Lower material handling costs.
Higher space requirements.	Lower space requirements.

(D) Hybrid Layout

Generally, pure process or product layout is not found in practice. Both are mutually exclusive. A proper compromise reaping the benefits of both the layouts is possible to some extent. So efforts are made to have the combined layout incorporating the benefits of process and product layout. For example, in refrigerator manufacturing, a process oriented layout is used to produce various part e.g. Metal forming, welding, heat treatment etc. for the final assembly of the refrigerator, all these functions are placed in a product oriented layout.

Importance/advantages of an Ideal Layout

1) **Economies in Handling**: Nearly 30% to 40% of the manufacturing cost is accounted for, by materials handling. Every effort should, therefore, be made to cut down on this cost. Long distance movements should be avoided and specific handling operations must be eliminated. A cynic may say that the cheapest way to handle materials is not to handle them at all. But, in a factory, materials have to be handled; and therefore, it all depends on the layout.

2) Effective Use of Available Area: Every inch of the plant area is valuable, especially in urban areas. Efforts should therefore be made to make use of the available area by planning the layout properly. Some steps for achieving this end are: location of equipment and services in order that they may perform multiple functions; development of up-to-date work areas and operator job assignments for a full utilization of the labor force.

3) **Minimization of Production Delays**: Repeat orders and new customers will be the result of prompt execution of orders. Every management should try to keep to the delivery schedules. Often, the deadline dates for delivery of production orders are a bug-a-boo to the management.

Plant layout is a significant factor in the timely execution of orders. An ideal layout eliminates such causes of delays as shortage of space, long-distance movements of materials, spoiled work and thus contributes to the speedy execution of orders.

4) **Improved Quality Control:** Timely execution of orders will be meaningful when the quality of the output is not below expectations. To ensure quality, inspection should be conducted at different stages of manufacture. An ideal layout provides for inspection to ensure better quality control.

5) **Minimum Equipment Investment**: Investment on equipment can be minimized by planned machine balance and location, minimum handling distances, by the installation of general purpose machines and by planned machine loading. A good plant layout provides all these advantages.

6) Avoidance of Bottlenecks: Bottlenecks refer to any place in a production process where materials tend to pile up or are produced at a speed, less rapid than the previous or subsequent operations. Bottlenecks are caused by inadequate machine capacity, inadequate storage space or low speed on part of the operators. The results of bottlenecks are delays in productions schedules, congestion, accidents and wastage of floor area. All these may be overcome with an efficient layout.

7) Better Production Control: Production Control is concerned with the production of the product of the right type, at the right time and at a reasonable cost. A good plant layout is a requisite for good production control and provides the production control officers with a systematic basis upon which to build organization and procedures.

8) **Better Supervision**: A good plant layout ensures better supervision in two ways:

- 1.Determining the number of workers to be handled by a supervisor and
- 2.Enabling the supervisor to get a full view of the entire plant at one glance.

A good plant layout is, therefore, the first step to good supervision.

9) **Improved Utilization of Labor**: Labor is paid for every hour it spends in the factory. The efficiency of a management lies in utilizing the time for productive purpose. A good plant layout is one of the factors

in effective utilization of labor. It makes possible individual operations, the process and flow of materials handling in such a way that the time of each worker is effectively spent on productive operations.

10) **Improved Employee Morale**: Employee morale is achieved when workers are cheerful and confident. This state of mental condition is vital to the success of any organization. Morale depends on:

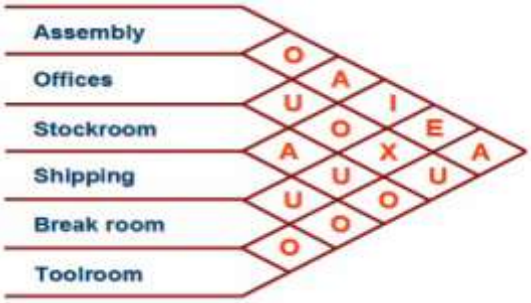
(a)Better working condition;
(b)Better employee facilities;
(c)Reduced number of accidents;
(d)Increased earnings.

11) **Avoidance of Unnecessary and Costly Changes**: A planned layout avoids frequent changes which are difficult and costly. The incorporation of flexibility elements in the layout would help in the avoidance of revisions.

