

Industrial Engineering and Management Science

Concept of Industrial Engineering:-

The American Institute of Industrial Engineers (AIIE) has defined the special field of Industrial Engg. as

- Concerned with the design, improvement and installation of integrated systems of people, material, equipment and energy.
- It draws upon specialized knowledge and skill in the mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.

Industrial Engineering is the engineering approach to the detailed analysis of the use and cost of the resources of an organisation. The main resources are men, money, material, equipment and machinery. The Industrial Engineer carries out such analysis in order to achieve the objectives (to increase productivity, or profits, etc) and

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policies of organization. An Industrial Engineer's techniques go beyond the mechanical cost factor. He is associated with organization structure, administrative techniques, human (labour) problems and at the same time he understands the relationship betⁿ efficiency and consent (of working group)

→ Essentially, the Industrial engineer is engaged in the design of a system and his function is primarily that of management

→ If industrial engineer had to focus on only one concept to describe his field of interest and objective, it would have to be productivity improvement.

Productivity improvement implies
(i) a more efficient use of resources
(ii) less waste per unit of input supplied
(iii) higher levels of output for fixed levels of input supplied and so on.

Input may be

(i) Human efforts (ii) energy in any of its myriad forms (iii) materials (iv) Invested capitals etc.

① Plant Engineering

A plant is a place, where men, materials, money, equipment, machinery, etc. are brought together for manufacturing products.

The problem of plant location arises when starting a new concern or during the expansion of the existing one plant. Site selection or plant location means deciding a suitable location, area, place, etc, where the plant or factory will start functioning.

Steps in the facility location study

In the following two phases the location studies are usually made

- (i) The General territory selection phase
- (ii) The exact site/community selection phase among those available in the general locale.

Phase ① Territory Selection

The following are some of the important factors that influence the site selection decision for the general territory/region/area selection

Markets:-

There has to be some customer/market for your product/service. The

market growth potential and the location of competitors are important factors that could influence the location.

Locating a plant or facility near to the market is preferred if promptness in service is required, ^{if the product} ~~if~~ is ^{easily broken} fragile, or is ^{capable of being} susceptible to spoilage like glass articles, bangles, ceramic goods, fresh breads, jam, Jelly, Pickles and fresh vegetables etc. Moreover, if the product is relatively expensive and transportation costs add substantially to the cost, a location close to the market is desired. Assembly type industries also tend to locate near markets.

(a) Raw materials and Supplies

Sometimes accessibility to vendors/suppliers of raw materials, part supplies, tools, equipment etc. may be very important. The issue here is promptness and regularity of delivery and inward freight cost minimization.

If the raw material is bulky or low in cost & if it is greatly reduced in bulk viz transformed into various products and by-products. If it is perishable and processing makes it less so, then location near raw materials sources is important. If the raw materials come from a variety of locations, the plant/facility may be situated so as to minimize total transportation costs. The

costs vary depending upon specific routes, mode of transportation and specific product classification.

Transportation Facilities

Adequate transportation facilities are essential for the economic operation of production system. For companies that produce or buy heavy bulky and low value per ton commodities, water transportation can be an important factor in locating plants. It can be seen that civilisations grew along rivers, water ways etc. Many facilities/plants are located along river banks.

Manpower Supply:- The availability of skilled manpower, the prevailing wage pattern, living costs and the industrial relations' situation influence the location.

Infrastructure: The factor refers to the availability and reliability of power, water, fuel and communication facilities in addition to transportation facilities.

Legislation and Taxation:- Factors such as financial and other incentives for new industries in backward areas

or no-industry - districts centres; exemption from certain state and local taxes, octroi etc. are important.

Climate:- climatic factors could dictate the location of certain type of industries like textile industry which requires high humidity zones and dry climate for cement mills etc.

Phase-II, Site/Community Selection

Site/Community Selection

Having selected the general territory/region, we would have to go in for site/community selection. Let us discuss some factors relevant for this stage.

Community Facilities:-

These involve factors such as quality of life which in turn depends on availability of facilities like schools, place of worship, medical services, police and fire stations, cultural, social and recreation opportunities, housing, good streets and good communication and transportation facilities.

Community Attitudes:-

These can be difficult to evaluate. Most communities usually welcome setting up of a new industry especially since it would provide opportunities to the local people directly or indirectly. However, in case of polluting or dirty industries, they would try their utmost to locate them as far away as possible.

Sometimes because of prevailing law and order situation, companies have been forced to relocate their units. The attitude of people as well as the state government has an impact on industrial location.

Waste Disposal: - The facilities required for the disposal of ~~of~~ process waste including solid, liquid and gaseous effluents need to be considered. The plant should be positioned so that prevailing winds carry any fumes away from populated areas and so that waste may be disposed of properly and at reasonable expense.

