Unit III Plant Location

Plant location decisions deal with where the plant is to be located. Plant layout refers to the method in which the machinery is laid down within the given plant area. These decisions will be taken at top level.

Plant location is a strategic decision. Several factors influence this decision. An entrepreneur has to necessarily understand the different factors that influence the location. This will facilitate a balanced and careful decision. The following are the factors that affect plant location.

(a) **Closeness to raw materials**:- The plant must be located close to the supply points of the raw material to minimise procurement cost, especially if the raw materials are perishable & heavy and bulky. This will save a good amount of transportation costs. Raw material should be supplied continuously and uninterrupted.

(b) **Nearness to the markets**:- The plant must be located close to the markets so that the transportation costs can be minimised. It helps to reduce the price of the product and the producers will be in direct touch with the customers. Their changing tastes and fashions can be known very easily and they can change the product to suit the customer needs.

(c) **Fuel and power**:- The plant must be located where there is a continuous supply of power and fuel. If the industry

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is using ~~the~~ power it can be located [illegible]. However if the factory is dependent on a particular fuel, it's better to locate the plant close to that source.

(d) Transportation - plants must be located where there are transportation facilities. If the products are bulky they must be located where cheap transport and rail transport facilities are available. If the products are perishable and emergency products, they must be located near to airports, so that the time can be saved as well as costs can be minimised.

(e) Availability of labour - Availability of skilled labour is also another important factor to be considered. Plants must be located where there is availability of labour, because wages constitute the major cost factor while fixing the price of the product.

(f) Natural and climatic factors - While locating a plant the climatic conditions required to produce the products also must be taken into consideration. For ex: Cotton requires slightly humid climate and black soil.

(g) Govt. influence - Under balanced regional development programme, govt is encouraging the entrepreneurs in locating their plants in the backward and less developed areas. It announces some subsidies and incentives to them.

(g) political interference - It will override the economic factors.

and give the entrepreneurs to locate the plants to suit the demands of the political leaders.

Pollution checks:- Now-a-days environmental hazards and pollution levels are given serious thought in location decisions. Licence can be procured only if the pollution control board satisfied that the plant location will not affect the human ~~kaiva~~ as well as marine habitation.

Plant layout-

It refers to the method in which the machinery is laid out within the given plant area. It is necessary to study how best the plant layout can be arranged to minimise the bottlenecks in the production process. Plant layout study is essential when

(i) There is a change in the product design.
(ii) The mgt wants to manufacture a new product.
(iii) The " " increase output
(iv) To reduce production costs.
(v) To replace the existing machinery when it become obsolete or

Consequences of poor layout-

(i) Material handling costs will be high
(ii) production time will be increased because workers will be moving between different work stations.
(iii) working conditions can not be safe.
(iv) It leads to low return on capital employed.

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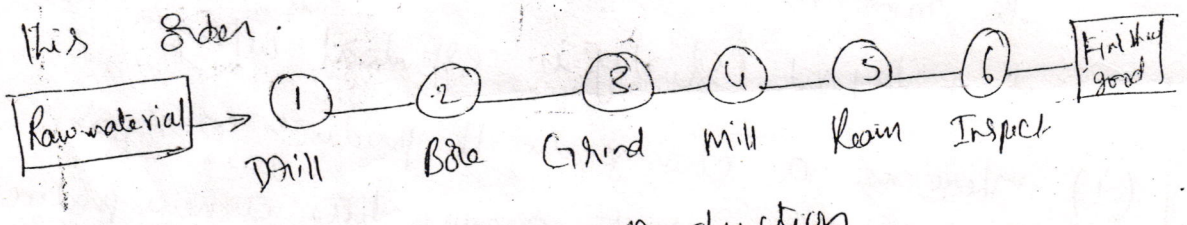
Systems of plant layout - (i) product layout (ii) process layout (iii) fixed layout

(i) Product layout: - plant layout is basically decided by the operation sequence between the no. of products (P) and the production quantity (Q). A long series of O/P quantities mass production and production facilities are located based on the process details. For a product it requires six types of operations: drilling, boring, grinding milling, reaming, and other operations and finally inspection In view of this sequence the machines will be arranged in this order.



