

Plant location may be understood as the function of determining where the plant should be located for maximum operating economy and effectiveness. The selection of a location for a plant is one of the problems, the most important, which is faced by an entrepreneur while launching a new enterprise. A selection on pure economic considerations will ensure an easy and regular supply of raw materials, labour force, efficient plant layout, proper utilization of production capacity and reduced cost of production. An ideal location may not, by itself, guarantee success; but it certainly contributes to the smooth and efficient working of an organization. A bad location, on the other hand, is a severe handicap for any enterprise and it finally bankrupts it. It is, therefore, very essential that utmost care should be exercised in the initial stages to select a proper place. Once a mistake is made in locating a plant, it becomes extremely difficult and costly to correct it, specially where large plants are concerned.

MEANING OF PLANT LOCATION:

Plant location or the facilities location problem is an important strategic level decision making for an organization. One of the key features of a conversion process (manufacturing system) is the efficiency with which the products (services) are transferred to the customers. This fact will include the determination of where to place the plant or facility.

The selection of location is a key-decision as large investment is made in building plant and machinery. It is not advisable or not possible to change the location very often. So an improper location of plant may lead to waste of all the investments made in building and machinery, equipment.

Before a location for a plant is selected, long range forecasts should be made anticipating future needs of the company. The plant location should be based on the company's expansion plan and policy, diversification plan for the products, changing market conditions, the changing sources of raw materials and many other factors that influence the choice of the location decision. The purpose of the location study is to find an optimum location one that will result in the greatest advantage to the organization.

NEED FOR SELECTING A SUITABLE LOCATION:

The need for selecting a suitable location arises because of three situations.

1. When starting a new organization, *i.e.*, location choice for the first time.
2. In case of existing organization.
3. In case of Global Location.

1. **In Case of Location Choice for the First Time or New Organizations**

Cost economies are always important while selecting a location for the first time, but should keep in mind the cost of long-term business/ organizational objectives. The following are the factors to be considered while selecting the location for the new organizations:

1. **Identification of region:**

The organizational objectives along with the various long-term considerations about marketing, technology, internal organizational strengths and weaknesses, region-specific resources and business environment, legal-governmental environment, social environment and geographical environment suggest a suitable region for locating the operations facility.

2. **Choice of a site within a region:**

Once the suitable region is identified, the next step is choosing the best site from an available set. Choice of a site is less dependent on the organization's long-term strategies. Evaluation of alternative sites for their tangible and intangible costs will resolve facilities-location problem. The problem of location of a site within the region can be approached with the following cost-oriented non-interactive model, *i.e.*, dimensional analysis.

3. **Dimensional analysis:**

If all the costs were tangible and quantifiable, the comparison and selection of a site is easy. The location with the least cost is selected. In most of the cases intangible costs which are expressed in relative terms than in absolute terms. Their relative merits and demerits of sites can also be compared easily. Since both tangible and intangible costs need to be considered for a selection of a site, dimensional analysis is used.

The existing firms will seek new locations in order to expand the capacity or to place the existing facilities. When the demand for product increases, it will give rise to following decisions:

- Whether to expand the existing capacity and facilities.
- Whether to look for new locations for additional facilities.
- Whether to close down existing facilities to take advantage of some new locations.
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2. ***In Case of Location Choice for Existing Organization***

In this case a manufacturing plant has to fit into a multi-plant operations strategy. That is, additional plant location in the same premises and elsewhere under following circumstances:

1. Plant manufacturing distinct products.
2. Manufacturing plant supplying to specific market area.
3. Plant divided on the basis of the process or stages in manufacturing.
4. Plants emphasizing flexibility.

The different operations strategies under the above circumstances could be:

1. ***Plants manufacturing distinct products:***

Each plant services the entire market area for the organization. This strategy is necessary where the needs of technological and resource inputs are specialized or distinctively different for the different product-lines.

2. ***Manufacturing plants supplying to a specific market area:***

Here, each plant manufactures almost all of the company's products. This type of strategy is useful where market proximity consideration dominates the resources and technology considerations. This strategy requires great deal of coordination from the corporate office. An extreme example of this strategy is that of soft drinks bottling plants.

3. ***Plants divided on the basis of the process or stages in manufacturing:***

Each production process or stage of manufacturing may require distinctively different equipment capabilities, labor skills, technologies, and managerial policies and emphasis. Since the products of one plant feed into the other plant, this strategy requires much centralized coordination of the manufacturing activities from the corporate office that are expected to understand the various technological aspects of all the plants.