REL Chart or nearness diagram –

1) Nearness chart/diagram or REL Chart indicates the relationship between pairs of departments in terms of closeness depending upon the activities of the department

Example –



2) The closeness ratings are as follows –

A – Absolutely essential
E – Essential
I – Important
O – Ordinary closeness OK
U – Unimportant
X – Not desirable

3) REL Chart shows the relative importance of having 2 work centres placed closed to each other based on reasons such as –

i) Ease of Supervision (Eg- Casting & forging)
ii) Need for sudden & immediate attention
iii) Common personnel / labour (Eg.- Drilling & Machinery meterology & inspection)
iv) Need for common lighting

4) Similarly there may be a need to avoid 2 work areas from being close to one other due to the following reasons.

i) Safety reasons (eg- meterology & welding/forging deptt.)
ii) Avoidance of the risk of infection (eg-pathology & OT Deptt. in a hospital)
iii) Avoidance of noise (one deptt. being noisy & other being quiet) (Eg-Rest room of forging deptt.)

5) How to make REL-chart / algorithm**?**

i) List all the activities in the vertical column, production operations come first & survices follows.

ii) Determine the importance of having each combinations of operations close/far from one another specifying the reasons.

iii) Enter the code letters for each combination using A, E, I, O, U, X etc. & make a REL Chart.

Computerized Layout Tools & techniques

ALDEP

The layout of facilities is a special problem like the problem of locating facilities. There may be a very large number of alternative configurations for a process layout. Infact, there are n! possible arrangements of n departments. Thus, if there are 8 departments, there are 8! = 40,320 possible arrangements. This makes finding the best possible layout an extremely difficult task. Several computer packages have been written expressly for facility layout. One of them is ALDEP (Automated Layout Design Programme). This allows interactive design of layout in real time and can eliminate some of the disadvantages such as irregularly shaped departments.

Procedure Adapted for using ALDEP :

Step#01: Input the following

1. Length & width of facility
2. Area of each department
3. Minimum Closeness Preference (MCP) Value
4. Sweep width
5. Relationship chart showing the closeness rating
6. Location & size of any restricted area

Step#2: One department is selected randomly & placed in the layout

Step#3: In this step, the algorithm uses minimum closeness required b/w departments for the selection of departments to be placed with an earlier placed department. Select the department having maximum closeness rating. If there is no department having minimum closeness preference then any dept that remains to be placed is selected .

Step#4: If all the departments are placed in the layout, go to step#5. else go to step#3

Step#5: Compute the total score of the layout

Step#6: If the total score required is acceptable score, then go to step#7, else go to step#2

Step#7: Print the current layout & the corresponding score

CORELAP (Computrised relationship layout planning)

Corelap is the most widely used facility layout programmes. There are several versions of corelap.

Rather than using material handling cost as the primary solution, the software uses a preference table which specifies how important it is for 2 deptts to be close to one another. These 'closeness' ratings are as follows:

A – Absolutely essential
E – Essential
I – Important
O – Ordinary closeness OK
U – Unimportant
X – Not desirable

Corelap needs following data/information for working
i) Number of departments & their areas.
ii) Closeness relationship as given by REL Chart
iii) Weighted ratings for REL Chart.

CRAFT (Computerised Relative Allocation of Facilities Technique)
When the number of activity centers increases, the effectiveness of the graphical approach breaks down. Practical problems in facility layout often involves 20 are more activity centres. To provide an optimal solution for such a large number of activity centers, a computerized relative allocation of facilities technique (CRAFT) was developed.

Requirements for CRAFT
1) Initial layout
2) Flow data
3) Cost per unit distance
4) Total number of departments
5) Number of fixed departments and their location
6) Area of departments

The programme works in the following manner:
1) An initial layout is given.
2) The frequencies of movement between the various pairs of departments are also supplied alongwith cost per unit distance.
3) With the above inputs, CRAFT interchanges a pair of departments which either have a common border or the same area requirements. This is done by interchanging the center locations of the departments rather than an actual physical change.
4) After such interchange of centroids the total cost for the modified layout is calculated.
5) The least cost interchange is accepted.

