Lecture Notes

On

Production Management

BBA Second Year, Fourth Semester

(BBA -401)

Dr.Indal Kumar

Assistant Professor

Department of Management

NEHRU GRAM BHARATI DEEMED TO BE UNIVERSITY, PRAYAGRAJ

Unit 1: INTRODUCTION

Meaning ,Scope and Significance of Production Management ,Product Planning and Product Development Process.

Unit 2: PLANT LOCATION AND LAYOUT

Location : Factors, Theories, Webers, Sargent, Floorence.

Layout : Meaning and Types ,Process of Layout ,Plant environment and maintenance

Unit 3: MATERIAL MANAGEMENT

Meaning, Objectives and Importance of Material Management ,Techniques of Inventory Management.

Unit 4: PURCHASING

Objectives and Functions, Buying and Purchasing Rights, Quantity and Rights Price, Purchasing Process.

Unit 5: QUNLITY CONTROL

Meaning ,Objectives and Importance of Quality Control, Techniques of Quality Control.

Reference Books:

1-Nair- Operations management , TMH.

2-Adam & Ebert- Production and operation management prentice Hall India.

3-Production and Operations Management – By B.S. Goel.

4-Production and Operations Management by K. Aswathappa.

5-Production and Operations Management by S.N.Chary.

UNIT-1

What is production management?

Meaning: Production management means planning, organizing, directing, and controlling of production activities.

Production management deals with converting raw materials info finished goods or products. It brings together the 6M's i.e. men, money, machines, materials, methods and markets to satisfy the wants of the people.

Production management also deals with decision-making regarding the quality, quantity, cost, etc., of production. It applies management principles to production.

Definition of production management

According to **E.S. buffa,-** "production management deals with decision-making related to production processes so that the resulting goods or service is produced according to specification, in the amount and by the schedule demanded and at minimum cost".

Scope of production management.

1- Location of facilities - the selection of location is a key decision as large investment is made in building, land, and machinery.

2- Plant layout & material handling - plant layout refers to the physical arrangement of facilities. Material handling refers to the moving of material from the storeroom to the machine to the next during process of manufacturing.

3- Product design - product design deals with the conversion of the ideas about the product into the reality.

4- Process design - it is the decision making on overall process route for converting the raw material into the finished goods.

5- Production planning & controlling (p.p.c) - p.p.c can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting & finishing dates for each item to given production order to shops & to follow up the progress of products according to the orders.

6- Quality control - quality control may be defined as a system that is used to maintain a desired level of quality in a product & service.

7- Maintenance management - maintenance deals with taking care of factory layout, types of machinery. This is essential for equipment & machinery which are every important part of the total production process.

Significance/important of production management

1. Accomplishment of firm's objectives- production management helps the business firm to achieve all its objectives. It produces products, which satisfy the customers' needs and wants. So, the firm will increase its sales. This will help it to achieve its objectives.

2. Reputation, goodwill and image- production management helps the firm to satisfy its customers. This increases the form reputation, goodwill and image helps the firm to expand and grow.

3. Helps to introduce new product- production management help to introduce new products in the markets. It conducts research development (R&D). This helps the firm develop newer and better quality products. These products successful in the market because they give full satisfaction to the customers.

4. Supports other functional areas- production management supports other functional areas in an organisation, such as marketing, finance, and personnel. The marketing department will find it easier to sell good- quality products, and the finance department will get more funds due to increase in sales.

5. Help to face competition - production management helps the firm to face competition in the markets. This is because production management produces products of right quantity, right quality, and right price and at the right time. These products are delivered to the customers as per their requirements.

6. Optimum utilisation of resources- production management facilities optimum utilisation of resources such as manpower, machines, etc.so, and the firm can meet its capacity utilisation objective. This will bring higher returns to the organisation.

7. Minimises cost of production- production management helps to minimise the cost of production. It tries to maximise the output and minimise the inputs. This helps the firm to achieve its cost reduction and efficiency objective.

8. Expansion of the firm - the production management helps the firm to expand and grow. This is because it tries to improve quality and reduce costs. This helps the firm to earn higher profits. These profits help the firm to expand and grow.

What is production planning?

Meaning: Production planning means to fix the production goals and to estimate the resources which are required to achieve these goals. It prepares a detailed plan for achieving the production goals economically, efficiently and in time. It forecast each step in the production process. It forecast the problem, which may arise in the production process. It tries to remove these problems. It also tries to remove the causes of wastage.

Definition of production planning

According to **ray wild,** "production planning is concerned with the determination, acquisition and arrangement of all facilities necessary for future operations".

Objective of production planning

1. Effective utilization of resources.

2. Steady flow of production.

3. Estimate the resources.

4. Ensures optimum inventory.

5. Coordinates activities of departments.

6. Minimize wastage of raw materials.

7. Improves the labour productivity

8. Helps to capture the market.

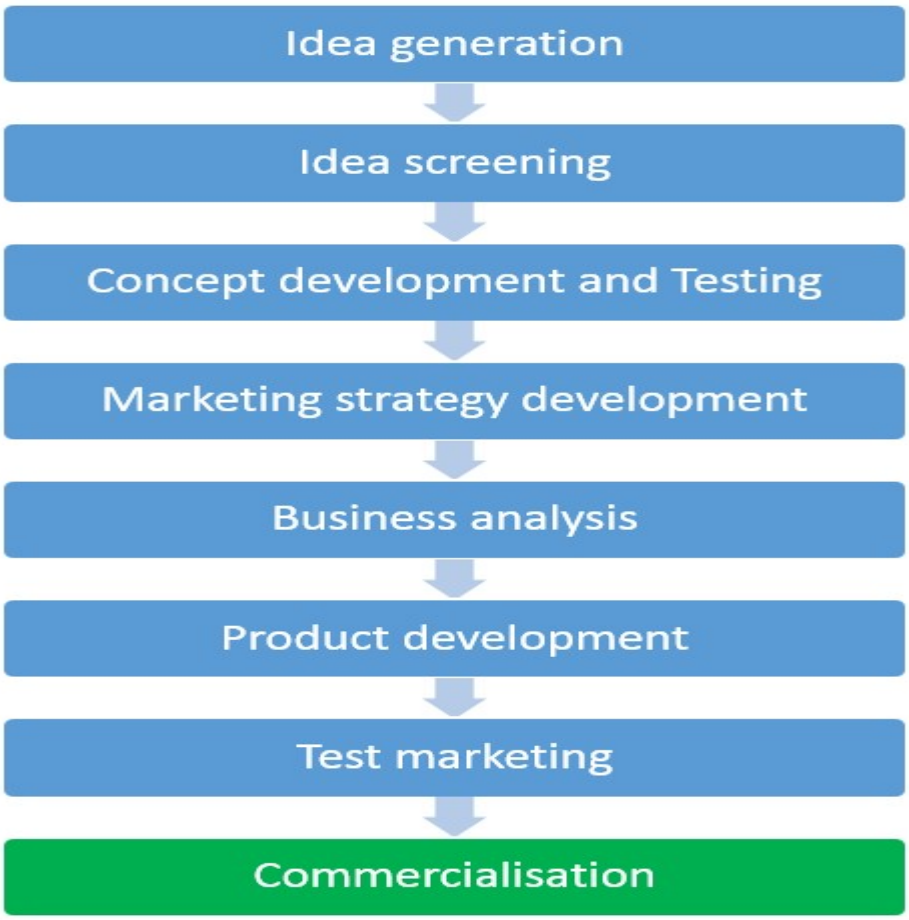
9. Provides a better work.

10. Facilities quality improvement.

11. Results in consumer satisfaction.

12. Reduces the production cost.

Product development process :



1. Idea generation- idea generation refers to the systematic search for new- product ideas. Typically, a company generates hundreds of ideas, maybe even thousand, to find a handful of goods ones in the end.

2. Idea screening- the next step in the new product development process is idea screening. Idea screening means nothing else than filtering the ideas to pick out good ones. In other words, all ideas generated are screened to spot good ones and drop ones as soon as possible. While the purpose of idea generation was to create a large number of ideas, the purpose of the succeeding stages is to reduce that number.

3. Concept development and testing- to go on in the new product development process, attractive ideas must be developed into product concept. A product concept is a detailed version of the new-product idea stated in meaningful consumer terms.

4. Marketing strategy development- the next step in the new product development process is the marketing strategy development. When a promising concept has been developed and tested, it is time to design and initial marketing strategy for the new product based on the product concept for introducing this new product to the market.

5. Business analysis- one decided upon a product concept and marketing strategy, management can evaluate the business attractiveness of the proposed new product. The fifth

step in the new product development process involves a review of the sales, cost and profit projection for the new product to fid out whether these factors satisfy the company's objectives.

6. Product development - the new product development process goes on with actual product development. Up to this point, for, many new products concept there may exist only a word description, a drawing or perhaps a rough prototype. But if the product concept passes the business test, it must be developed into a physical product to ensure that the product idea can be turned into a workable market offering. The problem is, though, that at this stage, R&D and engineering cost cause a huge jump in investment.