4. ***Plants emphasizing flexibility:***

This requires much coordination between plants to meet the changing needs and at the same time ensure efficient use of the facilities and resources. Frequent changes in the long-term strategy in order to improve be efficiently temporarily, are not healthy for the organization. In any facility location problem the central question is: 'Is this a location at which the company can remain competitive for a long time?'

For an established organization in order to add on to the capacity, following are the ways:

- *Expansion of the facilities at the existing site:* This is acceptable when it does not violate the basic business and managerial outlines, *i.e.* , philosophies, purposes, strategies and capabilities. For example, expansion should not compromise quality, delivery, or customer service.
- *Relocation of the facilities (closing down the existing ones):* This is a drastic step which can be called as 'Uprooting and Transplanting'. Unless there are very compelling reasons, relocation is not done. The reasons will be either bringing radical changes in technology, resource availability or other destabilization.

All these factors are applicable to service organizations, whose objectives, priorities and strategies may differ from those of hardcore manufacturing organizations.

3. ***In Case of Global Location***

Because of globalization, multinational corporations are setting up their organizations in India and Indian companies are extending their operations in other countries. In case of global locations there is scope for virtual proximity and virtual factory.

VIRTUAL PROXIMITY

With the advance in telecommunications technology, a firm can be in virtual proximity to its customers. For a software services firm much of its logistics is through the information/ communication pathway. Many firms use the communications highway for conducting a large portion of their business transactions. Logistics is certainly an important factor in deciding on a location whether in the home country or abroad. Markets have to be reached. Customers have to be contacted. Hence, a market presence in the country of the customers is quite necessary.

VIRTUAL FACTORY

Many firms based in USA and UK in the service sector and in the manufacturing sector often out sources part of their business processes to foreign locations such as India. Thus, instead of one's own operations, a firm could use its business associates' operations facilities. The Indian BPO firm is a foreign-based company's 'virtual service factory'. So a location could be one's own or one's business associates. The location decision need not always necessarily pertain to own operations.

Advantages of Urban Area:

1. Better modes of transportation for collection and distribution of materials and finished products.
2. Availability to requisite type of labour for special and specific jobs is there.
3. Utilities like water, power, fuels etc. are easily available.
4. 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.

Advantages of Semi - Urban Area:

1. Land is easily and cheaply available in comparison to big cities.
2. Lower tax rates in comparison to big cities and urban areas.
3. Transportation facilities equal to big cities available.
4. Good living accommodation to enjoy advantages of big cities available for workers/employees.
5. Unskilled labour cheaply available.
6. Recreational facilities of cities available due to easy transport facilities.

Advantages of Rural Area:

1. The initial cost of land, erection cost of building and plant is less in rural area as compared to urban or city area.
2. 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.
3. Rural areas are free from labour trouble which is most common in towns and cities.
4. Overcrowding of working class population in cities is avoided.

Factors affecting plant Locations:

(a) Deciding on Domestic or International Location:

The first step in plant location is to decide whether the facility be located domestically or internationally. A few years ago, this factor would have received little consideration. But with increasing internationalization of business, the issue of home or foreign country is gaining grater relevance. If the management decides on foreign location, the next logical step would be to decide upon a particular country for location. This is necessary because, countries across the world are varying with other to attract foreign investments. The choice of a particular country depends on such factors as political stability, export and import quotas, currency and exchange rates, cultural and economic peculiarities, and natural or physical conditions.

(b) Selection of Region:

(i) Availability of Raw Materials:

As a manufacturing unit is engaged in the conversion of raw materials into finished products, it is very essential that it should be located in a place where the supply of raw materials is assured at minimum transport cost.

Nearness to raw materials offers such advantages as:

- (i) Reduced cost of transportation;
- (ii) Regular and proper supply of materials uninterrupted by transportation breakdowns;
- (iii) Savings in the cost storages of materials;

(ii) Nearness to the Market:

Since goods are produced for sale, it is very essential that the factory should be located near their market. A reduction in the of transporting finished goods to the market; the ability to adjust the production programme to suit the likes and dislikes of consumers; the ability to render prompt service to the consumers, provide after-sale services and execute replacement orders without delay – these are some of the advantages that accrue to the entrepreneur if the establishes his factory near his market.

