**Facility Layout**

**Introduction**

Facility layout is concerned with planning how to obtain optimum arrangement of industrial facilities such as operating equipment, storage space, personnel, material handling equipment, as well as other supporting services. The layout of a plant can affect material flow and processes, the efficiency of labour, use of equipment, space utilization, supervision and control as well as plant appearance. For these reasons, plant layout should be of major consideration. A good layout prevents waste of resources, such as time, efforts and money. Proper and systematic arrangement of plants and equipment increases the speed of production process, meeting delivery schedules, and in meeting quality of products. Good layout of plant gives room for expansion and contraction of production depending upon fluctuation in demand for its products.

**Why the Need for Plant Layout?**

Plant layout is the disposition of the various parts of a plant, together with all the equipment

used therein in a way that allows the plant to function effectively. With this understanding, the

need for plant location may arise under the following situations:

* A new plant is to be set up to manufacture a new product.
* A new product is introduced in an existing plant.
* The existing factory is to be shifted to a new area.
* Occurrence of frequent accidents in the plant.
* Additional space is required to meet increased demand for the product.
* Improvements are to be made by the incorporation of scientific and technological innovation.

**Objectives of Plant Layout**

The six cardinal objectives of plant location are:

1. **Facilitating manufacturing process**

A good layout must facilitate the entire manufacturing process to enable production to be

carried out optimally. This objective can only be achieved when equipment are arranged to

Provide greater utilisation in a way that minimizes production delays and reduces congestion

as a result of better flow of materials, handling of equipment and personnel, as well as

Increasing the output through shortening of the manufacturing time which can only be

achieved by improved layout.

1. **Provision of effective utilisation of space**

When plants and equipment are arranged in an orderly manner, the utilisation of the floor space in the production department is increased.

1. **Provision of effective utilisation of labour**

A good layout provides enough space for the workers to move round to perform their jobs thus eliminating or reducing the idle time that is experienced in bad layout. Such an arrangement also boosts the morale of workers.

1. **Minimise material handling cost**

The arrangement of plants and material handling equipment in a good layout will bring about a reduction in material handling cost due to the fact that it is easier to move the equipment about because enough space has been provided. Additionally, such an arrangement will provide for a direct movement of raw materials and semi-finished products without any hindrance.

1. **Maintenance of high turnover of semi-finished goods process**

It is common to observe accumulation of semi-finished goods at various stages in factories where the production process involves long time, which leads to higher storage costs and requires additional space. Accumulation of semi-finished goods also hinders easy flow of materials, hence a good layout must provide for high turnover of semi-finished goods through proper arrangement of plants and other machineries.

1. **Provide for comfort and job satisfaction**

A good layout must provide a conducive environment for the worker through the reduction of noise and provision for safety measures. In other words, there must be no excessive heat, while the ventilation and lightening system must be adequate.

**Basic Principles of Plant Layout**

The following are the basic principles for designing a good layout.

* **Overall integration:** A good layout must be capable of integrating the various

ingredients of a factory in a balanced and logical way. These include raw materials, machines, workers and all other necessary activities that aid the production process. Hence, it is necessary for these factors of production to have been procured in the right quantity and right time before integration so as to be able to arrange them in the correct order. By so doing, maximum benefit can be derived from them.

* **Minimum distance:**the principle of minimum distance requires both men and

materials to move through a minimum distance between operations.The handling of materials canaffect the production process thus increasing the cost of production.By ensuring a proper plant layout, this cost can be substantially reduced.

* **Principle of flow:** A good layout must arrange the work area for each of the

operations in the sequence of production so as to ensure that there is no bottlenecks in the flow process by removing congestion points and avoiding back tracking.Plant layout should therefore provide for easy movement of raw materials to production department and finished products to packaging department to achieve proper flow.

* **Principle of flexibility:** Changes that have been brought about by scientific and

technological innovations may bring about a change in the plant layout due to the expansion of the factory. For this reason, the arrangement of the existing pattern should be made somehow flexible so that such expansion could be achieved at least cost.

