CHAPTER | EIGHT

Facility Location

Learning Objectives

After reading this chapter, you should be able to:

- Understand the maning of facility location
- Discuss the need for location selection.
- Explain the steps in location selection
- Discuss the relative importance of location factors
- Describe the various location models.

I INTRODUCTION

Plant location is the function of determining location for a plant for maximum operating economy and effectiveness.

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 place for locating a plant is one of the problems, perhaps 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 utilisation 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 organisation. 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. Cases are not wanting where mistakes were committed and wrong places selected. M/s. Samrat Thermo Plastic Industries, *for example,* are the manufacturers of mixers and grinders, located in Raipur district in Madhya Pradesh. Seventy-five per cent of the raw materials required by them had to be bought from Mumbai, and 75 percent of the finished products had to be marketed in Pune and Mumbai. To overcome this difficulty, it was decided to shift the entire plant to Pune. Similarly, Associated Breweries & Distilleries first set up its plant for brewing beer at Goa, though Mumbai is its main consuming centre. The plant is now shifted to Vashi, near Mumbai. This enabled the firm to save considerably on transportation costs. Since the shifting to Mumbai, the firm has had a steady run of success. The difficulties experienced by the proprietors and the cost of shifting the plant can easily be imagined.

The need for the selection of the location may arise under any of the following conditions:

(a) When the business is newly started;

(b) The existing business unit has outgrown its original facilities and expansion is not possible; hence a new location has to be found;

(c) The volume of business or the extent of market necessitates the establishment of branches;

(d) A lease expires and the landlord does not renew the lease;

(e) When a company thinks that there is a possibility of reducting manufacturing cost by shifting from one location to another location; and

(f) Other social or economic reasons; for instance, inadequate labour supply, shifting of the market etc.

Whatever the reason, the selection of the location has to be made after considering all the economic factors which have a bearing on it. It may be impossible to find a place which abounds in all the facilities that are required to start a factory; but a search has to be made for a place which enjoys as many facilities as possible. The guiding principle in the search should be for a place where the cost of the raw material and of fabrication, plus the cost of the marketing of the finished product, will be minimum.

I LOCATION THEORIES

Before discussing the locational factors, it is desirable to know what Alfred Weber told about location. Called the location theory, Weber's version fails to explain all subtle variances in decision-making but does provide simple set of guidelines.

Weber classified locational factors into two broad categories-primary and secondary. Materials and labour constitute primary factors that contribute to dispersal of industries over different regions. Industrial units are materials oriented if their cost of transportation to units is

higher. Industrial plants are market-oriented when cost of transporting finished goods to markets is higher. Another primary factor is labour. Weber assumes that centres flush with cheap and skilled labour pull industries towards themselves.

Banking credit, insurance, communication and rent and rates constitute the secondary factors of location. Some of these attract industries to certain areas from different places and some others contribute to their dispersal from original places. The latter are called the *degglomerating* factors and the former the *agglomerating factors*.

Though Weber told his theory in 1909, its relevance has not diminished over the years. We do have companies today with market or materials orientation.

Andreas Predohl also told something on location. He only told that a plant will be relocated because the new location offers added advantages. He does not tell why new industries are located at particular places.

I FREEDOM OF LOCATION

An entrepreneur seeking location for his/her enterprise has greater freedom than in the past. How difficult the task of selecting the location in the past was is better explained by narrating the ordeal that was gone through by the founders of the great Tata Iron & Steel Company (TISCO). The site (present Jamshedpur) was selected after extensive geological survey which established the existence of coal, iron, ore, and other minerals. The site selected was at the confluence of two small rivers amidst thick jungle. Between the two rivers, a city had to be planned. As the jungles were cleared, in place of towering trees, steel chimneys arose.

Though the Maharaja of Mayurbhanj had given highly favourable terms to Tatas, the local 'Kings' of the jungle were less hospitable. Tigers killed two tribal labourers. An elephant driven frantic by the din of dam construction stampeded over a number of huts and flattened them. (One night a she-bear crawled into the hut of the Railway Superintendent and delivered a cub under his table). Erecting a plant of this nature in the wilderness was called by contemporaries 'a titanic enterprise'. Communications were slow, machinery was hauled over vast distances from home or abroad; labour had to be trained.

That was at the beginning of the 20th century. Now we are in the 21st century. The passage of time has made site selection easier for contemporary businessmen, thanks to certain specific developments that have taken place over a period of nine decades. Following are the developments;

1. Improvements in transportation and communication facilities and speed of services.
2. Reduction in wage differentials between regions.
3. Mobility of workers and management.
4. Improvements in construction methods and designs for plant buildings which make them less expensive to build.
5. Vigorous policy pursued by the Government to remove regional imbalances in industrial development thus making all regions almost equal in attraction.
6. Improvements in processing and machine designs that reduce the relative number of employees required for a given output.
7. Availability of air-conditioning equipment to counteract adverse climatic conditions for employees and processes.
8. Expansion of markets for almost all goods and services so that more enterprises are needed to meet the demands.