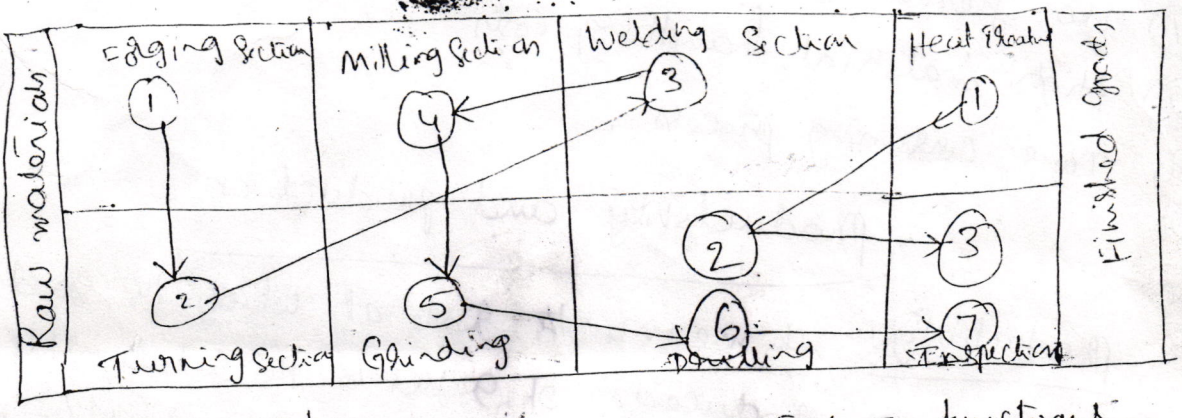
Advantages: - (1) Faster & cheaper production
(2) Lower cost of material handling.
(3) Effective utilisation of floor place.
(4) Easy monitoring.

Disadvantages: - (i) little flexibility to make changes in the product.
(ii) If one machine fails whole process gets disturbed
(iii) monitoring each workers is difficult.

(ii) Process or functional layout: - In case of small lot products machines and services of like types are located together as work centres in one area of the plant. If the

equipment is arranged as per the nature of its operation, it is called functional or process layout. All boring machines will be placed in one dept, all drilling machines will be placed in another section and so on. Any product with any design as long as it requires the available processes can be manufactured with its same layout.

Functional & process layout -



Product 'p' requires 1, 2, 3, 4, 5, 6, 7 functions
Product 'q' requires 1, 2, 3 functions.

Advantages:-

1. No duplication of work
2. optimum utilisation of resources is ensured
3. different products can be manufactured with same layout.
4. No breakdown in work if one machine goes out of order.

Disadvantages:-

1. High material handling costs because of zigzag movements.
2. monitoring of many units becomes complex.
3. Increase in wages because skilled people must be appointed at each machine.

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(iii) Fixed layouts:- Here the manufacturing facilities are fixed in their position. This type of layout is used in case of large projects such as building ships, aeroplanes. All spare parts, tools, equipment and men are brought to this point for further assembly and operations.

Advantages:-

(1) It is a flexible method of layout.
(2) It does not involve large investment.

Disadvantages:-

(1) No flexibility
(2) High material handling costs.
(3) Time consuming process.

Productivity and production.

Productivity:- It means the rate at which the goods and services are produced. It refers to the relationship between the inputs and the output. Productivity = output / input.

Production:- It means total amount of goods or services produced.

Factors affecting productivity:-

(1) Ineffective product design.
(2) Improper machines, cutting tools.
(3) Poor plant layout.
(4) Shortage of inputs.
(5) Poor working conditions.
(6) Lack of trained labour.
(7) Lack of motivation etc.

Method study:-

Select Task
↓
Record all relevant facts
↓
Examine
↓
Develop & define
↓
Install
↓
Maintain

Techniques for enhancement of Productivity:-

1. Minimising the material handling costs through proper plant layout.
2. Implement quality control and process control techniques.
3. Use Implement work study techniques to minimise the production problems in the process of doing job and minimise wastage of time.
4. Implement latest technologies such as Computer aided manufacturing
5. Implement proper inventory control techniques.
6. Maintain standard HR techniques.

Methods of production:-

I Job production:- In this method only one product & service provided every time. The design & cost also differs from one product to another product. It is a costly and time consuming method. It may involve special machinery and skilled labour and division of work is difficult.

