

* Plant Location

" Plant Location refers to the choice of region and the selection of a particular site for setting up a business or factory. But the choice is made only after considering cost and benefits of different alternatives sites. It is a strategic decision that cannot be changed once taken."

Plant location means deciding a suitable location, area, place, etc., where the plant or factory will start functioning. plant layout involves two major activities. First, to select a proper geographic region and second, selecting a specific site within the region. Plant layout location plays major role in the design of a production system as it determines the cost of

- (a) getting suitable raw material
- (b) Processing raw material to finished goods; and
- (c) finished products distribution to customer.

* Factors affecting plant location :-

- (1) Quick availability of raw materials.
- (2) Transport facilities.
- (3) Nearness to markets.

- (4) Availability of labour
- (5) Availability of fuel and Power
- (6) Availability of Water.
- (7) climatic conditions
- (8) financial and other Aids
- (9) Land
- (10) Community Attitude.

(1) Quick availability of raw materials :-

It is important for a business, to understand and analyze the proportion of cost of raw material to cost of production for every product. The cost of getting possession of the raw materials from the supply points can be minimized to a great extent if the plant is located close to the place where there is easy access & availability of raw materials.

It will be extremely beneficial set up a plant close to the supply of raw materials, especially, when the raw materials required are extremely heavy and delicate to handle. This is the main reason why most rice mills are located close to the paddy fields.

(2) Transport facilities - A lot of money is spent both in transporting the raw materials and finished goods. Depending up on the size of raw material and finished goods, a suitable method of transportation like road, rail, water & air is selected.

and accordingly the plant location is decided. (2)

(3) Neatness to Markets :- It reduce the cost of transportation as well as the chances of the finished products getting damaged and spoiled in the way (especially perishable products). More-over a plant being near to the market can catch a big share of the market and can render quick service to the customers.

(4) Availability of labour :- stable labour force, of right kind, of adequate size, and at reasonable rates with its proper attitude ~~to~~ towards work are a few factors which govern plant location to a major extent.

(5) Availability of fuel and power :- Because of the wide spread use of electric power, in most cases fuel has not remained a deciding factor for plant location. Even then steel industries are located near source of fuel to cut down the fuel transportation costs.

(6) Availability of water :- Water is used for processing, as in paper and chemical industries, and is also required for drinking and sanitary purposes. Depending upon the nature of plant, water should be available in adequate quantity and should be proper quality.

A chemical industry should not be set up at location which is famous for water shortage.

(7) Climatic Conditions — With the developments in the field of heating, ventilating and air-conditioning, climatic of the region does not present much problem. Of course, control of climate needs money.

(8) Financial and other Aids :— Certain States give aids as loans, feed money, machinery, built up sheds, etc. to attract industrialists.

(9) Land :— Area, the shape of the site, cost, drainage and other facilities, the probability of floods, earthquakes etc. influence the selection of plant location.

(10) Community Attitude :— Success of an industry depends very much on the attitude of the local people and whether they want work or not.

* Plant layout

A plant layout is an arrangement of facilities and services in the plant. It outlines relationship between production centres and departments.

Plant layout can be defined as an optimum arrangement of industrial facilities, including personnel, equipments, storage space, material

Handling Equipments and all other supporting ⁽³⁾ service on existing or proposed plants.

Plant layout can be defined as: "A technique of locating machines, processes and plant services within the factory in order to secure the greatest possible output of high quality at the lowest possible total cost of production."

Objectives of a Good plant layout :-

- (1) Integrate the production centres.
- (2) Reduce Material Handling.
- (3) Effective utilization of available space.
- (4) Worker Convenience and Job Satisfaction.
- (5) Flexibility
- (6) Quick disposal of work.
- (7) Avoids industrial accidents.

Importance of Plant layout :-

- (1) The layout determines the arrangement of facilities and services in the plant. It outlines the relationship between production centres and service departments.
- (2) It determines the type of handling systems their integration in the overall production programme, and the cost of their installation.
- (3) It specifies the location, accessibility, and size of stores, and also the space and location of temporary storage for work in process.