ERRORS IN SELECTION

Though location selection is relatively easy, businessmen commit errors and wrong locations are selected. Interestingly, errors in site selection seem to fall into a pattern. Some of the most common errors are;

1. Lack of thorough investigation and consideration of factors involved.
2. Personal likes and prejudices of key executives or owners overriding impartially established facts.
3. Reluctance of key executives to move from traditional established home ground to new and better locations.
4. Moving to congested areas already or about to be over industrialised.
5. Preference for acquiring an existing structure (usually at an imagined bargain) that is improperly located or not designed for the most efficient production.
6. Choice of community with low cultural and educational standards, so that key administrative and technical personnel eventually accept employment elsewhere.

In order to avoid the errors occurring and to ensure selection of a good location, a selection committee comprising people knowledgeable on facts and factors, as well as those responsible for operating the factors should be constituted. The committee should then tour places, select two or three locations, study their plus and minus points, and finally select one among them. It is advisable that the selection committee first selects a country, a region out of the country, locality out of region and the exact site out of chosen locality. Selection of the site out of locality and locality out of region and a particular region out of the country should be based on a thorough investigation into relevant factors.

STEPS IN LOCATION SELECTION

Deciding the country in which to locate the plant is the first step in location.

To be systematic, in choosing a plant location, the entrepreneur would do well to proceed step by step, the steps being;

1. Within the country or outside;
2. Selection of the region;
3. Selection of the locality or community;
4. Selection of the exact site.

1. Deciding on Domestic or International Location

The first step in plant location is to decide whether the facility should be located domestically or internationally. A few years ago, this factor would have received little consideration. But with increasing internationalisation of business, the issue of home or foreign country is gaining greater 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 *vying* with each 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.

2. Selection of Region

The selection of a particular region out of the many natural regions of a country is the second step in plant location.

The following factors influence such selection:

(i) Availability of Raw Materials

A firm that depends on heavy raw materials locates nearer to 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. The sugar industry, the paper industry, the iron and steel industry, the industries engaged in the solvent extraction of oil from rice bran, the China clay washery, factories manufacturing low tension porcelain insulators, and the like should be located near the sources of their raw materials. The heavy concentration of the sugar industry in Bihar and Uttar Pradesh is due to the fact that these two States are the leading producers of sugarcane in the country. Similarly, the steel industry is concentrated in Bihar, West Bengal, Orissa and Madhya Pradesh because of the availability of raw materials in these states. The location of the paper mill at Dandeli, an iron and steel industry at Bhadravathi, the sandalwood oil factory at Shimoga, the Vijayanagar Steel Plant at Donimalai, all in Karnataka, are examples of factories located near the sources of their raw materials. Nearness to raw materials offers such advantages as:

(a) Reduced cost of transportation;

(b) Regular and proper supply of materials uninterrupted by transportation breakdowns; and

(c) Savings in the cost of storage of materials.

Raw materials in this context may be classified into two types, viz., weight-losing or gross materials and non-weight losing or pure materials. Weight-losing materials lose much of their weight in the process of manufacture. The cost of transporting these raw materials from the source of supply to the place of manufacture is more than the cost of transporting the finished products from the factory to the market. Examples of these raw materials are iron ore, sugarcane, coal, timber, and limestone. Industries using such materials tend to be located near their sources of supply to save the cost of transportation.

Non-weight-losing materials, as the term itself implies, do not lose their weight in the process of manufacture. Instead, they grow in weight when they are converted into finished products. The cost of transporting the finished product is, therefore, more than the cost of transporting the raw materials. Examples of non-weight-losing materials are cotton and woollen. These materials exercise little influence on plant location.

(ii) Nearness to the Market

A company that wants to reduce transportation cost locates near market.

Since goods are produced for sale, it is very essential that the factory should be located near their market. A reduction in the cost 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 he/she establishes his/her factory near his market. Industries using pure or non-weight-losing raw materials, industries producing perishable or bulky products and servicing units tend to be located near their market. To be specific, pesticides and insecticides manufacturing concerns, auto-servicing and repairing units, tyre retreading concerns, concerns manufacturing wooden accessories for electrical wiring, distilled water concerns and hosiery units, must be located near their 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, in Pennsylvania in the U.S.A. and in Jamshedpur in India. Industries using electricity have to be located at a place where electric power is available regularly and at cheap rates. The aluminium extraction plant and a semi-mechanised bakery have to be located in places where electric power is cheaply available in plenty. Electricity as a source of power has become very significant in modern industries because of ease in handling, its cleanliness, flexibility and cheapness. In fact, its emergence as a source of power has reduced the importance of coal as a natural factor influencing plant location. Similarly, huge pipelines traversing long distances have kept up oil supplies to industries located in different regions.

(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 rail, road and water transport is ideal for a plant location. It may be said that industry follows transportation. In other words, places with well-developed means of transport attract industries. In extreme cases, transport may follow industries. For instance, if a public sector unit is started in a remote place, the Government will naturally provide transport facilities to cater to the requirements of the unit. But, generally speaking a place with existing transport facilities is perfect for locating a plant.

(v) Suitability of Climate

Suitability of climate is very important for setting up of cotton mills.

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 textiles and jute. Such industries have to be located in places where humid climatic conditions are available. This explains why the cotton textile industry is concentrated in Mumbai and the jute textile industry in Kolkota. Of late, scientific and technological developments have enabled us to create artificial climatic conditions. Places which were considered to be climatically unsuitable are now selected for some industries; *for example,* the establishment of cotton textile mills in Delhi. It may, therefore, be said that climate as a factor in plant location has lot much of its significance. Nevertheless, the entrepreneur would do well to take advantage of a natural climate because the cost of providing an artificial climate is quite exorbitant. Secondly, climate affects labour efficiency. Extreme climatic conditions adversely affect labour efficiency, and such places do not attract industries. It is for this reason that little industrial activity is found in tropical and polar regions, whereas there is a heavy concentration of industrial activities in cool and temperate regions.