UNIT – 5
MATERIALS MANAGEMENT

Introduction:

Materials management is a body of knowledge, which helps the manager to improve the productivity of capital by reducing materials costs, preventing large amounts of capital being locked up for long periods and improving the capital-turnover ratio.

Materials management covers all aspect of material costs, materials supply and utilization. It covers the whole range of functions involved in converting raw materials and ancillary supplies into finished products. It is concerned with the planning and programming of material and equipment; market research for purchases; pre-design value analysis; procurement of all materials including capital goods, raw materials, components and assemblies, finished good, packaging and packing, stores control and inventory control; transportation of materials; materials handling; value analysis; disposal of scrap and surplus; salvage; and operations research for materials.

Materials management is an important organized activity of any business system, which is essential for any manufacturing sector. A careful planning is required while laying the objectives.

The objectives of materials management are either set by the top management or by the materials manager himself keeping in view corporate policies. The main aim of material management is to provide efficient service of continuous supply of bought out materials at minimum cost. These can be raw materials or components for production as direct inputs, spare parts or factory operating supplies. Stock out of any of these may totally disrupt the production causing severe losses to the company.

Objectives of Material management

Due to the conflicting nature of objectives it is difficult to achieve all of them at a time. For example, low cost of acquisition and storing would come in conflict with minimizing the storing costs while, the objective of procurement at a low cost will conflict with continuous supply of materials. Thus, it is difficult to attain all the objectives at a time

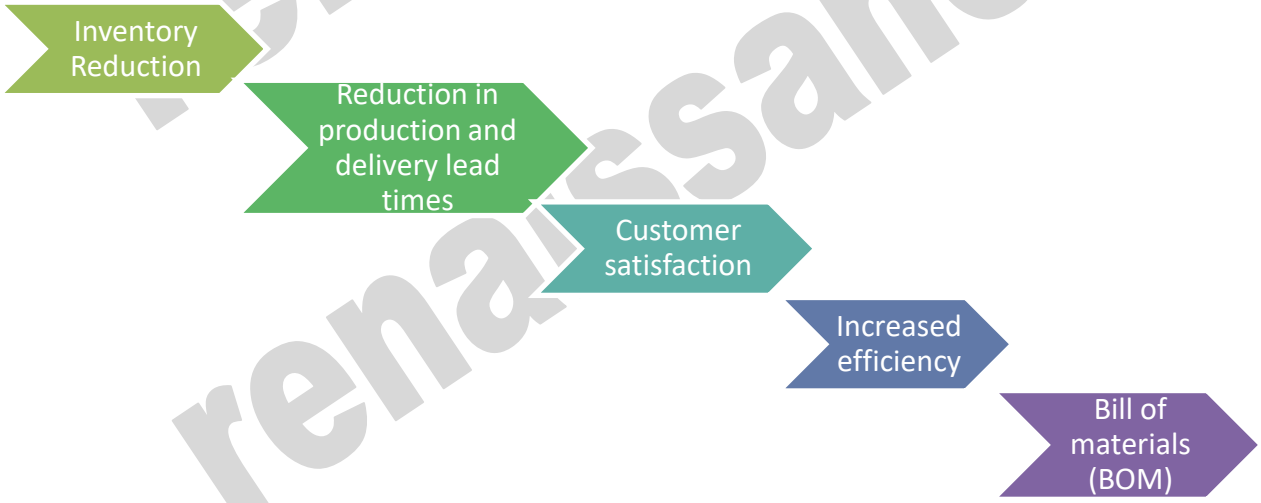
Importance of Material Management:

The importance of material management arises from the fact that materials account for 60 to 65 percent of the sales value of a product i.e. from every rupee of the sales revenue, 65 paise are spent on materials. Hence, small changes in material costs can result in large sums of money saved or lost. Materials management should therefore be considered as a function of prime importance for our industrial economy. Material costs form the bulk of the total cost of a manufactured product. A survey in India revealed that in major industries, the materials cost on an average works to 64 paise per rupee, the balance of 36 paise being accounted for by wages and salaries, overheads and profits. In material intensive production industries, the share of materials cost may be still higher. If we take material carrying charges, procurement charges into consideration, the percentage may be still higher.