II Batch production:- In this method a large no. of products can be produced at a time. Ex:- Biscuits, medicines etc. All the products will be uniform in their size, design cost etc. Economies of large scale production can be obtained. Automation and mechanisation is possible.

III Mass production:- If the production is continuous and large scale, we call it as mass production. Mechanisation and division of labour is possible. Cost per unit will be less.

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Work

Method + Time measurement = Work Study

Work Study → motion study (method study) + time study.

Work study refers to the method study and work measurement. The principle aim of work study is to bring efficiency and economy in the method of doing the job. It aims at eliminating unnecessary human movements and determining the standard time for the job. It is extensively employed in manufacturing, assembly, etc.

I Method Study - Method study is the systematic recording and critical examination of the existing and proposed ways of doing the job. It aims at reducing costs and increasing efficiency. This study helps to find solution to a variety of production problems, such as plant layout, product / process design, workers fatigue study etc.

Basic Procedure:

(A) Select the task: The task to which method study principles are to be applied is to be identified and the underlying objectives, such as saving the costs, increasing productivity, eliminating unnecessary movements

* (B) Record all related facts: The current process of doing the job has to be recorded. Each and every details however small it may be has to be identified, the length of the process, Inspection, human body movements etc. The

recording techniques include process charts, diagrams, motion and films analysis etc.

(c) Examine:- The recorded events are to be critically examined in a sequence, given to the extent of questioning the very purpose of an activity. Then only the job 'why' should be done this? why it is to be done? where it is done? why only there? why not else where? How is it done? Is there any other method of doing it? what are its implications on resources? these questions help us to find the best way of doing the work.

(d) Develop and define:- Based on the recorded data, the alternative methods of doing the same job must be identified and evaluated. From these alternatives, the best one is selected and developed to suit the requirements. An alternative is considered to be the best when it is thoroughly evaluated in terms of feasibility, safety, effectiveness etc. The selected alternative must be defined clearly.

(e) Install:- The new method so developed is to be installed in phased manner. Adequate planning of schedules and deployment of resources should be taken care of. once the method is adopted the workers have to be retrained and the equipment has to be provided and the method to be tested.

(f) Maintain:- It should be ensured that the method is

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used in the manner outlined. Complaints and [illegible] in productivity should be registered. The method should be monitored from time to time.

Recording Techniques:

(1) Outline process chart. It shows main events sequence wise considering only operations [illegible]

(2) Flow process chart. This chart reflects indirect delays in transferring work between work stations, duplication of work and ~~unfair~~ ~~work~~ assignments etc.

(3) Two-handed process chart:- This presents the simultaneous activities of both the right and left hand of an operator during works of repetitive nature.

(4) Multiple activity charts:- These charts depict interactions between several machines & items of equipment which are deployed alongside each other in a work station.

Diagrams:-

(1) Flow diagram:- It is intended to show the relative positions of the production machinery show the route followed by the machines, materials, and men.

(2) Cyclegraph:- A small electric bulb is attached to each part of the body, which makes the movement for carrying out an operation. The path of movement is photographed ~~with~~ by a high-speed camera, it is called cyclegraph.

Motion study, film analysis, string diagrams are the important techniques used for recording.

Recording Techniques:- I. outline process charts:- This chart outlines the basic process of the job in terms of two elements i.e (a) operations (b) Inspection. This constitutes the basic step for the beginning of a detailed analysis.

For Ex:- Refilling the gas cylinder at home.

Summary:-

○ 4 operations.