(vi) Government Policy

Any firm that is looking for subsidy or incentives has to locate factory in the states which provide them.

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

The establishments of textile units in Rajasthan, Orissa, Assam and Punjab, sugar factories and distilleries in Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra, steel rolling mills in Assam, Madhya Pradesh, Kerala and Bihar, and a tyre and tube factory and electric lamps factory in Kerala are all instances which show that new industries have been located in these economically backward states.

The Government of India has been influencing plant location in a number of ways. Some of these are:

Licensing policy;

Freight rate policy;

Establishing a unit in the public sector in a remote area and developing it to attract other industries;

Institutional finance and government subsidies.

The influence of government policies on plant location began to be felt only after Independence. But, until Independence, purely commercial considerations decided industrial location. Such has been the case with TISCO and IISCO. It was because there was no over-solicitous government which was ready to come to the rescue of a sick unit to save it from bankruptcy, no ideologue anxious to give a face-lift to losing public sector concerns by allowing them to jack up prices, give protection and capitalise losses by converting them into equity.

(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. *Box 8.1* gives details about the facilities made available by different states. 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.

3. 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 is influenced by the following factors:

(i) Availability of Labour

Trade Union discourage establishing new industries

Despite the talk of mechanisation 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 organisation. The development of the plantation industry in India has been due to, among other things, the availability of adequate labour at cheap rates. The labour required may be skilled or unskilled. It is skilled labour which influences plant location because unskilled labour is supposed to be available everywhere, specially in our country. The location of the glass industry at Firozabad, the woollen carpet industry at Mirzapur, the lock industry at Aligharh and the manufacture of silk sarees at Dharmavaram and Kanjeevaram in the south, are examples of industries which are located near the supply centres of skilled labour. But nowadays the influence of skilled labour on plant location has lost some of its significance because labour has become mobile.

Labour, however, may be a deterrent factor in the development of industries in a particular area. The attitude of workers, union activities and industrial disputes drive away the existing factories and discourage new industrialists from locating new factories in particular places. The exodus of industrialists from Calcutta and Madras in search of new locations in the past illustrates this point.

(ii) Civic Amenities for Workers

Availability of civic amenities for workers also plays role in facility location.

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 in all these facilities will naturally be preferred to another place which lacks them. However, if the facilities are not available at a particular place, and if that place is advantageous in other respects, the

management should provide such facilities, as has been done in the modern townships at Rourkela, Bhilai, Durgapur and Chhota Nagpur. But this entails the diversion of funds from more productive purposes to less productive purposes.

(iii) Existence of Complementary and Competing Industries

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

- An industrial unit, in collaboration with other similar units, can secure materials on better terms than it can do it by itself. The concentration of such similar establishments helps to increase the variety of materials that can be offered by suppliers.
- The concentration of similar industries at one place improves the labour market, both for the employer and the employee.
- In specialised centres, banks become familiar with the requirements of the industry. This makes the granting of loans easy.
- A group of plants will attract a variety of repair plants, such as *foundries*, machine shops, tool makers and the like.
- The reputation build up by the existing units will be shared by the new units established in the same locality.

The existence of competing industries may appear to be disadvantageous; but a closer look would prove the contrary. An association with competing industries confers real benefits, particularly when the competition is healthy. Problems relating to the procurement of raw materials, labour troubles and government restrictions can be effectively tackled if the competing units work together. But care should be taken by all the competing units to ensure that competition does not degenerate into unhealthy rivalry.

(iv) Finance and Research Facilities

Adequate capital is essential for the successful working of any organisation. 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. In advanced countries, the case is different because, in such countries, capital is distributed uniformly.

In the course of its working, a factory may encounter a number of problems. Whenever a problem crops up, it has to be examined and a suitable solution has to be found. Moreover, a manufacturing unit has to be dynamic, *i.e.*, it should always be on the lookout for new technology. For this purpose, research facilities are essential; and a place where such facilities are available naturally attracts new industries.

(v) Availability of Water and Fire-fighting Facilities

Availability of water influences paper manufacturing plant location

Some industries require a 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. Water may be obtained from the local authority, from the canal, from a river or a lake, or by sinking a borewell. In any case, the supply of water should be considered with respect to its regularity, cost and purity.

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. Otherwise, the loss from a fire will be considerable. Though the availability of fire-fighting facilities is not a decisive factor in plant location, the fact remains that the existence of such facilities will enhance the suitability of a location.

(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. It is natural, therefore, for industrialists to prefer an area where such taxes and restrictions are the least irksome.

(vii) **Momentum of an Early Start**

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

Transport facilities are developed because the railways and other agencies find it economical to serve such places;

Facilities for repairs and maintenance begin to be provided by specialist firms;

Banking facilities become available; and

Labour possessing various skills is attracted to these places.

These are important facilities, and will automatically attract more industries.