(4) Machine utilization is partly determined by layout.

Factors Influencing plant layout :-

- (1) Management policy.
- (2) Manufacturing process
- (3) Nature of product.
- (4) Volume of production
- (5) Type of Equipment
- (6) Type of building
- (7) Availability of total floor area
- (8) Arrangement of material handling equipment.
- (9) Service facilities
- (10) Possibility of future expansion.

(1) Management policy :- Management has to decide on many matters, e.g. nature and quality of products, size of the plant, integration of production process, plans for expansion, amount of inventory in stock, employee facilities etc.

(2) Manufacturing process :- The type of manufacturing process, e.g. synthetic/analytical, continuous/intermittent and repetitive/non-repetitive, with will govern the type of plant layout.

(3) Nature of Product :- The type of product to be manufactured affects plant layout in several ways. Small and light products can be moved easily

to the machines whereas ~~is~~ for heavy and bulky Products the machines may have to be moved

(4) Volume of Production :- The plant layout and material handling Equipment in the large Scale Organisation will be different from the same in the small scale manufacturing industry.

(5) Type of Equipment :- The use of single purpose and multi-purpose machines Substantially affects the plant layout.

(6) Type of building :- The plant layout in a single storey building will be different from that in a multi storey building. The Covered area, the number of storeys, Elevators, Stairs, Parking and storage area all affect the layout.

(7) Availability of total floor area :- The allocation of space for machines, work benches, sub-stole, etc. is made on the basis of the available floor area.

(8) Arrangement of material handling equipment :-

The plant layout and material handling services are closely related and the latter has a decisive effect on the arrangement of production process and plant services.

(9) Service facilities - The layout of factory must include proper service facilities required for the comfort and welfare of workers. These include canteen, locker, drinking water, first aid etc.

(10) Possibility of future expansion - Plant layout is made in the light of future requirements and installations of additional facilities.

* Principles of Plant layout -

According to Muther, there are six basic principles of best layout, which may guide the plant layout engineers. These principles are;

- (1) Principle of overall integration
- (2) Principle of minimum movement
- (3) Principle of smooth and continuous flow.
- (4) Principle of cubic space.
- (5) Principle of satisfaction and safety.
- (6) Principle of flexibility

(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 results in the best compromise.

(2) Principle of minimum movement - According to this principle, the number of movements

workers, and materials and the distance moved should be minimized. The material should be transported in bulk rather than in small amounts.

(3) Principle of Smooth and Continuous flow :-

It states that, bottlenecks, congestion points and backtracking should be removed by proper line balancing techniques.

(4) Principle of cubic space :- Besides using the floor space of a room, if the ceiling height is also utilized, more materials can be accommodated in the same space.

(5) Principle of satisfaction and safety :- Working places — safe, well-ventilated and free from dust, noise, fumes, odours and other hazardous conditions helps to increase the efficiency of the workers and improve their morale.

(6) Principle of flexibility :- It means that the best layout is one which can be adapted and re-arranged at a minimum cost with least inconvenience.

Types of layouts (plant layouts)