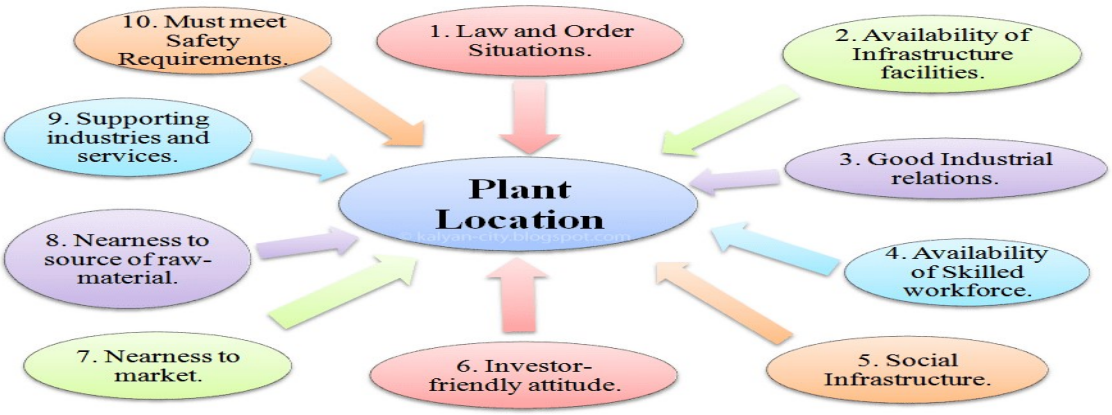
7. Test marketing - the last stage before commercialisation in the new product development process is test marketing. In this stage of the new product development process, the product and its proposed marketing programme are tested in realistic market settings. Therefore, test marketing gives the marketer experience with the marketing the product before going to the great expense of full introduction.

8. Commercialisation - test marketing has given management the information needed to make the final decision launch or do not launch the new product. The final stage in the new product development process is commercialisation. Commercialisation means nothing else then introducing a new product into the market. At this point, the highest costs are incurred: the company may need to be build or a rent a manufacturing facility.

UNIT-2

Plant location- plant location refers to the choice of the region where men, materials, money, machinery and equipment are brought together for setting up a business or factory. A plant is place where the cost of the product is kept to low in order to maximise gains.

Factor affecting plant location- plant location must be selected properly by entrepreneurs while planning to set up their business units. While taking such a decision, they must consider some important factors.



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.

1. **Law and order situation-** plant location must be at that place where law and order situation is in control. Entrepreneurs give a lot of importance to this factor while locating a business unit in any state, or region.
2. **Availability of infrastructure facilities-** plant location which is selected must have proper infrastructure facilities. Without good infrastructure facilities, it will be difficult to do business efficiently. The infrastructure facilities are the backbone of all industries. Without it business cannot to be done.

Crucial infrastructure facilities that help industries to grow.

- O Transport and communication,
- O Banking and insurance services,
- O Regular fuel supply,
- O continuous supply of electricity and water, etc.

3. Good industrial relations- plant location must be at those places where good industrial-relations are maintained. Industrial location becomes bad, because of militant and selfish trade unions. Entrepreneurs do not want to locate their business at places where anti-social element are rampant, although there are other favorable factors such as good infrastructure facilities, cheap labor, etc.

4. Availability of skilled workforce- plant location must be convenient and easily accessible to skilled workforce. Most business requires skilled-labour force such as engineers, management experts, computer programmers, etc.

5. Social infrastructure- plant location must good a social infrastructure. There is a need for social-infrastructure not only for employees' welfare.

There must suitable social infrastructure facilities like;

- Education institution,
- Hospitals and health centres,
- Community centres like worship place, garden, meditation center etc.
- Recreation facilities like theatres, clubs, communication facilities etc.

6. Investor friendly attitude- plant location must be in those states whose governments have an investor-friendly attitude. Government must give attractive incentives and concessions to those who start business units in their states. There must not be any bureaucratic control for starting a business.

7. Nearness to market- plant location must be near a market. Every business unit depends on a market on time, and it must be available to the consumers at a low price.

8. Nearness to raw-materials' source- plant location must be usually near to the source of raw-materials' costs are about 50% of the total cost. So, it is important in the business to get the raw materials in time and at a reasonable price. Therefore, a business must be located close to the source of raw material, especially in the case of "gross materials"

Gross materials are those which lose weight in the production process. Examples of gross materials are sugarcane, iron ore, so on.

Pure materials are those which add their weight to the finished product. Examples of pure materials of cotton textiles, bakeries, silk fabrics, etc.

9. Nearness to supporting industries- plant location must be near its supporting industries and services. If it purchases spare parts from an outside agency, then these agencies must be located very close to the business. If not, the business will have to spend a lot of extra money on transport. It will also be difficult, to control the quality of the spare parts because of the distant location.

10. Must meet safety requirements- plant location must meet all essential safety requirements. Due to air, water and sound pollution, some factories have a bad effect on the health of the people. Therefore, these factories must be located away from residential areas. Safety to environment must also be given priority in this regards.

Theory of Alfred Weber

Definition- This theory is taken as the starting point of all the analytical studies made on the subject of location of plant and office. Weber gave his theory in 1909 which was published in the form of an essay in German and subsequently translated in English in 1929 that the modern thinking started.

Salient features of Weber's theory:

The first and perhaps the most important feature of the theory given by weber is its division into two parts: pure theory and realistic theory. Other features of his theory are that it is based on the deductive method and incorporates all those general factors

which attract of localize. In some areas or regions and ultimately decide the basic location structure of these industries.

According to Weber, factors affecting location of industries may be broadly classified into two groups or categories:

1. Regional factors or primary causes of regional distribution of industry.
2. Agglomerative and degglomerative factor or secondary causes responsible for redistribution of industry.

Regional factors: After examining the cost structures of different industries, Weber come to conclusion that the cost of production varies from region to region. Therefore, the industry in general is localized at a place or in a region where the cost of production was the minimum.

According to Weber there are two general regional factors which affect 'cost of production:

1. Transportation cost
2. Labour costs. In fact, these two are basic factor influencing location of industries**.**

Transportation cost: transportation cost plays an important part in the location of an industry. Transportation costs are influenced by the weight to be transported and the distance to be covered. Generally, industries will have a tendency to localize at a place where material and fuel are not difficult to obtain. Weber has further given that the basic factors for location of an industry are the nature or type of material used and the nature of their transformation into products.

Weber has divided raw material into two categories: iniquities and specific local raw material. The former is generally available at all places whereas the letter is found only in a few. Likewise, material may be pure raw material and gross raw material.

Pure raw material is one which does not lose its weight during production process and the gross raw material is that which loses considerable weight in the transformation process. The finished product is less in weight than the weight of raw material used in its manufacture.

Examples of this type of material are sugar cane and iron ore. Weber has given a material index to show the tendency of industries to get located either at a place where raw materials are easily available or where the markets are closer.

The formula given by him is:

Material index = weight of localized gross material/weight of finished commodity

If the index number is greater than unity, industries will have a tendency to localize at the place of raw materials; in case of its being less than unity, they will get located near the places of consumption or markets. In case of unity, industries may be located at any of the places of raw material or markets depending upon discretion of the entrepreneur and his convenience.

Labour cost also affects the location of industries. If transportation cost are favourable but labour costs unfavourable, the problem of location becomes difficult to have a readymade solution.

Industries may have tendency to get located at the place where labour costs are low. But labour and transportation costs should be low for an ideal situation. Whether labour costs will have an industry will be decided by labour cost index.

This can be found by the following formula:

Labour cost index = labour cost / weight of product

If labour coefficient is higher, the industry will get located at the place where costs are low and if labour the coefficient is lower, transportation costs may influence the decision.

Criticism of Weber's theory:

The main criticism against Weber's theory is that it is too simple, unrealistic and imaginary because it does not throw sufficient light on different factors and circumstances having a bearing on location.

The following points are important in this regards:

1. Inadequate analysis of transportation costs-

Weber considers only two factors in transportation costs - the weight to be transported and the distances to be covered. There are some other factors such as quality of goods, topography etc., which also influence transportation costs. Weber has not given any consideration to these points. Also, Weber has taken transportation on the basis of tone mileage, and not on physical cost basis.

2. Omission of important causes of location- Weber has included only transportation costs and labour costs among the causes location, centralization or decentralization of industry. Other factors affecting location, such as climate, credit facilities, cost of capital etc., were not given any consideration.

3. Mathematical expression- Weber has used index numbers and coefficient in his theory which has made it complicated. In fact, the theory is based on technical analysis and has become mathematical in character. This has made it more difficult to understand.

4. Categorisation of raw materials- Austin Robinson has regarded to division of raw materials made by Weber as artificial and unnatural.

5. Historical factors ignored- Weber has not given any importance to non-economic factors historical, social and political.

6. Consumption centres- Weber takes consumption centres as stable. But consumption centers change and consumers and buyers are generally scattered all over.

Sargent Florence's Theory of location:

Definition: Professor Sargent has followed the inductive method in formulating his theory of location. Sargent's theory is more practical and realistic than that given by weber. After properly analyzing statistical data, Sargent tried to ascertain the tendency of location of industries.

On the basis of production census he has tried to find out the statistical measures of location and has not accepted the traditional view of the geographical context, not the region or area as such but the working population in that area is more important. Sargent has used two new concepts in his theory of location.

Factors:

1. Location factor: location factor indicates the centralization or otherwise of an industry. If the location factor index is greater than unity, there is a tendency of centralization; on the other hand, if it is less than unity, the otherwise is true. In case

of unity, a state of evenness exists this indicates that there is neither centralization nor decentralization.