MRP (Material Required Planning)

- Maintenance of inventories to support production is of great significance for a manufacturing concern. The technique which is used to plan and control manufacturing inventories is called 'material requirements planning. It involves acquiring materials, coordinating the availability of materials and controlling its utilization.
- Material Requirements Planning (MRP) is a computer-based production planning and inventory control system. MRP is concerned with both production scheduling and inventory control. It is a material control system that attempts to keep adequate inventory levels to assure that required materials are available when needed. MRP is applicable in situations of multiple items with complex bills of materials. MRP is not useful for job shops or for continuous processes that are tightly linked.

The major objectives of an MRP system are:



Advantages of MRP

1. It reduces inventories and their costs because it carries only those items and because it carries only those items and components which are needed – not more and not less.
2. It minimizes order processing delays because all materials are available when needed.
3. Jobs get done on time by setting the job completion dates.
4. Order promises are kept and production lead times are reduced.
5. Capable of adopting to changes in master schedules due to un-avoidable circumstances.

Limitations of MRP

1. It is a scheduling programme. It cannot generate aggregate scheduling. However, information given by MRP help in scheduling.
2. It is not an inventory control system. It does not dicate when to place the order, how much and where. But MRP information are of a great help in inventory control.
3. MRP does not do capacity planning.

MRP System in Practice

- MRP is especially suited to manufacturing settings where the demand of many of the components and subassemblies depend on the demands of items that face external demands. Demand for end items are independent. In contrast, demand for components used to manufacture end items depend on the demands for the end items. The distinctions between independent and dependent demands are important in classifying inventory items and in developing systems to manage items within each demand classification. MRP systems were developed to cope better with dependent demand items. The three major inputs of an MRP system are the master production schedule, the product structure records, and the inventory status records. Without these basic inputs the MRP system cannot function.

- The demand for end items is scheduled over a number of time periods and recorded on a master production schedule (MPS). The master production schedule expresses how much of each item is wanted and when it is wanted. The MPS is developed from forecasts and firm customer orders for end items, safety stock requirements, and internal orders. MRP takes the master schedule for end items and translates it into individual time-phased component requirements.

- The product structure records, also known as bill of material records (BOM), contain information on every item or assembly required to produce end items. Information on each item, such as part number, description, quantity per assembly, next higher assembly, lead times, and quantity per end item, must be available.

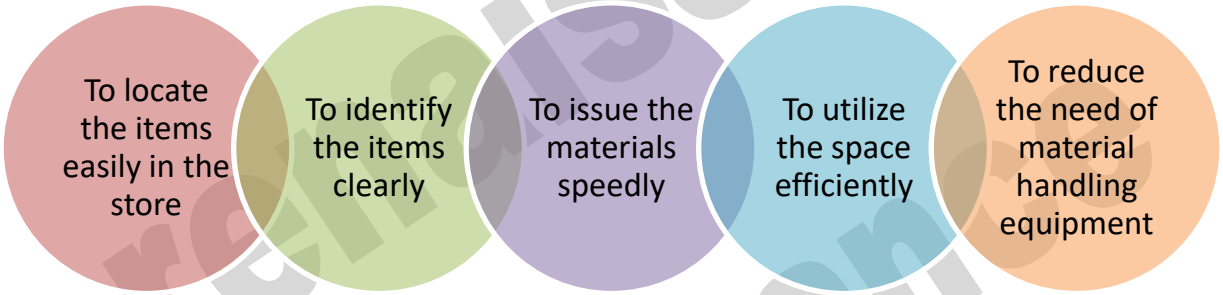
- The inventory status records contain the status of all items in inventory, including on hand inventory and scheduled receipts. These records must be kept up to date, with each receipt, disbursement, or withdrawal documented to maintain record integrity. MRP will determine from the master production schedule and the product structure records the gross component requirements; the gross component requirements will be reduced by the available inventory as indicated in the inventory status records.