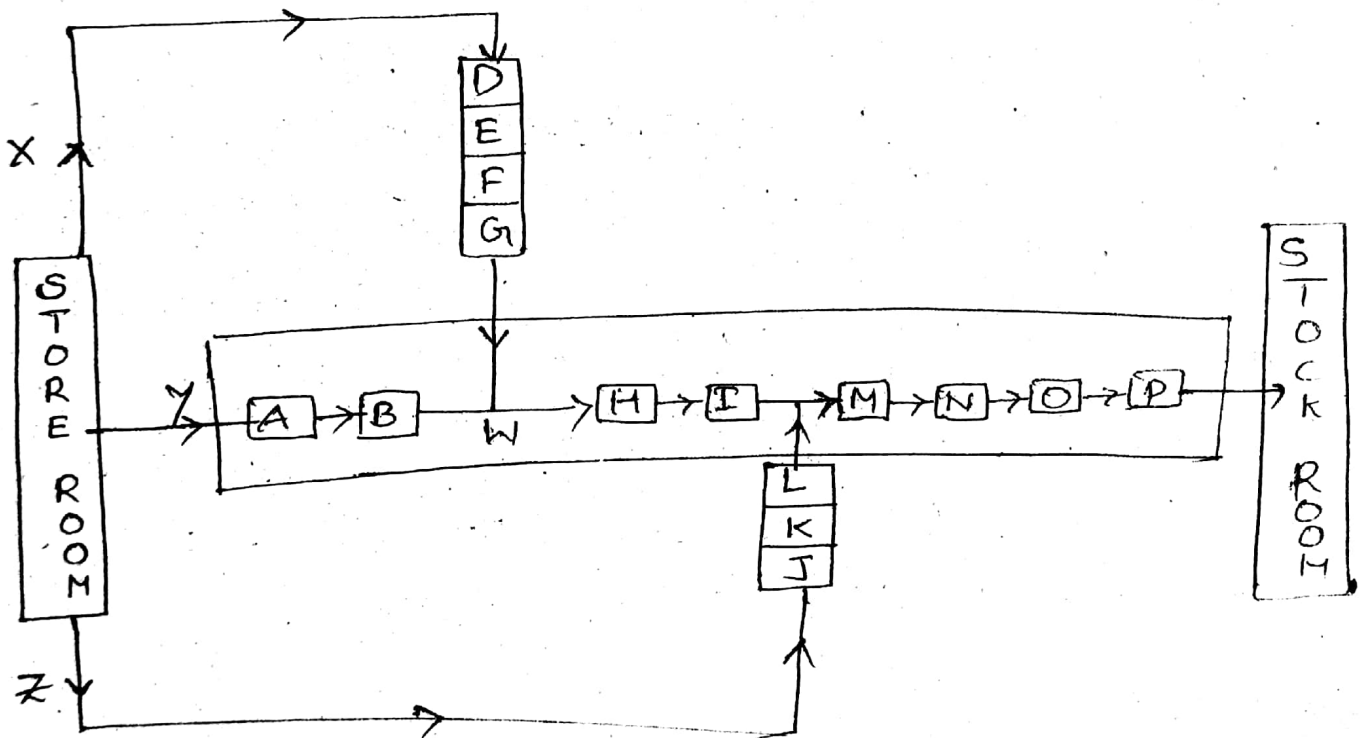
There are four types of layouts. They are,

- (1) Product layout
- (2) Process layout

(3) fixed position layout

(4) Combination layout.

(1) Product layout — It is also known as line layout. It implies that various operations on raw-material performed in a sequence and the machines are placed along the product flow line, i.e., machines are arranged in the sequence in which the raw-material will be operated upon. This type of layout is preferred for continuous production.



Product layout

⑥
Raw material from the store is fed to three lines X, Y and Z. Material in X line gets processed on machines D, E, F and G and meets material of Y line after it has been processed on the main assembly line machine A & B. Products of X and Y lines are assembled at W and get processed on machines H and I till another part comes from Z line and assembles with the main product at V. After that the total assembly get worked on machines M, N, O and P and goes to the stock room.

Advantages :-

- (1) Less space requirements for the same volume of production.
- (2) Automatic material handling, lesser material handling movements, times and costs.
- (3) Less in-process inventory.
- (4) Product completes in lesser time.
- (5) Better co-ordination and simple production planning and control.
- (6) Smooth and continuous workflow.
- (7) Less skilled workers may serve the purpose.

Disadvantages

- (1) Since the specified product determines the layout, a change in product involves major

Changes in layout and thus the layout flexibility is considerably reduced.