Ecology and Pollution: - These days there is a great deal of awareness toward maintenance of natural ecological balance. There are quite a few agencies propagating the concepts to make the society at large more conscious of the dangers of certain avoidable actions.

Site Size: - The plot of land must be large enough to hold the proposed plant and parking and access facilities and provide room for future expansion.

These days a lot of industrial areas/parks are being earmarked in which certain standard sheds are being provided to entrepreneurs (especially small scale ones)

Topography ^(The arrangement of the natural & artificial physical features of an area) The topography, soil structure and drainage must be suitable. Of considerable land improvement is required, low priced land might turn out to be expensive.

Transportation Facilities

The site should be accessible by road and rail preferably. The dependability and character of the available transport carriers, frequency of service and freight and terminal facilities are also worth considering.

Supporting Industries and Services

The availability of supporting services such as tool rooms, plant services etc. need to be considered.

Land Costs

These are generally of lesser importance as they are non-recurring and possibly make up a relatively small proportion of the total cost of locating a new plant. Generally, if the site will be in a city, ^{or a suburb} or a country location. In general, the location for large-scale industries should be in rural ~~area~~ areas, which helps in regional

development also. It is seen that once a large industry is set up or (even if a decision to this effect has been taken) a lot of infrastructure develops around it as a result of the location decision. As for the location of medium scale industries, these could be preferably in the suburban/semi-urban areas where the advantages of urban and rural areas are available. For the small scale industries, the location could be urban areas where the infrastructural facilities are already available. However in real life, the situation is somewhat paradoxical as people, with money and means, are usually in the cities and would like to locate the units in the city itself.

PLANT LAYOUT

Layout refers to the arrangement of facilities in a particular workstation.

Plant layout implies the physical arrangement of machines, equipment and other industrial facilities on the factory floor in such a manner that they may be handled efficiently.

It may be defined as "plant layout is the optimum arrangement of different facilities including man, machine, equipment and material etc. showing the space allocated for material movement, storage and all supporting activities from the receipt of raw material to the shipping of the finished goods for an overall economy of production". It involves a judicious arrangement of production facilities so that work flows in, as direct a path as possible.

According to the great management expert Riggs, the overall objective of plant layout is to design a physical arrangement that most economically meets the required output, quantity and quality. An optimum layout would permit an uninterrupted flow of work through the work station. It ensures best possible utilization of machines, workers and space. A plant layout study is required to create an arrangement that will minimise unit production costs.

Such a study involves a careful analysis of all factors affecting layout. It is an important decision as it represents a long term commitment. It is also important because it affects the flow of materials and processes, labour efficiency, supervision and control use of equipment, use of space, expansion possibilities etc. plant layout covers not only the initial layout of machines and other facilities but encompasses revision or improvement in existing layout in the light of changes in the methods and techniques of production.

Objectives and of plant layout:-

Some of the important objectives of a good plant layout are as follows:-

- ① Overall simplification of production process in terms of equipment utilization, minimisation of delays, reducing manufacturing time and better provision for maintenance.
- ② Overall integration of men, materials, machinery, supporting activities and any other considerations in a way that result in the best compromise.

- ③ Minimisation of material handling cost by suitably placing the facilities in the best flow sequence.
- ④ Saving in floor space, effective space utilization and less congestion/confusion.
- ⑤ Increased output and reduced inventories - in - Process.
- ⑥ Better Supervision and Control.
- ⑦ Worker convenience, improved morale and worker satisfaction.
- ⑧ Better working environment, safety of employee and reduced hazards.
- ⑨ Minimisation of waste and higher productivity.
- ⑩ Avoid unnecessary capital investment
- ⑪ Higher flexibility and adaptability to changing conditions.

Factors affecting Layout

Following are the major considerations which should be followed while making a layout of any kind of factory:-

① Or

Principles of plant layout:-

According to Mulhern, there are six basic principles of plant layout. These are

① Principle of Overall Integration

According to this principle, the best layout is one which integrates the men, materials, machinery, supporting activities and any other such factors that result

in the best compromise.

② Principle of Minimum distance:-

According to this principle, the best layout other things being equal, the best layout is one in which men and material have to move the minimum distance betⁿ operations.

③ Principle of Flow:- According to this Principle, other things being equal, the best layout is one which arranges the work area for each operation or process in the same order or sequence that forms, treats & assembles the materials.

④ Principle of Cubic Space:-

According to this, the best layout is one in which all the available space both vertical and horizontal is most economically and effectively used.

⑤ Principle of Satisfaction and Safety

According to this, ^{other things being equal} the best layout is one in which all the available space both vertical and horizontal is most economically and effectively used.

⑥ makes work satisfying, pleasant and safer for workers.

⑥ Principle of flexibility. It means the best layout is one which is flexible enough to be adopted and rearranged at a minimum cost and least inconvenience.

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