**Production Management**

**Unit-3**

**Plant location**

**Location of an industry** is an important management decision. It is a two-step decision: first, choice of general area or region and second, the choice of site within the area selected. Location decision is based on the organizations long-term strategies such as technological, mar­keting, resource availability and financial strategies.

The objective of plant location decision-making is to minimise the sum of all costs affected by location.

**Plant location is important because of the following:**

(i) Location influences plant layout facilities needed.

(ii) Location influences capital investment and operating costs.

Location decisions are strategic, long-term and non-repetitive in nature. Without sound and careful location planning in the beginning itself, the new facilities may create continuous operating problems in future. Location decision also affects the efficiency, effectiveness, produc­tivity and profitability.

The location decision should be taken very carefully, as any mistake may cause poor location, which could be a constant source of higher cost, higher investment, difficult marketing and transportation, dissatisfied and frustrated employees and consumers, frequent interruptions of production, abnormal wastages, delays and substandard quality etc.

Therefore, it should be based upon a careful consideration of all factors that are essentially needed in efficient running of a particular industry. The necessary factors in the selection of plant location vary among industries and with changing technical and economical conditions.

Site selection is not an easy problem because if the selection is not proper then all money spent on factory building, machinery and their installation etc., will go as waste and the owner has to suffer a great loss. Therefore, while selecting a site, owner must consider technical, commercial, financial aspects which may provide maximum advantages.

It is sometimes pos­sible that all the requirements and features of ideal site may not be available at one particular location but then it will be advantageous to find out suitable site with combinations of all essential requirements of the particular industry to be established as explained in following:

**Market Location:**

**To solve such problems a market analysis of the area is conducted and answers of the following questions can be found out:**

1. If there is a market which could be served and if retail price of product can be re­duced?
2. Whether quick delivery of the product can be made by better plant location to the particular market?
3. Whether there is a competitor for the product in the market? Whether demand for product may increase? Whether an additional plant is required to meet the future demand?
4. What is the potential purchasing power of the market?
5. What are the buying habits of local people, and what must be done to fit your service to these habits?

**Economical Aspects:**

Locational economics for an enterprise includes a consideration of the product to be manu­factured, the processes and machinery to be used, and the service and facilities required.

**To know this the following factors may be studied:**

1. **Product**:

(a) Nature,

(b) Volume, and

(c) Value.

1. **Production process:**

(a) Continuous,

(b) Intermittent, and

(c) Interrupted.

1. **Manufacturing machinery.**
2. **Other manufacturing equipment’s.**
3. **Special manufacturing requirement.**
4. **Service:**

(a) Steam,

(b) Gas,

(c) Water,

(d) Air or high pressure,

(e) Electricity, and

(f) Sewerage.

**Plant Location Methods, Factor Rating Method**

Techniques used for Selecting Best Location:

**Following are the few important techniques used to decide best location from the available alternative locations:**

1. **Subjective Techniques**:

(a) Industry precedence,

(b) Preferential factor and

(c) Dominant factor.

1. Qualitative Techniques (Factor ranking system)
2. Semi-quantitative Techniques (Factor weight-rating system)
3. **Quantitative Techniques (Operation Research Models)**:

(a) Break-even analysis.

(b) Economic/cost analysis, and

(c) Transportation model.

**Procedure for Selecting a Site:**

**For selecting a site following procedure should be followed:**

1. Constitution of a site selection committee.
2. Determining the company needs.
3. Deciding criteria for selection.
4. Accumulate the data.
5. Analyse the data.
6. Evaluate the alternatives.
7. Reduce number of alternatives.
8. Investigation in detail.
9. Collect and analyze further data.

**Factor Rating Method for Location Planning**

The process of selecting a new facility location involves a series of following steps:

1. Identify the important location factors.
2. Rate each factor according to its relative importance, e., higher the ratings is indicative of prominent factor.
3. Assign each location according to the merits of the location for each factor.
4. Calculate the rating for each location by multiplying factor assigned to each location with basic factors considered.
5. Find the sum of product calculated for each factor and select best location having highest total score.

**Factors affecting Plant Location**

**Eight Factors Affecting Plant Location**

1. **Selection of Region**

The selection of a region or area in which plant is to be installed requires the consideration of the following:

**(i) Availability of Raw Materials:** Proximity of sources of raw materials is the obvious explanation of the location of majority of sugar mills in Uttar Pradesh. This means that the raw material should be available within the economical distance. Easy availability of supplies required for maintenance and operation of the plant should also be considered.

**(ii) Proximity to Markets:** Cost of distribution is an important item in the overhead expenses. So it will be advantageous to be near to the center of demand for finished products. Importance of this is fully realized if the material required for the manufacturing of products are not bulk and fright charges are small.

**(iii) Transport Facilities:** Since freight charges of raw materials and finished goods enter into the cost of production, therefore transportation facilities are becoming the governing factor in economic location of the plant. Depending upon the volume of the raw materials and finished products, a suitable method of transportation like rail, road, water transportation (through river, canals or sea) and air transport is selected and accordingly plant location is decided. Important consideration should be that the cost of transportation should remain fairly small in comparison to the total cost of production.

**(iv) Availability of Power, Fuel or Gas:** Because of the wide spread use of electrical power the availability of fuel or gas has not remained a deciding factor in most of the cases for plant location. The location of thermal power plants (like Bokaro Thermal Plant) and steel plants near coal fields are for cutting down cost of the fuel transportation. The reliability of continuous supply of these facilities is an important factor.