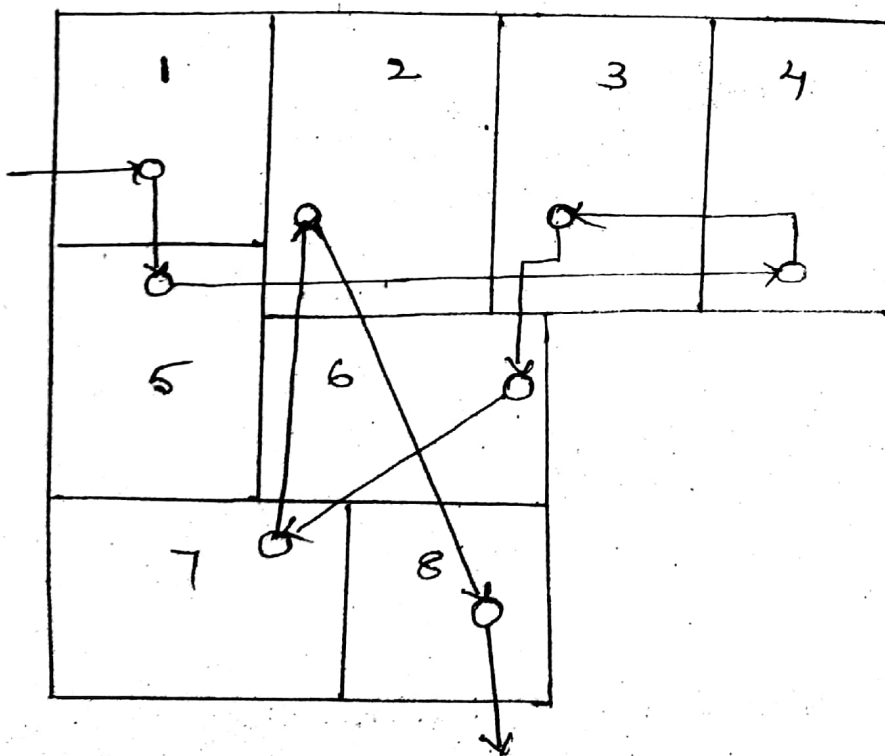
(2) It is quite expensive.

(3) Once the layout is made expansion is difficult.

(4) It is difficult to increase production beyond the capacities of the production lines.

(5) Failure of even one machine leads to shutdown of the complete production line.

(2) Process layout :- It is also known as functional layout and is characterised by keeping similar machines or similar operations at one location. In other words, all lathes will be at one place, all milling machines at another and so on, that is, machines have been arranged according to their functions. This type of layout is preferred for job order production.



- (1) Store room
- (2) Inspection Department
- (3) Broaching section
- (4) Milling section
- (5) Lathe section
- (6) Shaper section
- (7) Drill section
- (8) Stock room

Advantages :-

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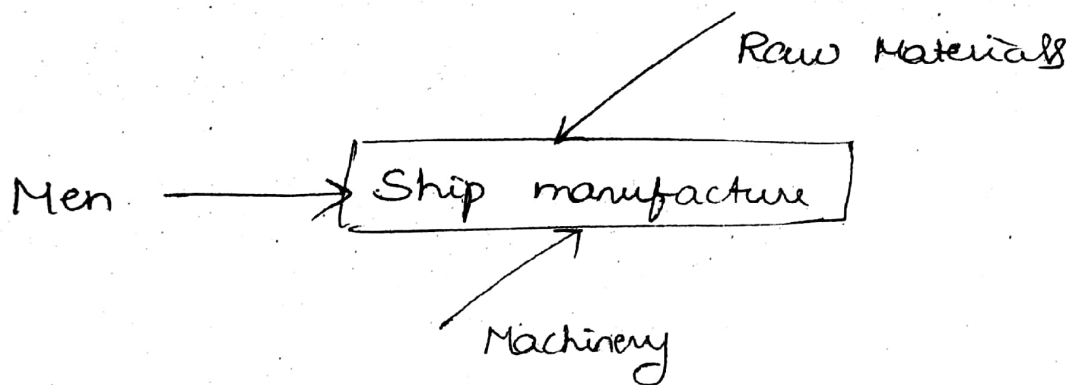
- (1) Comparatively less number of machines are needed, thus involving reduced Capital investment
- (2) Better Product Quality, because the supervisors and workers attend to one type of machines and operations.
- (3) Better utilization of the available equipment.
- (4) Machine breakdowns can easily be negotiated by shifting the work to other machines.
- (5) Workers in one section are not affected by the nature of the operations carried out in another section. For example, a lathe operator is not affected by the rays of the welding as the two sections are quite separate.