The location factor index is calculated by using the following formula:

No. of workers engaged in a particular industry of an area * 100
Total no. of workers engaged in all industries in the area

Location factor index

Total no. of workers engaged in all industry of an area * 100
Total no. of industries workers in the country

0r percentage of workers engaged in a particular industry
Proportion of total number of workers engaged in the area
To the total industrial workers of the country

We take an example to explain the use of the formula. Suppose that the population of industrial workers in a country is 500; workers engaged in a given area is 200 and workers engaged in a particular industry (cement, etc.) are 100.

The location factor index will be calculated in the following manner:

$$\textbf{Location factor index} = \frac{\frac{200 * 100}{200}}{\frac{200 * 100}{500}}$$

$$\textbf{Or} = \frac{50}{40}$$

$$= 1.25$$

The index is greater than 1; therefore, industry appears to be centralized in that area.

2. Coefficient of location: Coefficient of localization indicates the propensity of concentration of industries. This has no relation as such with the area. If the percentage of workers over different areas is also given in percentage, the variance between the two percentage is divided by 100 which give the coefficient of location.

The coefficient of localization can be calculated in the following manner:

$$\textbf{Coefficient of localisation} = \frac{\text{\% of workers in The area} - \text{\% of workers in particular industry}}{100}$$

Take an example: Suppose the percentage of workers in the area is 90 and those engaged in a particular industry is 60. The coefficient would be found out in this manner.

$$\textbf{Coefficient of localization} = \frac{90 - 60}{} = \frac{30}{} = 0.3$$

100 100

Since the coefficient of localization is less than unity or one, industries have a tendency of decentralization in that area.

Criticism of Sargent Florence's theory:

Following are the points of criticism against the theory of location given by florence:

1. Ignorance of causes of location: The theory tells only whether the industry is centralized or decentralised but does not give the causes of such a tendency.
2. Difficulty of knowing propensity of localization: It is difficult to know only on the basis of coefficient of localization whether there is propensity of centralization or decentralization.
3. Ignorance of favourable local conditions: The theory does not care for the favourable local factors influencing centralization of industries.
4. Absence of knowledge of productive capacity: The theory given by Florence emphasizes the number of workers in calculating the index and coefficient but ignores production. It is difficult to know the productive capacity of different areas. In spite of these deficiencies the theory at least suggests a way to know the tendency of localization of industries.
Meaning of layout: Master plan or blueprint of a printed or published work (such as an advertisement, book, magazine, newspaper, or website) that lays out the arrangement of its different graphic elements (such as body copy, colors, headlines, illustrations, scale). It establishes the overall appearance, relative importance, and relationship between the graphic elements to achieve a smooth flow of information (message) eye movement for maximum effectiveness or impact. Often alternative layouts (called roughs) are prepared to explore different arrangements before the final layout is made for printing or production.

Plant layout
Meaning: Plant layout is the most effective physical arrangement, either existing or in plans of industrial facilities i.e. arrangement of machines, processing equipment and service departments to achieve greatest co-ordination and efficiency of 4 M's (Men, Materials, Machines and Methods) in a plant.
Layout problems are fundamental to every type of organization/enterprise and are experienced in all kinds of concerns/undertakings. The adequacy of layout affects the efficiency of subsequent operations.

Objectives of Plant Layout

A properly planned plant layout aims at achieving the following objectives:

1. To achieve economies in handling of raw materials, work in- progress and finished goods.

2. To reduce the quantum of work-in-progress.
3. To have most effective and optimum utilisation of available floor space.
4. To minimise bottlenecks and obstacles in various production processes thereby avoiding the accumulation of work at important points.
5. To introduce system of production control.
6. To ensure means of safety and provision of amenities to the workers.
7. To provide better quality products at lesser costs to the consumers.
8. To ensure loyalty of workers and improving their morale.
9. To minimise the possibility of accidents.
10. To provide for adequate storage and packing facilities.
11. To workout possibilities of future expansion of the plant.
12. To provide such a layout which permits meeting of competitive costs?

The objectives of plant layout have been nicely explained by Shubin and Madeheim. "Its objective is to combine labour with the physical properties of a plant (machinery, plant services, and handling equipment) in such a manner that the greatest output of high quality goods and services, manufactured at the lowest unit cost of production and distribution, will result."

Principles of Plant Layout:

1. **Principle of Overall Integration:** According to this principle the best layout is one which provides integration of production facilities like men, machinery, raw materials, supporting activities and any other such factors which result in the best compromise.

2. **Principle of Minimum Distance:** According to this principle, the movements of men and materials should be minimized.

3. **Principle of Flow:** According to Muther, the best layout is one which arranges the work station for each operate process in same order or sequence that forms treats or assembles the materials.

4. **Principle of Cubic Space Utilization:** According to this, the best layout utilizes cubic space i.e. space available both in vertical and horizontal directions is most economically and effectively utilized.

5. **Principle of Satisfaction and Safety:** According to this principle, best layout is one which provides satisfaction and safety to all workers.

6. **Principle of Flexibility:** In automotive and other allied industries where models of products change after sometime, the principle of flexibility provides adoption and rearrangements at a minimum cost and least inconvenience.

Factors affecting for Plant Layout

1)Policies of management: It is important to keep in mind various managerial policies and plans before deciding plant layout. Various managerial policies relate to future volume of production and expansion, size of the plant, integration of production processes; facilities to

employees, sales and marketing policies and purchasing policies etc. These policies and plans have positive impact in deciding plant layout.

(2) Plant location: Location of a plant greatly influences the layout of the plant. Topography, shape, climate conditions, and size of the site selected will influence the general arrangement of the layout and the flow of work in and out of the building.

(3) Nature of the product: Nature of the commodity or article to be produced greatly affects the type of layout to be adopted. In case of process industries, where the production is carried in a sequence, product layout is suitable. For example, soap manufacturing, sugar producing units and breweries apply product type of layout. On the other hand in case of intermittent or assembly industries, process type of layout best suited. For example, in case of industries manufacturing cycles, typewriters, sewing machines and refrigerators etc., process layout method is best suited.

Production of heavy and bulky items need different layout as compared to small and light items. Similarly products with complex and dangerous operations would require isolation instead of integration of processes.

(4) Volume of production:

Plant layout is generally determined by taking into consideration the quantum of production to be produced. There are three systems of production viz.,

(a) Job production:

Under this method peculiar, special or non- standardized products are produced in accordance with the orders received from the customers. As each product is non- standardized varying in size and nature, it requires separate job for production. The machines and equipment's are adjusted in such a manner so as to suit the requirements of a particular job.

Job production involves intermittent process as the work is carried as and when the order is received. Ship building is an appropriate example of this kind. This method of plant layout viz., Stationery Material Layout is suitable for job production.

(b) Mass production:

This method involves a continuous production of standardized products on large scale. Under this method, production remains continuous in anticipation of future demand. Standardization is the basis of mass production. Standardized products are produced under this method by using standardized materials and equipment. There is a continuous or uninterrupted flow of production obtained by arranging the machines in a proper sequence of operations. Product layout is best suited for mass production units.

(c) Batch production:

It is that form of production where identical products are produced in batches on the basis of demand of customers or of expected demand for products. This method is generally similar to job production except the quality of production.

Instead of making one single product as in case of job production a batch or group of products is produced at one time, It should be remembered here that one batch of products has no resemblance with the next batch. This method is generally adopted in case of biscuit and confectionary manufacturing, medicines, tinned food and hardware's like nuts and bolts etc.

(5) Availability of floor space:

Availability of floor space can be other decisive factor in adopting a particular mode of layout. If there is a scarcity of space, product layout may be undertaken. On the other hand more space may lead to the adoption of process layout.

(6) Nature of manufacturing process:

The type of manufacturing process undertaken by a business enterprise will greatly affect the type of layout to be undertaken.

Types of Plant layout

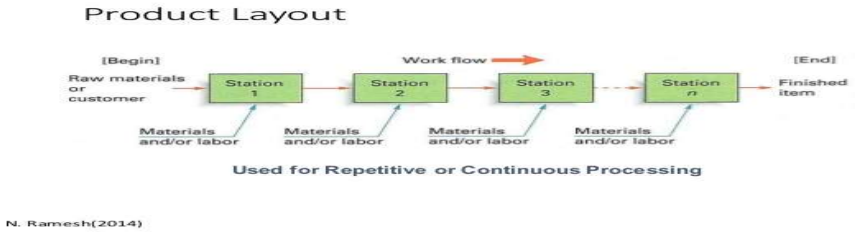
Four Main Types of Plant Layout

1. Product or Line Layout
2. Process or Functional Layout.
3. Fixed Position Layout.
4. Combination type of Layout.

1. Product or Line Layout

If all the processing equipment and machines are arranged according to the sequence of operations of the product, the layout is called product type of layout. In this type of layout, only one product of one type of products is produced in an operating area. This product must be standardized and produced in large quantities in order to justify the product layout.

The raw material is supplied at one end of the line and goes from one operation to the next quite rapidly with a minimum work in process, storage and material handling. Fig. 8.3 shows product layout for two types of products A and B.



N. Ramesh(2014)

Advantages offered by Product Layout:

(i) Lowers total material handling cost.

(ii) There is less work in processes.

(iii) Better utilization of men and machines,

(iv) Less floor area is occupied by material in transit and for temporary storages.

(v) Greater simplicity of production control.

(vi) Total production time is also minimized.

Limitations of Product Layout:

(i) No flexibility which is generally required is obtained in this layout.

(ii) The manufacturing cost increases with a fall in volume of production.