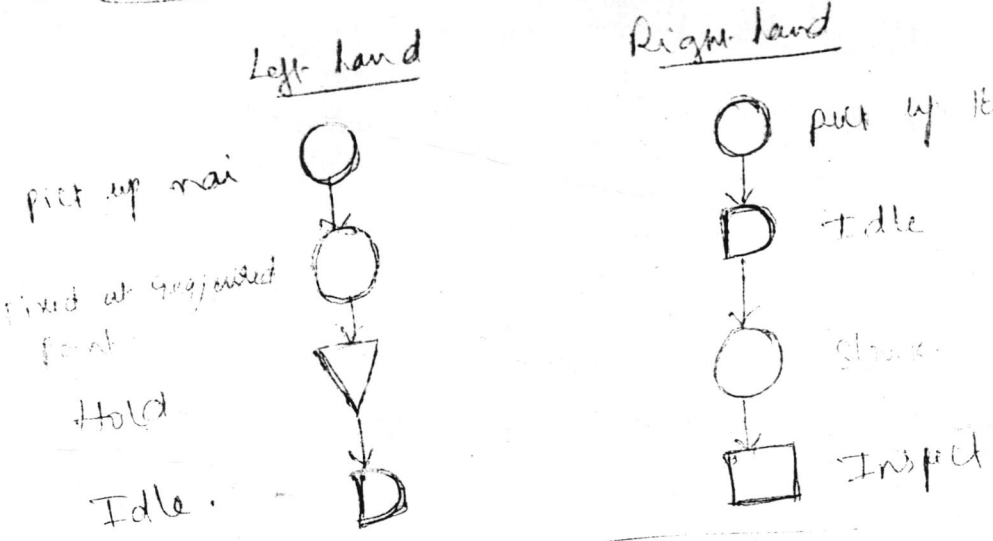
□ + Inspection.

The advantage of this chart is that it describes the essential elements in a sequential order using two symbols and in a simplified way.

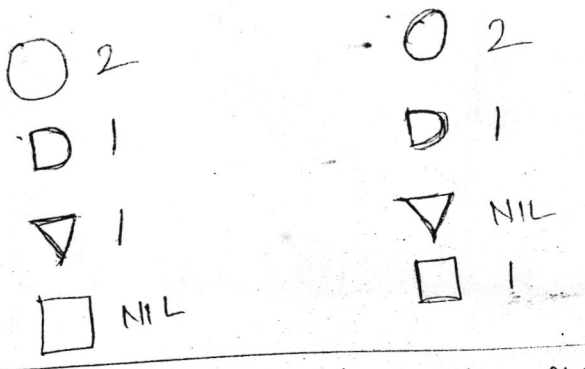
II Two handed process chart:- This records the activities of the left hand and right hand of an operator. For certain jobs such as typing, repairing, nut-bolting etc; it is common to use both hands. Sometimes one of the hands may be free or supporting the other hand.

The purpose of this chart is to depict the existing method of doing the job. It helps us to identify, remove unnecessary movements and reduce the time consumption.

Left hand filling Two handed process chart



Summary



It helps us to probe to reduce the no. of inspections, delays, to integrate the operations to save time & efforts.

III. Flow process chart :- This chart provides information about the time taken for all the events and the distance involved for movement of work, materials, machinery and men. It can be of three types : man type (Records only what the man does) material type (records only what happens to material) & equipment type (records only what happens to the equipment). (Ex Screw making process flowchart)

Name of the component :- Screw

Dept: Manufacturing

Date :

Existing proposed drawing No.

(B)

Sketch of the component operation chart

Symbols

No	Description of the process.	○	□	⇨	D	▽	Distance in mts	Time in minutes	Remarks
1	MS Rods from store						45	20	By hand trolley
2	To lathe								
3	Turning operation								
4	To Inspection dept.						20	5	11
5	Inspection.								
6	To boring machine						14	8	11
7	Boring operation								
8	Inspection								
9	To thread cutting						3	5	By hand
10	Thread cutting								
11	To inspection dept.						15	10	By hand trolley
12	Inspection								
13	To heat treatment section						10	5	11
14	Heat Treatment								
15	Inspection						20	10	By van
16	To stores								

Summary: Operation — 4
Inspection — 4
Transportation — 7
Delay — 0
Storage — 2

Work Measurement

Work measurement is also called time study. It refers to the time taken by a qualified worker to complete a specified job. The main objectives of work time study are

(1) To develop costing system
(2) To determine the production schedules.
(3) To develop incentives schemes.
(4) To compare the time taken by alternative methods.
(5) To determine the optimum no. of men and machines to ensure their effective utilization.

To carry on time study (work measurement) the first method study should be completed. Having decided the new method, the next step is to find out how much time is taken to carry out that new method has to be examined. In determining this, the following process is involved.

(a) Break the job into elements which can be identified as distinct parts of an operation. Each part must be capable of being observed, measured and analysed.
(b) Measure time taken to perform each element using a stopwatch.

add the time taken to do all the elements and arrive at the basic time required to do the entire job.

Time Study equipments:- stop watch, motion picture camera, Time recording machine, Electronic timer etc.