(viii) **Personal Factors**

There are entrepreneurs, specially small industrialists, who locate their plants purely on personal grounds disregarding economic considerations. Such locations sometimes totally disapprove the may current theories of plant location. M/s A, a unit making ropes is located at Naraina, 45 kms. from Jaipur in Rajasthan. They manufacture sisal ropes, manila ropes and jute twines. There are very few rope-making units in the country and the unit at Naraina is the th biggest. It is located in a place where there are no resources and no markets. It gets fibre from Maharashtra, Karnataka and the Philippines, and supplies ropes to the Navy. Moreover, Naraina is a small place and has no particular advantage of economic or social facilities. This is clearly an example of an enterprise which has been set up purely on the basis of personal factors.

4. Selection of the Site

The selection of an exact site in a chosen locality is the fourth step in plant location. The selection of the site 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. If the land is to be purchased, and if the place enjoys all the facilities for plant location, its price should not affect the decision to locate the plant in that particular place, because the cost of land forms a small percentage of the total fixed investment. But if the land is to be leased, the question of rent, rates and taxes has to be seriously considered because they constitute a part of the permanent working expense.

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

installation of plant and equipment would be difficult tasks. Moreover, such places do not attract population; and it is difficult and uneconomical to provide infrastructure facilities in such areas.

(ii) Disposal of Waste

Leather and chemical industries locate where there is a provision for the 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 or a river or sea should be available. A disregard of this consideration in the beginning had put M/s Gemini Breweries, located about 10 kms from Bangalore, into difficulties with the local farmers. The farmers were afraid that the waste (spent wash), which was directed into a tank, might pollute the water and make it unsuitable for cultivation. The matter was taken to court. The court decreed the closure of the plant. The plant is now closed.

(iii) The site selected should, as far as possible, be in the midst of a good scenery. The question of beauty should not be ignored.

Factors influencing selection of location are summarised in *Table 8.1*.

Table 8.1 : Factors in Selection of Location

(A) NationalDecision	(B) Selection of Region	(C) Selection of Community	(D) Selection of Site
(i) Political stability Export & Import	(i) Availability of raw materials	(i) Availability of labour	(i) Soil, size and topography
(ii) Currency and exchange rates	(ii) Nearness to market	(ii) Civic amenities for workers	(ii) Disposal of waste
(iii) Cultural and economic peculiarities	(iii) Availability of power	(iii) Existence of complementary and competing Industries	
(iv) Natural environment	(iv) Transport facilities	(iv) Finance and research facilities	
	(v) Suitability of climate	(v) Availability of water and fire fighting facilities	
	(vi) Government policy	(vi) Local taxes and restrictions	
	(vii) Competition among states	(vii) Momentum of an early start	
		(viii) Personal factors	

I RELATIVE IMPORTANCE OF LOCATION FACTORS

Among all the locational factors, personal or business contacts seem to influence location decision most (65%) followed by availability of infrastructure (33%), good communication (26%) and others. See *Table 8.2* for relative ranking of location factors.

Table 8.2 : Relative Importance of Location Factors

Factors	Unimportant %	Neutral %	Important %
Personal business contacts in a particular region	24	11	65
Good communication and/or transport facilities	53	21	26
Availability of sufficient infrastructure	47	20	33
Market research indicating size or other benefits of local market	58	16	26
Availability of skilled labour	70	15	15
Region's promotion efforts	83	13	04
Particular local/regional policies to attract business	81	09	10
Lack of information on other potential areas	78	14	08

Village, Suburban or City Site

The site selected may be a urban, a suburban or a rural one. All these offer advantages as industrial sites.

(i) Rural Site

The facilities available at a village site are not as many as are found in a city ; but they are more attractive. *For example,*

Attracting skilled labour to plants located in rural areas is difficult.

- Land is available at cheaper rates;
- The rates and taxes are negligible;
- Spacious layout available and open spaces are possible;
- Advantages of single-storey buildings are available;
- Low wages for unskilled workers but high wages for skilled workers because they have to be mobilised from elsewhere;
- Fewer labour troubles;
- Avoidance of danger from fire and other hazards resulting from the operations of neighbouring units;
- Avoidance of undesirable neighbours;
- Absence of restrictions on smoke and disposal of waste.
- Against this, a country site raises such problems as:
- Lack of supply of skilled workers;
- Lack of civic amenities for employees;
- Lack of transport facilities.

(ii) Suburban Site

Suburban sites offer a compromise between the city and the village and have the advantages of both. They are less costly. All the rail and road transport facilities are available; labour can be drawn from the nearby city or villages; quarters for workers are provided by the local authorities or by private entrepreneurs; and such facilities as parks, schools and clubs can easily be provided, for land is available at fairly cheap rates.

(iii) Urban Site

Labour unions and labour unrest is frequent in city site plant.

A big city has all the facilities which favour a location for a plant. *For example,*:

- Transport facilities are no problem;
- Labour is available in plenty;
- Municipal services for water, sewage disposal, public health and education are available;
- All type of technical and commercial institutions and universities for the training of the staff and workers are available;
- Banking, repair and related services are available;
- Facilities for contracting out a portion of the work are available
- A large local market is available;
- High advertising value is available.

These are some of the advantages available in a big city. On the other hand, sites in big cities suffer from certain drawbacks. These are:

- The cost of land is exorbitant;
- House taxes, water taxes, sanitation taxes and other similar taxes and rates are fairly high;
- Labour unions are many and labour unrest is frequent.
- The cost of labour is high;
- Because of limited space, factory buildings are awkwardly shaped, ill-lighted and ill-ventilated;
- Several restrictions have been imposed in regard to smoke and the disposal of effluents.