(iii) If one or two lines are running light, there is a considerable machine idleness.

(iv) A single machine break down may shut down the whole production line.

(v) Specialized and strict supervision is essential.

2. **Process or Functional Layout**

The process layout is particularly useful where low volume of production is needed. If the products are not standardized, the process layout is more low desirable, because it has creator process flexibility than other. In this type of layout, the machines and not arranged according to the sequence of operations but are arranged according to the nature or type of the operations. This layout is commonly suitable for non repetitive jobs.

Same type of operation facilities are grouped together such as lathes will be placed at one place, all the drill machines are at another place and so on. See Fig. 8.4 for process layout. Therefore, the process carried out in that area is according to the machine available in that area.

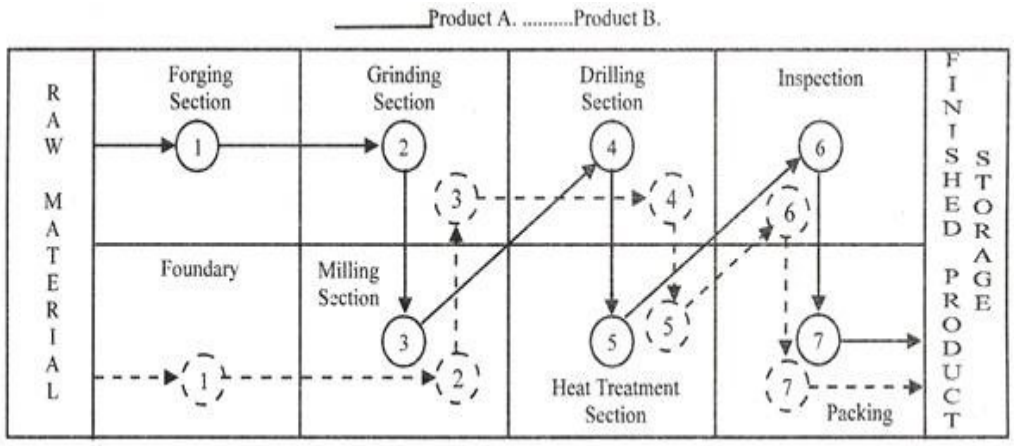


Fig. 3.4

Advantages of Process Layout

(i) There will be less duplication of machines. Thus, total investment in equipment purchase will be reduced.

(ii) It offers better and more efficient supervision through specialization at various levels.

(iii) There is a greater flexibility in equipment and man power thus load distribution is easily controlled.

(iv) Better utilization of equipment available is possible.

(v) Break down of equipment can be easily handled by transferring work to another machine/work station.

(vi) There will be better control of complicated or precision processes, especially where much inspection is required.

Limitations of Process Layout

(i) There are long material flow lines and hence the expensive handling is required.

(ii) Total production cycle time is more owing to long distances and waiting at various points.

(iii) Since more work is in queue and waiting for further operation hence bottle necks occur.

(iv) Generally, more floor area is required.

(v) Since work does not flow through definite lines, counting and scheduling is more tedious.

(vi) Specialization creates monotony and there will be difficult for the laid workers to find job in other industries.

3. **Fixed Position Layout**

This type of layout is the least important for today's manufacturing industries. In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment's are brought to this location.

The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment's to work place along with the man power. This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.

Advantages Offered by Fixed Position Layout

(i) Material movement is reduced

(ii) Capital investment is minimized.

(iii) The task is usually done by gang of operators, hence continuity of operations is ensured

(iv) Production centers are independent of each other. Hence, effective planning and loading can be made. Thus total production cost will be reduced.

(v) It offers greater flexibility and allows change in product design, product mix and production volume.

Limitations of Fixed Position Layout

(i) Highly skilled man power is required.

(ii) Movement of machines equipment's to production centre may be time consuming.

(iii) Complicated fixtures may be required for positioning of jobs and tools. This may increase the cost of production.

4. **Combination Type of Layout**

Now a days in pure state any one form of layouts discussed above is rarely found. Therefore, generally the layouts used in industries are the compromise of the above mentioned layouts. Every layout has got certain advantages and limitations. Therefore, industries would to like use any type of layout as such.

Flexibility is a very important factory, so layout should be such which can be molded according to the requirements of industry, without much investment. If the good features of all types of layouts are connected, a compromise solution can be obtained which will be more economical and flexible.

Plant Maintenance: In modern industries, equipment and machinery are very important parts of the production activity. A large amount of money is invested in machineries and equipments. Special purpose and modern machineries cost a lot of money. If those machineries and equipments are kept idle then it will be a great loss to that company. So they have to be kept always in good working condition. Then only they will work efficiently for more number of years. They should not breakdown or stop production. So it is very important that machineries and equipments in plants are properly maintained. In order to take smooth production of finished goods from the factory, machinery and equipment should be in proper conditions and with breakdown free. The damage caused to plant and machineries due to normal wear and tear, improper use, under and over utilization, mis-operation etc can be viewed seriously and can hamper the smooth production of goods and services and machine down time. Keeping the productive resources of plant, machinery, equipment etc in good working condition is an important responsibility of management to achieve specified level of quality and reliability of operation.

Maintenance –Definition: Maintenance is the process of keeping the machine and equipment in good working condition so that the efficiency of machine is retained and its life is increased.

Or

"Plant maintenance is a combination of actions carried out by an organization to replace, repair, service the machineries, components or their groups in a manufacturing plant, so that it will continue to operate satisfactorily"

Objective of plant maintenance: The objective of maintenance is to maximize the performance of productive resources of an organization by ensuring that these resources perform regularly and efficiently. This is achieved by preventing the breakdown and failures and by minimizing the production loss.

The main objectives of plant maintenance are:

- To maximize the availability of plant, equipment and machinery for productivity through planned maintenance.
- To extend the life span of the plant, equipment , machinery etc., by minimizing their wear and tear and deterioration.
- To reduce the cost of production due to plant breakdown due to improper plant maintenance.
- To help the production department to go ahead with their production plans without any problem.
- To ensure operational readiness of all production facilities for emergency use at all times, such as fire fighting equipment , first aid facilities, alternative method of production and packing etc
- To provide management with proper information on the cost and effectiveness of maintenance.
- To ensure safety of staff through regular inspection and maintenance of facilities such as boilers, compressors, elevations, material handling system, conveyors , dangerous heavy machineries etc.

Environmental Factors Affecting Plant Growth

Plant growth and geographic distribution are greatly affected by the environment. If any environmental factor is less than ideal, it limits a plant's growth and/or distribution. For example, only plants adapted to limited amounts of water can live in deserts.

Either directly or indirectly, most plant problems are caused by environmental stress. In some cases, poor environmental conditions (e.g., too little water) damage a plant directly. In other cases, environmental stress weakens a plant and makes it more susceptible to disease or insect attack.

Environmental factors that affect plant growth include light, temperature, water, humidity, and nutrition. It is important to understand how these factors affect plant growth and development. With a basic understanding of these factors, you may be able to manipulate plants to meet your needs, whether for increased leaf, flower, or fruit production. By recognizing the roles of these factors, you also will be better able to diagnose plant problems caused by environmental stress.

Light: Three principal characteristics of light affect plant growth: quantity, quality, and duration.

Quantity:Light quantity refers to the intensity, or concentration, of sunlight. It varies with the seasons. The maximum amount of light is present in summer, and the minimum in winter. Up to a point, the more sunlight a plant receives, the greater its capacity for producing food via photosynthesis.

You can manipulate light quantity to achieve different plant growth patterns. Increase light by surrounding plants with reflective materials, a white background, or supplemental lights. Decrease it by shading plants with cheesecloth or woven shade cloths.

Quality: Light quality refers to the color (wavelength) of light. Sunlight supplies the complete range of wavelengths and can be broken up by a prism into bands of red, orange, yellow, green, blue, indigo, and violet.

Blue and red light, which plants absorb, have the greatest effect on plant growth. Blue light is responsible primarily for vegetative (leaf) growth. Red light, when combined with blue light, encourages flowering. Plants look green to us because they reflect, rather than absorb, green light.

Knowing which light source to use is important for manipulating plant growth. For example, fluorescent (cool white) light is high in the blue wavelength. It encourages leafy growth and is excellent for starting seedlings. Incandescent light is high in the red or orange range, but generally produces too much heat to be a valuable light source for plants. Fluorescent grow-lights attempt to imitate sunlight with a mixture of red and blue wavelengths, but they are costly and generally no better than regular fluorescent lights.

Duration: Duration, or photoperiod, refers to the amount of time a plant is exposed to light. Photoperiod controls flowering in many plants (Figure 26). Scientists initially thought the length of light period triggered flowering and other responses within plants. Thus, they describe plants as short-day or long-day, depending on what conditions they flower under. We now know that it is not the length of the light period, but rather the length of uninterrupted darkness, that is critical to floral development.

Plants are classified into three categories: short-day (long-night), long-day (short-night), or day-neutral, depending on their response to the duration of light or darkness. Short-day plants form flowers only when day length is less than about 12 hours. Many spring- and fall-flowering plants, such as chrysanthemum, poinsettia, and Christmas cactus, are in this category.

In contrast, long-day plants form flowers only when day length exceeds 12 hours. Most summer flowering plants (e.g., rudbeckia, California poppy, and aster), as well as many vegetables (beet, radish, lettuce, spinach, and potato), are in this category.