* **Satisfaction and safety:** This requires a good layout to protect the employees from accidents within the plant. The satisfaction of the employees depends largely on the environmental facilities, hence good facility layout must safeguard the employees from fire incidence, provide good ventilation and lightening facilities, and prevent the employees from all hazardous conditions.

The basic principles of plant layout are principle of overall integration; principle of minimum travel distance by men and materials; principle of smooth flow; and principle of flexibility.

**Factory Layout**

There are two components of plant layout, namely, factory layout and machine layout.

Factory layout simply refers to the positioning of the departments or shops in the factory,

storage points in the working areas, and office and other staff facilities relative to one

another. When designing a factory layout, the following rules are to be observed:

* Machining departments are to be placed under the same roof where possible. Furthermore, heavy machines should be on the ground floor to avoid unnecessary accident that could occur in the process of moving the machines to higher floors and reduce the cost of moving machines about.
* Machine departments should be centrally located near sub-stores, tool room and inspection unit.
* The assembly unit should be located close to the despatch section.
* Storeroom is to be located near transport avenue
* While the main office of inspection department should be at the head office of the firm, sub-inspection units should be established at each of the manufacturing departments.
* The general office is to be located in front of the factory building.
* Where a multi-storey building is used, drawing office is situated at the top-most floor of the building. This is because the materials required by the drawing office are often of light weight.

**Machine Layout**

Machine layout is concerned with the arrangement of the machines that are to be used for

Productive purpose. In setting out the machine layout, certain conditions must be kept to,

namely:

1. Enough space must be provided between machines to allow the workers operate the machines very easily.
2. Allowance must be provided for projection (moving in and out) and overhanging of machine parts.
3. Enough space has to be created for the insertion of raw materials of huge size into machines.
4. Materials handling equipment must have sufficient space for easy movement.
5. Enough space must be provided near the machines for the storage of both raw materials and finished products, as well as goods in progress.
6. Adequate space is to be provided for safety devices for easy access in case of emergency.

**Factors Influencing Machine Layout**

Four basic factors are crucial to the layout of machines. These are the location of the factory, the manufacturing process in place, the type of product involved and the managerial policies..

The general location and the specific site to be used for the factory have great influence on the design of machine layout. Some locations have great advantages over others in terms of availability of raw materials, labour supply, proximity to market, transport and communication systems, and so on. Furthermore, the topography, shape and size of the site will have some effect on the construction of the factory building, which may also affect the general layout of the machines.

The manufacturing process relates to the type of machine layout design. The decision to be made here is where the process should be synthetic, analytic, intermittent, repetitive or non-repetitive process. Synthetic process combines various inputs to manufacture a finished good. Examples of such process are soap and cement manufacturing. In the case of analytic process, it begins with a basic raw material and splits down into various constituent products. A typical example is crude oil refining which is split into petrol, kerosene, diesel, bitumen and so on.

Intermittent process involves completing work in various stages at different workshops within the factory. Cars and plane manufacturing are good examples of intermittent process. While repetitive process involves operations that are repeated in the same way for getting the finished products, non-repetitive processes involve operations that are not used for the manufacturing of all orders. In other words, repetitive processes are used for producing standardised products (e.g. soap, drug, etc.) in large quantity, while non-repetitive processes are used to manufacture products based on the specification of individual customers.Machine layout is therefore expected to be different in all the above considerations.

The type of product to be produced would also decide the pattern of machine layout to be put in place. In addition, the simplicity or complexity of the product (e.g., Is it liquid or solid, costly or cheap, and the quantity of manufacture), in terms of production, must be considered.

Management policies often affect machine layout with respect to the quality of products, size of the plant and its degree of integration or disintegration, extent to which the plans desired is flexible, plans for future expansion, amount of stock to be held in storeroom, and other facilities to be provided for the employees.