Thus, all the three types of sites, namely village, suburban and city, offer advantages as well as disadvantages. Sometimes, it becomes a problem for an entrepreneur to choose one from among these three. A city location is preferable for small plants. A country location is best suited for very large plants, provided that skilled labour can be easily drawn from nearby places.

I LOCATION MODELS

There are four location methods.

Various models are available which help identify a near ideal location. The most popular models are:

1. Factor Rating Method
2. Point Rating Method
3. Break-even Analysis
4. Qualitative Factor Analysis

Factor Rating Method

Factor rating method involves giving rating to each factor based on its importance.

In this method, factor ratings are used to evaluate alternative locations. The method has the following advantages:

(a) Simplicity which facilitates communication about why one location/site is better than another.

(b) Enables bringing diverse locational considerations into the evaluation process.

(c) Foster consistency of judgement about location alternatives.

The steps involved are :

1. List the most relevant factors in the location decision.
2. Rate each factor (say from 1 for very low and to 5 for very high) according to its relative importance, *i.e.*, a factor rating is given to each factor based on its importance, the higher the ratings the more important is the factor.
3. Rate each location (say 1 for very low and to 10 for very high) according to its merits on each factor.
4. Compute the product of ratings by multiplying the factor rating by the location rating for each factor.
5. Compute the sum of the product of ratings for each location.

Decision : Select the location alternative which has the maximum sum of the product ratings as the choice.

Illustration : *Table 8.3* gives the various factors considered for location decision and the factor ratings assigned to each factor based on its importance for location decision and the location rating for the location alternatives based on the merit of each location in each of the factors considered.

Since the total score for location A is higher than that of location B, location A is the choice.

Table 8.3 : Factor Ratings and Location Ratings for Location Alternatives

Factor	Factor Rating	Location Rating		Product of Rating	
		Location A	Location B	Location A	Location B
1. Tax advantage	4	8	6	32	24
2. Suitability of labour skill	3	2	3	6	9
3. Proximity to customers	3	6	5	18	15
4. Proximity to suppliers	5	2	4	10	20
5. Adequacy of water	1	3	3	3	3
6. Receptivity of community	5	4	3	20	15
7. Quality of educational system	4	1	2	4	8
8. Access to rail and air transportation	3	10	8	30	24
9. Suitability of climate	2	7	9	14	18
10. Availability of power	2	6	4	12	8
		Total score		149	144

Point Rating Method

In selecting a site or location, companies have several objectives, but not all are of equal importance. The relative weight a company assigns to each objective or to each location factor may be represented by the number of points a perfect site would receive in each category. Each potential site is then evaluated with respect to every factor a company is looking for and points are assigned for each factor. The site with the highest total number of points is considered superior to other sites. The drawback of this method is that high score in any factor can overcome a low score in any other factor. Since some factors are considered as important or

essential, any site that does not have at least a specified number of points for those essential factors will be excluded from further consideration.

What is significant in point-rating system is the relative importance of tangible cost factors compared to intangible factors. Points are usually assigned only to intangible factors and an evaluation is made to determine whether the difference between the intangible scores is worth the difference if any between the tangible costs of the competing locations.

If two alternative locations are found to be equally attractive by comparing the costs (based on tangible factors) then these two alternative potential locations may further be evaluated, based on the intangible factors using the point-rating method.

Illustration : After evaluating two potential sites A and B by comparing costs and finding them approximately equal from cost point of view, a manufacturer decided to evaluate the intangible factors for these two locations by point rating. Comparative ratings assigned to major intangible location factors to determine the relative importance for each factor and the points assigned to each location alternative for each of the factors are given in the *Table 8.4*.

Table 8.4 : Points Assigned to Alternative Locations

Factors Rated	Maximum Possible Points	Points assigned to Locations	
		Location A	Location B
Future availability of fuel	300	200	250
Transportation flexibility and growth	200	150	150
Adequacy of water supply	100	100	100
Labour availability	250	220	200
Pollution regulations	30	20	20
Site topography	50	40	30
Living conditions	150	100	125
Total	1080	830	875

From the table it is seen that location B has slight advantage over location A.

Locational Break-even Analysis

In comparing several potential locations on an economic basis, (*i.e.*, tangible factors), the only revenues and costs that need to be considered are the ones that vary from one location to another. If revenue per unit is the same regardless of where the good is produced, the total revenues can be eliminated from consideration. An economic comparison of locations can be made by identifying the fixed costs and variable costs and plotting the break even-analysis on a graph for each location.

This graphical approach can easily identify the range of annual production volume over which a location is preferable.

The steps involved in this method are :

1. Determine all relevant costs that vary with each location.
2. Categorize the costs for each location into annual fixed costs (FC) and variable cost per unit (VC) and calculate the total cost (TC) for the desired volume of production per annum, for each location.
3. Plot the total costs associated with each location on a single chart or graph of annual cost versus annual production volume.

4. Select the location with the lowest total annual cost (TC) at the expected production volume per annum (Q).

Note : If revenues vary from one location to another, then comparison of locations should be made on the basis of profits (*i.e.*,. Total revenue - Total cost) at each location.