Disadvantages :-

- (1) Automatic material handling is extremely difficult.
- (2) More material - in - process remains in queue for further operations.
- (3) work in process inventory is large.
- (4) Production Control becomes difficult.
- (5) Material handling cost will increase.
- (6) Raw material has to travel larger distances for being processed to finished goods. This increases material handling and the associated costs.

(3) Fixed layout :- In this type of layout, all manufacturing facilities are brought and arranged at the work site. The required input resources (such as machines, equipments, men, materials) are shifted from their respective positions to one fixed position, where production operations are required.

Example :- Layout by fixed position of the production is inherent in ship building, aircraft manufacturing and flyover constructions.



Advantages

- (1) It involves least movement of materials thereby minimizing material handling cost.
- (2) We can achieve maximum flexibility and adaptability in production and process.
- (3) It is possible to assign one or more skilled workers to a project from start to finish in order to ensure continuity of work.
- (4) Space can be effectively utilized and the same layout can be used for many different projects.

Disadvantages :-

- (1) It usually involves a low content of work - in - progress.
- (2) There appears to be low utilization of labour and equipment.
- (3) It involves high equipment handling costs.
- (4) It sometimes proves to be unsafe and hazardous as workers are engaged in different activities simultaneously on the same job.

(4) Combination layout :- It is also known as Cellular layout. Combination layout is a layout formed by taking into consideration the advantages of functional layout and product layout. In this layout machines are grouped into cells as similar to that process layout and these cells function on the lines of product layout within large shop floor. Each cell produces a single part of a family. The machines are arranged according to the similarity of operations.

Example, casting, milling, welding etc., and these parts of the family are assembled taking into consideration the advantages of product layout.

Combination layout is useful where items or products are being made in different types and sizes.

Combination layout

Process layout	Product layout
Produce Various operations Stamping / welding / Heat treatment	Manufacturing Various Components parts Assembly A → B → C → D → E

Advantages :-

- (1) Less work-in-process.
- (2) Reduces handling costs.
- (3) Improves or enhances production control.
- (4) Increases the responsibility of workers.

Disadvantages :-

- (1) Reduces the manufacturing flexibility.
- (2) Increases the machine idle time.
- (3) Requires huge capital expenditure.
- (4) Machines can not be replaced easily.

* Difference between Product layout and Process layout :-

<u>Product layout</u>	<u>Process layout</u>
(1) It is very much suitable for a standard product where mass production is required.	(1) It is highly concerned with different job orders or different types of products.

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|---|--|
| <p>It requires less floor area.</p> | <p>(2) It requires larger floor area when compared to product layout. (9)</p> |
| <p>3) Less skilled workers may serve the purpose.</p> | <p>(3) It requires dedicated skilled workers.</p> |
| <p>4) Better production control is possible.</p> | <p>(4) Production control is difficult.</p> |
| <p>5) Involves less production time.</p> | <p>(5) Requires more production time compared to product layout.</p> |
| <p>6) Involves less-in-process inventory.</p> | <p>(6) Involves high inventory and inventory carrying cost.</p> |
| <p>(7) Full utilization of the plant is possible.</p> | <p>(7) utilization of plant greatly depends on the nature of product.</p> |
| <p>(8) Supervision is very simple.</p> | <p>(8) It requires extensive supervision.</p> |

Layouts Applications

Applications of product layout - (line layout)

The following are the circumstances in which Product layout is used.

- (1) Product layout is used when one or few products are standardized.
- (2) When a firm has to produce large volume of items.

- (3) When the inspection needed during the sequence of operations is less.
- (4) If the same machine or a work station is not applied for performing more than one operation.
- (5) When the materials and products allow continuous handling by mechanical methods.