Day-neutral plants form flowers regardless of day length. Examples are tomato, corn, cucumber, and some strawberry cultivars. Some plants do not fit into any category, but may respond to combinations of day lengths. Petunias, for example, flower regardless of day length, but flower earlier and more profusely with long days.

You can easily manipulate photoperiod to stimulate flowering. For example, chrysanthemums normally flower in the short days of spring or fall, but you can get them to bloom in midsummer by covering them with a cloth that completely blocks out light for 12 hours each day. After several weeks of this treatment, the artificial dark period no longer is needed, and the plants will bloom as if it were spring or fall. This method also is used to make poinsettias flower in time for Christmas.

To bring a long-day plant into flower when day length is less than 12 hours, expose the plant to supplemental light. After a few weeks, flower buds will form.

Temperature: Temperature influences most plant processes, including photosynthesis, transpiration, respiration, germination, and flowering. As temperature increases (up to a point), photosynthesis, transpiration, and respiration increase. When combined with day-length, temperature also affects the change from vegetative (leafy) to reproductive (flowering) growth. Depending on the situation and the specific plant, the effect of temperature can either speed up or slow down this transition.

Germination

The temperature required for germination varies by species. Generally, cool-season crops (e.g., spinach, radish, and lettuce) germinate best at 55° to 65°F, while warm-season crops (e.g., tomato, petunia, and lobelia) germinate best at 65° to 75°F.

Flowering

Sometimes horticulturists use temperature in combination with day length to manipulate flowering. For example, a Christmas cactus forms flowers as a result of short days and low temperatures (Figure 26). To encourage a Christmas cactus to bloom, place it in a room with more than 12 hours of darkness each day and a temperature of 50° to 55°F until flower buds form.

If temperatures are high and days are long, cool-season crops such as spinach will flower (bolt). However, if temperatures are too cool, fruit will not set on warm-season crops such as tomato.

Crop quality

Low temperatures reduce energy use and increase sugar storage. Thus, leaving crops such as ripe winter squash on the vine during cool, fall nights increases their sweetness.

Adverse temperatures, however, cause stunted growth and poor-quality vegetables. For example, high temperatures cause bitter lettuce.

Photosynthesis and respiration

Thermoperiod refers to daily temperature change. Plants grow best when daytime temperature is about 10 to 15 degrees higher than nighttime temperature. Under these conditions, plants photosynthesize (build up) and respire (break down) during optimum daytime temperatures and then curtail respiration at night. However, not all plants grow best under the same range between nighttime and daytime temperatures. For example, snapdragons grow best at nighttime temperatures of 55°F; poinsettias, at 62°F.

Temperatures higher than needed increase respiration, sometimes above the rate of photosynthesis. Thus, photosynthates are used faster than they are produced. For growth to occur, photosynthesis must be greater than respiration.

Daytime temperatures that are too low often produce poor growth by slowing down photosynthesis. The result is reduced yield (i.e., fruit or grain production).

Breaking dormancy

Some plants that grow in cold regions need a certain number of days of low temperature (dormancy). Knowing the period of low temperature required by a plant, if any, is essential in getting it to grow to its potential.

Peaches are a prime example; most varieties require 700 to 1,000 hours between 32° and 45°F before breaking their rest period and beginning growth. Lilies need 6 weeks of temperatures at or slightly below 33°F before blooming.

Daffodils can be forced to flower by storing the bulbs at 35° to 40°F in October. The cold temperature allows the bulbs to mature. When transferred to a greenhouse in midwinter, they begin to grow, and flowers are ready to cut in 3 to 4 weeks.

Hardiness

Plants are classified as hardy or nonhardy depending on their ability to withstand cold temperatures. *Hardy* plants are those that are adapted to the cold temperatures of their growing environment.

Woody plants in the temperate zone have very sophisticated means for sensing the progression from fall to winter. Decreasing day length and temperature trigger hormonal changes that cause leaves to stop photosynthesizing and to ship nutrients to twigs, buds, stems, and roots. An abscission layer forms where each petiole joins a stem, and the leaves eventually fall off. Changes within the trunk and stem tissues over a relatively short period of time "freeze-proof" the plant.

Winter injury to hardy plants generally occurs when temperatures drop too quickly in the fall before a plant has progressed to full dormancy. In other cases, a plant may break dormancy in mid- or late winter if the weather is unseasonably warm. If a sudden, severe cold snap follows the warm spell, otherwise hardy plants can be seriously damaged.

It is worth noting that the tops of hardy plants are much more cold-tolerant than the roots. Plants that normally are hardy to 10°F may be killed if they are in containers and the roots are exposed to 20°F.

Winter injury also may occur because of desiccation (drying out) of plant tissues. People often forget that plants need water even during winter. When the soil is frozen, water movement into a plant is severely restricted. On a windy winter day, broadleaf evergreens can become water-deficient in a few minutes, and the leaves or needles then turn brown. To minimize the risk of this type of injury, make sure your plants go into the winter well watered.

Water and Humidity

Most growing plants contain about 90 percent water. Water plays many roles in plants. It is:

A primary component in photosynthesis and respiration

Responsible for turgor pressure in cells (Like air in an inflated balloon, water is responsible for the fullness and firmness of plant tissue. Turgor is needed to maintain cell shape and ensure cell growth.)

A solvent for minerals and carbohydrates moving through the plant

Responsible for cooling leaves as it evaporates from leaf tissue during transpiration

A regulator of stomatal opening and closing, thus controlling transpiration and, to some degree, photosynthesis

The source of pressure to move roots through the soil

The medium in which most biochemical reactions take place

Relative humidity is the ratio of water vapor in the air to the amount of water the air could hold at the current temperature and pressure. Warm air can hold more water vapor than cold air. Relative humidity (RH) is expressed by the following equation:

RH = water in air ÷ water air could hold (at constant temperature and pressure)

Relative humidity is given as a percent. For example, if a pound of air at 75°F could hold 4 grams of water vapor, and there are only 3 grams of water in the air, then the relative humidity (RH) is:

$3 \div 4 = 0.75 = 75\%$

Water vapor moves from an area of high relative humidity to one of low relative humidity. The greater the difference in humidity, the faster water moves. This factor is important because the rate of water movement directly affects a plant's transpiration rate.

The relative humidity in the air spaces between leaf cells approaches 100 percent. When a stoma opens, water vapor inside the leaf rushes out into the surrounding air (Figure 25), and a bubble of high humidity forms around the stoma. By saturating this small area of air, the bubble reduces the difference in relative humidity between the air spaces within the leaf and the air adjacent to the leaf. As a result, transpiration slows down.

If wind blows the humidity bubble away, however, transpiration increases. Thus, transpiration usually is at its peak on hot, dry, windy days. On the other hand, transpiration generally is quite slow when temperatures are cool, humidity is high, and there is no wind.

Hot, dry conditions generally occur during the summer, which partially explains why plants wilt quickly in the summer. If a constant supply of water is not available to be absorbed by the roots and moved to the leaves, turgor pressure is lost and leaves go limp.

Plant Nutrition

Plant nutrition often is confused with fertilization. Plant nutrition refers to a plant's need for and use of basic chemical elements. Fertilization is the term used when these materials are added to the environment around a plant. A lot must happen before a chemical element in a fertilizer can be used by a plant.

Plants need 17 elements for normal growth. Three of them--carbon, hydrogen, and oxygen--are found in air and water. The rest are found in the soil.

UNIT-3

Material Management: The need for materials management was first felt in manufacturing undertakings. The servicing organizations also started feeling the need for this control. And now even non-trading organizations like hospitals, universities etc. have realized the importance of materials management. Every organization uses a number of materials. It is necessary that these materials are properly purchased, stored and used.

Any avoidable amount spent on materials or any loss due to wastage of materials increases the cost of production. The object of materials management is to attack materials cost on all fronts and to optimize the overall end results. Materials management connotes controlling the kind, amount , location and turning of the various commodities used in and produced by the industrial enterprises. It is the control of materials in such a manner that it ensures maximum return on working capital.

De Rose : "Material management is the planning, directing, controlling and co-ordination of all those activities concerned with material and inventory requirements, from the point of their inception to their introduction into manufacturing process."

As per De Rose all those functions which start with the procurement of materials and end with completion of manufacturing are a part of material management.N.K. Nair: "Material management is the integrated functioning of the various sections of an organization dealing with the supply of materials and allied activities in order to achieve maximum co-ordination."

N.K. Nair has emphasized the co-ordination of all those activities which are related to the efficient use of materials.

Objectives of material management: The objective of material management can be classified into two categories viz; **primary objectives** and **secondary objectives.**

Primary objectives:

1. Low prices- it material department succeeds in reducing the price of items it buys, it contributes in not only reducing the operating cost but also in enhancing the profits.

2. Lower inventories- by keeping inventories low in relation to sales, it ensures that less capital is tied up in inventories. This increases the efficiency with which the capital of the company is utilized resulting in higher return on investment. Storage and carrying costs are also lower.

3. Reduction in real cost- efficient and economical handling of materials and storage lowers the acquisition and possession cost resulting in the reduction in the real cost.

4. Regular supply- continuity of supply of materials is essential for eliminating the disruption in the production process. In the absence of regular supply of materials, production cost go up.

5. Procurement of quality materials- materials department is responsible for ensuring quality becomes the single most objective in procurement of materials.

Secondary objective:

1. Reciprocity: the purchase of raw materials from the organization/customer's by the concern and in turn, sale of finished products to the above customers is known as reciprocity.