**(v) Water Supply:** Water is required for processing as in chemical, sugar and paper industries and is also used for drinking and sanitary purposes. Investigation for quality and probable source of supply is important, since the cost of treating water is substantial so the chemical properties like hardness, alkalinity and acidity.

**(vi) Disposal Facility for Waste Products:** Thorough study should be made regarding disposal of water like effluents, solids, chemicals and other waste products likely to be produced during the production process.

**(vii) Availability of Labour:**Potential supply of requisite type of labour governs plant location to major extent. Some industries need highly skilled labour while other need unskilled and intelligent labour. But the former type is difficult in rural areas in comparison with industrially developed location.

1. **Township Selection**

The factors to be considered regarding township selection are:

(i) Availability of men power of requisite skill

(ii) Competitive wage rates of workers

(iii) Other enterprises which are complementary or supplementary regarding raw materials, other input, labour and skill required.

(iv) Moderate taxes and the absence of restricting laws.

(v) Favourable cooperative and friendly attitude towards the industry.

(vi) Favourable living conditions and standards keeping in view the availability of medical and educational facilities, housing, fire service, recreational facilities, cost of living etc.

1. **Question of Urban and Rural Area**

Question of urban and rural area should be decided in view of the following:

**Advantages of Rural Area:**

(i) The initial cost of land, erection cost of building and plant is less in rural area as compared to urban or city area.

(ii) Acquisition for additional area for extension work expansion of plant is possible without much difficulty whereas urban area being congested; the additional land is not easily available.

(iii) Rural areas are free form labour trouble which is most common in towns and cities.

(iv) Over crowding of working class population in cities is avoided.

**Advantages of Urban Area:**

(i) Better modes of transportation for collection and distribution of materials and finished products.

(ii) Availability to requisite type of labour for special and specific jobs is there.

(iii) Utilities like water, power, fuels etc. are easily available.

(iv) Industries do not need to construct colonies to provide residential facilities to their workers since houses are available on rental basis whereas in rural areas, houses have to be build for workers.

1. **Location of a Factory in a Big City**

Generally factories are located in big cities for obvious reasons of skilled labour, market proximity for both raw materials and end products.

Its advantages and disadvantages are mentioned below:

(i) Existence of educational and recreational facilities is advantageous for children and dependents of workers.

(ii) Facilities for technical/ industrial education and training for children of workers are available.

(iii) Evening classes facilities are available.

(iv) Discussion opportunities and facilities for exchange of thoughts are available for interested people in societies and clubs.

(v) All types of skilled man power is available.

(vi) Repair, maintenance and service facilities for various utilities are available in abundance.

(vii) Banking facilities regarding finance (loan etc.) for industry in case of necessity are available.

(ix) Big markets for sale of products available.

(x) Better transport facilities for movement of raw materials, finished products and workers are available.

1. **Location of an Industry in Small Town**

There are some industries which are located in the rural areas or small towns specifically for the want of raw material and cheap labour.

Its advantages and disadvantages are mentioned below:

(i) Less labour trouble and co-ordinal employee-employer relation.

(ii) Suitable land for current and future requirements easily available.

(iii) Local bye laws do not impose problem in working of the unit.

(iv) No resistance from existing industries.

(v) Possibility of tax exemptions exist.

(vi) Not much congestion.

(vii) Lower rents in comparison to big cities and urban areas.

(viii) Lower wage rates for labour/ employees / workers.

(ix) Less fire risks.

(x) Noise not much problem.

1. **Site Selection**

The third step is to select the exact plant site with the following considerations:

(i) The cheap availability of land for current and future requirements, soil characteristics sub soil water, availability or possibility of economic drainage and waste disposal system are desirable parameters.

(ii) The site should be easily accessible to various modes of transport as required so that apart from input materials, employees can also reach the site conveniently.

(iii) The site should be free from zonal restrictions like from railways or civil aviation restrictions.

1. **Current Trends in Pant Location**

**(I) Location in Proximity of Cities:**First tendency is to locate the industries or enterprises in the proximity of cities rather than in rural or urban areas. These sub-urban sites offer today practically all advantages, facilities and services available in cities and towns with the added advantage of land required for future expansion on cheap rates.

**(II) Planned Industrial Centers:** While industrial towns may be planned and developed by big industrial houses or govt., the late trend is to develop areas as industrial estates and sell these to people interested in starting their units at various places. Noida and Faridabad are the examples of this type of development.

**(III) Competition for Development of Industries:** In order to generate the employment opportunities the state and central govt. offer concessions to attract industrialists to set up industries in their states or territories.

1. **The Design of Factory Plant Building**

After a plant location has been decided upon, management’s next problem deals with the design of building. A building is designed and built to protect the property and employees of an organization. This basic fact is mostly overlooked in planning the requirement for building structures.

For those plants where employees, materials and infrastructure facilities require protection, the problems involved in designing and constructing effective and economical structures are many.

# 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?

#### Principles of Plant Layout:

According to Muther there are six basic principles of “best layout”.

**These are:**

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.

1. **Principle of Minimum Distance:**

According to this principle, the movements of men and materials should be minimized.

1. **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.

1. **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.

1. **Principle of Satisfaction and Safety:**

According to this principle, best layout is one which provides satisfaction and safety to all workers.

1. **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.

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**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.

**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.

1. **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.

**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.

1. **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.

1. **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.