Illustration : Potential locations A, B and C have the cost structures shown for producing a product expected to sell at Rs.100 per unit. Find the most economical location for an expected volume of 2,000 units/year. Also determine the range of annual volume of production for which each of the locations A, B and C would be most economical.

Location	Fixed Cost/year (Rs.)	Variable Cost per unit (Rs.)
A	25,000	50
B	50,000	25
C	80,000	15

Solution :

(a) To determine the most economical location for an expected annual volume of production of 2,000 units, calculate the total cost of production at each of the locations for the annual production volume Q = 2,000 nos.

$$\text{Total Cost} = \begin{pmatrix}\text{Fixed cost}\\ \text{per annum}\end{pmatrix} + \begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix} \times \begin{pmatrix}\text{Quantity}\\ \text{produced}\end{pmatrix}$$

Total cost at location A, $TC_A = (FC)_A + (V.C)_A \times Q$

$TC_A = 25,000 + 50 \times 2000$

$= 25,000 + 1,00,000 = Rs.1,25,000$

Similarly,

Total cost at location B, $TC_B = 50,000 + 25 \times 2,000$

$= 50,000 + 50,000 = Rs.1,00,000$

Total cost at location C, $TC_C = 80,000 + 15 \times 2000$

$= 80,000 + 30,000 = Rs.1,10,000$

By comparing the total costs at each of the three locations, it is seen that location 'B' is the most economical location for a volume of production of 2,000 Nos. per year.

(b) To determine the range of annual volumes of production at which each of the three locations would become most economical, it is necessary to determine the break-even volumes either by graphical method or by analytical method.

Analytical method

(i) To determine the break even volume between location A and location B, the total cost for producing the break-even quantity say

Q_{AB} at each of location A and B are equated *i.e.*,

$$25,000 + 50\ Q_{AB} = 50,000 + 25\ Q_{AB}$$

$$50\ Q_{AB} - 25\ Q_{AB} = 50,000 - 25,000$$

$$25\ Q_{AB} = 25,000$$

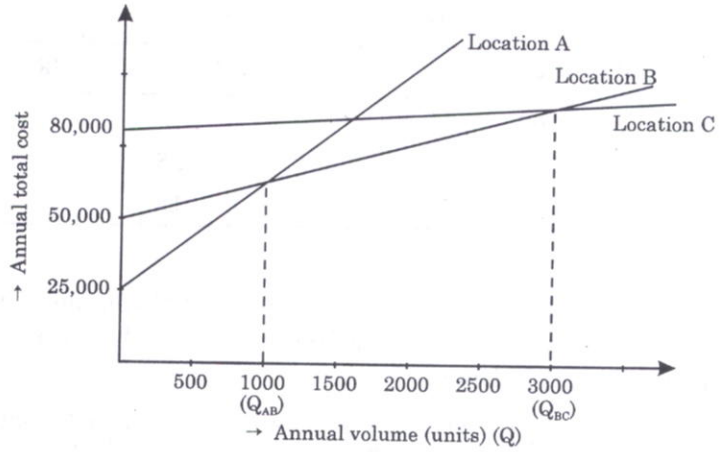
$$Q_{AB} = \frac{25,000}{25} = 1,000 \text{ units}$$

To determine the break - even volume between location B and C, the total cost for producing the break-even quantity say Q_{BC} at each of location B and C are equated *i.e.*,

$$50,000 + 25\ Q_{BC} = 80,000 + 15\ Q_{BC}$$
$$25\ Q_{BC} - 15\ Q_{BC} = 80,000 - 50,000$$
$$10Q_{BC} = 30,000 \text{ or } Q_{BC} = 3,000 \text{ units.}$$

The above break-even quantities are shown graphically in *Exhibit 8.1*.

Exhibit 8.1 : Break-Even Analysis



Qualitative Factor Analysis Method

If economic criteria are not sufficiently influential to decide the location alternative, a system of weighting the criteria might be useful in making a plant location decision. This approach is referred to as qualitative factor analysis. The steps involved are :

1. Develop a list of relevant factors.
2. Assign a weight to each factor to indicate its relative importance (Weights may total upto 1.0).
3. Assign a common scale to each factor (say 0 to 100) and designate any minimum point to be scored by any location.
4. Score each potential location according to the designated scale and multiply the scores by the weights to arrive at the weighted scores.
5. Total the points for each location, and choose the location with the maximum points.

Illustration : XYZ company is evaluating four locations for a new plant and has weighted the relevant scores as given below. Scores have been assigned with higher values indicative of preferred conditions. Using these scores, develop a qualitative factor comparison for the four locations.

Relevant Factors	Assigned Weight	Scores for Locations			
		A	B	C	D
Production cost	0.35	50	40	60	30
Raw material supply	0.25	70	80	80	60
Labour availability	0.20	60	70	60	50
Cost of living	0.05	80	70	40	80
Environment	0.05	50	60	70	90
Markets	0.10	70	90	80	50
Total	1.00				

Solution :

Factor	Weighted Score for Locations			
	A	B	C	D
Production cost	17.5	14.0	21.0	10.5
Raw material supply	17.5	20.0	20.0	15.0
Labour availability	12.0	14.0	12.0	10.0
Cost of living	04.0	03.5	02.0	04.0
Environment	02.5	03.0	03.5	04.5
Markets	07.0	09.0	08.0	05.0
Total	60.5	63.5	66.5	49.0

Location C is preferred because of the highest weighted score.