2. New developments: the staff of the materials department deals regularly with the suppliers responsible for ne development in material handling. These developments can be successfully applied in material handling and management.

3. Make or buy decisions: the material manager with regular reviews of cost and availability of materials can safely conclude that whether the material is to be purchased or developed in the organisation itself.

4. Standardisation: standardisation of material is greatly helpful in controlling the material management process. With regular stock - taking, the non - standardised items can be rejected and standard components may be brought into product designs to reduce the cost of production.

5. Assistance to production department: by supplying the standardised materials are components to the production department, quality products can be assured. It is helpful in imparting the economic knowledge in bringing about the desired improvement in the product.
Importance of Material Management: Material management is a service function. It is as important as manufacturing, engineering and finance. The supply of proper quality of materials is essential for manufacturing standard products. The avoidance of material wastage helps in controlling cost of production. Material management is essential for every type of concern.

The importance of material management may be summarized as follows:

1. The material cost content of total cost is kept at a reasonable level. Scientific purchasing helps in acquiring materials at reasonable prices. Proper storing of materials also helps in reducing their wastages. These factors help in controlling cost content of products.
2. The cost of indirect materials is kept under check. Sometimes cost of indirect materials also increases total cost of production because there is no proper control over such materials.
3. The equipment is properly utilized because there are no break downs due to late supply of materials.
4. The loss of direct labour is avoided.
5. The wastages of materials at the stage of storage as well as their movement is kept under control.
6. The supply of materials is prompt and late delivery instances are only few.
7. The investments on materials are kept under control as under and over stocking is avoided.
8. Congestion in the stores and at different stages of manufacturing is avoided.

Functions of Material Management: Material management covers all aspects of material costs, supply and utilization. The functional areas involved in material management usually include purchasing, production control, shipping, receiving and stores.

The following functions are assigned for material management:

1. **Production and Material Control** Production manager prepares schedules of production to be carried in future. The requirements of parts and materials are determined as per production schedules. Production schedules are prepared on the basis of orders received or anticipated demand for goods. It is ensured that every type or part of material is made available so that production is carried on smoothly.

2. **Purchasing** Purchasing department is authorized to make buying arrangements on the basis of requisitions issued by other departments. This department keeps contracts with suppliers and collects quotations etc. at regular intervals. The effort by this department is to purchase proper quality goods at reasonable prices. Purchasing is a managerial activity that goes beyond the simple act of buying and includes the planning and policy activities covering a wide range of related and complementary activities.

3. **Non-Production Stores:**Non-production materials like office supplies, perishable tools and maintenance, repair and operating supplies are maintained as per the needs of the business. These stores may not be required daily but their availability in stores is essential. The non-availability of such stores may lead to stoppage of work.

4. **Transportation:**The transporting of materials from suppliers is an important function of materials management. The traffic department is responsible for arranging transportation service. The vehicles may be purchased for the business or these may be chartered from outside. It all depends upon the quantity and frequency of buying materials. The purpose is to arrange cheap and quick transport facilities for incoming materials.

5. **Materials Handling:**It is concerned with the movement of materials within a manufacturing establishment and the cost of handling materials is kept under control. It is also seen that there are no wastages or losses of materials during their movement. Special equipment's may be acquired for material handling.

6. **Receiving:** The receiving department is responsible for the unloading of materials, counting the units, determining their quality and sending them to stores etc. The purchasing department is also informed about the receipt of various materials.

Meaning of inventory, Types of inventory: Inventory is the term for the goods available for sale and raw materials used to produce goods available for sale. Inventory represents one of the most important assets of a business because the turnover of inventory represents one of the primary sources of revenue generation and subsequent earnings for the company's shareholders.

Inventory is the array of finished goods or goods used in production held by a company. Inventory is classified as a current asset on a company's balance sheet, and it serves as a buffer between manufacturing and order fulfilment. When an inventory item is sold, its carrying cost transfers to the cost of goods sold (COGS) category on the income statement.

Organizations with inventory items of small unit cost generally update their inventory records at the end of an accounting period or when financial statements are prepared (called periodic inventory method). The value of an inventory depends on the valuation method used, such as first-in, first-out (FIFO) method or last-in, first-out (LIFO) method. GAAP require that inventory should be valued on the basis of either its cost price or its current market price whichever is lower of the two to prevent overstating of assets and earning due to sharp increase in the inventory's value in inflationary periods. The optimum level of inventory for an organization is determined by inventory analysis. Called also stock in trade, or just stock.

Importance of Inventory Management: Possessing a high amount of inventory for a long time is usually not advantageous for a business because of storage costs, spoilage costs, and the threat of obsolescence. However, possessing too little inventory also has its disadvantages; for example, the business runs the risk of market share erosion and losing profit from potential sales. Inventory management forecasts and strategies, such as a just-in-time (JIT) inventory system, can help minimize inventory costs because goods are created or received only when needed.

INVENTORY TYPES: Generally, inventory types can be grouped into four classifications: raw material, work-in-process, finished goods, and MRO goods.

1. **RAW MATERIALS:** Raw materials are inventory items that are used in the manufacturer's conversion process to produce components, subassemblies, or finished products. These inventory items may be commodities or extracted materials that the firm or its subsidiary has produced or extracted. They also may be objects or elements that the firm has purchased from outside the organization. Even if the item is partially assembled or is considered a finished good to the supplier, the purchaser may classify it as a raw material if his or her firm had no input into its production. Typically, raw materials are commodities such as ore, grain, minerals, petroleum, chemicals, paper, wood, paint, steel, and food items. However, items such as nuts and bolts, ball bearings, key stock, casters, seats, wheels, and even engines may be regarded as raw materials if they are purchased from outside the firm.

   The bill-of-materials file in a material requirements planning system (MRP) or a manufacturing resource planning (MRP II) system utilizes a tool known as a product structure tree to clarify the relationship among its inventory items and provide a basis for filling out, or "exploding," the master production schedule. Consider an example of a rolling cart. This cart consists of a top that is pressed from a sheet of steel, a frame formed from four steel bars, and a leg assembly consisting of four legs, rolled from sheet steel, each with a caster attached.

   Generally, raw materials are used in the manufacture of components. These components are then incorporated into the final product or become part of a subassembly. Subassemblies are then used to manufacture or assemble the final product. A part that goes into making another part is known as a component, while the part it goes into is known as its parent. Any item that does not have a component is regarded as a raw material or purchased item. From the product structure tree it is apparent that the rolling cart's raw materials are steel, bars, wheels, ball bearings, axles, and caster frames.

2. **WORK-IN-PROCESS:** Work-in-process (WIP) is made up of all the materials, parts (components), assemblies, and subassemblies that are being processed or are waiting to be

processed within the system. This generally includes all material—from raw material that has been released for initial processing up to material that has been completely processed and is awaiting final inspection and acceptance before inclusion in finished goods.

Any item that has a parent but is not a raw material is considered to be work-in-process. A glance at the rolling cart product structure tree example reveals that work-in-process in this situation consists of tops, leg assemblies, frames, legs, and casters. Actually, the leg assembly and casters are labeled as subassemblies because the leg assembly consists of legs and casters and the casters are assembled from wheels, ball bearings, axles, and caster frames.

3. **FINISHED GOODS:** A finished good is a completed part that is ready for a customer order. Therefore, finished goods inventory is the stock of completed products. These goods have been inspected and have passed final inspection requirements so that they can be transferred out of work-in-process and into finished goods inventory. From this point, finished goods can be sold directly to their final user, sold to retailers, sold to wholesalers, sent to distribution centers, or held in anticipation of a customer order.

   Any item that does not have a parent can be classified as a finished good. By looking at the rolling cart product structure tree example one can determine that the finished good in this case is a cart.

   Inventories can be further classified according to the purpose they serve. These types include transit inventory, buffer inventory, anticipation inventory, decoupling inventory, cycle inventory, and MRO goods inventory. Some of these also are know by other names, such as speculative inventory, safety inventory, and seasonal inventory.

4. **MRO GOODS INVENTORY:** Maintenance, repair, and operating supplies, or MRO goods, are items that are used to support and maintain the production process and its infrastructure. These goods are usually consumed as a result of the production process but are not directly a part of the finished product. Examples of MRO goods include oils, lubricants, coolants, janitorial supplies, uniforms, gloves, packing material, tools, nuts, bolts, screws, shim stock, and key stock. Even office supplies such as staples, pens and pencils, copier paper, and toner are considered part of MRO goods inventory.

Meaning of inventory management:

Inventory management is a practice of tracking and controlling the inventory orders, its usage and storage along with the management of finished goods that are ready for sale. If the inventory in not managed properly, it can lead to increase in storage cost, working capital crunch, wastage of labor resources, increase in idle time, disruption of the supply chain, etc. all this leads to a reduction in sales and unsatisfied customers. Therefore inventory management is an important aspect of the business which should not be ignored and must be managed properly.

Inventory management techniques:

There are various types of inventory management techniques which can help in efficient inventory management.

1. ABC analysis- ABC stands for always better control technique. ABC analysis is an inventory management technique where inventory items are classified into three categories namely: A, B, C. the items in a category of inventory are closely controlled as it consists of high- priced inventory which may be less in number but are very expensive. The items in B category are relatively lesser expensive inventory as compared to A category and the number of items in B category is moderate so control level is also moderate. The C category consists of a high number of inventory items which require lesser investments so the control level is minimum.