How to Calculate required no of observations:- While computing the basic time, it is always safe to take the average time taken by the worker to complete the given task. Ex:- An operator takes some time say 50, 55, & 64 sec to complete a task. which reading should be considered. So it is better to take average of these three readings. Again how many reading should be taken to compute such an average. Using the following formula, the minimum no. of observations can be calculated.

$$N = 40 \sqrt{\frac{n \Sigma(fx^2) - \Sigma(fx)^2}{\Sigma(fx)}}$$

Ex:- For a particular task 40 observations were taken by a time study observer. Check whether or this no. of observations are sufficient for ± 5 % accuracy with 95 % confidence limit. calculate minimum no. of observations required.

Time Seconds (x)	4	5	6	7	8
Frequency (f)	10	5	10	10	5

x	f	fx	x^2	fx^2
4	10	40	16	160
5	5	25	25	125
6	10	60	36	360
7	10	70	49	490
8	5	40	64	320
	$\Sigma f = 40$	$\Sigma fx = 235$		$\Sigma fx^2 = 1455$

$$N = 40\sqrt{\frac{n\Sigma(fx^2) - (\Sigma(fx))^2}{\Sigma(fx)}}$$

$$= 40\sqrt{\frac{40(1455) - (235)^2}{235}}$$

$$= 40\sqrt{\frac{2975}{235}}$$

$$= 40\sqrt{12.65} = 40 \times 3.556$$

$$= 142$$

∴ No of observations = 142

Since the present No is only 40 we need 102 more observations

What happens if the degree of efficiency among the workers is different:- After the no. of observations, now the question is what type of worker is to be selected for the observation?

What happens if the actual worker is less efficient or more efficient than the average worker? What should be the standard rating?

(Standard rating is the average rate at which qualified workers will naturally work at a job)

Calculation of standard time:-

Standard time = Basic time + Allowance Time

↓

$$\text{Basic time or Normal time} = \frac{\text{observed time} \times \text{Rating}}{\text{standard rating}}$$

For ex:- If an employee's time for a particular element is observed to be 0.20 minutes, and he is rated as 120, allowance of 0.06 minutes is given

Then his basic time will be as follows. (17)

Basic time (Normal time) = $\frac{0.20 \times 120}{100}$ = 0.24 minutes.

Standard time = Basic time + allowance

= 0.24 + 0.06 = 0.30 minutes.

Thus standard time can be defined as the amount of time required to complete the given task under given working conditions.

Work Sampling :- Work sampling is used where the engr. wants to (1) know the % of idle time for workers

(2) establish standard time for an operation.

(3) fix the performance rate.

No of observations required :- $S \times P = 2\sqrt{\frac{P(1-P)}{n}}$ or

$n = \frac{4P(1-P)}{S^2 \times P^2}$

S = desired level of accuracy

P = % occurence of an activity & delay being measured.

n = Total no. of observations

Ex :- Check whether the no. of observations is adequate for ±5% accuracy and 95% confidence limit; if

(a) The no. of observations of workers working = 4000

(b) " " " idle = 1000

(c) Total no. of observations = 5000.

desired level of accuracy P = $\frac{\text{observations of idle workers}}{\text{Total no. of observations}}$

$P = \frac{1000}{5000} = 0.20$. Substitute P value in

$$S \times P = 2\sqrt{\frac{P(1-P)}{n}}$$

$$S \times 0.2 = 2\sqrt{\frac{0.2(1-0.2)}{5000}}$$

$$S \times 0.2 = 2\sqrt{\frac{0.2(0.8)}{5000}}$$

$$S \times 0.2 = 0.000032$$

$$S = \frac{0.000032}{0.2} = 0.00016.$$

$S = \pm 5\%$ i.e $= 0.05$ calculated $S = 0.00016$.

which is less than the required. The data is sufficient

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(2)(2) If $P = 0.5$ and confidence level is 95% calculate no of observations. ($\because$ 5% accuracy $\therefore S = \pm 5\%$)

Here $S = \pm 5\%$ (0.05) $P = 0.5$.

$$n = \frac{4P(1-P)}{S^2 \times I^2}$$

$$= \frac{4 \times 0.5 (1-0.5)}{(0.05)^2 \times (0.5)^2}$$

$$= \frac{1}{0.000625}$$

$n = 1600$ observations.

To maintain 5% accuracy 1600 observations are required