

ENGINEERING MANAGEMENT - ENG 501.1 (2 UNITS)

FACILITY LOCATION AND LAYOUT

PLANT LOCATION

Every entrepreneur is faced with the problem of deciding the best site for location of his plant or factory. Plant location refers to the choice of region and the selection of a particular site for setting up a business or factory. Facility location may also be defined as a place where the facility will be set up for producing goods or services.

An ideal location is one where the cost of the product is kept to minimum, with a large market share, the least risk and the maximum social gain.

Reason for firm should look for additional or alternate location

- i. To establish new venture: When a business is newly started
- ii. Expansion of existing business: - When the existing business unit has outgrown its original facilities and expansion is not possible; hence a new location has to be found.
- iii. Changes in demand and supply: - When the volume of business or the extent of market necessitates the establishment of branches
- iv. Expand existing organization
- v. Dispose of the existing plant and build new one
- vi. When the lease expires and the landlord does not renew the lease
- vii. Other social or economic reasons

Need for Facility Location Planning

- Facility location planning is required for providing a cost benefit to the organisation.
- The location planning should help in reducing the transportation cost for the organisation. This ultimately helps in decreasing the cost of production and generating cost advantage for the organisation.
- It is also needed to identify proximity to the sources of raw materials and transportation facilities.
- A facility should ideally be located at a place where raw materials are available. This is necessary for maintaining continuity in the production process.

Factors influencing plant location/facility location

1. General locational factors, which include controllable and uncontrollable factors for all type of organisations.

Controllable factors

- ✓ Proximity to markets
- ✓ Supply of materials
- ✓ Transportation Facilities
- ✓ Infrastructure availability
- ✓ Labour and wages
- ✓ Capital Controllable factors

Uncontrollable factors

- ✓ Government policy
 - ✓ Climate conditions
 - ✓ Supporting industries and services
 - ✓ Community and labour attitudes
2. Specific locational factors specifically required for manufacturing and service organisations.
- ✓ Favorable labour climate
 - ✓ Proximity to markets
 - ✓ Quality of life
 - ✓ Proximity to suppliers and resources
 - ✓ Utilities, taxes, and real estate costs

Techniques/ Models for Selecting Facility Location

Various models are available which help to identify the ideal location. Some of the popular models are:

- a. Factor rating method
- b. Weighted factor rating method
- c. Load-distance method
- d. Centre of gravity method
- e. Break even analysis

Factor rating method: - The process of selecting a new facility location involves a series of the following steps;

Step 1: Identify the important location factors

Step 2: Rate each factor according to its relative importance, i.e., higher the ratings is indicative of prominent factor.

Step 3: Assign each location according to the merits of the location for each factor.

Step 4: Calculate the rating for each location by multiplying factor assigned to each location with basic factors considered.

Step 5: Find the sum of product calculated for each factor and select best location having highest total score.

Example

Let us assume that a new medical facility, Health-care, is to be located in Delhi. The location factors, factor rating and scores for two potential sites are shown in the following table. Which is the best location based on factor rating method?

S/N	Location factor	Factor rating	Rating	
			Location 1	Location 2
1	Facility utilization	8	3	5
2	Total patients per month	5	4	3
3	Employee preference	5	5	3

Solution

S/N	location factor	Factor rating (1)	Location 1		Location 2	
			Rating	total	Rating	total
1	Facility utilization	8	3	24	5	40
2	Total patients per month	5	4	20	3	15
3	Employee preference	5	5	25	3	15
			Total	69	Total	70

Weighted Factor Rating Method: - In this method to merge quantitative and qualitative factors, factors are assigned weights based on relative importance and weight age score for each site using a preference matrix is calculated. The site with the highest weighted score is selected as the best choice.

Example

Let us assume that a new medical facility, Health-care, is to be located in Delhi. The location factors, weights, and scores (1 = poor, 5 = excellent) for two potential sites are shown in the following table. What is the weighted score for these sites? Which is the best location?