2. Just in time (jit) method- in just in time method of inventory control, the company keeps only as much inventory as it needs during the production process. With no excess inventory in hand, the company saves the cost of storage and insurance.

3. Material requirements planning (mrp) method- material requirements planning is an inventory control method in which the manufacturers order the inventory after considering the sales forecast. MRP system integrates data from various areas of the business where inventory is utilized. Based on the data and demand in the market, order for new inventory is placed with the material suppliers.

4.Economic order quantity (ECQ) model- economic order quantity technique focuses on taking a decision regarding how much quantity of inventory should the company order at any point of time and when should they place the order. In this model, inventory is reordered when it reaches the minimum level.

5.minimum safety stocks- the minimum safety stock is the level of inventory which an organization maintains to avoid stock out situation. It is the level at which the new order is placed before the existing inventory is over.

6. Ved analysis- ved stands for vital essential and desirable. Organizations mainly use this technique for controlling spare parts of inventory. Like, high level of inventory is required for vital parts that are very costly and essential for production.

7. Fast, slow & non- moving (fsn) method- this method of inventory control is very useful for controlling obsolescence. All the items of inventory are not used in same order, some are required frequently, while some are not required at all.

Supply chain management:

meaning - supply chain management is broad range of activities required to plan, control and execute a products' flow, from acquiring raw materials and production through distribution to the final customer, in the most streamlined and cost- effective way possible.

Types of supply chain management:

1. Supply chain planning- these systems provide information that help business in the planning of their supply chain. Some of the important supply chain planning functions as follows:

* forecasting demand for specific products and preparing sourcing and manufacturing plan for those products.

- Estimating the quantity of the product to be manufactured in a given time period
- Deciding the location where the finished goods are to be stored.
- Identifying the transportation mode to be used for delivering the products
- Setting the inventory levels for raw materials, intermediate products, and finished goods

2. Supply chain execution systems - these systems provide information that help businesses in the execution of their supply chain steps.

- Managing the flow products from the manufacturers to distributors to retailers and finally to customers in order to ensure the accurate delivery of products.
- Providing information about the status of orders being processed so that the vendors could provide the exact delivery dates to customers

- Tracking the shipment and accounting for the products that have been returned or are to be repaired and serviced.

3. Benefits of supply chain management- effective supply chain management systems provide the following benefits to optimize the organization's performance.

- Improve the customer service by delivering them the right product at the right time and at the right location, which in tum increase the organization's sales.
- Enable the companies to bring the products to the market at a quicker rate. thus , the companies get their payment sooner than those who lack an efficient supply chain.
- Lower the total supply chain cost, including procuring materials cost, transportation cost, inventor, carrying cost, etc. the reduction in supply chain cost helps to increase the firm's profitability.

UNIT-4

Meaning of purchasing- purchasing is the first phase of materials management.
Purchasing means procurement of goods and services from some external agencies. The object of purchase department is to arrange the supply of materials, spare parts and services or semi finished goods required by the organization to produce the desired product, from some agency or source outside the organization.

Objective:

1. Reducing cost- getting the lowest price for a particular product or service may not be necessary, but purchasers strive to save money for their businesses by getting the best prices and terms overall. Capitalizing on incentives and discounts that suppliers offer is important.

2. Diversifying supply- spending to much with one supplier is risky. If that suppliers should have trouble fulfilling their obligations or raise their prices significantly, the company that depends on them may have to delay delivery of goods to theirs customers or raise their prices, which could cost them business.

3. Fulfilling business requirements- doing business with the right suppliers can matter as much as pricing and supplying.for example, companies may want to ensure that they support small businesses by allocating a certain percentage of their purchasing budgets accordingly.

4. Sparking innovation- purchasing professionals can support their company's growth by obtaining innovative solutions to business problems and opportunities. They do so by working closely with vendors, sharing their company's needs and exploring how suppliers can help. Together, they can develop better technologies and products for customers, and refine processes that allow them to deliver goods and services more efficiently.

5. Managing relationships- purchasing professionals can work with just about anyone in their companies. They may deal with representatives from marketing, finance and logistics departments to name just a few.
6. Spending wisely- purchasing often accounts for more than half of a company's spending. Investing purchasing dollars correctly can help a company expand market share and increase its sales by allowing it to bring quality products to market first.

Functions of purchasing:
1. Procuring raw materials and other resources- one role of the purchasing department is to procure all necessary materials needed for production or daily operation of the company or government organization. For a manufacturing company, this might include raw materials such as iron, steel, aluminum or plastics, but it also might include tools, machinery, delivery trucks or even the office supplies needed for the secretaries and sales team.
2. Achieving the best possible price- a purchasing department also is charged with continuously evaluating whether it is receiving these materials at the best possible price in order to maximise profitability. This can be challenging for a small business that may purchase in larger vendor and which thus may not receive the same type of bulk discounts.

3. Paperwork and accounting- purchasing departments handle all of the paperwork involved with purchasing and delivery of supplies and materials. Purchasing ensure timely delivery of materials from vendors, generates and tracks purchase orders and works alongside the receiving department and the accounts payable department to ensure that promised delivers were received in full and are being paid for on time.

4.Compliance with business protocols- the purchasing department also must ensure that it is complying with all company policies. For example, in a small business, individual staff members may communicate with the purchasing needs for things such as office supplies or computer.

Principles of purchasing :

1. Right quality- the term right quality refers to a suitability of an item for the purpose it is required. For producing the goods of best quality, the best grade of raw material may be the right quality whereas for producing items of medium quality, the average lowest grade may be the right quality.

2. Right quantity- materials purchased should be of right quantity. The right quantity is the quantity that may be purchased at a time with minimum total cost and which obviates shortage of materials.

3. Right time- the time at which the purchase are to be made is of vital importance. In case of items used regularly, right time when the stock reaches the minimum level. The recorder level of material is fixed for each item under the principle of right time.

4. Right source- selecting the right source for the purchase of materials is an important consideration in the purchase procedure. The right source for the procurement of materials is that supplier who can supply the material of right quality as ordered, in right quantity as ordered, at a right time.

5. Right price- determination of right price is a difficult task. It is the main object of any organisation to procure the material items at the right price. It is that price which brings the best ultimate value of the money invested in purchasing the materials.

6. Right place. Besides obtaining the materials of the right quality and quantity from the right source at the right place, it should be ensured that the materials are available at the right place.

Purchasing process : In general term, the purchasing process of a company involves an organized, informed process that empowers the purchase managers in the company to purchase right product for their need. The right purchasing process provides the company with a qualified supplier, a supplier who can provide higher quality products at the optimum price.

1. The identification of need- this is the step where your company wants to provide or add a service for their customer, for which it need to acquire a product or they need something for their internal operations, or for employees. Therefore the need for a purchase is identified.

2. Selecting a specific product- based on highly developed and competitive market, there are a large amount of suppliers available on market able to provide this kind of machine. The next step in the purchasing process consists in selecting a specific product.

3. Deciding the technical specifications- the third step starts with identifying and specifying the technical specifications that the desired product should have. The company should arrive at a list of required technical specification for the product to ensure it meets the company needs.

4. Price- what is the price of the product or the budget the company has for the product or service it is looking for? As the price plays a vital role in the final selection of the desired purchasing item, the company should establish a desired budget for the respective purchase.

5. Contacting suppliers- the fifth step consists in researching and identifying potential suppliers. Usually companies tend to start focusing first on who supplies competing companies with resources before they start looking outside their area.

6. Finalizing suppliers- after two or more suppliers are shortlisted, and are able to meet the requirements set by the company, then the company is going to ask the final questions from suppliers.

7. The purchase- with all the above steps done, the company finalizes on one supplier. Or alternatively, it can place 70% of its orders to one supplier and 30% to another so that it maintains relations with both the suppliers and has a safety net in case any supplier is not able to meet demand or requirements.

Types of purchases

1. Personal purchases- the consumer purchases for the consumption of the themselves, then they fall into this very important category class. They are ultimately driving the economy through the purchase of it products therefore the economy becomes dependent on them.

2. Mercantile purchasing- facilitated by middlemen for the intention of re-sale to meet others requirements. Agents, wholesalers and retailers come under this category providing their own channels of distribution to the consumer.

3. Industrial purchasing- the purchaser is buying to convert material into finished goods and product. It entails buying raw materials. Components, supplies and consumable stores, spares and tools, machines and equipment and office appliance.

UNIT-5

Dimensions of Quality

Important Dimensions of Quality formulated by David A. Garvin

David A. Garvin, a specialist in the area of quality control, argues that quality can be used in a strategic way to compete effectively and an appropriate quality strategy would take into consideration various important dimensions of quality

Eight dimensions of product quality management can be used at a strategic level to analyze quality characteristics. The concept was defined by David A. Garvin, formerly C. Roland Christensen Professor of Business Administration at Harvard Business School (died 30 April 2017). Some of the dimensions are mutually reinforcing, whereas others are not—improvement in one may be at the expense of others. Understanding the trade-offs desired by customers among these dimensions can help build a competitive advantage.

Garvin's eight dimensions can be summarized as follows:

1. **Performance:** It involves the various operating characteristics of the product. For a television set, for example, these characteristics will be the quality of the picture, sound and longevity of the picture tube.

2. **Features:** These are characteristics that are supplemental to the basic operating characteristics. In an automobile, for example, a stereo CD player would be an additional feature.