(iii) Availability of Power:

Power is essential to move the wheels of an industry. Coal, electricity, oil and natural gas are the sources of power. Where coal is the source of power, as in the case of the iron and steel industry, the factory has to be located near the coal fields. Examples of such industries are: the iron and steel industry in Germany, Pennsylvania, in the U.S.A and Jamshedpur in India. Industries using electricity have to be located at a place

Where electric power is available regularly and at cheap rates.

(iv) Transport Facilities:

While making a study of a location, an entrepreneur considers the question of the availability of transport facilities. Transport facilities are essential for bringing raw materials and men to the factory and for carrying the finished products from the factory to the market. A place which is well connected by rail, road and sea is ideal for a plant location. It may be said that industry follows transportation. Other words, places with well- developed means of transport attract industries.

(v) Suitability of Climate:

The climate has its own importance in the location of a plant because of two reasons. First, there are certain industries which, because of the nature of their production, require particular climatic conditions; for example, humid climate for cotton textile and jute.

Secondly, climate affects labour efficiency. Extreme climate conditions adversely affect labour efficiency, and such places do not attract industries.

(vi) Government Policy:

the influence of government policies and programmes on plant location is apparent in every country, particularly in planned economic like ours in the balanced regional development , many backward regions In India have been selected for the location of new industries which would generate the regions and on a larger canvas the national economy.

(vii) Competition between states:

States vie with each other to attract new industries. Various states offer investment subsidies and sales tax exemptions to new units. The incentives may not be of big help to big sized plants. But for small and medium-sized plants, the incentives do matter. The owners of these plants certainly consider incentive in selection of region.

(c) Selection of Community:

Selecting a particular locality or community in a region is the third step in plant location the selection of a locality in a particular region by the following factors:

(i) Availability of Labour:

Despite the talk of mechanization and automation, the importance of labour on the industrial side has not been completely lost. Labour is an important factor in the production of goods. An adequacy of labour supply at reasonable wages is very essential for the smooth and successful working of an organization.

(ii) Civic Amenities for Workers:

Besides good working conditions inside the factory, the employees require certain facilities outside it. Recreation facilities such as clubs, theatres and parks must be provided for the employees. They require schools for their children. A place which abounds all these facilities will naturally be preferred to another place which lacks them.

(iii) Existence of Complementary and Competing Industries:

The existence of complementary industries is favourable to the location of industries because and industrial unit, in association with other units, can get the following benefits;

1. An industrial unit, in association with other similar units, can secure materials on better terms than it can do it by itself.
2. The concentration of similar industries at one place improves the labour market, both for the employer and the employee.
3. In specialized centers, banks become familiar with the requirements of the industry. This makes the granting of loans easy.
4. A group of plants will attract a variety of ancillary plants such as foundries, machine shops tool makers and the like.

(iv) Finance and Research Facilities:

Adequate capital is essential for the successful working of any organization. A place where facilities for raising capital are available attracts new industries. This is particularly true in developing countries, where capital is not available uniformly throughout the country.

(v) Availability of Water and Fire-Fighting Facilities:

Some industries require plentiful supply of water for their working. Some of these are: fertilizer units, rayon manufacturing units, absorbent cotton manufacturing units, leather tanneries, bleaching, dyeing and screen printing units. These factories must be located in places where, water is available in abundance.

Industrial units are exposed to fire hazards. A fire may break out either from within or from neighbouring units. In either case, adequate fire-fighting facilities must be available.

(vi) Local Taxes and Restrictions:

Local authorities collect charges for the supply of water, electricity and other facilities. They also collect various taxes from industrial units. They impose restrictions on the location of new units in the public interest.

(vii) Momentum of an Early Start:

The momentum of an early start exercised a considerable influence on plant location. Certain places, where one or more factories existed before, gain prominence as centers of an industrial complex with passage of time because, around them, a number of facilities develop.

(d) Selection of the Site:

The selection of an exact site in a chosen locality is the fourth step in plant location. This selection is influenced by the following considerations:

(i) Soil, Size and Topography:

For factories producing engineering goods, the fertility or otherwise of the soil may not be a factor influencing plant location. But for agro-based industries, a fertile soil is necessary for ensuring a strategic plant location: The area of the land should be such as to accommodate not only the existing manufacturing facilities, but offer scope for future expansion programmes as well. Besides the area, the cost of land deserves consideration.