SOLVED PROBLEMS

1. *A company has to decide on the location of a new plant. It has narrowed down the choice to 3 locations A, B and C; data in respect of which is furnished below:*

Data	Locations		
	A (Rs.)	B (Rs.)	C (Rs.)
Wages and Salaries	20,000	20,000	20,000
Power and Water supply expenses	20,000	30,000	25,000
Raw materials and other supplies	80,000	75,000	60,000
Total initial investment	2,00,000	3,00,000	2,50,000
Distribution expenses	50,000	40,000	60,000
Miscellaneous expenses	40,000	25,000	30,000
Expected sales per year	2,25,000	2,50,000	2,25,000

Use a suitable criterion and advise the company on the best choice.

Solution :

	Locations		
	A (Rs.)	B (Rs.)	C (Rs.)
Sales Revenue	2,25,000	2,50,000	2,25,000
Total expenses	2,10,000	1,90,000	1,95,000
Profit	15,000	60,000	30,000
Initial investment	2,00,000	3,00,000	2,50,000
Return on investment (RoI)	$\frac{15,000}{2,00,000} \times 100$ = 7.5%	$\frac{60,000}{3,00,000} \times 100$ = 20%	$\frac{30,000}{2,50,000} \times 100$ = 12%

Based on ROI criteria, location 'B' is the best location.

2. *Location A would result in fixed costs of $3,00,000 variable costs of $63 per unit and revenues of $68 per unit.*

Annual fixed costs at location B are $8,00,000 with variable costs of $32 per unit and revenue of $68 per unit. Sales volume is estimated to be 25,000 units/year. Which location is most attractive. ***(MBA - 1994 BU)***

Solution :

Total cost of production at location A = Fixed cost + Variable cost per unit × Sales value

= $3,00,000 + $63 × 25,000

= $3,00,000 + $15,75,000 = $18,75,000

Total cost of production at location B = $8,00,000 + $32 × 25,000

= $8,00,000 + $8,00,000 = $16,00,000

Total revenue at location A = $68 × 25,000 = $17,00,000

Total revenue at location B = $68 × 25,000 = $17,00,000

Total profit at location A = $17,00,000 – $18,75,000

= –$1,75,000 (i.e., loss of $1,75,000)

Total profit at location B = $17,00,000 – $16,00,000 = $1,00,000

Since location 'B' gives a profit of $1,00,000 as compared to a loss of $1,75,000 at location A, location B is the best choice.

3. *A company has to select one location out of the five alternatives considered for a new plant. The annual operating costs and other intangible factors are given below for these five locations.*

Factors	Location				
	A	B	C	D	E
(a) Economic Factors :					
Labour costs (Rs.)	1,20,000	1,10,000	1,60,000	85,000	75,000
Transportation costs (Rs.)	10,000	8,000	7,000	12,000	14,000
Local taxes (Rs.)	17,000	20,000	25,000	19,000	17,000
Cost of power (Rs.)	21,000	29,000	25,000	18,000	23,000
Other costs (Rs.)	16,000	11,000	12,000	16,000	18,000
(b) Intangible Factors :					
Community attitude	Very good	Fair	Good	Fair	Very good
Labour availability	Good	Very good	Fair	Outstanding	Acceptable
Quality of transportation	Fair	Acceptable	Outstanding	Acceptable	Fair
Quality of life	Acceptable	Fair	Good	Very good	Outstanding

(i) On the basis of annual operating factors, which site would you choose?

(ii) Devise a method of quantifying the intangible factors and integrate them with the cost data into the overall evaluation. Which is best now?

Solution :

(i) On the basis of annual operating costs :

	A	B	C	D	E
Total operating cost (Rs.)	1,84,000	1,78,000	2,29,000	1,50,000	1,47,000
Rank	4	3	5	2	1

Since the total annual operating costs is least at location E, location E is the best choice based on economic considerations only.

(ii) On the basis of overall evaluation including intangible factors and economic factors.

To quantify the intangible factors, the qualitative factors are converted into quantitative factors using a five point rating scale as below:

Grade	Point
Outstanding	5
Very good	4
Good	3
Fair	2
Acceptable	1

The intangible factor's ratings are as below:

Factor	Ratings for Locations				
Community attitude	4	2	3	2	4
Labour availability	3	4	2	5	1
Quality of transportation	2	1	5	1	2
Quality of life	1	2	3	4	5
Total rating	10	9	13	12	12
Rank	3	4	1	2	2

To combine the economic factor (operating cost) rating with intangible factor rating, let us allot highest rating of say ten, for the location which has the lowest annual operating cost (i.e., for location E).

Hence the economic factor ratings are proportionately reduced from 10 as the operating cost increases.

$\therefore$ Economic rating of location A $= \dfrac{10 \times 1,47,000}{1,84,000} = 7.98$

- do - B $= \dfrac{10 \times 1,47,000}{1,78,000} = 8.25$

- do - C $= \dfrac{10 \times 1,47,000}{2,29,000} = 6.41$

- do - D $= \dfrac{10 \times 1,47,000}{1,50,000} = 9.80$

$$\text{Total factor rating} = \text{Total factor rating} = \begin{pmatrix}\text{Economic}\\ \text{factor rating}\end{pmatrix} + \begin{pmatrix}\text{Intan gible}\\ \text{facror rating}\end{pmatrix}$$

	Locations				
	A	B	C	D	E
Total factor rating =	7.98 + 10.00 = 17.98	8.25 + 9.00 = 17.25	6.41 + 13.00 = 19.41	9.80 + 12.00 = 21.80	10.00 + 12.00 = 22.00

Since the total factor rating for location E is the highest, location E is the best choice.