3. **Reliability:** Reliability of a product is the degree of dependability and trustworthiness of the benefit of the product for a long period of time.

   It addresses the probability that the product will work without interruption or breaking down.

4. **Conformance:** It is the degree to which the product conforms to pre- established specifications. All quality products are expected to precisely meet the set standards.

5. **Durability:** It measures the length of time that a product performs before a replacement becomes necessary. The durability of home appliances such as a washing machine can range from 10 to 15 years.

6. **Serviceability:** Serviceability refers to the promptness, courtesy, proficiency and ease in repair when the product breaks down and is sent for repairs.

7. **Aesthetics:** Aesthetic aspect of a product is comparatively subjective in nature and refers to its impact on the human senses such as how it looks, feels, sounds, tastes and so on, depending upon the type of product. Automobile companies make sure that in addition to functional quality, the automobiles are also artistically attractive.

8. **Perceived quality:** An equally important dimension of quality is the perception of the quality of the product in the mind of the consumer. Honda cars, Sony Walkman and Rolex watches are perceived to be high quality items by the consumers.

Quality control- the practice of checking goods, products, etc. during and after the production process to make sure that they are of the expected standard.
Quality control is a process by which entities review the quality of all factors involved in production. **ISO 9000** defines quality control as " A part of quality management focused on fulfilling quality requirements".
"Quality control may be defined as that industrial management technique or group of techniques by means of which products of uniform acceptable quality of manufactured.

Definition:

According to Alford and Beatty " Quality control means the recognition and removal of identifiable causes and defects, and variables from the set standards."

According to J.A. Shubin "quality control is used to connote all those activities which are directed for defining, controlling and maintaining quality".

According to K.G. Lockyer " Quality control is systematic control by management of the variables in the manufacturing process that affect goodness of the end-product."
Objectives of quality control:

1. To establish the desired quality standards which are acceptable to the customers?
2. To discover flaws or variations in the raw materials and the manufacturing processes in order to ensure smooth and uninterrupted production.
3. To evaluate the methods and processes of production and suggest further improvements in their functioning.
4. To study and determine the extent of quality deviation in a product during the manufacturing process.
5. To analyse in detail the causes responsible for such deviation.
6. To undertake such steps which are helpful in achieving the desired quality of the product.

Importance of quality control:

1. Encourages quality consciousness: The most important advantage derived by introducing quality control that it develops and encourages quality consciousness among the workers in the factory which is greatly helpful in achieving desired level of quality in the product.
2. Satisfaction of consumers: Consumers are greatly benefited as they get better quality products on account of quality control. It gives them satisfaction.
3. Reduction in production cost: By undertaking effective inspection and control over production processes and operations, production cost are considerably reduced.
4. Most effective utilisation of resources: Quality control ensures maximum utilisation of available resources thereby minimising wastage and efficiency of every kind.
5. Reduction in inspection costs: Quality control brings about economies in inspection and considerably reduces cost of inspection.

6. Increased goodwill: By producing better quality products and satisfying customer's needs, quality control raise the goodwill of the concern in the minds of people's reputed concern can easily raise finances from the market.

Techniques of quality control:

(I) Inspection: Inspection is that component of quality control programme which is concerned with checking on the performance of items to the specifications set for it. It involves periodic checking and measuring – before, during and after the production process. Because of the numerous variables that enter into manufacturing, inspection is a never ending process.

Inspection may be 'Centralised' or 'Floor Inspection.'

Under centralized inspection, all the work from a department is sent to the Inspection Department, before passing on to the next operation. Floor inspection, on the other hand, follows the practice of sending inspectors to the floor and inspects work at the machines of operatives. It is also called patrolling or travelling inspection.

Advantages of centralized inspection:

(i) Centralised inspection ensures impartial supervision; because the inspector is not under the strain of not rejecting the work of a person with him he has good personal relations.

(ii) Under centralized inspection, it is easier to keep records of items/parts which are approved or rejected.

(iii) Production work is liable to less interruption, under centralized inspection.

Advantages of floor inspection:

(i) Since work is inspected on the floor; delay in sending work to next station is avoided.

(ii) Inspector can immediately locate the fault and suggest rectification.

(iii) It involves minimum material handling.

(II) Statistical Quality Control (SQC):

SQC is based upon the laws of probability. It is a system for controlling the quality of production within specified limits (tolerance limits) by means of a sample procedure and continuing analysis of inspection results.

Grant defines SQC as follows:

"SQC is a simple statistic method for determining the extent to which quality goods are being met without necessarily checking every item produced and for indicating whether or not the variations which occur are exceeding normal expectations. It enables us to decide whether to reject or accept a particular product."

Point of Comment:

SQC does not produce a quality product. It merely informs management that things are not going as they should. Management must take necessary action to remove the causes of variations and ensure production of quality products.

Inspections vs. SQC:

It is an interesting academic exercise to compare inspection and SQC.

The two techniques of quality control may be compared as follows:

(i) The result of inspection is acceptance or rejection of production; while SQC enables management to take action so that products will meet specifications. As such inspection enables one "to be wiser after the event" whereas SQC enables one **"to get wiser before the event."**

(ii) Inspection can be cent per cent; while SQC always involves sampling.

Techniques of SQC:

Techniques of SQC can be divided into two parts:

(1) Process control

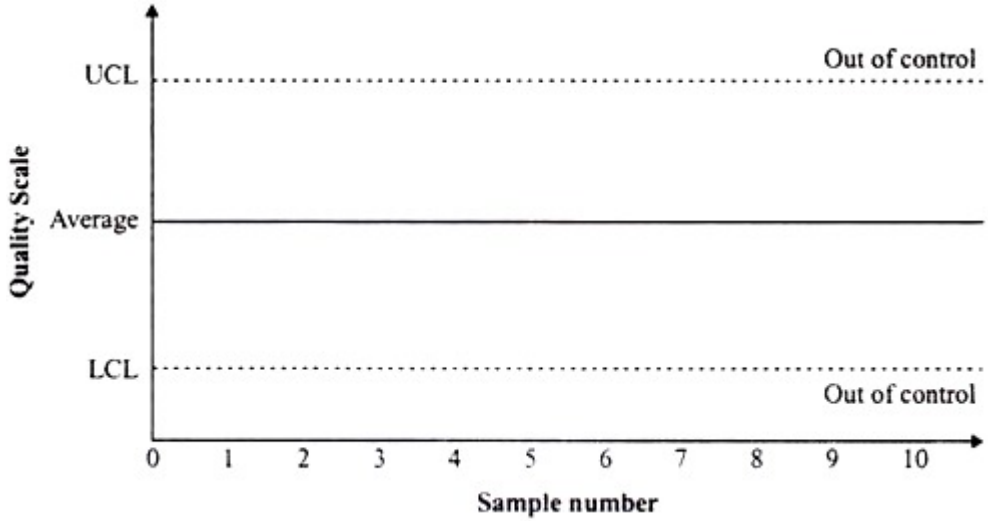
(2) Acceptance sampling

Following is a brief account of these techniques of SQC:

(1) Process Control:

The checking up of quality characteristics under process control is done with the help of charts. There may be many types of charts like 'X-Chart', 'R-Chart', 'C-Chart' and 'P-Chart'. All types of charts are similar in composition and structure. All of them represent how quality- characteristic is changing from one sample to another.

A control chart when prepared would appear as follows:



Note: UCL = Upper Control Limit

LCL = lower control Limit

A process is considered out of control and an action to check and correct the process is taken; when a plotted point falls outside the control limits.

Advantages of control charts:

1. They provide visual aids

2. They are easy to prepare.

3. They give early warning of trouble

(2) Acceptance Sampling:

Control charts are useful for process control. In case of receipt of materials and dispatch of finished goods; a different method is used, that of acceptance sampling. Acceptance sampling plans are of utmost value when the nature of the process used to manufacture products remains unchanged.

In acceptance sampling, decisions [e.g. whether acceptable/not acceptable (rejection)] about the quality of batches or lots are made after inspection of only a portion i.e. a sample. If the sample of items conforms to requisite quality levels; then the whole batch from which the sample is taken is accepted. If the sample does not conform to the requisite quality level; then the whole batch is rejected.

An acceptance sampling is defined as:

Lot size (N)

Sample size (n)

Acceptance number (C)

Suppose N = 9000; n = 300 and C = 7; then this sampling plan means that a lot of 9000 items has 300 units (sample size) inspected. If seven or less defectives are found in 300 units sample; the lot is accepted. If eight or more defectives are found in the sample; the lot is rejected.

A close study of acceptance sampling technique would reveal that there is likelihood that a lot of satisfactory quality is rejected on the basis of sample result. This is technically called producer's risk. Similarly, the consumer (or buyer) has the risk of accepting a lot of unsatisfactory quality, on the basis of sample results. This risk is called consumer's risk.

Advantages of acceptance sampling:

(i) Less expensive than 100% inspection

(ii) Used where 100% inspection is not possible.

(iii) Useful when inspection may cause damage or complete destruction.

Advantages of SQC:

(i) Reduced Cost:

Since only a fraction of output is inspected; costs of inspection are greatly reduced.

(ii) Early Warning of Defects:

SQC gives an early warning of defects in the production process; so that these defects can be detected and corrected at inception.

(iii) Simple Technique:

SQC techniques are simple and can be operated by semi-skilled operators.

(iv) Continuous Inspection:

SQC is a technique which provides a continuous inspection of the product at various stages of the manufacturing process.