The topography of the place deserves consideration to some extent. A hilly, rocky and rough terrain is unsuitable for a plant location because a great of expenditure has to be incurred to level it.

(ii) Disposal of Waste:

The problem of the disposal of effluents is common to many industries, particularly chemical, sugar, steel and leather industries and breweries. The site selected for the location of the plant should have provision for the disposal of waste. There must be enough vacant land for the dumping of solid waste. For liquid waste, satisfactory sewer connections and an effective drainages system should be available.

Facility Layout:

Introduction

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

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

Facility Layout Objective

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

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

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

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

Factors affecting Facility Layout

Facility layout designing and implementation is influenced by various factors. These factors vary from industry to industry but influence facility layout. These factors are as follows:

- The design of the facility layout should consider overall objectives set by the organization.
- Optimum space needs to be allocated for process and technology.
- A proper safety measure as to avoid mishaps.
- Overall management policies and future direction of the organization

Design of Facility Layout

Principles which drive design of the facility layout need to take into the consideration objective of facility layout, factors influencing facility layout and constraints of facility layout. These principles are as follows:

- **Flexibility:** Facility layout should provide flexibility for expansion or modification.
- **Space Utilization:** Optimum space utilization reduces the time in material and people movement and promotes safety.
- **Capital:** Capital investment should be minimal when finalizing different models of facility layout.

Design Layout Techniques

There are three techniques of design layout, and they are as follows:

1. **Two or Three Dimensional Templates:** This technique utilizes development of a scaled-down model based on approved drawings.
2. **Sequence Analysis:** This technique utilizes computer technology in designing the facility layout by sequencing out all activities and then arranging them in circular or in a straight line.
3. **Line Balancing:** This kind of technique is used for assembly line.

Factor influencing layout

As pointed out earlier, the pattern of layout varies from industry, location to location and plant to plant. Different types of layout are in use and the selection of a particular type of suit the requirement of a plant depends on a number of factors. Primarily, the layout of a plant is influenced by the relationship among materials, machinery and men. Other factor such as the type of product, the type of workers, the type of industry and management policies also influence the layout.

(1) Materials:

When it is said that materials influence plant layout, what is meant is that there is a need to provide for the storage and movement of raw materials in a plant economically when they are available, they should be stored properly and moved through production centres efficiently for manual or mechanical operations or chemical processing. The storage and movement of raw materials require properly placed storage rooms and materials movement or handling equipment. These involve initial investment and recurring costs. The type and size of storage, as also the type of material, equipment, cranes, trolleys and pipelines depend upon:

- i. the type of raw material used, i.e., whether the raw material are liquid or solid, light or heavy, small or large; and
- ii. The availabilities or scarcity of material even when this affected by seasonal variation and market conditions.

(2) PRODUCT:

A layout is designed with the ultimate purpose of production a product. The type of product – that is, whether the product is heavy light, big or small liquid or solid – and its position in relation to the plant location influence the layout.

(3) WORKER:

The layout designer should also consider the type, position and requirements of employees. If women workers are employed, the layout must be planned after keeping in mind their particular requirement.

(4) MACHINERY:

The type of product, the volume of its production, the type of process and management policy determines the size and type of the machinery to be installed which, in turn, influences the plant layout. Production and manipulation of men, materials and machines. These elements may be combined in various ratios and in various ways in the course of the production activity. The ratio in which these elements are used depends in their relative costs and on the production processes selected. Before laying out a plant, it is necessary to determine which of these elements are to be stationary or fixed as to location in the plant and which will be mobile during the process of production.

(5) TYPE OF INDUSTRY:

The type of industry and the method of the manufacturing process exercise a significant influence on plant layout.

Industries in this context may be broadly classified into four types:

(a) Synthetic (b) Analytical (c) Conditioning (d) extractive.

Extractive industries involve the separation of one element from another, as in the case of metal from the ore. A conditioning industry involves a change in form or physical properties. To have the end products. An analytical industry converts raw materials in to various elements or constituent parts. An oil refinery, for example, yields naphtha, gasoline, paraffin, tar and kerosene. Also called the assembling industry, involves the production of a product by the use of various elements.

(6) LOCATION:

The site selected for the location of a plant influences its layout in more than one way. First, the size and the terrain of the site determine the type of building which, in turn, influences the layout. Second, the location of the plant determines the mode of transportation, depending upon the distances from the source of raw materials and market to the plant.