Stores Management:

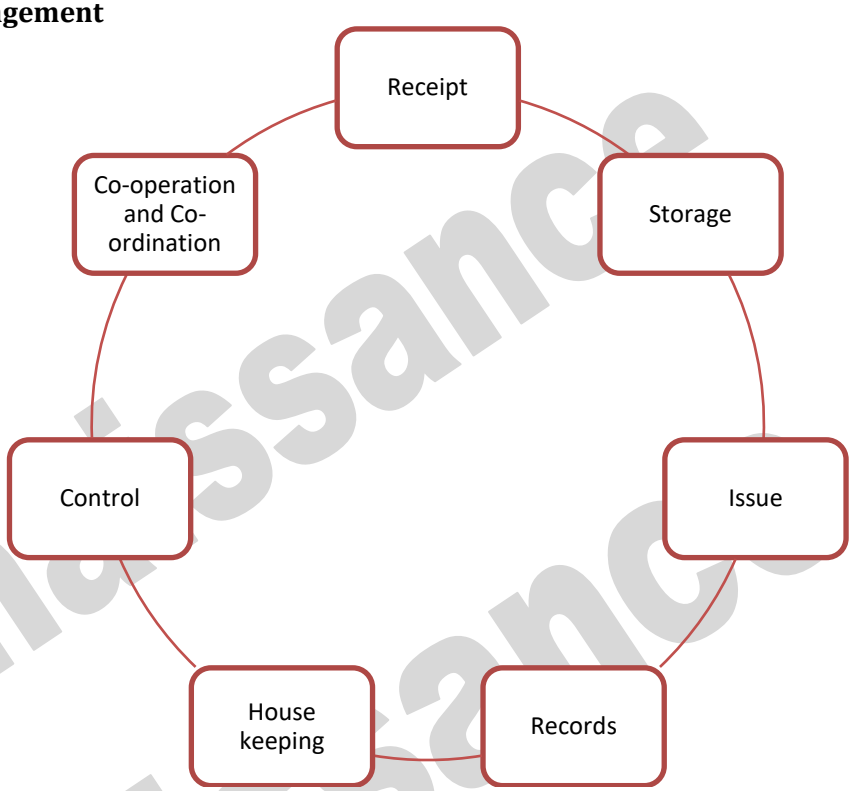
Stores management is concerned with the serving facility, inside an organization, responsible for proper storage of the material and then issuing it to respective departments on proper requisition. It is also concerned with the physical storage of goods. It also helps in carrying the right kind of materials in right quantity, neither in excess nor in short supply, also when required. In short, it can be said that store management refers "to receive materials, to protect them while in storage from damage and unauthorized removal to issue the materials in right qualities, at right time, to the right place and to provide these services promptly and at least cost".

The basic job of the Stores Manager hence is to receive the goods and act as a caretaker of the materials and issue them as and when Production demands it. Needless to say storekeeping activity does not add any value to the product. In fact it only adds to the cost. The organization has to spend money on space i.e. expenditure on land, building and roads, equipment, machinery and other facilities provided such as electricity, people i.e. salaries and wages, insurance, maintenance costs, stationary, communication expenses and the cost to maintain the inventory etc. All of these get added to the organizational overheads and finally get reflected in the costing of the finished product. However, it is an essential function in any manufacturing or marketing organization. This basic reason has propelled the evolution of philosophies such as JIT, JIT II etc.