Application of process layout :-

- (1) Process layout is used when several types of products are produced or when special orders are emphasized.
- (2) It is used when the volume of production of individual items is relatively low.
- (3) It can be used when many inspections are needed during a sequence of operations.
- (4) Process layout is used when the same machine or work station is used for two or more different operations.
- (5) It is used when materials or products are in substantial amount and allows continuous handling by mechanical methods.
- (6) It is mostly used in intermittent production.

Applications of fixed position layout :-

- (1) When the material used in operations needs only tools or simple portable machines.
- (2) When manufacturing only few pieces of items.

- 3) When the cost of transferring the bulk volume of material is very high.
- 4) When the skill of workmanship depends on the abilities of the workers.

Applications of Combination layout :-

- (1) It helps in producing products having different parts.
- (2) It can be applied in the work centres having easily movable machine tools.
- (3) It is used when the production of a product is independent of its capacity.
- (4) A combination layout is suitable when an item has to be produced in various forms and size.
- (5) It can be employed when several items are produced in same sequence but these items should not be produced in bulk.

** Plant Maintenance

Plant :- A plant is a place, where men, material, money, equipment, machinery etc., are brought together for manufacturing products.

Maintenance :- Maintenance is defined as that function of production management concerned with the day to day problem of keeping the physical plant in good operating condition.

Maintenance management is concerned with the direction and organisation of resources in order to control the availability and performance of the industrial plants to some specified level.

Scope of Maintenance Management ←

It is very essential for all the manufacturing organisations to manage maintenance as machines breakdown, parts wear out and buildings deteriorate after a particular period of time.

The scope of maintenance management includes two types of functions as follows,

(1) Primary functions

(2) Secondary functions

(1) Primary functions :-

(a) To maintain existing plant and equipments.

(b) To install new equipments and buildings.

(c) To maintain existing plant buildings and grounds.

(d) To modify existing equipments and buildings.

(e) To inspect equipment and lubrication.

(2) Secondary functions ←

(a) To keep the stock of spare parts.

(b) To protect the plant.

(c) To provide insurance against fire, theft etc.

(d) To reduce pollution and control noise.

(e) To dispose off the waste.

Objectives of Maintenance Management :-

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- (1) It reduces the loss of productive time due to equipment failure.
- (2) To reduce the repair time and repair cost.
- (3) It is optimally utilise maintenance personnel and equipments.
- (4) To enhance the quality of products and to bring improvement of productivity.
- (5) To reduce the losses incurred due to stoppage of production.
- (6) To reduce the frequency of accidents by regularly carrying out the inspection and repair of the safety devices.
- (7) To maintain all productive assets in a good operating condition.
- (8) To extend the life of capital assets by improving their handling mechanisms.

Plant Maintenance :-

Plant maintenance is concerned with actions taken by the plant user to maintain an existing system and facilities or to restore it to an operating condition.

Plant maintenance - methods, strategies, and practices used to keep an industrial factory running efficiently.

The general aim of plant maintenance is to create a productive working environment that is also safe for workers.

Objectives of plant Maintenance :-

- (1) The objective of plant maintenance is to achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost.
- (2) Machines and other facilities should be kept in such a condition which permits them to be used at their optimum (profit making) capacity without any interruption or hindrance.
- (3) Maintenance division of the factory ensures the availability of the machines, buildings and services required by other sections of the factory for the performance of their functions at optimum return on investment whether this investment be in material, machinery or personnel.

* Types of Maintenance :-

Maintenance may be classified into following categories.

- (1) Corrective or Breakdown maintenance.
- (2) Scheduled Maintenance
- (3) Preventive maintenance
- (4) Predictive maintenance.

(1) Breakdown Maintenance :- Breakdown maintenance implies that repairs are made after the equipment is out of order and it cannot

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perform its normal function any longer, e.g., an electric motor will not start, a belt is broken, etc.

Under such conditions, production department calls on the maintenance department to rectify the defect. The maintenance department checks into the difficulty and makes the necessary repairs.

After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs.