QUESTIONS

1. What is meant by plant location ? Discuss the steps to be taken in choosing a location for a plant.
2. Define the term location. "Discuss the factors which determine the location of a plant".
3. Enumerate and explain the major factors governing plant location.
4. Evaluate the advantages and disadvantages of an urban site versus a rural site.
5. "The guiding principle in the search for a location should be for a place where the cost of the raw materials and of fabrication, plus the cost of the marketing of the finished product, will be minimum". Elaborate.
6. "A city location is preferable for small plants. Suburban locations are best suited for medium-sized plants. A country location is best suited for very large plants." Do you agree? Why? Give examples.
7. Among the states and union territories, which state or union territory in India, you feel, is ideal for locating a plant? Give reasons.
8. How is location for a plant selected?
9. Discuss the various factors involved in the location of a plant, with an emphasis on a cement plant.
10. Discuss the steps to be taken in choosing a plant location.
11. Explain the reasons for more automotive industries presence in Faridabad, Mumbai and Chennai.
12. What are the various factors considered for locating a plant? How do you decide the layout after locating the plant?
13. What are the factors to be considered for the location at a plant of a multinational company?
14. Briefly state the important locational considerations for setting up a sheet metal fabrication shop.

PROBLEMS

1. A manufacturer of a farm equipment is considering 3 locations A, B and C for a new plant. Cost studies show that the fixed costs per year at the sites are Rs. 2,40,000, Rs. 2,70,000 and Rs. 2,52,000 respectively. The variable costs are Rs. 100 per unit, Rs. 90 per unit and Rs. 95 per unit respectively. If the plant is designed to have an effective system capacity of 2,500 units per year and is expected to operate at 80% efficiency, which is the most economic location on the basis of actual output?

2. A firm is considering 4 alternative locations for a new plant. It has attempted to study all costs at the various locations P, Q, R and S and found that the production costs of the following items vary from one location to another. The firm will finance the new plant from capital which attracts 10% interest.

Data	Locations			
	P	Q	R	S
Labour cost/unit (Re.)	0.75	1.10	0.80	0.90
Plant construction cost (Rs. in lakhs)	46	39	40	48
Materials and equipment (Re.) cost per unit	0.43	0.60	0.40	0.55
Electricity charges per year (Rs.)	30,000	26,000	30,000	28,000
Water charges (Rs.) per year	7,000	6,000	7,000	7,000
Transportation cost per unit (Re.)	0.02	0.10	0.10	0.05
Taxes per year (Rs.)	33,000	28,000	63,000	35,000

Determine the most suitable location for output volumes in the range of 50,000 units to 1,30,000 units.

3. Table below indicates ratings for locational factors for a steel plant. Location L_1 has a cost/Kg advantage whereas location L_2 has a local transportation advantage and location L_3 has a labour availability advantage.

Economic Factors	Locations		
	L_1	L_2	L_3
Annual operating costs (Rs. in lakhs)	953	1,006	1,040
Production cost per Kg (Rs.)	7.24	8.38	8.66

Qualitative Factors	Ratings on 5 Point Rating Scale (5 = Excellent, 4 = Good, 3 = Average, 2 = Below average, 1 = Poor)		
Housing availability	3	3	4
Cost of living	3	3	2
Labour availability	3	3	5
Community activities	3	2	4
Education and health services	3	3	4
Recreation	4	2	5
Union activities	3	1	3
Local transportation systems	3	5	3
Proximity to similar industry	3	4	4
Community attitude	5	5	5

The weightage factors are as below:

Factor	Weightage
Production cost/kg	0.60
Cost of living	0.05
Labour availability	0.20
Union activity	0.10
Proximity to similar industries	0.03
Local transportation	0.02
Total	1.00

Select the best location.

4. Two locations A and B are being examined for location of a new manufacturing plant. Two production processes X and Y are being examined. The annual operating costs for each process at two locations are as below:

Location	Process X		Process Y	
	Fixed cost (Rs. in lakhs)	Variable cost per unit (Rs.)	Fixed cost (Rs. in lakhs)	Variable cost per unit (Rs.)
A	15	5.9	34	3.8
B	12.5	6.4	30	4.1

In what range of outputs would each location-process combination be preferred?

5. XYZ Company is considering an additional facility. The Company is heavily dependent on water transportation. Therefore it has narrowed its choice of location to three port facilities in Mumbai, Karwar and Mangalore. On the basis of the following data, which location is preferable?

Relavent factors	Mumbai	Karwar	Mangalore
Variable cost per unit	Rs. 18	Rs. 20	Rs. 19.50
Fixed costs per year	Rs. 15 lakhs	Rs. 30 lakhs	Rs. 40 lakhs
Price per unit	Rs. 300	Rs. 300	Rs. 300
Volume (units\year)	3 lakhs	2.5 lakhs	3.25 lakhs

* * * * *