Objectives of Stores Management



Functions of Stores Management



Stores System

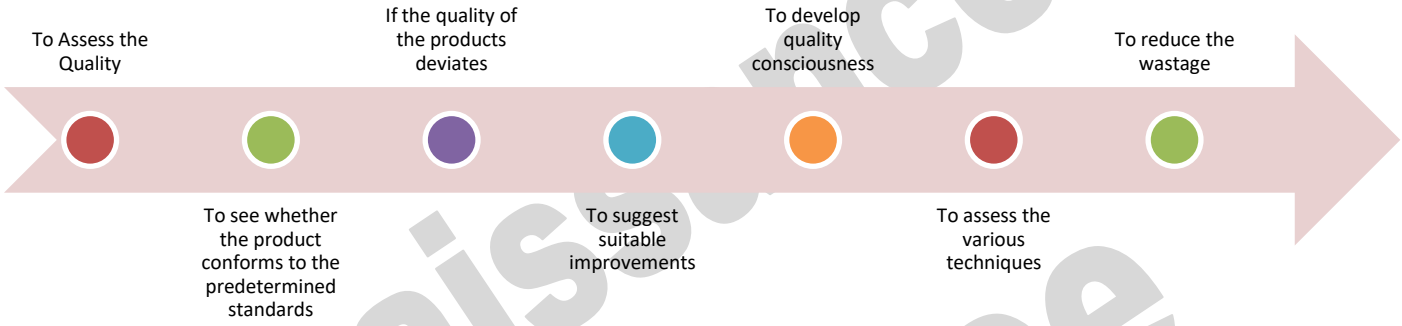
UNIT 6
QUALITY CONTROL

The term 'Quality Control' consists of two words 'Quality' and 'Control'. Quality is that characteristics or a combination of characteristics that distinguishes one article from the other or goods of one manufacturer from that of competitors or one grade of product from another when both are the outcome of the same factory. The main characteristics that determine the quality of an article may include elements such as design, size, materials, chemical such as design, size, materials, chemical composition, mechanical functioning, electrical properties, workmanship, finish and appearance.
In brief, quality control is the use of statistical or other control activities designed to ensure that goods or services meet their proclaimed standards, which may relate to materials, performance, reliability, time or any quantifiable characteristics.

Quality Control
The quality of product or service is ensured if proper designing process is followed. This designing process needs to be backed by appropriate process design supported by a suitable technology which confirms to requirements of customers. Quality control ensures that defects and errors are prevented and finally removed from the process or product. Therefore, quality control should include; planning, designing, implementation, gaps identification and improvisation. If organization can implement a stringent quality control than following benefits are possible:

- Reducing product defects lead to less variable cost associated with labor and material.
- Reduction in wastage, scrap and pollution.
- Ability to produce quality products over longer period of time
- With quality maintenance needs for inspection reduces leading to decrease in maintenance cost
- Large pool of satisfied customers.
- Increase in employee motivation and awareness of quality.
- Increase in productivity and overall efficiency.

Objectives of Quality Control



Statistical Quality Control

Quality control techniques require extensive usage of statistical methods. **Statistical Quality tools can broadly be classified into following categories:**

- Acceptance sampling is an important part of quality control wherein quality of products is assessed post production.
- Statistical process control helps in confirming whether the current process is falling within pre-determined parameters.

Acceptance Sampling

Acceptance sampling is done on sample's post production to check for quality parameters as decided by the organization covering both attributes as well as variables. If the sample does not meet the required parameters of quality than that given lot is rejected, and further analysis is done to identify the source and rectify the defects. Acceptance sampling is done on the basis of inspection, which includes physical verification of color, size, shape, etc.

The major objectives of inspection are:

- To detect and prevent defects in products and process.
- To identify defected parts or product and prevent it from further consumption or usage.
- To highlight the product or process defect to appropriate authorities for necessary and corrective actions.

Scope of inspection covers input materials, finished material, plant, machinery etc.

To sustain quality of product and services it is important to have in place robust quality control techniques.

OPERATING CHARACTERISTICS CURVE (O.C CURVE)

Introduction

OC Curves or Operating Characteristic Curves refer to a graph of attributes of a sampling plan considered during management of a project which depicts the percent of lots or batches which are expected to be acceptable under the specified sampling plan and for a specified process quality.

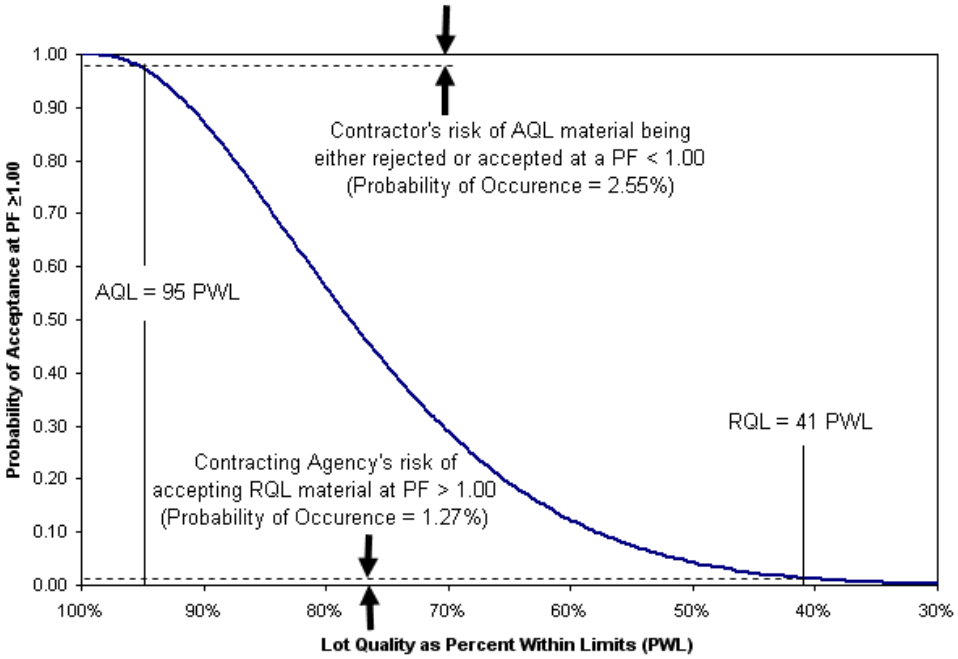
The specified sampling plan may be singular, sequential or iterative and may be using a particular size of a sample depending upon the demands of the project and could yield the results of acceptance or rejection based on a specified criteria.