(7) MANAGERIAL POLICIES:

Management policies significantly influence plant layout. The following are some managerial policies:

- (a) The volume of production and provision for expansion.
- (b) The extent of automation.
- (c) Making or buying a particular component.
- (d) Desire for rapid delivery of goods to customers.
- (e) Purchasing policy.
- (f) Personnel policies.

Types of Facility Layout

Process layout

Also called the functional layout, layout for job lot manufacture or batch production layout, the process layout involves a grouping together of like machines in one department. For example, machines performing drilling operation are installed in the drilling department and so on. In this way, there would be a heat treatment department, a painting department, a machining department and the like, where similar machines are installed in the plants which follow the process layout. The process arrangement is signified by the grouping together of like machines based upon their operational characteristics. For example, engine lathes will be arranged in one department, turret lathes in second department and milling machines in a third department.

A quantity of raw material is issued to a machine which performs the first operation. This machine may be situated any where in the factory. For the next operation, a different machine may be required, which may be situated in another part of the factory. The material should be transported to this other machine for treatment. Thus, material may be taken to a separate building, and along crisscrossing paths. At one stage, the material may be taken to a separate building, say, or heat treatment and then brought back for grinding. If machines in one department are engaged, the partly finished product awaiting operation may be taken to the store and later reissued for production.

While grouping machines according to process need to process type, certain principles must be kept in mind. These are:

- (a) The distance between departments needs to be as short as possible with a view to avoiding long distance movement of materials.
- (b) Through like machines are grouped in one department, the departments themselves should be located in accordance with the principle of sequence of operations. For example, in a steel plant, the operations are melting, casting, rolling and twisting. These different departments may be arranged in that order to avoid crossovers and back tracking of materials.
- (c) Convenience for inspection.
- (d) Convenience for supervision.

Advantages:

- (a) Reduced investment on machines as they are general purpose machines.
- (b) Greater flexibility in the production.
- (c) Better and more efficient supervision is possible through specialization.
- (d) There is greater scope for expansion as the capacities of different lines can be easily increased.
- (e) This type of layout results in better utilisation of men and machines.
- (f) It is easier to handle breakdown of equipment by transferring work to another machine or station.
- (g) There is full utilization of equipment.
- (h) The investment on equipment would be comparatively lower.

(i) There is greater incentive to the individual worker to increase his performance.

Disadvantages:

- (1) There is difficulty in the movement of materials. Mechanical devices for handling materials cannot be conveniently used.
- (2) This type of layout requires more floor space.
- (3) There is difficulty in production control.
- (4) Production time is more as work in progress has to travel from place to place in search of machines.
- (5) There is accumulation of work in progress at different places.

Product layout:

Also called the straight line layout for serialized manufacture, product layout involves the arrangement of machines in one line, depending upon the sequence of operations. Materials are fed into the first machine and finished products come out of the last machines. In between, partly finished goods travel automatically, from machine, the out put of one machine becoming the input for the next. It is a feast for the eyes to watch the way sugarcane, fed at one end of the mill, comes out as sugar at the other end. Similarly, in paper mill, bamboos are fed into the machine at one end and paper comes out at the other end.

The grouping of machines should be done, on product line, keeping in mind the following principles.

- (1) All the machine tools or other items of equipment must be placed at the point demanded by the sequence of operations.
- (2) There should be no points where one line crosses another line.
- (3) Materials may be fed where they are required for assembly, but, not necessarily all at one point.
- (4) All the operations, including assembly, testing and packing should be included in the line.

The product layout may be advantageously followed in plants manufacturing standardized products on a mass scale such as chemical, paper, sugar, rubber, refineries and cement industries.

Advantages:

- (a) There is mechanization of material handling and consequently reduction in materials handling cost.
- (b) This type of layout avoids production bottlenecks.
- (c) There is economy in manufacturing time.
- (d) The layout facilitates better production control.
- (e) It requires less floor area per unit of production.
- (f) Work in progress is reduced and investment thereon, minimized.
- (g) Early detection of mistakes or badly produced items is possible.
- (h) There is greater incentive to a group of workers to raises their level of performance.

Disadvantages:

- (a) Product layout is known for its inflexibility.
- (b) This type of layout is also expensive.
- (c) There is difficulty of supervision.
- (d) Expansion is also difficult.
- (e) Any breakdown of equipment along the production line can disrupt the whole system.