Objectives of Breakdown Maintenance -

- (1) To restore the normal functioning of an equipment by repairing it so as to minimise the production interruptions. This objective has a direct impact on production capacity, production costs, product quality and the level of customer's satisfaction.
- (2) To supervise and control the cost of repair crews which is inclusive of regular time and overtime labour costs.
- (3) To manage and to reduce the operation cost of repair shops.
- (4) To use adequate amount of repairs for each breakdown.

Advantages Typical Causes of Equipment Breakdowns

- (1) Failure to replace worn out parts.
- (2) Lack of lubrication.

(3) Neglected cooling system.

(4) External factors (such as too low or too high line voltage, wrong fuel etc).

Advantages :-

- (1) It is highly economical for the equipments or machines whose downtime or repair cost is low.
- (2) The cost incurred on this type of maintenance is less when compared to the other types of maintenance.
- (3) It involves very less administrative work.
- (4) Considerably small number of employees are able to handle breakdown maintenance.

Disadvantages :-

- (1) Breakdowns generally occur at inopportune times. This leads to poor, hurried maintenance and excessive delays in production.
- (2) Reduction of output.
- (3) Faster plant deterioration.
- (4) Increased chances of accidents and less safety to both workers and machines.
- (5) More spoilt material.
- (6) Direct loss of profit.
- (7) Breakdown maintenance practice cannot be employed for those plant items which are regulated by statutory provisions, for example cranes, lifts and pressure vessels.

Scheduled Maintenance :-

- > Scheduled Maintenance is a stick-in-time procedure aimed at avoiding breakdowns.
- > Breakdowns can be dangerous to life and as far as possible should be minimized.
- > Scheduled maintenance practice incorporates (in it) inspection, lubrication, repair and overhaul of certain equipments which if neglected can result in breakdown.
- > Scheduled maintenance practice is generally followed for overhauling of machines, cleaning of water and other tanks, white-washing of buildings, etc.

(3) Preventive Maintenance :- Preventive maintenance is a schedule of planned maintenance actions aimed at the preventive of breakdowns and failures. The primary goal of preventive maintenance is to prevent the failure of equipment before it actually occurs.

It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail.

In other words, Preventive maintenance means daily maintenance (cleaning, inspection, oiling and re-tightening).

Objectives of Preventive Maintenance :-

- (1) To minimize the possibility of unanticipated production interruption or major breakdown by locating or uncovering any condition which may lead to it.
- (2) To make plant equipment and machinery always available and ready for use.
- (3) To maintain the value of equipment and machinery by periodic inspections, repairs, overhauls, etc.
- (4) To maintain the optimum productive efficiency of the plant equipment and machinery.
- (5) To maintain the operational accuracy of the plant equipment.
- (6) To reduce the work content of maintenance jobs.
- (7) To achieve maximum production at minimum repair cost.
- (8) To attain maximum production at less repair cost.

Advantages :-

- (1) Helps in increasing the service life of machines and equipments by reducing its damage.
- (2) Reduces the frequency with which machines undergo breakdown.
- (3) It helps in improving the productivity by reducing machine downtime and loss of production.
- (4) Ensures secure working conditions for workers causing less accidental damages.

(5) Minimum reduced breakdowns and repairs the reliability of a production system can be increased.

(6) Increased Equipment life.

(7) Reduced breakdowns and connected down-time.
(8) Improved safety and quality conditions.

Disadvantages :-

(1) Preventive maintenance is very expensive in short run and during the early stages of maintenance programme.

(2) In preventive maintenance, ~~the~~ the inspection of plant, equipment and machinery need careful planning before its implementation.

(4) Predictive Maintenance :- It is comparatively a newer maintenance technique. It makes use of human senses or other sensitive instruments such as, Audio ~~gag~~ gauge, vibration analyzers, Amplitude meters, pressure, temperature and resistance strain gauges, etc., to predict troubles before the equipment failure.

In predictive maintenance, equipment conditions are measured periodically or on a continuous basis and this enables maintenance men to take a timely action such as equipment adjustments, repair & overhaul.

Predictive maintenance extends the service life of an equipment without fear of failure.