OC Curve Uses

* It helps in the selection of sampling plans
* It aids in the selection of plans that are effective in reducing risks.
* It can help in keeping the high cost of inspection low.

Types of OC Curve

Type A - Gives the probability of acceptance for an individual lot coming from finite production.
Type B - Gives the probability of acceptance for lots coming from a continuous process.
Type C - Gives the long-run percentage of product accepted during the sampling phase.



Fig(OC Curves)

AQL (accepted quality level)

The acceptable quality level (AQL) is the quality level of a good lot. It is the percent defective that can be considered satisfactory and represents a level of quality that the producer wants accepted with a high probability of acceptance.

Introduction to AQL Tables: The "AQL tables" are statistical tools at the disposal of buyers (for product inspections). They help determine two key elements:

- How many samples should be picked and inspected, among a batch of product or parts?
- Where is the limit between acceptability and refusal, when it comes to defective products?

Definition and application of 'AQL'

1) The limit, as described above, is called the 'AQL'. It stands for 'Acceptance Quality Limit', and is defined as the "quality level that is the worst tolerable" (ISO 2859-1 standard).
2) For example: "I want no more than 1.5% defective items in the whole order quantity, on average over several production runs with that supplier" means the AQL is 1.5%.
3) In practice, three types of defects are distinguished. For most consumer goods, the limits are:

- 0% for critical defects (totally unacceptable: a user might get harmed, or regulations are not respected).
- 2.5% for major defects (these products would usually not be considered acceptable by the end user).
- 4.0% for minor defects (there is some departure from specifications, but most users would not mind it).

These proportions vary in function of the product and its market. Components used in building an airplane are subject to much lower AQL limits.

AOQL - Average Outgoing Quality Limit

1) The AOQL of a sampling plan is maximum value on the AOQ curve. It is applicable for defective units, defects per unit, and defects per quantity. It is expressed as either a defective rate (fraction defective, percent defective, dpm) or as a defect rate (defects per unit, defects per 100 units, dpm).
2) The AOQ curve gives the average outgoing quality (left axis) as a function of the incoming quality (bottom axis). The AOQL is the maximum or worst possible defective or defect rate for the average outgoing quality. Regardless of the incoming quality, the defective or defect rate going to the customer should be no greater than the AOQL over an extended period of time. Individual lots might be worst than the AOQL but over the long run, the quality should not be worse than the AOQL.
3) The AOQ curve and AOQL assume rejected lots are 100% inspected, and is only applicable to this situation. They also assume the inspection is reasonably effective at removing defectives or defects (90% effective or more).

LTPD –

The lot tolerance percent defective (LTPD) is the quality level of a bad lot. It represents to a level of quality that the consumer want accepted with a low probability of acceptance.

Control Charts –

Control charts were first proposed by Dr. Walter Shewart in the 1920s. A control chart is a graphical tool for describing when a process is in control and when to search for assignable causes of variation and take corrective action. A control chart can be based on categorical information or actual measurement. Accordingly, they are called control chart for variables and control chart for attributes.

Types of Control Charts-

Control Chart for variables

- X-Chart or sample means chart
- R-Chart or the Range chart

Control chart for attributes

- Fraction Defective Chart or p-chart
- Number of Defects Chart or C-chart