S/N	Location factor	weight	scores	
			Location 1	Location 2
1	Facility utilization	25	3	5
2	Total patient per month	25	4	3
3	Average time per emergency trip	25	3	3
4	Land and construction cost	15	1	2
5	Employee preferences	10	5	3

Solution

The weighted score for this particular site is calculated by multiplying each factor's weight by its score and adding the results.

Weighted score location 1 = $25 \times 3 + 25 \times 4 + 25 \times 3 + 15 \times 1 + 10 \times 5 = 75 + 100 + 75 + 15 + 50 = 315$

Weighted score location 2 = $25 \times 5 + 25 \times 3 + 25 \times 3 + 15 \times 2 + 10 \times 3 = 335$

Load-distance Method: - The load-distance method is a mathematical model used to evaluate locations based on proximity factors. The objective is to select a location that minimizes the total weighted loads moving into and out of the facility. The distance between two points is expressed by assigning the points to grid coordinates on a map. An alternative approach is to use time rather than distance.

Centre of gravity: - Is based primarily on cost considerations. This method can be used to assist managers in balancing cost and service objectives. The centre of gravity method considers the locations of plants and markets, the volume of goods moved, and transportation costs in arriving at the best location for a single intermediate warehouse.

Break Even Analysis: - Break even analysis implies that at some point in the operations, total revenue equals total cost. Break even analysis is concerned with finding the point at which revenues and costs agree exactly.

Concept of Facility Layout

Facility layout may be defined as the arrangement of machinery, equipment, and other amenities in a facility, which should ensure a smooth movement of materials.

According to Moore, facility layout is the plan of or the act of planning an optimum arrangement of facilities, including personnel, operating equipment, storage space, material handling equipment, and all other supporting services along with the design of the best structure to contain these facilities.

Objectives of an Effective Facility Layout

- Minimum Material Handling
- Elimination of Bottlenecks
- Shorter Production Cycles
- Reduction in Production Delays
- Improved Quality Control
- Efficient Utilisation of Labour
- Improved Employee Morale

Types of Facility Layouts

- Process Layout
- Product Layout
- Fixed Position Layout
- Cellular Manufacturing Layout
- Combination or Hybrid Layout

Process layout: Process layout, also called functional layout or batch production layout, is characterised by the grouping together of similar machines, based upon their operational characteristics.

Product layout: In product layout, also called straight line layout, machinery is arranged in one line as per the sequence of production operations. Materials are fed into the first machine and finished products come out of the last machine.

Fixed position layout: This type of facility layout is used to assemble products that are too large, heavy or fragile to move to a location for completion. In the fixed position layout, machinery, men, as well as other pieces of material, are brought to the location where the product is to be assembled.

Cellular manufacturing layout: In Cellular Manufacturing (CM) layout, machines are grouped into cells, which function somewhat like a product layout in a larger shop or a process layout. Each cell in the CM layout is formed to produce a single part family, that is, a few parts with common characteristics.

Combination or hybrid layout: It is difficult to use the principles of product layout, process layout, or fixed location layout in facilities that involve fabrication of parts and assembly. Fabrication tends to employ the process layout, while assembly areas often employ the product layout.

Factors affecting facility layout

- ✓ Materials
- ✓ Product
- ✓ Machinery
- ✓ Type of Industry
- ✓ Management Policies

Prerequisites for Developing a Facility Layout

Developing process charts: A process chart is the graphical representation of production activities performed by an organisation. Process charts facilitate a systematic analysis and demonstration of the entire production process. These charts are further classified into two categories, namely operation process chart and flow process chart.

Making process flow diagrams: A process flow diagram represents the movement of materials on a floor layout. These diagrams help an organisation in avoiding needless material movement and rearranging facility operations.

Developing machine data cards: A machine data card helps in developing equipment layout (pieces of equipment layout in relation to everything including the persons using them) by providing information related to power and materials handling requirements and capacity and dimensions of different machines.

Visualising the layout: It represents the most common technique that is deployed for layout planning. It involves creating duplication of machines and equipment and arranging them in two- or three-dimensional plans for determining the effectiveness of a layout.